130 | MAY 1974

COMMISSION OF THE EUROPEAN COMMUNITIES

INTERNAL INFORMATION on AGRICULTURE

Use of substitute products in livestock feeding

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DIRECTORATE-GENERAL FOR AGRICULTURE

Directorate Agricultural Economics – Division «Balance-sheets, Studies, Statistical Information»

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Use of substitute products in livestock feeding

This Study has been carried out under the Studies programme of the Directorate-General for Agriculture of the European Communities.

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The study solely reflects the opinion of the authors, and must not be regarded as necessarily reflecting the views of the Commission of the European Communities. It in not way prejudge the attitude or decisions the Commisssion may adopt in this field.

SUMMARY (1)

(1) A detailed list of contents appears at the end of the report.

A/ ECONOMIC INTRODUCTION

HISTORICAL SURVEY OF THE POST WORLD WAR II PERIODS

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In the aftermath of World War II most of the countries that were to come together to establish the European Economic Community found themselves with their animal husbandry disorganized partly because of several years shortage of fodder products.

According to the statistics it was only towards 1950 that the average consumption of proteins supplied by land animals to the inhabitants of the future Community got back to its pre-war level of rather under 40g per head per day, compared with over 60 in North America and Australasia. In retrospect the available resources in the 9 countries at that time appear to us extremely inadequate in quantity and in quality. Productive pastuland (45 million hectares) yielding feedstuffs with a higher cellulose content and lower nutritive value than nowadays, figured prominently in the total of resources. The same is true of potatoes, practically devoid of protein, whose consumption for animal husbandry exceeded 20m metric tons. On the other hand cereal fodder crops were still only of the order of 30m metric tons, or a comparable volume to cereals for human consumption (in the form of bread, cakes, edible pastes, etc.) and barley and cats accounted for two-thirds of the total although both are highly cellulosic (4,5 % and 11 % cellulose content, compared with 2 and 2,5 % for maize and wheat).

National outputs of protein concentrates (animal meals and oilcake) were then as now very low. Imported concentrates only totalled 2,9m metric tons, of which 60 % oilcake containing under 32 % protein and over 10 % cellulose : linseed, rape, cottonseed, palm nut and copra.

The future Community was unable to step up production of monogastric animals (pigs and poultry) which have a shorter growth cycle than ruminats, and need no cellulose, but a large protein intake, especially of certain rare amino acids, lysine, methionine, tryptophan, which occur in insufficient quantity in animal meals (fish and meat) and in a limited number of oilcakes (soya, groundnut). Except in the United Kingdom and the Netherlands, the manufacture of compound feeds was on a small scale and numerous breeders fed small herds on cereals, potatoes, kitchen waste and greasy effluents, by-products of the food industry : bran, whey and especially groundnut or linseed cake for the winter feeding of dairy cattle. For lack of an adequate and well balanced diet, yields were poor, pigs were fat (too much carbohydrate) and monogastric liverstock accounted for only 24 % of total protein production as against 76 % from the meat and milk of ruminants.

During the next 20 years, the fodder constiuents of feeds used in animal husbandry changed completely. As a result of the fodder revolution, the relative share of production from grassland decreased, but its quality improved. Potatoes were not used as much, and nowadays they represent only 12m metric tons. From 1950 to 1970 however the use of cereals in animal feedingstuffs more than doubled, reaching 66m metric tons or 2,4 times the use in human foodstuffs.

Additionnaly wheat, sorghum and maize represent 51 % of fodder cereals. But above all, imports of protein concentrates have risen. They showed a fivefold increase in slightly under 20 years and now include 71 % animal meals and olicake containing more than 44 % protein and less than 7 % cellulose (groundnut and especially soya beans)

Total for the 9 EEC countries

	1950	1955	1960	1965	1970
Cereal use in feedings tuffs (million metric tons)	30,7	37,6	48,3	57,2	65,9
Net imports of protein concentrates (m metric tons)	2,9	4,1	7,2	9,9	13,3
Ratio of cereal use to protein concentrate imports	10,6	9,2	6,7	5,8	5,0
Proportion of animal meals and groundnut and soya oilcake in total protein concentrate	28 %	45 %	59 %	64 %	71 %

The situation in animal husbandry has become adapted to the fodder resources available. So for as frequent changes in statistical series allow this sort of analysis, production of pigmeat, poultrymeat and eggs in the 9 Community coun tries has grown on average 3 times as fact as that of milk and 1,5 times as fast as beef and veal.

Production of monogastric animals is now 3 times as high as that of beef and veal (1). In 1971 in the Community the average consumption of protein from land animals totalled 55g per day, of which 32 % was from pigmeat and poultrymeat.

Many analyses have been carried out on the growth conditions of monogastric animal husbandry in Europe. In this respect, manufacturers of compound feedingstuffs played an important role.

- by establishing contractual links with stock-farmers and fatteners, by lending technical and veterinary assistance, by active participation in the selection of more productive breeds, by helping to finance farms, building industrial plants and marketing the finished products,
- and also by helping to find uses for agricultural and industrial by-products.

The industry played a vital part in the gradual change in the structures of both fodder resources and animal husbandry. In order to appreciate its role, it should be recalled that there is no raw natural material accurately providing all the energy, protein, vitamin and mineral element requirements of any given animal species. The industry produces balanced mixtures of nermercus raic materials at minimum cost to obtain optimum economic results with animals having a good conversion rate. Thanks to the price ratios (supported cereal prices, supplies exempt from levies on the world market for protein concentrates) that already existed in many Member countries and were mostly maintained or even reinforced under the common agricultural policy, the industry played an essential part by gradually reducing the use of fodder cereals whilst increasing that of protein products and encouraging monogastric animal husbandry. Fermerly,Europe depended mainly on cereals as such rationalization of animal husbandry featuring a greater use of oilcake, has now enlarged the scope of such dependence.

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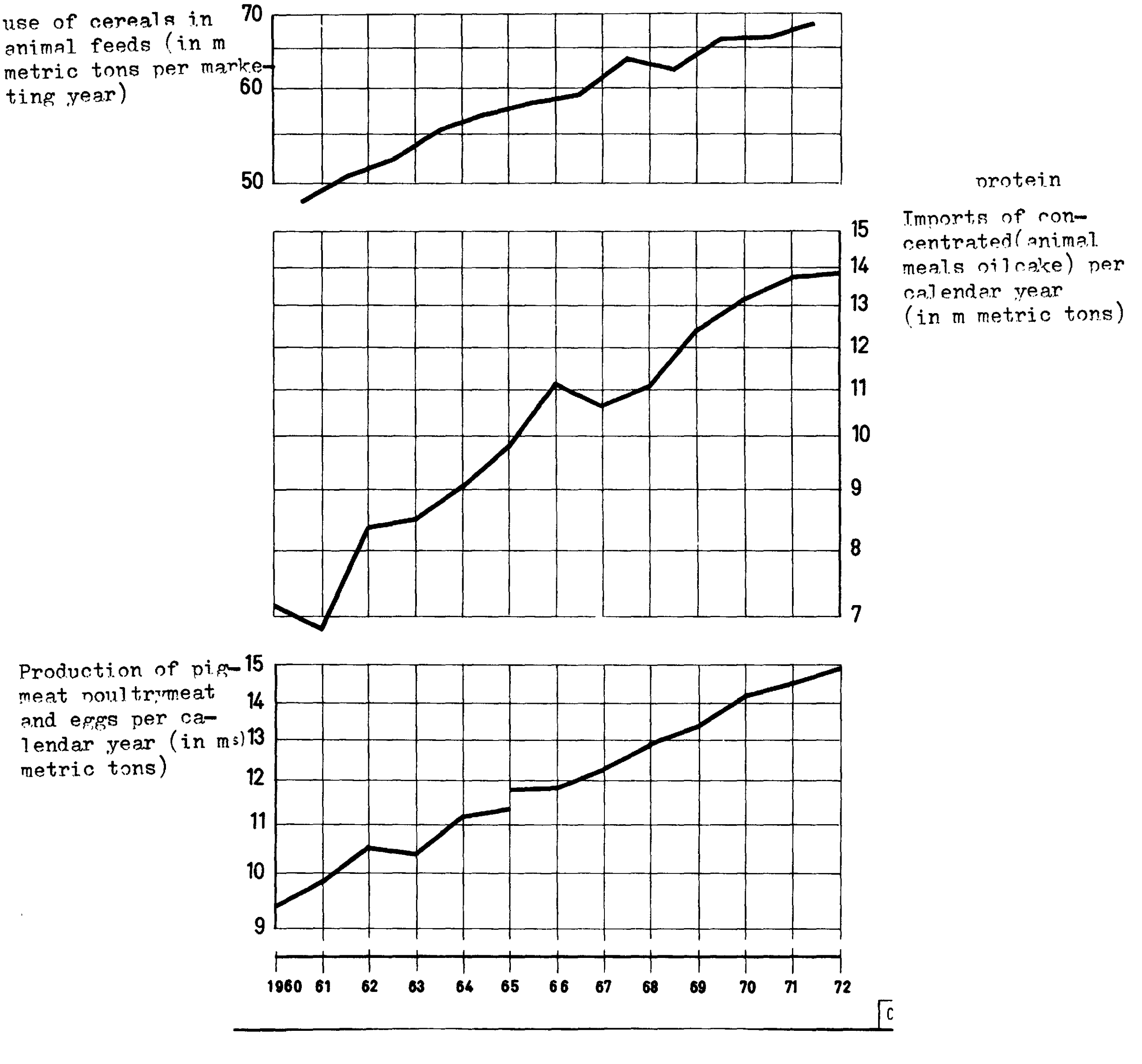
(1) Moreover, from 1965-1967 to 1970-1972, out of + 100g of protein accounted for by the growth in animal husbandry,

+ 30,9 g came from milk
+ 22,5 g came from pigmeat,
+ 15,2 g came from poultrymeat,
+ 13,2 g came from beef and veal, and
+ 9,4 g came from eggs

According to this calculation, the contribution of monogastric animals to the growth in animal husbandry was 47.1 % or 3.5 times that of beef and veal.

Spectacular advance in European animal husbandry ensued. However, as a result the Community gradually became more dependent on third countries as a growing proportion of its supplies came from fewer supplier countries. In the world market for protein concentrates, the Community has to compete with many countries which have in recent years undergone the same structural changes, e.g. Japan, the USSR, Spain and various developing countries. The protein crisis which hit European animal husbandry so hard in 1972-73 is perhaps merely a warming signal of a situation, which if repeated, might force the Community to reorientate or even the whole of its agriculture its husbandry in the fairly near future.

EVALUATION OF THE USE OF CONCENTRATED FODDER PRODUCTS AND PRODUCTION FROM MONOGASTRIC ANIMALS



A/ ECONOMIC INTRODUCTION (Continued)

RECENT TRENDS IN SOURCES OF FODDER PROTEINS IN THE ENLARGED EUROPEAN ECONOMIC COMMUNITY (EEC)

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In recent years, sources of fodder protein supplies in the Community have changed rapidly owing to dwingdling fish-meal supplies on the world market and also to increasing demand, which has led cattle feed manufacturers to use much greater amounts of soya oilcake. As far as possible, the analysis of the events in this period will be accompanied by a comparison with the concurrent situation of stock-farming in the United United states now the main fodder protein supplier for Europe.

One of the main features of the EEC is its relatively high population density : in 1970, only 0,17 ha grassland and pastureland on average was still available per inhabitant (0.1 ha in the Netherlands) as againts 1.26 ha in the United States for instance. In spite of some of the highest yields per hectare in the world, which are constantly being improved upon, fodder products (grasses, roots, tubers, artificial grassland, etc.) represent a diminishing share in the total fodder resources (1).

In addition the shortage available areas naturally means a heavy load per hectare, as shown by the following comparison :

- Average number of animals per ha grassland and pastureland in 1970/71 :

	Enlarged EEC	United States
Cattle	1.71	0.44
Sheep	1.16	0.08
Goats	0.049	0.003

(1) In the Sixties, the proportion of products obtained from grassland and pastureland of total fodder resources is said to have fallen from 77% to 59 % in five Community countries taken as a whole (Denmark, France, Germany, Italy and the Netherlands). Futhermore, due to the common agricultural policy in particular, the acreage of grassland is tending to fall off. Thus in Germany, the acreage of arable land for cereal growing first expanded to the detriment of the acreage for potato growing, then gradually encroached on grassland, which constituted a reserve of land whose area decreased from 5.7 to 5.4 million hectare between 1967 and 1972.

Finally the short supply and high prices of many fodder resources and the need to obtain maximum yields from their livestock by using very economical feeding techniques naturally led European farmers, with the exception of poultry farmers, to derive maximum productions from their stock :

1971	Enlarged EEC	United States
-Average production per head of cattle per year :		
Beef and veal (1)	72 kg	89 kg
Milk (2)	1.184 kg	470 kg
Total proteins	53.3 kg	31.2 kg
-Average production per ptg. unit per year :		
Pigmeat (1)	116 kg	91 kg
-Average production per poultry unit per years : (Chicken,hens, ducks, turkeys etc.)		
Poultrymeat (3)	4,5 kg	11.2 kg
Eggs (4)	5.6 kg	9.3 kg
Total proteins	1.20 kg	2.48 kg

During the period under investigation, especially in countries where cereal prices were fixed at high level in relation to world rates Community farmers maintained high yield dairy herds, which enabled them to make the most disposal. Meanwhile, the flood of protein concentrates imported under very favourable conditions into the Community and from 1967 onwards, the common price system for cereals favoured the production of monogastric animals (pigs, poultry) whose requirements cheaps (at the time) of proteins are greater then those of ruminats (5).

(1) carcase weight

(2) afeter deduction of whole liquid milk used in animal feeding

(3) Oven-ready weight

(4) Or approximately 100 eggs per fowl per year in the enlarged EEC, against 165 in the United States. Difficulties in statistical comparisons made the calculation of such ratios necessary. In 1972, the average production of eggs per hen is the Community of the Six was 197.

(5) Use of cereals in animal feeding - Chapter IV - CECD PARIS 1971.

Thus livestock farming in the Community is featured by high outpute of milk, pigmeat, poultrymeat and eggs (1) but relatilvely low meat production from ruminants (beef, mutton) (see table 1)

Two very simple ration (graph 1) show that stock-farming in the Community is increasing lagging behind that in the United States, where the abundance of grassland and cereal resources (2) have enabled especially the intensive production of ruminants (notable young bovines).

In the period under consideration, the use of compound feeds by American farmers stayed almost constant at around 55 million metric tons. The reason for this stability is that in the early Sixties very large quantities of compound feeds were already being used for monogastric animals. Also,young bovines are fattened in feed lots without compound feeds, using mixtures of cereals, grass silage, protein concentrates and urea (3).

In Europe, however, where farmers often still purchased only small quantities of compound feeds (Belgium, France, Italy, Ireland) and pig and poultry farming have developed considerably, the use of compound feeds increased by an average annual rate of almost 7 % between 1965 and 1972 (tables 2 to 5).

In the United States, the ratio of soya oilcake prices to cereal prices has become 2 to 1. In Europe, it stands at 1.2/1.4 and, as a result, larger quantities of soya have with rising cereal prices gradually been incorporated in animal feeds. This increasing use of oilcake provides a better explanation for the share accounted for in Europe by industry whetem in the United States, this trend has not emerged.

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(1) The addition of quantities of pigmeat, poultrymeat and eggs in a study on animal nutrition is justified by the fact that the corresponding figures for fodder consumptions have many features in common, including the amino acid requirements of monogastric animals.

(2) also urea (see chapter IV)

(3) Since international trade in these products is very small consumption can be roughly assimilated to productions, statistics being available for the latter only. In any case, these data are subject to criticism, since they cover cereal mixtures, very many supplements of grass cereals, milk products etc. as well as complete compound feeds, which seem to be gainging in relative importance.

TRENDS IN MILK PIGMEAT PRODUCTIONS POULTRY EGG IN RELATION TO THE PRODUCTION OF MEAT FROM RUMINANTS BETWEEN 1965 AND 1972 ENLARGED EEC AND THE UNITED STATES

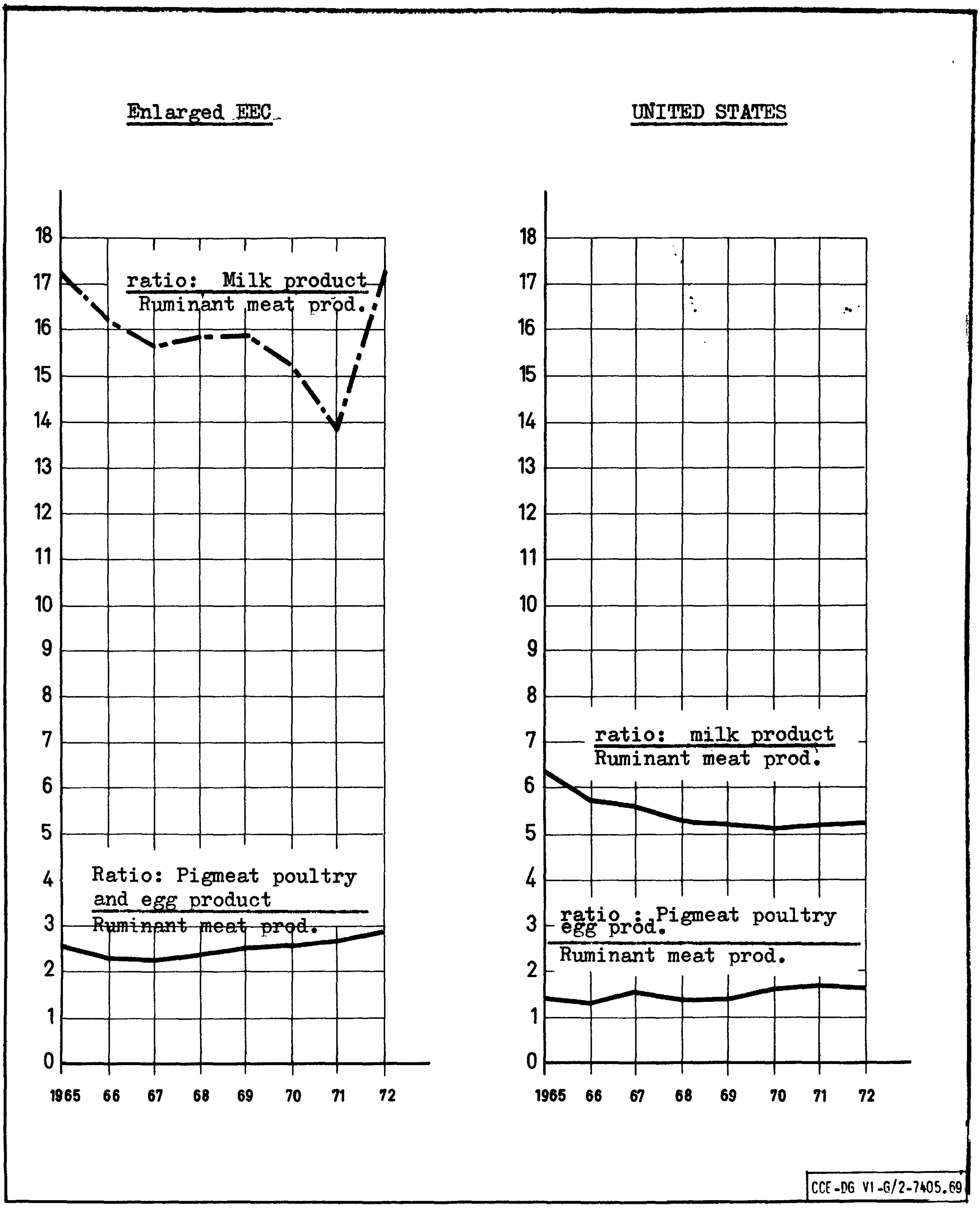

Table 1

MAIN ANIMAL PRODUCTIONS IN THE EUROPEAN ECONOMIC COMMUNITY (9 COUNTRIES) AND THE UNITED STATES (IN THOUSAND METRIC TONS)

EEC (9 countries)	1965	1966	1967	1968	1969	1970	1971	1972
Meat of ruminants (beef, mutton and goat meat	4 541	4 891	5 233	5 296	5 221	5 498	5 593	5 021
Veal	713	768	807	815	803	806	807	728
Pigmeat	6 610	6 486	6 662	7 116	7 081	7 515	8 084	8 129
Poultrymeat	1 977	2 130	2 231	2 332	2 527	2 738	2 810	3 014
Eggs	3 190	3 247	3 316	3 415	3 577	3 779	3 695	3 773
Milk (1)	77 747	79 348	81 687	83 642	83 447	82 990	83340	86 778
UNITED STATES								
Meat of Ruminants	8 633	9 098	9 372	9 610	9 716	9 950	10 083	10 258
Veal	458	405	354	324	296	257	239	198
Pigmeat	5 053	5 142	5 706	5 924	5 875	6 091	6 707	6 176
Poultrymeat	3 706	4 079	4 268	4 173	4 385	4 725	4 775	5 077
Eggs	3 898	3 945	4 156	4 111	4 100	4 168	4 257	4 204
Milk	55 392	53 493	52 998	52 346	51 873	52 284	53 019	53 823

(1) after deduction for liquid whole milk suckled by or given to calves.
Sources : OECD and SOEC.

Table 2

PRODUCTION OF COMPOUND FEEDS FOR POULTRY
(in thousand metric tons)

	1965	1966	1967	1968	1969	1970	1971	1972
BELGIUM (LUXEMBOURG (	764	808	845	884	1 002	1 120	1 110	1 115
FRANCE	1 861	1 942	2 079	2 084	2 274	2 600	2 834	3 271
GERMANY	2 815	3 200	3 281	3 197	3 167	3 660	3 606	3 648
ITALY	960	1 050	1 065	1 447	1 491	1 510	1 454	1 499
NETHERLANDS	1 725	1 750	1 788	1 781	1 844	2 030	2 188	2 162
DENMARK	-	-	-	-	533	570	562	601
UNITED KINGDOM	4 094	4 003	4 176	4 094	4 054	4 105	3 904	3 869
IRELANDE	-	-	-	215	-	240	258	270
TOTAL E.E.C.						15 835	15 916	16 435

Table 3

PRODUCTION OF COMPOUND FEEDS FOR PIGS
(in thousand metric tons)

	1965	1966	1967	1968	1969	1970	1971	1972
BELGIUM (LUXEMBOURG (	965	1 140	1 416	1 478	1 724	2 190	2 270	2 525
FRANCE	1 403	1 630	1 977	1 862	2 128	2 780	3 189	3 629
GERMANY	1 863	2 122	2 252	2 221	2 620	3 360	3 485	3 775
ITALY	500	550	600	559	566	650	715	806
NETHERLANDS	2 200	2 520	2 648	2 858	2 982	3 310	3 833	4 080
DENMARK	-	-	-	-	1 205	1 210	1 238	1 167
UNITED KINGDOM	2 256	1 961	2 052	2 174	2 428	2 591	2 663	2 532
IRELANDE	-	-	-	530	-	570	636	638
TOTAL E.E.C.						16 661	18 029	19 152

Sourece : E.F.M.A.

The figures in tables 2 and 3 combine national statistics covering both complete and supplementary compound feeds.

PRODUCTION OF SUCKLER FEEDS

(thousands metric tons)

Table 4

	1965	1966	1967	1968	1969	1970	1971	1972
BELGIUM (LUXEMBOURG (	48	59	60	66	73	74	61	64
FRANCE	282	337	374	432	554	617	679	699
GERMANY	135	175	190	200	200	210	195	230
ITALY	80	120	166	190	230	254	268	292
NETHERLANDS	200	208	225	238	315	352	370	380
DENMARK	-	-	-	-	-	-	20	20
UNITED KINGDOM	40	40	40	40	40	40	34	39
IRELANDE	-	-	-	-	-	50	53	30
TOTAL E.E.C.							1 614	1 754

Table 5

TOTAL PRODUCTION OF COMPOUND FEEDS

(in thousand metric tons)

	1965	1966	1967	1968	1969	1970	1971	1972
BELGIUM (LUXEMBOURG (	2 478	2 901	3 119	3 240	3 668	4 280	4 278	4 660
FRANCE	4 534	4 951	5 582	5 516	6 244	7 580	8 363	9 606
GERMANY	6 597	7 532	7 723	7 545	8 197	9 730	9 863	10 663
ITALY	2 000	2 300	2 500	3 188	3 301	3 630	3 711	4 023
NETHERLANDS	5 625	6 128	6 386	6 629	7 117	7 850	8 595	9 116
DENMARK	2 712	2 739	2 575	-	2 477	2 570	2 548	2 740
UNITED KINGDOM	9 896	9 489	-	10 140	10 678	11 010	10 603	10 848
IRELANDE	-	-	-	914	-	970	1 057	1 180
TOTAL E.E.C.	33 400	36 100	38 100	39 200	42 600	47 620	49 110	52 836
VARIATION %	100	103	114	117,5	128	142,5	147	158

Source : E.F.M.A

The figures in tables 4 and 5 combine nationale statistics covering both complets and supplementary compound feeds.

The two main groups of raw materials used for making animal feeds are :

a) energy-rich products : cereals, fats and starches

b) protein-rich products : oilcake, animal meals.

Cereal production in the EEC rose more or less steadily up to 1972, as did protein concentrate production (table 6) the two main concentrated being fishmeal (Denmark accounts for over half the Community production) and colza (France produces more than two-thrids of the Community total (1)

The volume of protein concentrates produced in the Community nevertheless remains very low in relation to imports, which in terms of crude protein equivalent, rose by 35 % from 1965 to 1972 (table 7). The EEC currently uses a total of more than 7 million metric tons of proteins in the form of animal meals and oilcake (table 8) and in 1972, only 7.7 % of consumption in the 9 member countries as a whole was met by domestic production.

In the United States, the use of cereals in animal feeds rose sharply between 1965 and 1972 (on average + 3.5 % year) whereas that of protein concentrates (animal meals, oilcake) was practically at a standstill (+ 0.6 % per year) (table 9).

On the other hand, cereal use in animal feeds within the Community advanced at a very moderate rate (+ 2.5 % per year) and that of protein concentrates very sharply (on average 4,6 % per year) (graph 2). Obviously, the differences between the two types of animal feeds in the Community and in the United States can be partly explained by the structural differences noted in animal husbandry the greater use of compound feeds difference in price ratios between cereals and protein concentrates etc.

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(1) For tables 6 to 8, net productions, imports and exports of animal meals, oilseeds and oilcake have been converted to crude protein, methionine and lysine equivalents, after convertion of production and net trade in oilseeds into oilcake equivalents. The sources for these tables were the OECD and FAC. The reader's attention is drawn to the fact that the statistics for each country were not necessarily compiled on entirely comparable bases.

EEC (9 Countries) - PRODUCTION OF PROTEIN CONCENTRATES

(in thousand metric ton)

Table 6

	1965	1966	1967	1968	1969	1970	1971	1972
Fishmeal and fish solubles	319	326	369	438	441	433	446	(431)
Oilseeds as oilcake equivalent of which :	370	354	427	457	480	535	653	714
Colza	(311)	(287)	(380)	(418)	(432)	(489)	(587)	(653)
Linseed	(43)	(52)	(34)	(23)	(27)	(18)	(23)	(18)
Sunflower	(9)	(10)	(9)	(12)	(17)	(25)	(40)	(40)
Total in crude protein equivalent	328	328	378	432	442	453	501	512
of which fishmeal and fish solubles of which:	(207)	(212)	(240)	(285)	(287)	(281)	(290)	(280)
colza	(100)	(92)	(122)	(134)	(138)	(156)	(188)	(209)
linseed	(14)	(17)	(11)	(7)	(9)	(6)	(7)	(6)
sunflower	(3)	(4)	(3)	(4)	(6)	(9)	(15)	(15)
Total in methionine equivalent	8,58	8,63	9,93	11,48	11,68	11,91	12,94	13,04
of which fishmeal and fish solubles of which :	(6,22)	(6,36)	(7,20)	(8,54)	(8,60)	(8,44)	(8,70)	(8,41)
Colza	(1,99)	(1,84)	(2,43)	(2,68)	(2,76)	(3,13)	(3,76)	(4,18)
linseed	(0,26)	(0,32)	(0,21)	(0,14)	(0,16)	(0,11)	(0,14)	(0,11)
sunflower	(0,07)	(0,08)	(0,07)	(0,10)	(0,14)	(0,21)	(0,32)	(0,32)
Total in lysine equivalent of which fishmeal	17,05	17,05	19,85	22,83	23,37	23,92	26,31	26,86
and fish solubles of which :	(11,03)	(11,30)	(12,79)	(15,19)	(15,30)	(15,00)	(15,46)	(14,95)
Colza	(5,29)	(4,89)	(6,46)	(7,11)	(7,34)	(8,31)	(9,98)	(11,10
linseed	(0,54)	(0,65)	(0,42)	(0,31)	(0,34)	(0,23)	(0,29)	(0,23)
sunflower	(0,12)	(0,13)	(0,12)	(0,16)	(0,23)	(0,33)	(0,53)	(0,53)

Table 7

EEC (9 countries) - NET IMPORTS OF PROTEIN CONCENTRATES

(in thousand metric tons)

	1965	1966	1967	1968	1969	1970	1971	1972
Animal meals	1169	1040	1237	1370	1492	1097	886	964
Oilcake	5004	5904	5374	5398	6514	6679	7052	6650
Oilseeds as oilcake equivalent	3753	4293	4238	4253	4406	5544	5900	6094
Total in crude protein equivalent of which :	4505	4979	4962	5080	5467	6015	6119	6107
animal meals	(760)	(676	(804)	(891)	(970)	(713)	(576)	(627)
soya	(1908)	(2368)	(2407)	(2423)	(2696)	(3568)	(3664)	(3768)
groundnut	(673)	(675)	(661)	(676)	(571)	(546)	(530)	(476)
other	(1164)	(1260)	(1090)	(1090)	(1240)	(1188)	(1349)	(1236)
Total in methionine equivqlent of which	73,29	79,89	81,52	83,28	89,93	90,43	93,31	93,91
animal meals	(22,80)	(20,28)	(24,12)	(26,72)	(29,09)	(21,39)	(17,28)	(18,80
soya	(24,79)	(30,79)	(31,30)	(31,49)	(34,91)	(46,37)	(49,22)	(48,67)
groundnut	(7,40)	(7,43)	(7,27)	(7,43)	(6,28)	(6,01)	(5,44)	(5,39)
other	(18,30)	(21,39)	(18,83)	(17,64)	(19,64)	(16,66)	(21,37)	(21,05)
Total in lysine equivalent of which :	252,17	281,33	286,09	294,34	318,83	356,84	359,31	361,70
animal meals	(62,31)	(55,43)	(65,93)	(73,92)	(79,52)	(58,47)	(47,22)	(51,38)
soya	(125,86)	(156,29)	(158,89)	(159,89)	(177,25)	(235,42)	(245,91)	(248,24)
groundnut	(22,85)	(22,96)	(22,47)	(22,95)	(19,41)	(18,57)	(18,03)	(16,18)
other	(41,11)	(46,65)	(38,80)	(38,48)	(42,65)	(44,38)	(48,15)	(45,90)

ECC (9 countries) - APPARENT USE OF CEREALS AND PROTEIN CONCENTRATESS IN ANIMAL FEEDS

Table 8

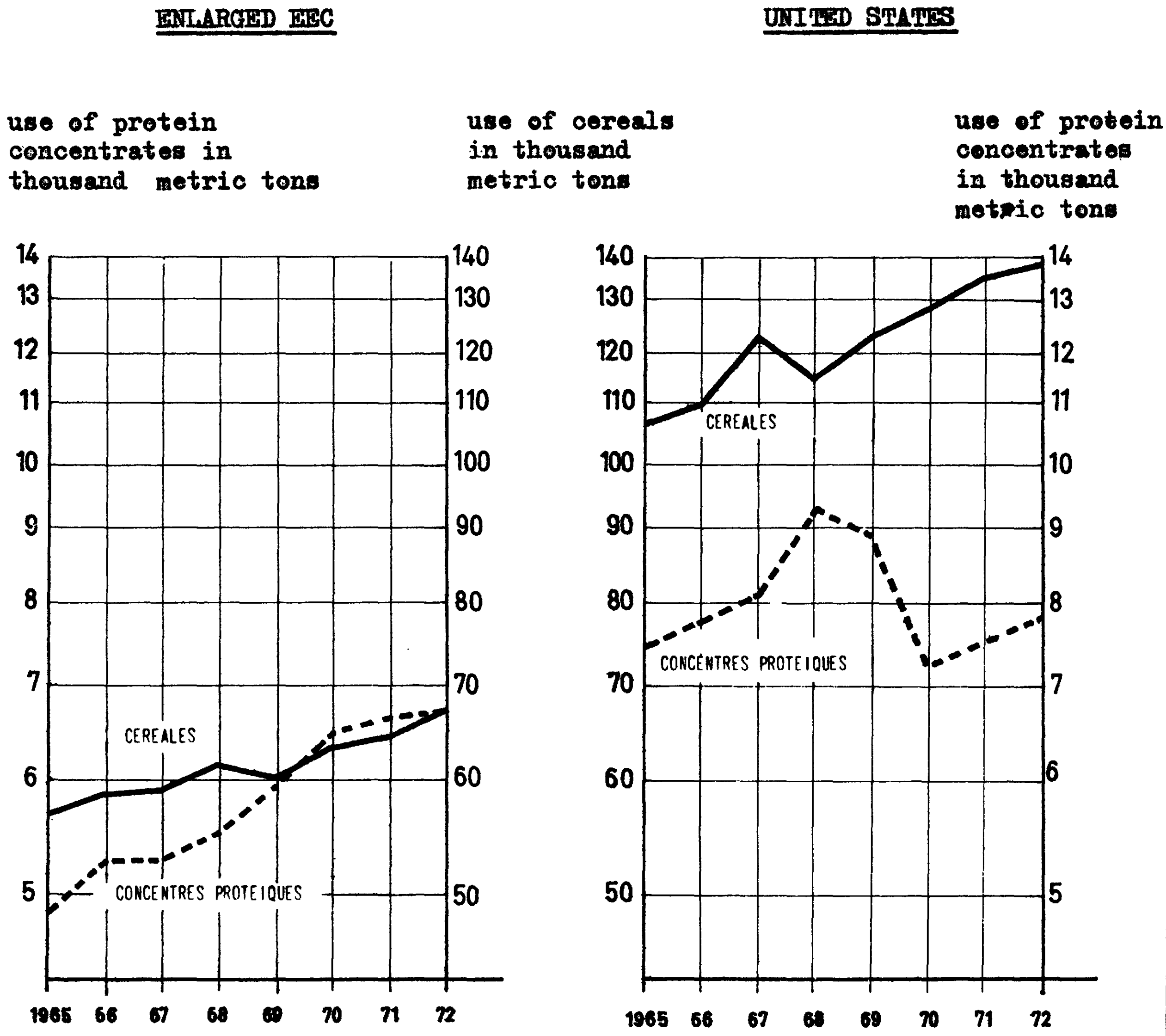
	1965	1966	1967	1968	1969	1970	1971	1972
-Cereal (1)	57 209	58 854	59 731	64 014	62 457	65 911	66 655	67 894
-Animal meal (2) (3)	1 488	1 366	1 506	1 808	1 933	1 530	1 332	1 395
Oilcake and oilseeds as oilcake equivqlent(2)	9 127	10 551	10 039	10 108	11 400	12 758	13 605	13 458
Protein concentrates in crude protein equivalent of which :	4 833	5 307	5 340	5 512	5 909	6 468	6 620	6 619
animals meals (3)	(967)	(888)	(1044)	(1176)	(1257)	(994)	(866)	(907)
soya	(1908)	(2368)	(2407)	(2423)	(2686)	(3568)	(3664)	(3768)
groundnut	(673)	(675)	(661)	(676)	(571)	(546)	(530)	(476)
% imports	93,2 %	93,8 %	92,9 %	92,2 %	92,5 %	93,0 %	92,4 %	92,3 %
Protein concentrates in Methionine equivalent of which:	81,87	88,52	91,45	94,76	101,60	102,34	106,25	106,95
animal meals (3)	(29,02)	(26,64)	(31,32)	(35,26)	(37,69)	(29,83)	(25,98)	(27,21)
soya	(24,79)	(30,79)	(31,30)	(31,49)	(34,91)	(46,37)	(49,22)	(48,67)
groundnut	(7,40)	(7,43)	(7,27)	(7,43)	(6,28)	(6,01)	(5,44)	(5,39)
% imports	89,5 %	90,3 %	89,1 %	87,9 %	88,5 %	88,4 %	87,8 %	87,8 %
Protein concentrates in lysine equivalent of which :	269,26	298,38	305,94	317,17	342,10	380,76	385,62	388,56
animal meals (3)	(73,34)	(66,73)	(78,72)	(88,21)	(94,82)	(73,47)	(62,68)	(66,33)
soya	(125,86)	(156,29)	(158,89)	(159,89)	(177,25)	(235,42)	(245,91)	(248,24)
groundnut	(22,89)	(22,96)	(22,47)	(22,95)	(19,41)	(18,57)	(18,03)	(16,18)
% imports	93,7 %	94,3 %	93,5 %	92,8 %	93,2 %	93,7 %	93,2 %	93,1 %

(1) per marketing year from 1964/65 to 1971/72

(2) per calendar year

(3) production of fishmeal and fish solubles - net imports of fishmeal and meat meal.

TREND IN CEREALS USE AND APPARENT USE OF PROTEIN CONCENTRATES (in crude protein equivalent)



Graph. n°2

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Table 9

UNITED STATES - APPARENT USE OF CEREALS AND PROTEIN CONCENTRATES IN ANIMAL FEEDS

(in thousand metric tons)

	1965	1966	1967	1968	1969	1970	1971	1972	1973
Cereals (1)	107 212	108 587	123 918	113 692	123 028	128 043	135 006	136 530	
Protein concentrates in crude protein equivalent (2)	7 494	7 689	7 896	9 263	8 847	7 120	7 333	7 740	
Actualuse of oilseed proteins fishmeal proteins and cereal proteins (3) in 44% soya oilcake equivalent(4)	15 880	16 113	16 160	16 952	18 213	18 221	18 166	16 702	17 509

(1) 1964/65 to 1971 marketing years

(2) stockpiling partly accounts for the increased apparent use in 1968-69

(3) including maize gluten, etc.

(4) Feed situation table 8 - ERS USDA - Washington August 1973.

Since 1969, cereal consumption in the Community have represented only approximately 10 times the volume of crude proteins contained in protein concentrates (graph 3). Taking an average protein content in cereals as a whole of 10 % (1); it can be deduced that cereals now provide no more protein than protein concentrates in animal feedingstuffs in the Community. In 1965, however, cereals provided 20 % more protein than protein concentrates. In the United States, they currently provide 80 % more (40 % more in 1965 (2)

Another important conclusion concerns the increasing share of soya oilcake in the EEC protein resources in recent years, and in particular from 1968 to 1969, with the drop in fishmeal imports (graph 4). Whereas in 1965 soya oilcake supplied 39.5 % of the crude proteins in protein concentrates used within the EEC and continued to provide around 45 % from 1968 to 1969, it rose to 55% in 1971 and 1972.

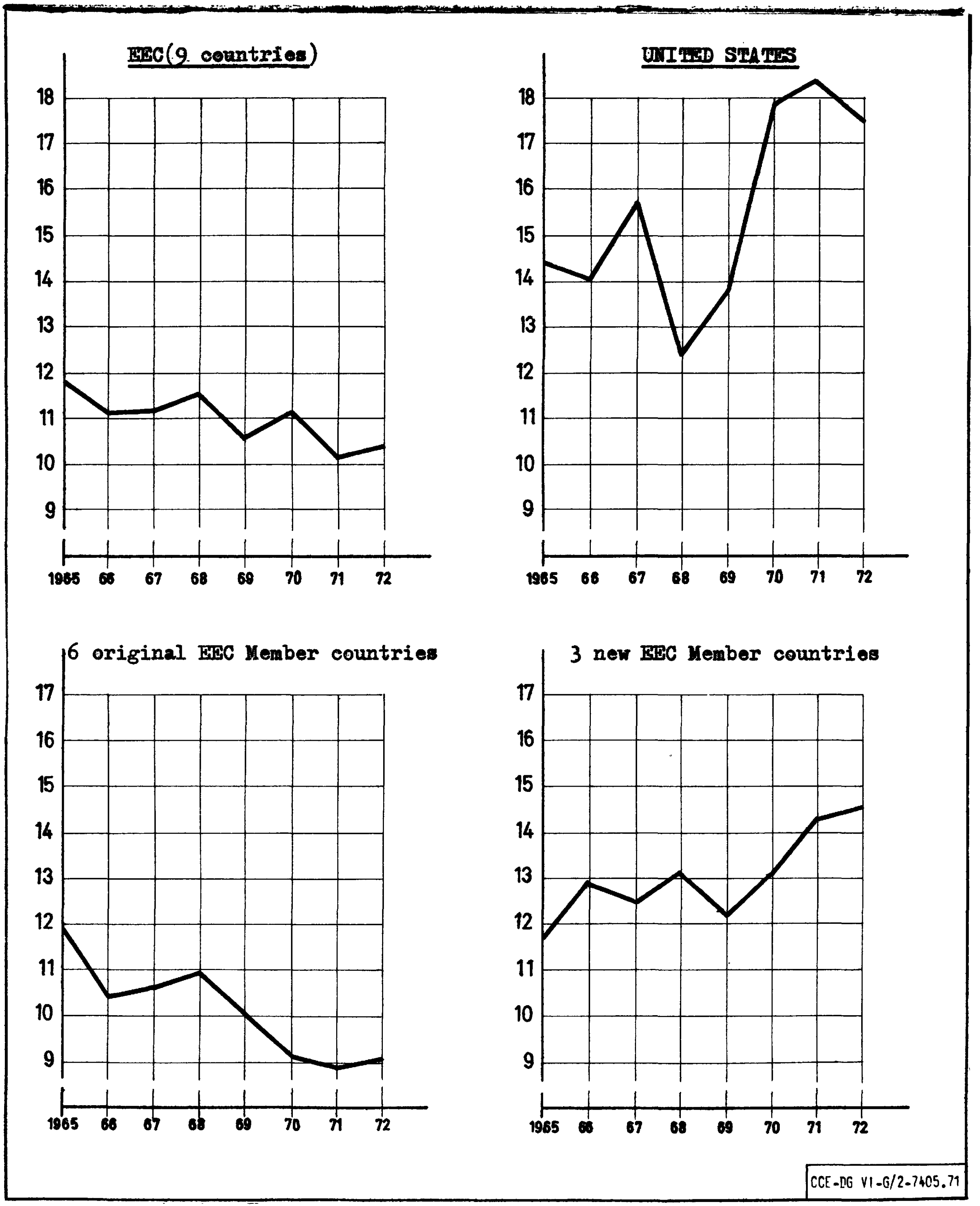
Between 1965 and 1972, the share of lysine provided by soya oilcake which is particularly rich in the amino acid rose from 47% to 64%.

---

(1) Maize : 9 to 10 % - Sorghum : 10 to 11 % - barley : 11 % wheat : 2 %.

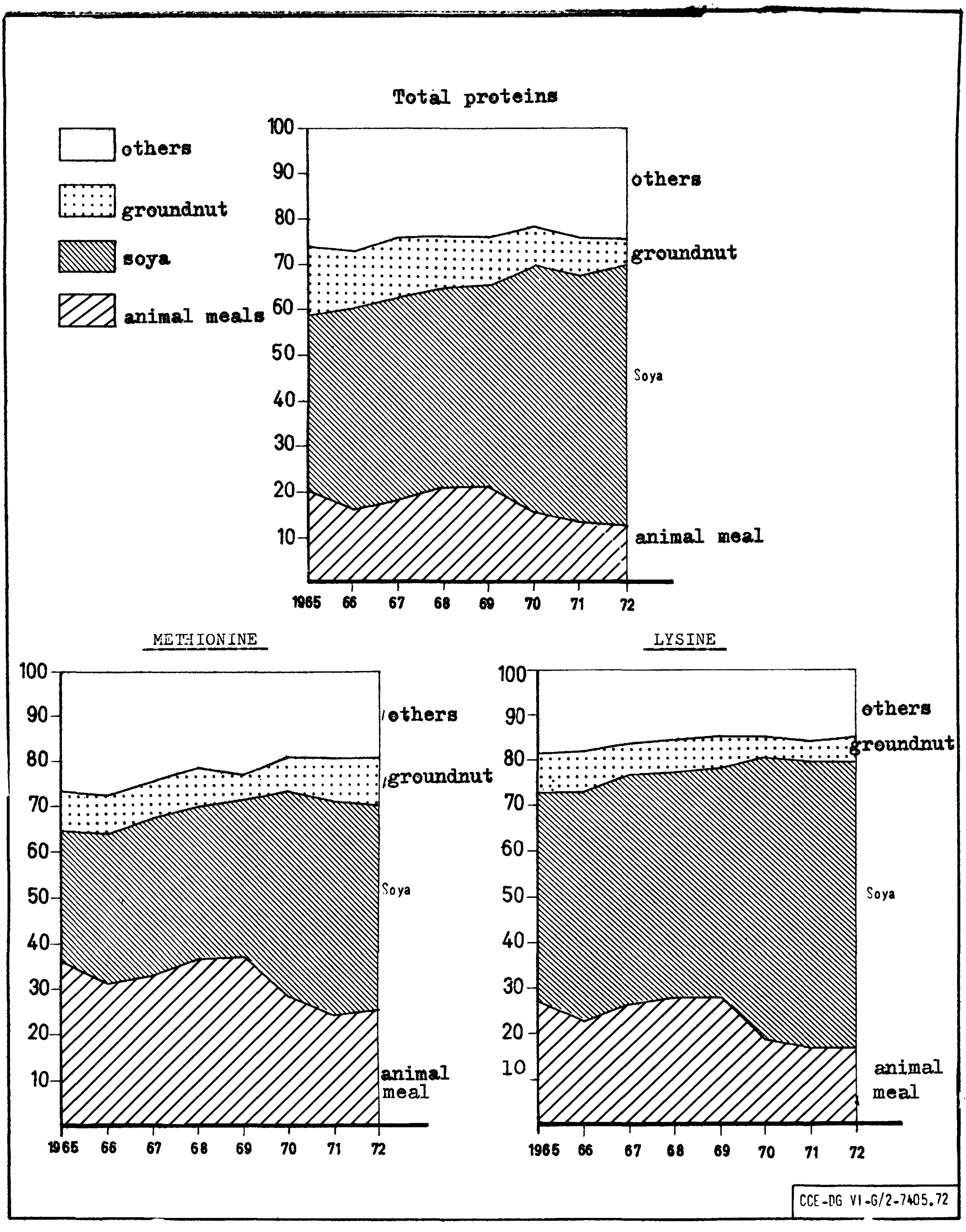
(2) In the three new member countries of the EEC (United Kingdom, Denmark and Ireland), cereal consumptions continued to increase in relation to protein concentrate consumption until accession to the Community. The massive use of cereals purchased on the world markets and the decreasing supply of protein concentrates may provide an explanation for this difference from the trends observed in the original 6 EEC member countries taken as a whole. Feed rations for monogastric animals contain much more cereals in the United Kingdom and Denmark than in the original member countries.

TRENDS IN THE RATIO AT CEREAL USE TO APPARENT USE OF PROTEIN CONCENTRATES (in crude protein equivalent) IN THE EEC AND IN UNITED STATES



Grap. 3.

Sources of TOTAL PROTEINS : METHIONINE - LYSINE contained de protein concentrates used in animal feeds in the EEC (9 countries)



Grap 4

A/ ECONOMIC INTRODUCTION

CHAPITRE II

PRECARIOUS BALANCE OF COMMUNITY SUPPLIES OF FODDER PROTEIN

-x-x-

In recent years the Community countries had gradually become almost exclusively dependent on two geographical sources of protein concentrates : Peru for fishmeal and the United States for soya oilcake.

True considerable economic benefits were derived from this dependence because of the very reasonable prices offered to the Community countries for soya oilcake over a long period of time. Import prices of soya oilcake were subject to seasonal variations rising in late summer and early autumn before the new crop, then tailing off from October onwards. For the past ten years, the annual average was approximately $ 100 per metric ton for imports to Europe.

I - BACKGROUND OF THE FODDER PROTEIN CRISIS (1972-1973)

A/ - Rise in protein prices (summer-autumn 1972)

In autumn 1971, the usual seasonal decrease did not occur, and since then soya oilcake prices have never stopped rising, exceeding $ 130 per metric in June-July 1972. This was due to several factors :

- an esteadily increasing demand for fishmeal, owing to lower fishmeal supplied following poor catches in Peru, produced higher prices ($ 220 per metric ton imported to Europe in July 1972.)

- a drought in Senegal meant that no supplies of groundnut cake were available until the next harvest (December) poor weather conditions in the United States resulting in a shortfall compared with the preliminary forecasts for the soya bean harvest.

- the United States concluded an agreement for the sale of one million metric tons of soya to the USSR. Shortly afterwards(beginning and end of August 1972), there were rumours on the Chicago stock exchange of further large purchase by USSR.

- simultaneous scarcity of colza and sunflower seeds.

- temporary unavailability of transport means, which were being used for other purposes.

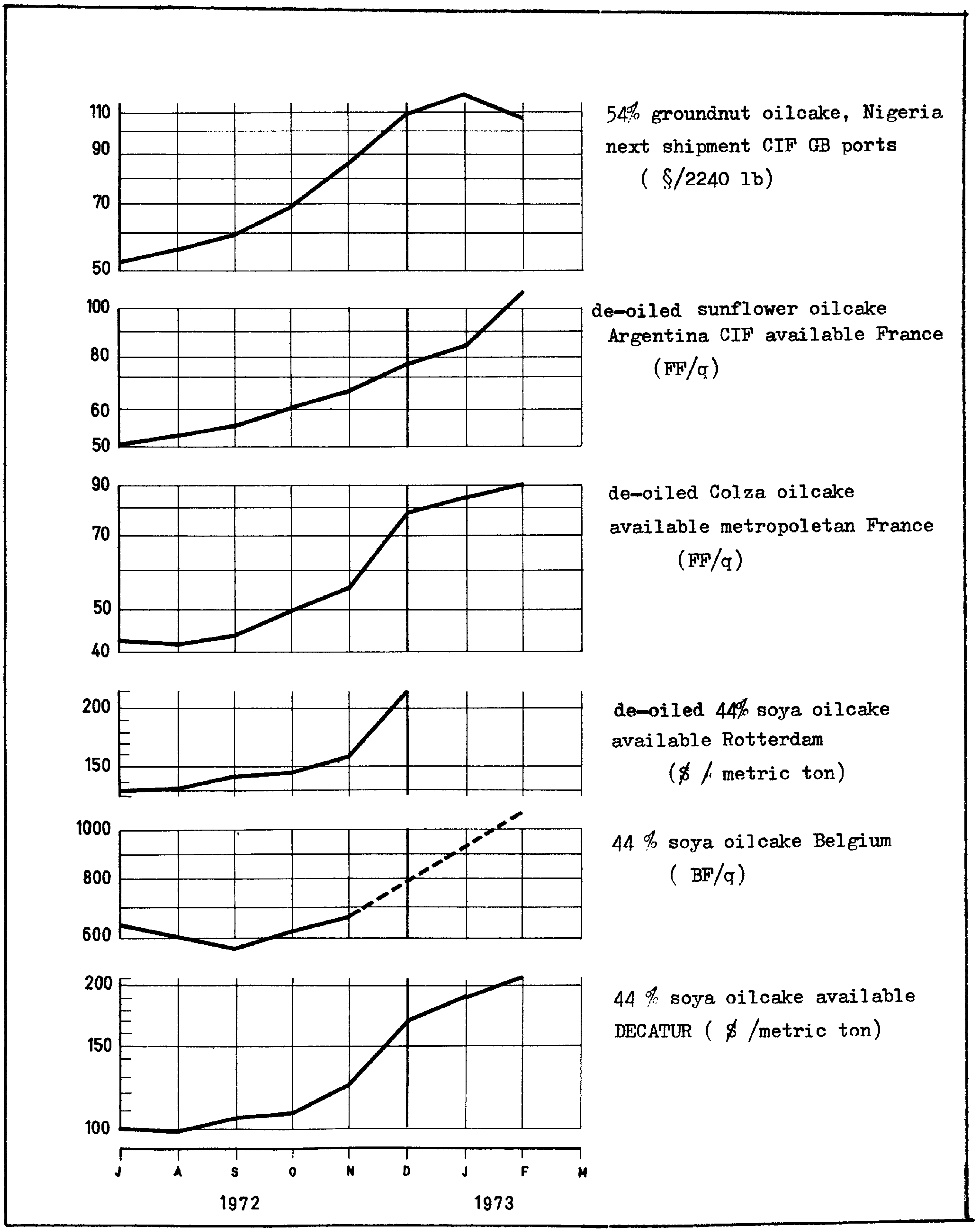
Although the news of a record soya bean harvest in Brazil (3.200,000 metric tons) and the hope of an early resumption of fishing activities in Peru, due to take place on 5 october 1972, were favourable signs, certain pessimistic and particularly shrewed middleman encouraged European compound feed manufacturers to cover their supplies for May 1973 (new crop) at the then seemingly very high price of $ 135 per metric ton. A few weeks later (end october 1972) the new crop could not be purchased for less than $ 135 per metric ton.

B/ First spurt of protein prices (winter 1972-1973)

The first jump in soya oilcake prices was early in November 1972. This occurred after an unprecedented price rise for other oilcakes, from 30 to 60 % in a single quarter. The combined effect of higher demand for colza oilcake and sunflower seeds due to the scarcity of groundnut cake and lack of fishmeal was to send soya oilcake prices scaring,although soya bean production in the United States and Brazil reached an all time record (graph 1) In winter 1972-1973,oilcake prices reached peak levels due to many factors :

- stockpiling following the uncertain monetary situation (possible dollar devaluation)
- fishing activities halted in Peru.
- additional requirements of European livestock farmers who had to turn to compound feeds since their purchasing contracts for groundnut cake could not be fulfilled.
- news of a poor groundnut harvest in Senegal (320,000 to 350,000 metric tons against 750,000 metric tons in 1971-1972) and embargo on shipments from Sudan precocious winter in the United States and announcement by the USDA of a two million ton shortfall of soya beans compared with the harvest forecasts.
- persistent rumours of fresh buying by USSR.
- suspension of soya oilcake exports from China to Japan.
- quantitative restriction of Brazilian soya exports to not more that 110 % of the figure for the previous year.

First spurt in the prices of Soya oilcake preceded price increases for other oilcake (Autumn 1972)



Graph 1.

. rumours of a possible restriction on American exports at the request of oil manufacturers.

In mid-February 1973, the price difference between availabilities and deliveries for winter 1973-1974, i.e. backwardation of the previous crop on the new, reached a record $ 80 to 90 per metric tons soya oilcake.

C/ Lull in spring 1973

From February to mid-April all oilcake prices fell comparatively. This temporary remission in the rise in prices can be attributed to several factors :

. resumption of fishing in Peru in early March, after the Eureka expidition, which had found anchovy shoals that has disappeared for several months;

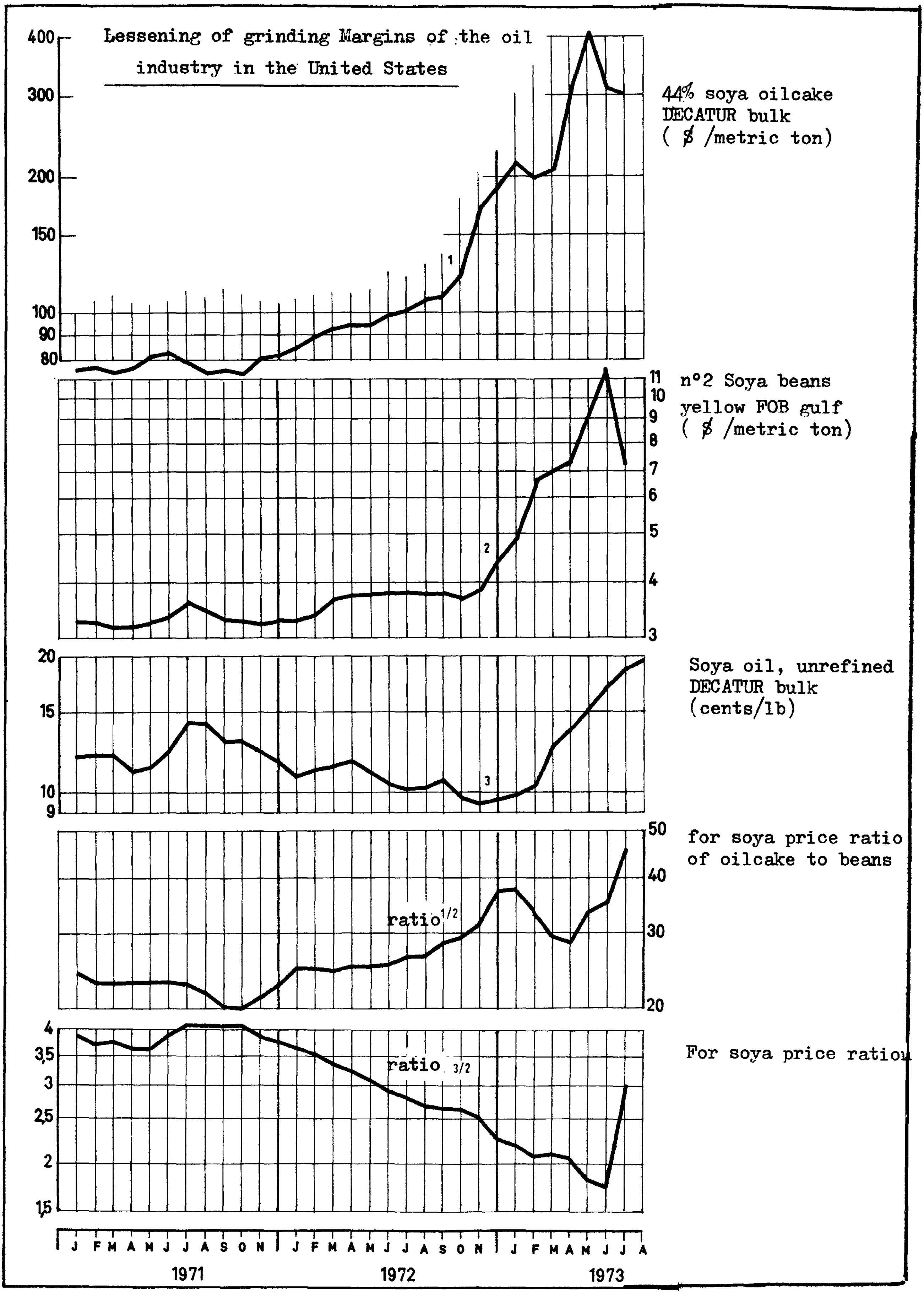
repeated announcements by the American auhtorities (BUTZ statement in January) of increased sowing the boost the new crop.

. application on the Chicago Stock Exchange of the "Limit up" procedure (1) hold down the rising prices with a reminder that price regulations should be observed seasonal dop in European producers' requirements at the end of the winter (cattle put out the grass).

Nevertheless an important factor caused a new jump in soya oilcake prices. Market disruption had led to discrepancies between prices for seeds, oil and oil-cake. Owing to the higher prices for seed and low world rates for vegetable oils (grap 2) oil manufacturers reduced their grinding operations and consequently their seed purchases, running down their in-pant stocks to dangerously low levels (graph.3) (2).

(1) The limit-up procedure consists in mandatory restriction on upward movements on the stock exchange (in this case, a maximum of $ per session).

(2) The last curve on graph. 2 show that oil prices never stopped falling in relation to

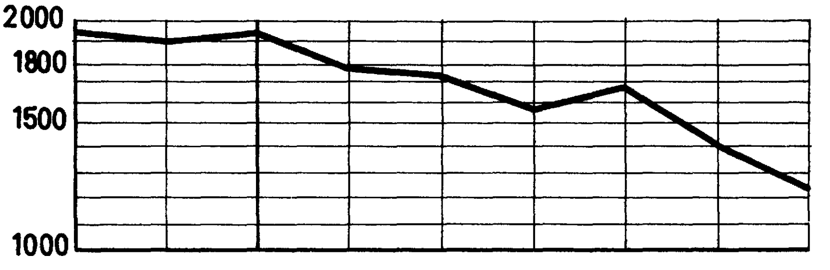

Lessening of grinding Margins of the oil
industry in the United States
400
300
200
150
100
90
80
44% soya oilcake
DECATUR bulk
($ /metric ton)
1
11
10
9
8
7
6
5
4
3
n°2 Soya beans
yellow FOB gulf
($ /metric ton)
2
20
15
10
9
Soya oil, unrefined
DECATUR bulk
(cents/lb)
3
50
40
30
20
for soya price ratio
of oilcake to beans
ratio 1/2
4
3,5
3
2,5
2
1,5
For soya price ratio
ratio 3/2
J F M A M J J A S O N J F M A M J J A S O N J F M A M J J A
1971
1972
1973

Graph. 2

Trend in activity of oil mills in the USA.

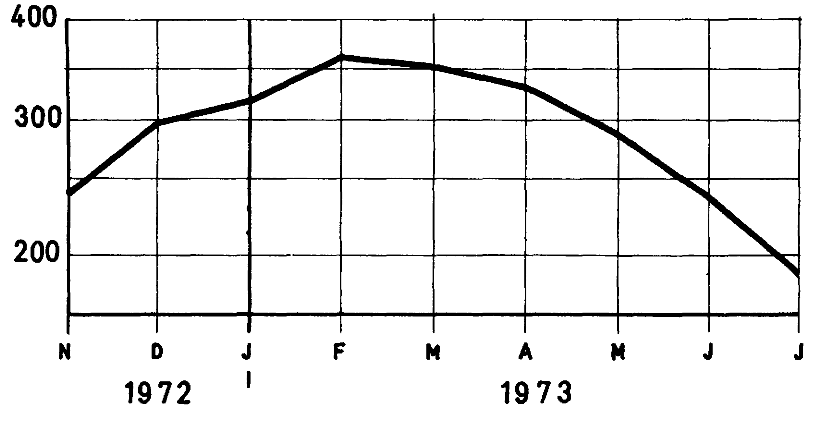
CRUSHING

(in thousand metric tons)



SOYA BEAN STOCKS

(in thousand metric tons)



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Graph. 3

D/ - Second spurt in protein prices (summer 1973)

After a short respite, however, prices rose again with the tightening of the supply situation in autumn 1973 pending the harvesting of the new crop. In May 1973 there recurred in quick succession a further suspension of fishing in Peru until October, the threat of poor yields in the Southern United States due to floods and above all, greater demand in a number of countries. No longer able to import from China, Japan was purchasing additional quantities of American soya (half a million metric tons) and even China itself was importing small amounts from the United States (1).

Within a few weeks, soya oilcake prices doubled again to reach $ 260 per metric ton in Chicago in June 1973. Prices for the new harvest, for delivery in November 1973 - March 1974, levelled off at $ 135, leaving a barely credible contango between the two harvests of over $ 120 (graph 4).

As early as May, there had been rumours of a run-down of manufacturers' stocks by September-October and a posssible suspension of American exports. In mid-June, operations were suspended on the Chicago stock exchange and a week later the first embargo measure were announced by the American Government.

E/ - Easing in late summer 1973

Starting in mid-July 197 , the confirmation of a bumper crop in the United States and Brazil, and then from mid-August onwards measures aimed at direct control of market rates ("lilit-up" on the Chicago stock exchange) finally led to a sharp drop in prices in Chicago and Rotterdam. In addition, endeavours were made by European compound feed manufacturers to replace soya oilcake by other raw materials in order to supply feeds of lower protein content and they even refused to manufacture high-protein feeds for supplementing cereals. The price fluctuations for proteins observed since summer 1973 have not been as wide as during the mergency (graph 5).

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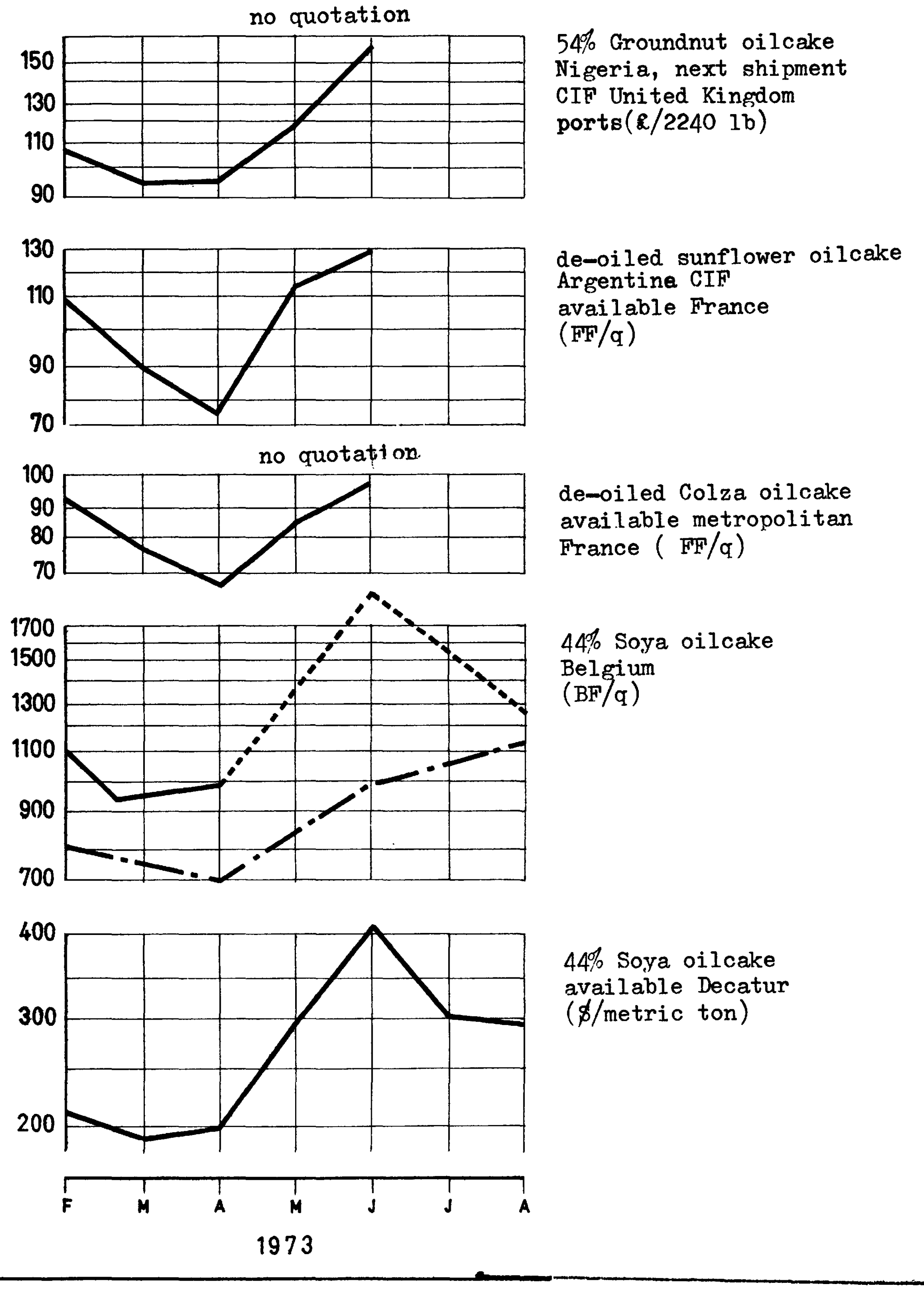
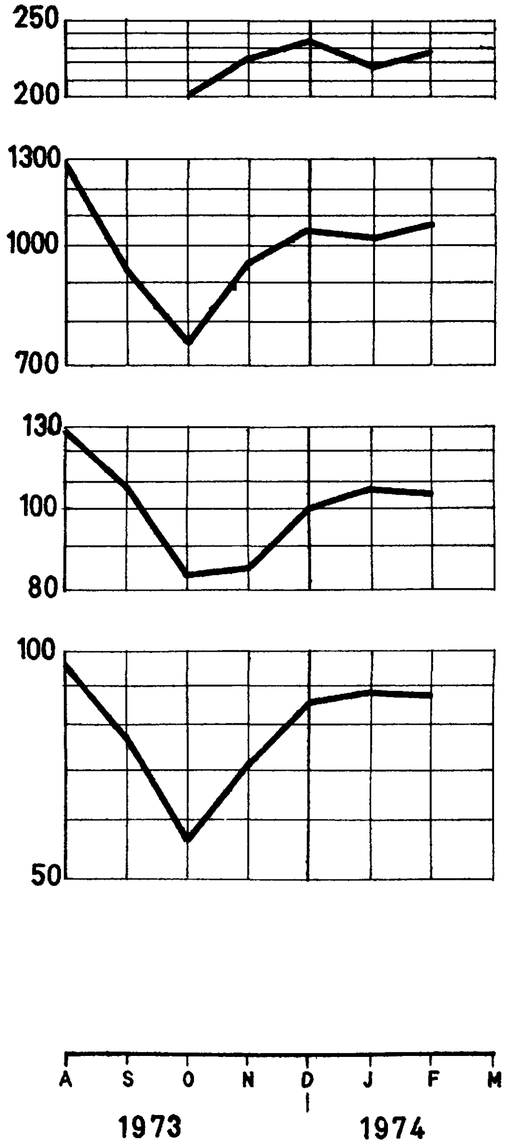
(1) In the first 11 months of 1973, imports to mainland China totalled 130.000 metric tons of beans and to Taïwan 540.000 metric tons.

SECOND SPURT OF PRICES IN SPRING—SUMMER 1973



Graph 4

Easing of Protein prices in autum-winter 1973-1974



44% US soya oilcake Rotterdam dealer quotation (US $ per metric ton)

44% soya oilcake Belgium (BF per quinta)

de-oiled Sunflower oilcake Argentina CIF France (FF per quintal)

de-oiled metropolitan Colza oilcake (FF per quintal)

(All quotations given for available stock or next delivery)

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Grap 5

II. GENERAL COMMENTS ON THE PROTEIN CRISIS OF 1972/73 AND ITS REPERCUSSION ON PRICE LEVELS FOR ANIMAL PRODUCTS

The general impression given by analysis of the protein crisis in 1972/73 is that Community manufacturers were unable to mitigate its effects. They could take no countexaction against the price increases of protein concentrates and when the contracts they has previously concluded at reasonable prices expired or were hit by the American embargo and they had to obtain spot supplies for very small quantities, they had to face sharp increases of up to or even sometimes over 100 %.

The manufacturers help less ness is attribuable to the absence of any siseable supplementary sources of proteins, and to the size of the short fall in 1972/73 caused by an almost complete stoppage of fishing in Peru and drought in Senegal.

With a deficit in the Senegalese harvest of some 350.000 metric tons of seeds and a shortfall in the world output of fishmeal of 1.7 million metric tons, the overall deficit can be estimated at :

- 1.2 million metric tons of total crude proteins
- 35 thousand metric tons of methionine
- 92 thousand metric tons of lysine.

Although the increase in American exports (including with drawages from stock)and for the Brazilian harvest (in spite of temporary export restrictions) in 1971/72 and 1972/73 meant a growth in world soya bean resources, imports into USSR and additional purchases by Japan probally reduced these extra resources to 2.3 million tons of seeds or the equivqalent of :

- 900 thousands metric tons of total crude proteins (or 75 % or the deficit entailed by reduced groundnut and fishmeal production.)
- 12 thousand metric tons of methionine (or 34 % of the deficit entailed by reduced groundnut and fishmeal production).
- 60 thousand metric tons of l sine (or 65 % of the deficit entailed by reduced groundnut and fishmeal production).

Obviously, the bumper crops in 1972/73 could not make up for the shortages of groundnuts and fishmeal as well as meet the extra demand from compound feed manufacturers in Europe and Japan, or about half a million metric tons of crude proteins per year at the pace achieved just before the crisis broke out (1).

The hardest hit member countries of the Community were of course those importing large amounts of fishmeal. In Germany and the United Kingdom in particular, their combined fishmeal imports fell by 42 % from 1971/72 to 1972/73 and their imports of soya oilcake rose by 10 % and of other oilcake by 8 %.

By hasty purchase, the manufacturers of both countries helped to worsen the crisis and a certain amount of caused panic.

Generally speaking European compound feed manufacturers were the victims of the market situation, since they had to face unprecedented increased and most unalatable supply conditions (2). They were unable in particular to avert the price increase for protein product concentrates by introducing more cereals into their formulas since cereals also sharply increaded in winter 1972/73 and summer 1973 partly due to demand from the manufacturers.

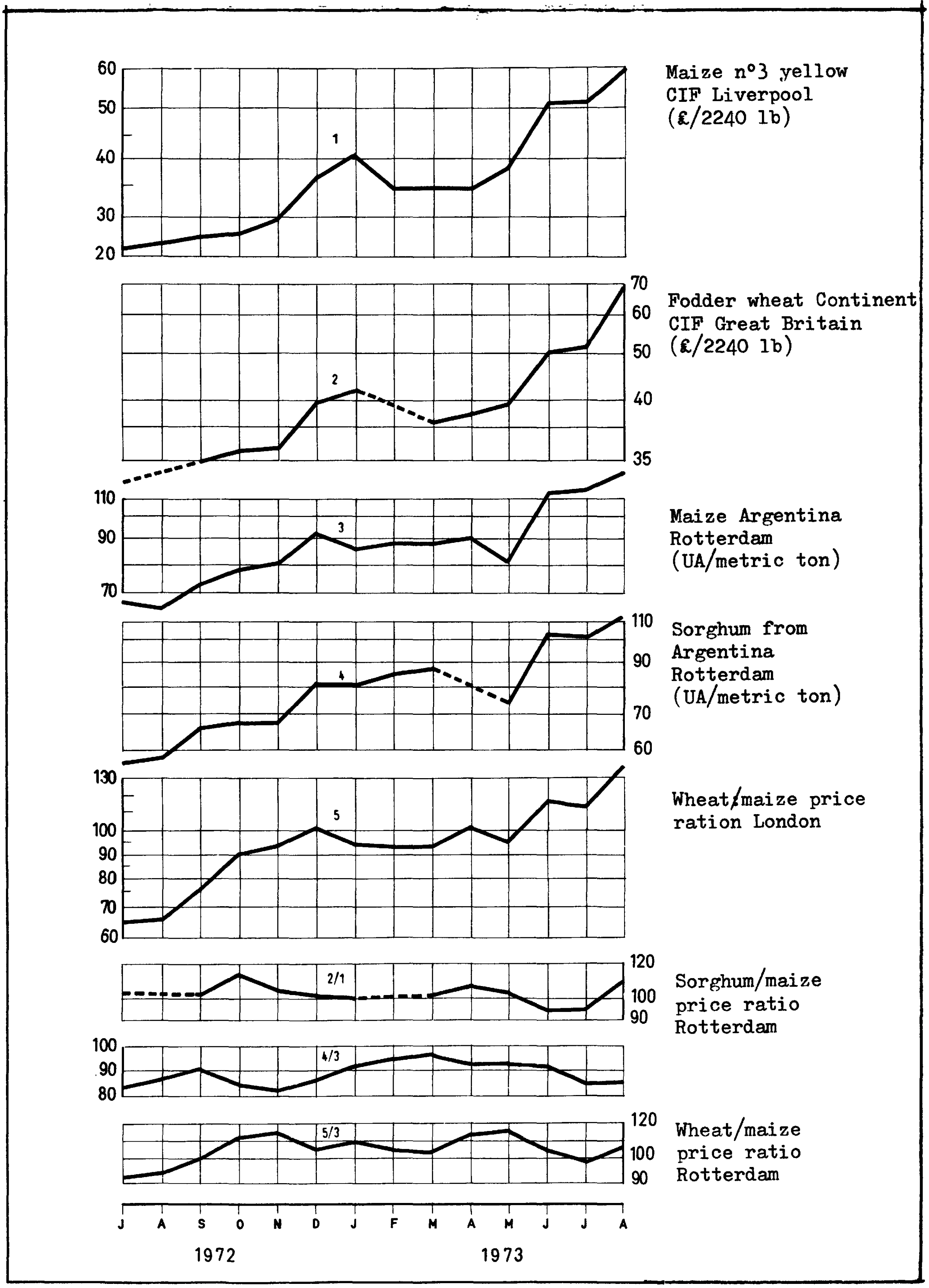
Also the prices of cereals with the highest protein content (sorghum and especially wheat) were very high in relation to those less rich in protein (maize) throughout the protein crisis (graph 6).

---

(1) Within the EEC, productions of compound feeds for pigs and poultry alone grew at an average rate of 1.5 million metric tons per year between 1971 and 1973, implying an extra consumption each year of 250.000 to 300.000 metric tons of protein from protein concentrates. In Japan the growth rates were only slightly behind those of the Community (+ 1.2 million metric tons per year for pig and poultry feeds).

(2) There were cases of plants threatened with closure du to the protein shortage, saved at the last minute in return for cash payments. A black market in lysine a raw material which enables soya oilcake to be replaced by less costly oilcake or partially by cereals in certain formulas, even developed (Chapter IV). The price for lysine was more than four times the export price from Japan to Europe.

Increase in CEREAL prices during the protein crisis



Graph. 6

It is not easy to assess the effect of the increase in the prices of protein concentrate products on those of animal products and on farm incomes. In theory, they should have had more impact on the price of meat poultry, since more protein is required for its production (1), but for cyclical reasons, prices for this product were those that rose least during the period under consideration (graph 7).

Pigmeat and egg prices rose sharply in the Community and may be considered to have largely affect the effects of the higher protein concentrate costs. Between July 1972 and May 1973, prices of soya and groundnut oilcake tripled, corresponding to a 30% rise in the cost of feeds on the basis of an average incorporation rate of about 15 % (2).

It may therefore be assumed that apart from meat poultry the increase in protein concentrate prices was generally affect by the overall increase in foodstuffs. (3).

---

(1) During the finishing period meat poultry requires feeds containing nearly 20% proteins against 16/17% for laying hens and 14/15% for pigs weighing 50 to 100 kg.

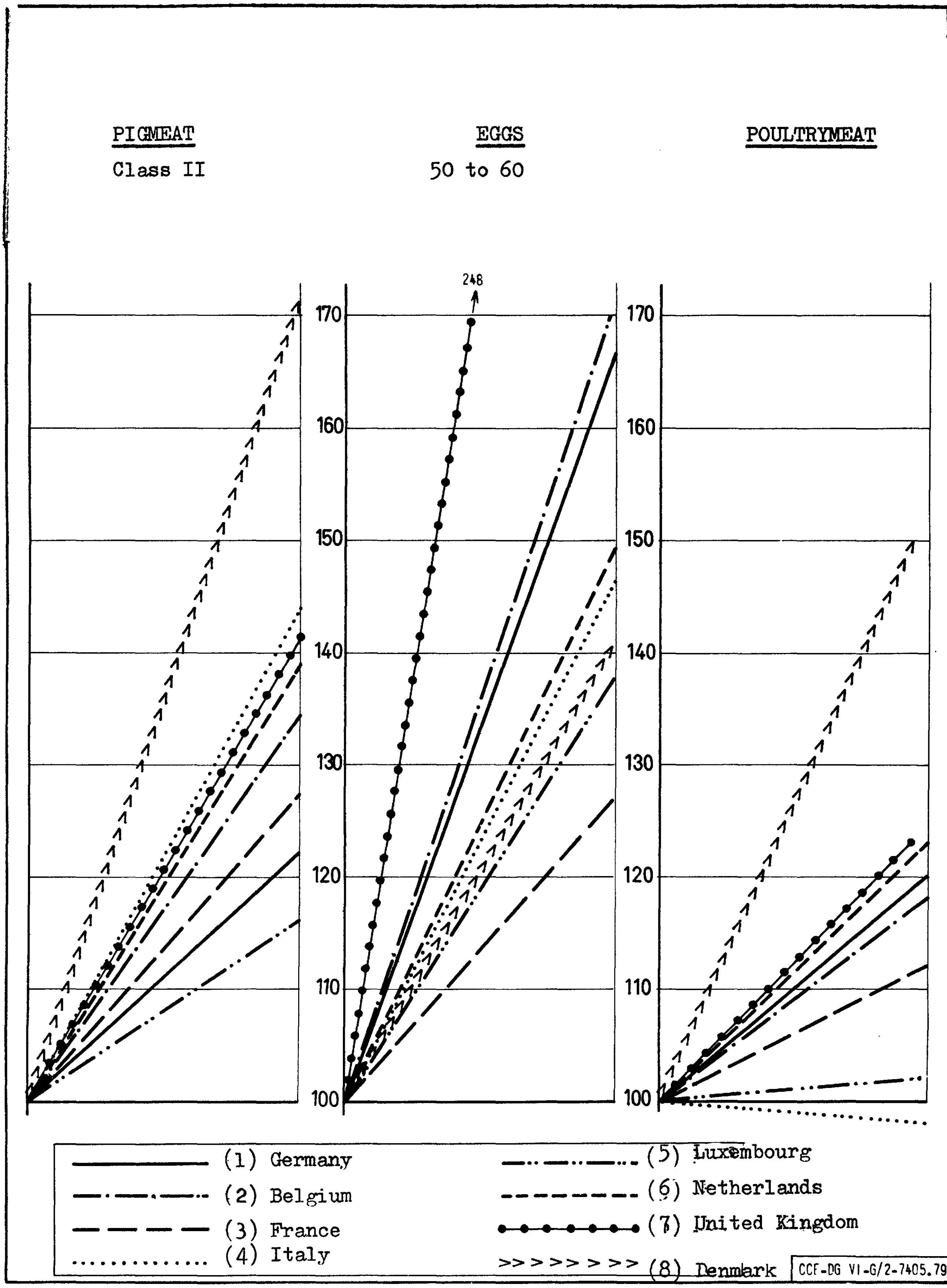
(2) For meat poultry the increase would be 50% on the basis of a soya oilcake incorporation rate of 20%.

(3) In the United Kingdom and Denmark which suffered the full impact of the price rise of cereals as well as oilcake, the price increase were much sharper than in the 6 original Member States of the Community :

(from July 1972 to May 1973)	Denmark	United Kingdom
pigmeat	+ 72.5%	+ 41.2%
poultrymeat	+ 50% (*)	+ 27%
eggs	+ 42.9%	+148%

(*) from July 1972 to March 1973

PRICE index of MONOGASTRIC ANIMAL PRODUCTIONS in May 1973 (Index in July 1972 = 100)



B/ REVIEW OF TECHNICAL ASPECTS

CHAPTER III

FINDING SUBSTITUTES FOR RAW MATERIALS

-x-x-

INTRODUCTION

Nutrients are systematically classified by nutritionists in the following main groups :

- Nitrogenous substances, or Protein, and their constituents amino acids
- Fats or lipids, and their constituents fatty acids
- Minerals

  (Macroelements : phosphorus, calcium, sodium chloride, salt magnesium
  (Trace elements : cobalt,copper, iodine, iron manganese, selenium,zinc

- Cellulose or cellulosic substances
- Glucids (often wrongly referred to as "carbohydrates").

In the raw materials used in animal feeds only supplied one nutrient each finding substitutes would be a simple task : it would be sufficient to replace the raw material by one or more substitute raw materials belonging to the same category on an equal weight basis.
Very bulk raw materials, i. e.; those required in large amounts, provide one nutrient only (1) :

. tallow	provides	practically	only	lipide
. salt	"	"	"	sodium chloride
. calcium carbonate	"	"	"	calcium

On the contrary, the constituents of cattle feeds supply a range of the above nutrients.

. cereals	provide	mainly	starch and a little protein
. oilcake	"	"	protein and a little starch
. bulk foods	"	"	cellulose substances
. molasses	"	"	carbohydrates, etc...

(1) Many raw materials, of little importance bulkwise, but very important from a nutritional point of view, fall within this group : vitamins, mineral trace elements, antibiotics antioxidants, anticoccidial agents. etc...

The multiplicity of nutrients supplied by each raw material determine its "character" and is responsible for the complexity of the search for substitutes, for within each category few raw materials are alike (See Annexe I, page III/13).

Substitutes were used well before the industrial manufacture of compound feeds began. Their nature has altered in the course of time, in the sense that beforehand they were considered as second best or were used to meet an unforeseen supply problem. Today they are

- more scientific, because of better knowledge of
  - (the composition of raw materials and
  - (the nutrient requirements of animals;
- more frequent, due to
  - frequent changes in the market prices of raw materials
  - the unsettled world supply situation
  - the certainty that a feed has the same nutrient value even if its consituents are different, provided that the nutrients supplied remain identical
  - more sophisticated internationale trade patterns (sweet potato from China, manioc from Thaïland, etc)
  - modern means at the disposal of manufacturers in making up their formulas computers.

Raw material substitutes are indispensible to feed manufacturers, including both industrial producers and growers making up their own mixtures on the farm (1). They eliminate the disadvantage of :

- delays in the delivery of raw materials
- short supply or temporary disappearance from the market of one or more raw materials
- sudden increase in the price of one or more raw materials
- variations in the quality of one or more raw materials due e.g. to weather conditions (excess moisture content at harvest-time, excess cellulose content owing to drought etc.).

Moreover, they have the great advantage of often constituting an advance in animal feed manufacturing and providing new types of formulation, by dispelling preconceived ideas such as "this raw material is not suitable for this animal species".

If, when a raw material has been omitted from a feed for several days, no drop in perfomance is observed (2),this proves that it is not essential. There are many examples of traditional views abandoned sooner or later, for instance :

- "wheat causes congestion in piglets"
- "maize is too fattening for animals"
- "broilers must have one source of animal protein (fish or meat meal)" etc.

The seekers of substitutes aim at altering the characteristics of a feed as littele as possible, since uniformity of manufacture is of great importance.

---

(1) In practice, this distinction is quite arbitrary : some manufacturers own farms which absorbe part of their output of feeds and sometimes of it. On the other hand some growers (particularly in the United States) have such large herds that bymanufacturing the feeds required they reach the scale of large industrial concerns and use raw material substitutes in just the same way.

(2) The speed at which perfomances drop following changes in the diet can vary considerably : one to two days for laying hens or dairy cows, if the food is left by the animals because it is no longer appetizing or has a different physical appearance. True deficiencies (of vitamins, trace elements etc.) take much longer to make themselves felt (several weeks or months).

The characteristic should be changed as little as possible

- for <u>NUTRITIONAL</u> reasons : if the feed does not have the same constituents, it should supply <u>at least</u> the same amount of vital elements nitrogen substances proteins, fats, phosphorus, calcium, energy <u>at the most</u> the same amount of bulk elements.
- for <u>TECHNOLOGICAL</u> reasons : an apparently good value substitue from the point of view of raw material cost per quintal may turn out to be disastrous if it appreciably lengthens the production times difficulties in grinding treating with molasses, granulation, etc.) and consequently increase the production cost per metric ton to such an extent that the intended saving in the composition of the formula may be completely swallowed up. Formulators are constantly having to such practical problems.
- for <u>COMMERCIAL</u> reasons : changes in appearance (particularly colour) of compound feeds generally worry the farmers who buy them, because they fear a change in quality.
- for <u>TECHNICAL</u> reasons : variations in physical characteristics :
  - hardness or softness of granules (1).
  - small or large particle size of meals, taste, smell even, may provoke reactions in animals, causing lower (or excessive) consumptions, with rapid repercussions on perfomances.

---

(1) GRANULES : Since about 1955 compound feeds for most animal species are very commonly presented in the form of granules "cubes" (cylinders really) or plugs etc., even crumbs. The advantages of this presentation <u>are numerous</u>:

<u>nutrionàl</u> . better use of the nutrients contained in the feed (probably due to the pre-cooking of starches cereals, manioc legumes)

<u>economic</u> . decrease in consumption index
. less wastage by the animals
. transport in bulk made easier cost of bags abolished

<u>practical</u> . possibility of distributing the feed on the ground (pig houses pastureland), hence saving in feed troughs less dust(therefore fewer losses) etc. etc.

There are <u>some disadvantages</u> however :
. possible increase in consumption (greater density of the feed)
. increase in selling price compared with the same formula put up in meal form.

1/ – BASIC PRINCIPLE.. AND MEANS INVOLVED IN FINDING SUBTITUTES.

Since the 1950's, both have altered hand in hand with advances in nutrittional science.

11/ – A very elementary form previously widely used replacing wide categories of raw materials on an equal weight basic. For instance, the following were replaced, weight for weight :

- one cereal, wheat, by another, barley or maize
- one protein-rich oilcake of the groundnut type by another of the same type : e.s. cottonseed
- one low protein oilcake, palm nut, by another of the same type, copra
- one kind of wheat sharpe : bran, by another : middlings, etc.

Obviously, this sort of substitution is often incurrate, ashown by the contents in some main elements of the above raw materials used as substitutes.

Raw materials	Crude protein %	Fats %	Cellulose %	Minerals %	Fodder value, pigs (FU/q)
Oats	10,5	$\boxed{4,5}$	$\boxed{10,0}$	3,0	$\boxed{90}$
Wheat	11,0	$\boxed{2,0}$	$\boxed{2,5}$	1,5	$\boxed{10}$
Maize	9,5	$\boxed{4,4}$	$\boxed{2,0}$	1,3	$\boxed{115}$
Barley	10,0	$\boxed{2,0}$	$\boxed{4,1}$	2,5	$\boxed{100}$
Wheat bran	15,0	4,5	$\boxed{10,0}$	5,5	$\boxed{78}$
Wheat middlings	16,0	4,5	$\boxed{7,0}$	4,5	$\boxed{93}$
De-oiled groundnut oilcake	$\boxed{53,0}$	1,8	$\boxed{7,1}$	5,4	$\boxed{95}$
De oiled cottonseed oilcake	$\boxed{41,0}$	1,0	$\boxed{12,0}$	6,0	$\boxed{76}$
De-oiled copra oilcake	$\boxed{21,0}$	2,0	11,0	7,0	$\boxed{91}$
De-oiled palm nut oilcake	$\boxed{18,0}$	1,5	13,0	4,0	$\boxed{82}$

The more salient differences are framed in boxes.

But at the time when these substitutes were being used, the lack of precise knowledge about the requirements of animals the deficient selection of animal breeds and poor performances were such that greater accuracy in the formulation of feeds would have been futile.

12/ - A more accurate method is to maintain consistently identical <u>amounts of a few nutrients</u>. Thus, one or more raw materials are replaced by one or more others supplying as far as possible:

- an equal or higher (or not much lower) quantity of <u>vital</u> elements: crude proteins, fats, digestible protein, fodder value or energy (phosphorus, calcium);

- an equal or lower (or not much higher) quantity of undigestible or non-energy giving elements : cellulosic substances
  minerals subtances;

an equal or lower (or not much higher) raw material cost.

This kind of substitution was the rule for many years. It could be used by an experienced formulator, empirically or by means of a slide rule or calculating machine, or using tables of nutrient supplies of the main raw materials according to the percentages of use.

Formerly, at the fram or manufacturing plant, it was not uncommon to find "engineers" calculating substitutes formulas on the spot according to the data collected on the farm or to marcket requirements.

Examples :

Raw materials	% use	crude protein %	fats %	cellulose %	minerals %	Energy
BARLEY	10	$\boxed{1,00}$	0,20	0,41	0,25	10,0 UF
Replaced by or replacing the mixture						
(WHEAT	8	0,88	0,16	0,20	0,12	8,8
(WHEAT BRAN	2	0,33	0,09	0,18	0,11	1,6
	10	$\boxed{1,21}$	0,25	0,38	0,23	10,4 UF
MAIZE	20	1,90	0,88	0,40	0,26	674 CAL
replaced by or replacing the mixture						
(TALLOW	0,5	-	0,50	-	-	38
(WHEAT	19,5	2,15	0,39	0,49	0,29	600
	20,0	2,15	0,89	0,49	0,29	638 CAL
50 SOYA oilcake	18	9,00	0,31	0,68	1,10	18 UF
WHEAT BRAN	2	0,33	0,09	0,18	0,11	1,6
	20	9,33	0,40	$\boxed{0,86}$	1,21	19,6 UF
replaced by or replacing						
44 SOYA oilcake	20	9,06	0,32	$\boxed{1,32}$	1,18	19,4 UF

Raw materials	% use	crude protein	Lysine %	Méthionine %	Méthionine + Cystine %	energy Cal/kg
FISHMEAL	6	3,18	0,11	0,03	0,08	165
GROUNDNUT oilcake	4	2,60	0,21	0,08	0,10	119
WHEAT BRAN	2	0,32	0,008	0,003	0,007	26
	12	6,10	0,33	$\boxed{0,11}$	0,19	310
replaced by						
50 SOYA oilcake	11,9	5,95	0,37	0,08	0,17	303
METHIONINE	0,1	0,06	-	0,10	-	1
	12,0	6,01	0,37	$\boxed{0,18}$	0,17	304

The more salient differences are framed in boxes.

This substitution method is still commonly used

- in straightforward cases not requiring very great accuracy
- in emergency cases
- when the number of elements concerned (raw materials or nutrients) is small

For instance :

- when one raw material is to be replaced by one or two others
- when only approximately consistent proportions of the following are required : cure protein, minerals (phosphorus,calcium), energy.

Such is the case for bovins-sheep and Goat feeds. The nutrition of bovins etc., or polygastric animals, is very different from that of monogastric animals (pigs, young calves, poultry etc.) (1) for at least two reasons :

a) the diet of monogastric animals must include a certain number of amino acide (approximately 10), called "essential", precisely because the animals are incapable of synthesizing them. On the contrary, by means of the bacteries and protozoa living in their rumens, polygastric animals can make these amino acids themselves from more elementary sources of nitrogen or nitrogen substances. They therefore do not require any essential amino acids (2).

b) rations for monogastric animals generally only contain compound or concentred feeds, wherereas ruminants often consume a large proportion of fodders (hay, beet, green meadow grass, maize silage, green fodders, fresh pulps, etc.) supplemented by concentrated feeds.

(1) The nutrition of animals such as HORSES or rabbits sometimes called "Pseudo-ruminants", is half-way between that of polygastric and monogastric animals (due to the size of their CAECUM)

(2) In the very general case at least. The need for amino acide, even for ruminants is confined to solely very special cases (high performance animals) and is somewhat controversial.

DRAWBACKS

Unfortunately, this method has several disadvantages. Not only does it require great skill or experience on the part of formulators.

(1) it cannot be applied when many raw materials are involved

(2) " ' " " " " nutrients " "

(case of poultry or pig feeds for example).

(3) it rests on the false premise of seeking equivalent supplies of nutrients. If a formula F1 contains surplus nutrients (e.g. feed formulas for LAYING HENS often contain excess lysine) it is no good trying to find the same excess in the substitut formula F 2. In other words, substituting parts of formulas generally produces unsatisfactory results from both the technical and economic stand points

(4) it gives no guarantee that the substitute found will be the cheapest. In other words, unless by fluke, formulators have no guarantees wheatsoever of minimum cost substitution.

Raw material	Price (Augt 1973)		% use	crude protein %	fats	cellulose %	minerals %	Energy fodder value pigs (FU/kg)
	FF/q	UA (1)						
50 soya oilcake	115	20,71	10	4,82	0,19	0,36	0,60	9,5
1st. substitution								
Groundnut oilcake	110	19,80	9	4,77	0,16	0,64	0,49	9
wheat	55	9,90	1	0,11	0,02	0,03	0,02	1
			10	4,88	0,18	0,67	0,51	10
2nd. substitution								
Groundnut oilcake	110	19,80	9	4,77	0,16	0,64	0,49	9
wheat bran	48	8,64	1	0,16	0,05	0,09	0,06	0,8
			10	4,93	0,21	0,73	0,55	9,8

Both substitutes supply roughly equivalent nutrients, but

- the initial formula (10% 50 soya oilcake) has a raw material cost of 11.50 FF (2.07 UA)
- the first substitute has a raw material cost of 10.45 FF (1.88 UA)
- the 2nd. substitute has a slightly lower cost 10.38 FF (1.87 UA)

(1) 1 FF = 0.180044 UA

This difference in raw material costs between substitute formulas 1 and 2 may seem tiny; it is obviously very small per quintal of feed (0,07 FF. or 0.013 UA) but far from negligible when multiplied to the manufacturers scale of 5.000 or 6.000 metric tons per month.

Thus, large concerns xhich can "afford to do so" thanks to their technical staff or adequate equipment will benefit it from such savings to the detriment of small local undertakings. The result may be concentrations of firms since larger ones are more capable of competing on the level of the raw material costs of formulas and rapid adaptation to changes in the market situation.

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In order to obtain greater accuracy and the certainly that the cheapest of technically equivqlent substitutes will be found the so-called "linear programming" method and the use of computers is essential (1). Because of their expensiveness these apparatus are not generally sold by the constructors to the users but rented. There is an even more original system. which consists in connecting approximately 30 clients to a single central computer, with each client communicates through a terminal or console. This is the teime-sharing or multiple renting systems. With every client using the computer to suit his own requirements.

(1) There are other kinds of equipment less familiar to the general public, such as analog computers, based on a different operating principle.

Annex I (pages AN/1 à AN/15) deals with :

- linear programming and data-processing
- the practical use of computers for dinding substitutes
- trends in substitutes

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X X

2/ - CONCLUSIONS

21/ - In practice, substitutes are often used for many reasons :

- raw material supplies
- price variations
- quality variations

22/ - They are often unwelcomed to the customer who easily tends to be more concerned with the physical characteristics of feeds (colour, smell) rather than the potential effects on his livestock.

23/ - They must ensure the coverage of animal requirements.

A balanced supply of nutrients is more important than the presence of a given raw material

Fishmeal + groundnut oilcake should be capable being replaced by soys oilcake + methionine if required by the price situation without any further consideration.

B/ Review of TECHNICAL ASPECTS (Continued)

CHAPTER IV

R E V I E W O F S U B S T I T U T E P R O D U C T S

From the theoretical point of view the problem of protein supplies for animal feeds in the next few years, and hence the problem of animal product supplies for human consumption, can be solved in several standard ways. For example, an individual or a company faced with indequate resources may, in order to make good the shortage :

- either cut back his expenditure
- increase his income or
- combine both.

Similarly, solutions to the problem of protein supplies for domestic animals might involve.

- reducing expenditure on proteins
- using new agricultural or industrial sources.

EFFECT OF REDUCED PROTEIN RATES ON THE PERFORMANCE OF LIVESTOCK

A reduction in protein and hence amino acid supplies may occur at three different levels :

LEVEL 1

The reduced suppplies do not affect 300 technical perfomances

- average daily gain
- consumption index
- egg production per hen per day, etc.

because the standard requirements were set too high in the past.

LEVEL 2

Reduced supplies lower the 300 technical perfomances. but not the stockbreeding margin. It is easy to see that protein sources can reach a certain price level beyond which a compound feed yielding lower perfomances but relatively cheaper would be used and would thus ensure a per capita margin at least equivqlent. if not higher.

LEVEL 3

The reduction in supply of nutrients is excessive : it lowers not only production of livestock but also farm profits.

See annex. pages IV/82 and IV/83

SOLUTION 1 : REDUCED STANDARDS, AND HENCE, REDUCED PROTEIN SUPPLIES.

Although, strictly speaking, this measure does not form part of the subject under discussion, we think that it merits a quick glance, because

- it is a common sense logical solution
- it can be immediately put into action

Since 1972 several cattle feed manufacturers have been applying it.

Is there therefore a surplus nitrogenous content

In many cases the answer is yes, for several reasons :

a) Our knowledge of livestock requirements is continually evolving, not only because methods of determination are becoming increasingly accurate, but because of the change in requirements for animals which are being bred more selectively. The methionine requirement of meat poultry in 1955 was very different from today's. Because there is a welle-established routine in stock farming, changes are often unwelcome. A given feed may have a high protein level in fact too high because if the nutritionist lowered it, farmers might blame it for variations in perfomance engendered other factors.

b) In the common Market, the ratio of cereal prices to protein sources has long been very different from what it is in the United States. In the Community, since cereals were expensive, soya oilcake was not much dearer. (before end 1972)

	France (june 1972		United States average May-August 1972	
	FF/q	UA/q(1)		
49/50 soya oilcake	70	12.60	11 87 $/q	(2)
Cereal (maize wheat)	app. 50	app. 9 00	5.06 $/q	(3)
Soya oilcake/cereal ratio	1.4		2.3	

(1) 1 FF = 0,180044 UA

(2) Decatur - Price in dollars per American ton : 107.70

(3) Wholesale price in dollar per 56 lb maize 1.28

Consequently, excess, wasted protein is wastefully used in certain feeds because it is nexpensive. (This practice does not in any way prevent the search for cheaper formulas).

c) The nitrogen requirements of monogastric animals are chifly expressed in levins of amino acids, which are mainly supplied by raw materials with widely differing protein levels for the came content of amino acids.

	% CP	% Methionine (1) as % of protein	Lysine (1) as % of proteins
50 oilcake soya	50	1.40	6.4
Groundnut oilcake	53	1.10	3.4
Fishmeal 65	65	3.00	8.1

Thus in order to provide	1000 g Methionine (1)	1000 g lysine (1)
it takes : soya oilcake 50	145 kg (or 72.5 kg/CP)	31 kg (or 15;5kg/CP)
Groundnut oilcake	173 kg (or 91.5 kg/CP)	55 kg (or 29 kg/CP)
Fishmeal 65	51 kg (or 33 kg/CP)	19 kg (or12.3kg/CP)

The fact that only small amounts of synthetic amino acids, especially lysine are available or the high cost of synthetic amino acids compared sith raw materials prices sometimes lead to the establishment of formulas too rich in protein or a given amino acid to cover the requirements in other amino acids. For instance, for a long time many feeds for laying hens had higher lysine contents than required because the protein supply sas determined by that of methionine, obtained mainly from soya oilcake. Extra synthetic methionine and less soya oilcake would not have been economical. Subsequently, it did become praticable following the fall in methionine prices. It is even,

(1) These two amino acids are taken as examples because they are the most important for monogastric animals (pigs, poultry, non-ruminant calves). On the other hand, as will be seen later (Chapter IV B), they are not essential for polygastric ruminants.

more so with the recent considerable increase in soya oilcake prices (June to August 1973). This example confirms the self-evident need for adequate and cheap supplies of synthetic amino acids.

Example of a feed for laying hens, providing 0.060 kg lysine in ~~excess per~~ quintal of feed :

Prix (1) juin 1972		Raw material	Composition	Lysine	Methionine + Cystine kg/q	Cost R.M.	
FF/q	UC/q					FF/q	UA/q
70	12.60	(Soya oilcake 50 replaceable by :	14	0,448	0,211	9,80	1,75
70	12,60	soya oilcake 50	12	0.384	0.180	8,40	1,51
52	9,36	maize	2	0.005	0.008	1.04	0;19
675	121,53	methionine 980	0,025	-	0,024	0,17	0,03
			14	0,389	0,212	9,61	1,73

It can be seen that the 2 kg decrease in soya oilcake "mopped up" the surplus lysine (0.448 - 0.060 = 0.388) but it simultaneously lowered the methionine rate which had to be brought back to the previous level by adding synthetic methionine (25 g).

It is clear that the use of these substitutes is of economical. From the technical point of view, it maintains the methionine + cystine supply and slightly increase the energy value of the feed (approximately 16 cal/kg), since maize has a higher energy value than soya oilcake 50.

(1) 1 FF = 0,180044 UA

d) The protein contents of raw materials often very quite considerably. For instance, so-called soya oilcake 44 can in fact show an actual crude protein content of less than 40 %.

Raw material	Number of samples analysed	average protein rate %	standard deviation (1)	66% of the samples thus have protein contents varying between		
				min. %		max. %
Groundnut	405	50,6	2,8	47,8		53,4
soya oilcake "44"	215	43,7	2.1	41,6		45,8
soya oilcake "50"	490	48.1	1.1	47.0		49.2

In order to forestall these unforeseable and detrimental variations, feed manufacturers adopt wider "safety margine" than would be needed with consistently "standard" raw materials. Thus to secure a guaranted crude protein content of 15 % the formulator has reckon an actual content of 16 or 16.5 %.

Conceivably, the problem might easily be solved if manufacturers took care to analyse their raw materials or have them analysed before use and then used them exactly in according to their actual composition and not their supposed or guaranteed composition.

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(1) Let M be the mean of a raw laterial "population". According to statistical analysis, 66 % of this population is known to have characteristics ranging between :

Mean - standard deviation

and Mean + standard deviation

In practice, this can only be readily done by his manufacturers with a laboratory attached to the production plant. Otherwise, the time spent waiting for the analytical results (time required for sending the samples + times for carrying out the analysis + time for returning the results) is too long : manufacturers would have to put aside all those raw materials in temporary storage with a considerable increase in the storage area or number of bulk bays required involving an unacceptable change on the manufacturing cost per metric ton.

Even in the most favourable case (in-plant laboratory), once a raw material received in bulk has been unloaded from a barge into bays, the manufacturer is practically obliged to use it : it would be too costly to take the raw material back out of the bay (bay unusable pending the outcome of any claim against the importer or broker).

e) The nitrogen requirement, or requirement of a given amino acid, for a species is <u>scientifically</u> expressed in grammes per day.

<u>In practice</u> formulators must convert it into a percentage or parts per thousand of a feed, on the assumption that animals will consume X kg or Y grammes of the feed per day. But in the estimation of this estimate of daily consumption has a certain margin of error.

Consequently formulators allow fors allow for a safety margin to guard against harmful effects at level:

- higher daily requirements in certain animals (e.g. intensive laying in laying hens.
- reduced feed consumption due to the slight build of animals, hot summer weather feeds with high energy values.

SOLUTION 2 : USE OF SUBSTITUTE PRODUCTS

AGRICULTURAL PRODUCTS

Replacing crops by others with higher protein contents :
(see table on page IV/8)

. either going back to crops grown formely, but abandonned or economic or farming reasons	(FIELD BEANS AND (BROAD BEAN
. or expanding currently grown crops	(GARDEN PEAS (LUCERNE(and clover)
. or introducing new ones to the EEC countries	(SOYA BEANS (SUNFLOWERS (LYSINE-RICH CEREALS (SEAWEED

INDUSTRIAL PRODUCTS :

. either existing ones but capable of being used in larger amounts	(SYNTHETIC METHIONINE (UREA
. or new ones	
- synthetic amino acids	(LYSINE
- urea analogues and non-protein nitrogen ous products	(BIURET (feed-grade) (IBDU (UREA PHOSPHATE (AMMONIUM PHOSPHATE
- unicellular organisms	(N-PARAFFIN YEASTS
. or future one	(TRYPTOPHAN (THREONINE (BACTERIAL MEAL

Comparative production (in kg/hectare)
of three AMINO ACIDS
from a few plant crops

CROP NAME	yield q/ha	METHIONINE Contents %	METHIONINE Supply %	Methionine plus CYSTINE Contents %	Methionine plus CYSTINE Supply %	LYSINE Contents %	LYSINE Supply %
Oats	40	0,17	6,8	0,53	21,2	0,45	18,0
Wheat	50	0,16	8,0	0,43	21,5	0,31	15,5
Maize (with irrigation	70	0,17	11,9	0,39	27,3	0,26	18,2
(without irrigation	50		8,5		19,5		13,0
Barley	45	0,18	8,1	0,41	18,5	0,36	16,2
Maize opaque 2	60	0,21	12,6	0,46	27,6	0,40	24,0
Hybrids opaque 2-Sweet 2	60 ?	?	-	?	-	0,50	30,0
Fields beans	30	0,22	6,6	0,61	18,3	1,78	53,4
" "	40	0,22	8,8	0,61	24,4	1,78	71,2
Garden peas	40	0,23	9,2	0,62	24,8	1,42	56,8
Dried lucerne	100	0,23	23,0	0,44	44,0	0,70	70,0
Soya beans	23,8	-	-	-	-	-	-
oilcake (3) (type 48/3.5(2)	16	0,68	10,9	1,45	23,2	3,10	50
Sunflower seeds	25	-	-	-	-	-	-
oilcake (3) (type 43/14 (4)	10	0,93	9,3	1,60	16,0	1,55	15,5

(1) Soya beans contain approximately 20% oil
We count 70 parts of dehusked oilcake for 100 of beans.

(2) Type with 48/49 % proteins and 3.5 cellulose

(3) Sunflower seeds contain 40/45 % oil
We count 40 parts of oilcake for 100 of seeds

(4) Type with 43 % proteins and 14 % cellulose.

A/ AGRICULTURAL SUBSTITUTE PRODUCTS

1/ FIELD BEANS and BROAD BEANSD

Field beans VICIA FABA minor and VICIA FABA equina and BROAD BEANS, VIVIA FABA major, are only very close varieties of the same botanical species, differing only by the size of the beans and their end-use (animal consumption for one and human consumption for the other). We shall deal merely with field beans.

After a very marked regression,

in FRANCE

Years	1929	1953	1967	1972
Broad beans, cultivated area in ha	app. 38.000	app. 26.000	appr. 4.700	–
Field beans cultivated area in ha	app. 30.000	app. 32.000	app. 16.000	app. 15.000

in the COMMUNITY

Years	1960	1972
Cultivated area in ha for the Six	app. 630.000	appr. 325.000
for the Nine	–	appr. 382.000

There has been a revival interest for this crop in France, Great Britain and Danemark.

a/ CULTIVATION

According to P. BERTHELEM and P. COMBE (1), the following factors are required in order to obtain maximum yields :

- deep soils with a good water retention capacity
- areas receiving abundant rainfall at the end of spring and in early summer (e.g; Great Britain, Belgium, West, North and East of France, etc).
- iirigation wherever the rainfall is nadequate
- sowing as early as possible (to avoid rust disease) of large bean varieties under precise conditions of density and dept of sowing
- chemical weedkiller treatment
- insecticide treatment (against black fly especially for the spring varieties)

(1) La FEVEROLE. Allons-nous vers un renouveau de sa culture ? Bulletin technique d'information n° 253, 1970.

b/ ECONOMICS

According to comparative production cost calculations (BERTHELEM and COMBE, op.cit) for maize, colza and field beans, the latter give farmers a net product equal to that for colza for yields from 37 q/ha upwards.

In addition, Y. HENRY (1) has proposed a substitution formula for calculating at any time the value or threshold price of field beans in pig feeds

10 parts of field beans = 4 parts of soya oilcake 44
+ 6 parts of barley
_ 0.02 parts of 98 % DL methionine

Thus, taking
- soya oilcake 44 at 105 FF/q (2) (18.9 UA/q)
- barley at 52 FF/q (2) (9.36 UA/q)
- 98 % methionine at 7.75 FF/q (2) (1.40 UA/q)

Calculations show that field beans are not advantageous if they cost more than about 70/72 FF/q (12.6 to 13 UA/q (2) free factory, not de-husked. For exemple, in France, temporary aid for very restricted areas was fixed in 1972 at 16 FF/q (2.88 UA/q) of which :

13 FF/q (2.34 UA/q) for growers and
3 FF/q (0.54 UA/q) for the storage agency.

c/ OUTLOOK FOR FIELD BEANS

Their prospects reside in the early development of hybrids. A short while ago, generticists were hoping yo obtain.

- winter hybrids in 1973/74
- spring hybrids in 1975/76

As yields of 40 q are already being obtained now in experimental fields, it is hoped the new varieties will provide yields of more than 50 q/ha.

Thus, 300,000 hectares of fields beans at 40 q/ha would produce 1,200,000 metric tons of beans, representing a saving of

- about 500,000 metric tons soya oilcake, or 8,5 % approximately of the current EEC production
- plus 700,000 metric tons of cereals (3)

(1) La Feverole dans l'alimentation du Porc, Bulletin technique d'information n° 253-1970

(2) 1 FF = 0.180044 UA

(3) However, if field beans were grown instead of a cereal on these 300,000 hectares, there would be a final deficit of more than 700,000 metric tons (to be bridged by imports?) due to the difference in yield/ha between cereals(50q/ha and field beans.

ANALYTICAL POINT OF VIEW

The protein value (25 to 28 % approximately) and energy value of field beans is half-way between those of cereals (8 to 12 ù of crude protein approximately) and soya oilcake (43 to 49 % crude protein approximately). The table of amino acid supplies per hectare shows that field beans (at 40 q/ha) provide :

- Methionine : a little more than cereals (WHEAT and BARLEY)
- Methionine plus cystine : a little less than irrigated maize
- Lysine : three to four times more than irrigated maize

NUTRITIONAL POINT OF VIEW

Field beans do have a few drawbacks :

- a high cellulose content of about 7.5 % (57 % of which comes from the integuments)
- presence of large amounts of tannin in the integuments (about 1 %)
- presence of thermolabile antitrypsic factory (1) in the kernel

But the harmful effect of the above factors can be practically eliminated or largely reduced by

- de-husking the beans (2)
- steam granulation of the compound feed containing field beans
- selection of tanning-free varieties

d/ CONCLUSION

To sum up, it is to be hoped that in the near future, field beans will be regarded as a good substitute crop for cereals, due to the much higher lysine content per hectare.

Unfortunately, two problems remain unsolved :

the purchase price for farmers, who will only grow the crop if they can make a profit out of it

and especially, the production of hybrid seed beans, which at the moment is too uncertain for any estimate of acreages to be used for growing field beans in 1977/1978. Nothing substantial is likely to be done during the next three years.

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(1) An antitryptic factor inhibite the action of trypsin, an enzyme of the pancreatic juice which converts nitrogen substances to amino acide

(2) There remains to be found however:
- an efficient and cheap de-husking method
- commercial outlets for the integuments, which represent about 13% of the beans Failure to market them would unduly increase the cost of de-husked field beans.

2/ THE GARDEN PEA or Dry Pea or Preserved Pea (1) (Pisum Sativum)

FROM THE ANALYTICAL POINT OF VIEW this leguminous vegetable presente similarities with the field bean :

- a high protein rate of 25 to 29 %
- a low cellulose rate 5/6 %
- a low sulphurated amino acid content : Methionine and Cystine (0.50 - 0.70%) in relation to soya cake (1.50%)

It is practically grown so far only to satisfy human consumption (preserves) for which genetic selection has been undertaken for several years now (creation of varieties of "vegetable garden", winter peas which can resist cold on the basis of varieties of "fodder peas" which are naturally resistant, and search for varieties which are not very precocious.

In the EEC the possible areas of growth are varied but limited (2) Only the maritime regions, or those where the autumn is too mild, need to be eliminated (3)

Yields of 40 q/ha are perfectly possible (with extremes of 35-50 q/ha)

In conclusion for researchers who are specialists of this leguminous vegetable :

1. The pea has a heavy drawback in that it is easily beaten down hence the difficulty of harvesting in those regions where storms are frequent at the end of June and early July.
2. The pea is more resistant to dry conditions than the field bean.
3. In future, yields of peas will reach a ceiling at 40/45 q/ha, whereas those of field beans will exceed this figure.
4. The pea should not be opposed to the field bean but they should be envisaged together, each in its place according to the regions and the nature of the soils.
5. Prices : as in the case of the field bean, the pea will not replace other crops, for exemple, cereals. unless its production is attrative for the grower.

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(1) The name fodder pea (Pisum arvense) is normally reserved for the pea which is grown not for its grain, but as green forage which is not taken into consideration here.

(2) The Eastern regions of Great Britain, Northern Italy and the Paris Basin in the wide sense of the term.

(3) In these regions, the pea may be cultivated for preserving. The varieties are the same as those of dried peas but they are harvested one month before maturity.

3/ DEHYDRATED LUCERNE and DEHYDRATED CLOVER

The green fodder of leguminous vegetable such as lucerne and clover are consumed by animals in various forms :

1. Either directly on the producing farm - the most frequent case -
   - as fresh green fodder, grazing on the spot, or in the stable after cutting as ensilaged green fooder
   - as hay after drying (naturally in the sun, or artificially in the barn(1)
   - or after dehydration (and granulation or pressing). In this case it can be given directly to the animals in the form of "corke" or incorporated in balanced compound feeds.

Consumption on the farm concerns only ruminants (and accessorily horses and goats.

Consumption after dehydration can concern practically all the animal species: bovine cattle, sheep, goats, table poultry (yellow) laying poultry, rabbits,horses pigs. But the very special composition of dehydrated lucerne which, in general, is very rich in cellulose (20-28/30%) and consequently poor in energy, makes of it a raw material essentially destined for ruminants, rabbits and horses.

Its use for the monogastric animals, which is certainly possible is necessarily very restricted :

- 2-3% for yellow meat poultrry (as a source of yellowing pigments)
- 3-5% for laying hens (as ballast and a source of yellowing pigments)
- practically zero for the energy feeds for fattening pigs
- 5-10% for sows.

(1) Hay is also traded

- either in the form of bales or "bundles" pressed and about 50 kg in weight, intended above all for the feeding of horses (for sport or competition) or animals on livestock farms which produce on a toc limited scale,
- or in the form of meal (or granulates) sold to the animal feedingstuffs industry under the name of ordinary lucerne (in France).

And this is very regrettable since it is a raw material which is not a negligible source of proteins : 17-20% of raw protein, and could be used in greater quantity.

It is the crop which by far supplies the most amino acids per hectare (see Table page IV/8).

In conclusion, without any treatment other than dehydration, dehydrated lucerne has no future except for the feeding of ruminants. It could not be utilized in larger quantities for the monogastric animals without undergoing a treatment to separate the stems (which contain much cellulose) and the leaves, for example by seiving, on condition that this treatment is economical and sufficiently effective.

In order to situate ideas on this point, we have carried out in the laboratory a seiving treatment after crushing on two dehydrated lucernes in granulates and we have obtained two fractions "passed through the seive" and "refused" by the seive of roughly equal weight 'see attached Table). The noble portion which is the poorest in cellulose nevertheless contains very high quantities of this, which makes it little suited to be used on a large scale in high-energy feeds for monogastric animals. We must therefore remain very reserved as to the technical and economic interest of such treatment. Furthermore, from a nutritional angle, it must in any case be noted, against dehydrated lucerne :

- that it contains tanins which are harmful to the growth of table chickens and also of piglets
- that a researcher has noted in the course of dehydration a loss of more than half of the free lysine of this fodder (2).

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(1) Above all pigs.

(2) Mr. R. Pion - National Agronomic Research Institute, France.

DEHYDRATED LUCERNE

Treatment by seiving

Sample	Definition	Relative weight	Analysis %			
			Humidity	Crude protein	Cellulose	Mineral substance
I	Original lucerne	100	6,6	16,6	27,3	9,4
	Passage through a 0.4 mm seive about	50	6,7	19,3	21,6	10,2
	Refusal by the same seive (1) about	50	6,6	13,4	34,8	7,6
II	Original lucerne	100	5,6	25,0	19,7	10,7
	Passage through a o.125 mm seive about	50	5,7	27,6	16,4	8,8
	Refusal by a seive of the same mesh about	50	5,9	22,7	26,7	10,3

(1) Refusal utilizable by ruminants (and perhaps also for rabbits)

4/ SOYA BEAN

(a) World production in 1972 : about forty-eight million metric tons
Forecasts for 1976 : about fifty-six million metric tons (1)
Mainly grown in the United States (72% of world production - about 35 million metric tons in 1972, objective in 1973 about forty-million - and increasingly in Brazil (2), where the forecast for 1974 is 6 500 000 to 7 000 000 metric tons), the soya bean can be grown in certain EEC countries. Plant health technicians consider that the area of growing is limited in the North by the isotherm 18°C from 1 May to 30 September. In France this area corresponds to a part of the Southwest, the Midi and the Southeast. It is certain that in Italy the climate of several regions would be favourable to this crop.

(b) Growing : this demands three preconditions :

1. Inoculation of the soil by the specific bacteria of soya rhizobium japonicum. Iy is known that numerous cultivated leguminous vegetables (in particular lucernes) have the property, thanks to the nodosities of their roots provoked by bacteria of fixing the nitrogen in the air. (symbiotic fixation of the atmospheric nitrogen). However, as the European soils do not contain the specific bacteria inoculation is indispensable. On a given piece of ground yields rise from 11 and 8 q/ha without inoculation to 25 and 34 q/ha with inoculation.

2. Irrigation : soya is a plant which is very demanding as regards water (and temperature). On the same ground in 1971 were obtained : without irrigation : about 22.3 q/ha, and with irrigation about 26.7 q/ha.

3. Chemical field cleaning. A systematic study of the choice of insecticides led to the retention of 1 out of 3 (unfortunately of irregular efficacity following the climatic conditions).

(1) According to the US department of Agriculture

(2) However, the rapid development of this group seems to be inhibited in this country for various reasons, in particular : the inadequacy of the roads linking the areas of crop to the embarkment ports, the lack of ports with high turnround, and the consecutive reduction of the areas given over to the bean, which is the basis of the food of the Brazilians.

c/ Discussion

1. The growing of soya beans is possible in the southern countries of the EEC. If the bean were introduced into EEC Regulation 136 the Cetiom (1) foresees in the fifth year following this introduction :

. a minimum area of 80 000 ha in France . a maximum area of 130 000 ha in France . a minimum crop of 180 000 t in France (about 130 000 metric tons of cake) . a maximum crop of 280 000 t in France 'about 200 000 t of cake)	i.e. a yield of around 22 q/ha

2. The yield continue to be low :

. 30 q/ha seems to be a very good performance . 25 q/ha a good average	for the future

In the United States the average yield was 15.9 q/ha in 1960, 18.0 q/ha in 1970 and 18.8 q/ha in 1972.

Geneticians do not appear to tbe optimistic on the chances of obtaining higher yields by improving the varieties. Between 1960 and 1962 the average annual progress was only 1.5%.

3. From the economic angle, the farmer will cultivate the bean only if his hectare income is at least equal to that obtained with a cereal. According to Cetiom (1) the price paid to the producer would need to be 105FF/q (February 1973, i.e. 18.9 u.a.) (3).

In comparaison, American farmers grow soya if the price they get for it is 2.3 times that of maize.

4. The use of the bean in animal feeding can be of two kinds :

- indirect : use of the cake as at present
- direct : use of the bean itself

If the technical problem of animal feeding is alone considered, i.e; leaving out of account the supply of soya oil for human consumption and the comparative prices of vegetable oils and animal fats in France at 19 june 1973.

- soya oil 200 FF/q, or 36.01 u.a./q
- suet 175 FF/q, or 31.51 u.a./q

(1) E. Chone, Sce Développement du Centre d'Etudes Techniques et Industrielles des Oléagineux Métropolitains, France - Revue Française des Corps,20 n°4,April 1973.
(2) Le Soja, Economie,Culture et Sélection - Revue Agriculture, Sept.1963, n°368.
(3) At this time approximate price of cereals paid to producers
Wheat 43.50 FF/q - 7.83 u.a./q - Maize 47.90 FF/q -8.62 u.a/q - Barley 47.90FF/q 8.62 u.a./q

it may appear paradoxical :

- to have available a grain with 20% of oil
- to renove the lipids from it (cake at 0.5-1% of oil
- to use this cake in animal feeding conjointly with a source of animal fat.

In the "high energy feeds" in which it is usual to incorporate 5-6% of suet - feed for table chickens for example -

. instead of	%	Proteins %	Fats %	Metabolisable Energy - Cal/kg
Soya cake	30	14,5	0,2	765
Beef suet	6	ZERO	6,0	462
	36	14,5	6,2	1.227
. it would be possible to use :				
Soya bean	36	13,7	7,2	1.267

on condition that the bean is cooked as is done with the cake the margin of tributation of the grain (extraction of the oil) would thus be saved.

d/ Conclusion

TECHNICAL INTEREST OF THE SOYA BEAN (see Table I)

We note that 22.5 q of beans per hectare contribute in :

- Methionine : not much more than 70 q of irrigated maizes (as much as 72 q)
- Methionine plus Cystine : not much more than 70 q of maize or 40 q of field beans
- Lysine : a smaller quantity than 40 q of field beans
  a quantity equal to 32 q of field beans

These three figures make it possible to pinpoint its interest in relation to the other sources of proteins, in particular cereals and field beans. In addition, it must be noted that the growing of soya would be effected to the detriment of other crops, for example :

- cereals : there would then be an increase in the Community deficit and a rise in imports.
- colza : which would lead to a quantitative and qualitative improvement in the production of corresponding proteins.

5/ SUNFLOWER

The sunflower, imported from Peru in the 16th century is grown mainly :

- in the USSR and the East bloc countries
- in Argentina
- in Turkey

Statistics	Area in 1966 (in tones/ha) metric	Production (in 1000 t.)	
		1966	1971
U. S.S.R.	5 005	6 150	5 700
Rumania	468	671	900
Bulgaria	255	423	437
Yugoslavia	154	282	300
Argentina	1 023	782	830
Turkey	218	200	396
World	7 850	9 070	8 500

GROWING (From J. PRATS (1))

"Mild, sunny climates with little wind suit it best. The vegetation zero is around + 5°C, and therefore a little below that of maize. In practice the sunflower demands that the ground should be at 8-10° to grow suitably? The sowing-growth phase demands a total of temperatures of 170°C, the complete vegetative cycle requires 2 000°C, for the precocious varieties, from 2 600 to 2 800°C for the late varieties. However the young plant resists at -5° and even -8° according to certain authors".

For information, about 22 000 hectares were grown in France in 1970 in very varied regions (Southwest, Poitou et Charentes - Centre - the Paris Basin - Côte d'Or - Champagne Rhône valley).

Areas grown (ha) in	1970	1971	1972	1973
France and Italy (2)	31 600	52 400	52 700	?
France (2)	27 685	44 900	47 400	42 300

(1) J. PRATS - L'AVENIR DU TOURNESOL - Bulletin Technique d'Information n° 254 - Nov. 1970

(2) SOEC (Source)

VARIETIES OF SEEDS

The varieties at present available :

Russian : Pérédovick - Ienissei

French (of the National Institut of Agronomic Research)

: Issanka - INRA 65.01

are rich in oils (40/45% as against 30% for the old ones).

For some years French research has been concentrating on obtaining hybrid varieties chosen for their growing qualities, size, resistance to beating down, seed yield, percentage of almonds, resistance to parasites.

According to PRATS (Op ict) :

"In conclusion, it would seem that in 1972 INRA will have available enough seeds of the INRA 65-01 and Issanka varieties to sow areas of the same order as those at present cultivated and that after 4 to 5 years we will have new varieties which are still more interesting in their resistance to diseases and their productivity, and in certain cases their precociousness".

USE OF THE CAKE IN ANIMAL FEEDING

It is characterized by (low lysine
(high sulphuric animo acid contents

Composition %	For 100 of cake		
	Groundnut	Sunflower	Soya
Crude protein	53,0	43,0	50
Lysine	1,83	1,55	3,20
Methionine	0,58	0,93	0,50
Methionine + cystine	1,35	1,60	1,50
Metabolizable energy (poultry)	2.750	1.900	2.550

Table 1 shows that its contribution per hectare in relation to cereals is :

. in METHIONINE : a little higher except for irrigated maize

. in METHIONINE and CYSTINE : a little lower

. in LYSINE : equivalent

In addition, its often too high cellulose content conferes on it a very low energy value which makes it practically unusable in the feeding of meat poultry whose feeds have metabolizable energy contents between 3 000 and 3 250 calories per kg.

It can be used : for laying hens
for pigs

For the latter, Y. HENRY and his colleagues (1) have shown that :

"The addition of 0.2 per 100 of L-LYSINE to a diet exclusively consisting of wheat (85 per 100) and of dehydrated lucerne meal (12 per 100) has made it possible to obtain, with a rate of 13.5 per 100 of nitrogenated substances, the same performances as a sample diet based on wheat and soya cake (10 per 100) including 16 per 100 of nitrogenated substances. In the same way, the results obtaines have shown the possibility with wheat of replacing all the soya cake by sunflower cake without any change in the performances of the animals on condition, however, that a supplementary contribution of o.15 per 100 of L-LYSINE is added".

This means that soya cake can be substituted for sunflower cake according to the following equation :

10 kg of soya cake = 12 kg of sunflower cake + o.15 kg of L-LYSINE

or 1 kg of soya cake = 1.2 kg of sunflower cake + 15 g of L-LYSINE

(1) Y. HENRY - D. BOURDON Supplémentation du blé par la Lysine et le tourteau de tournesol chez le Porc en finition.

(Supplementing of wheat by lysine and sunflower cake for pigs in the finishing stages of fattening.)

Annales de Zootechnie, 1973, 22 (2), 147.155.

6/ LYSINE-RICH MAIZE

American genericians have selected maize hybride with a high lysine content the most well-known possessing the genes OPAQUE 2, FLOURY 2, SUGAR 2 and AMYLOSE EXTENDER.

	Lysine content as a % of the maize
Noraml maize	0,25
Maize with OPAQUE 2 gene	0,40
Maize with the two genes OPAQUE 2 and SUGAR 2	0,50

Composition :

OPAQUE 2 maize differs from normal maize :

- by somewhat different protein contents,
- by higher lysine and tryptophane contents
- by lower contents of methionine and leucine.

This feature of being rich in lysine is extremely important, for yellow maize is the most appreciated cereal in animal feeding because of :

- its richness in energy(high fats content)
- its high content of yellowing elements (Xanthophyllis sought after for the production of yellow chickens and of colored-yolk eggs).

However, its gravest defect is the presence of zeins, proteins which are very poor in lysine. The mutations which are at the origin of these lysine-rich maizes cause a reduction of the zeins and an increase in the glutelins and the hydrosoluble nitrogenated fractions.

Conclusion

The technical interest of these maizes is evident. They make possible a reduction in the contributions of soya cake, as may be seen from the following formules for pigs by D. BOURDON and ASSISTANTS (1).

In the growing phase about 25 % of cake is saved.

In the finishing phase about 33 % of cake is saved

(1) D. BOURDON : Utilisation du MAIS OPAQUE 2 par le porc en croissance finition (Utilization of OPAQUE 2 MAIZE by the pig at the finishing stages of growth).

Annales de Zootechnie, 1973, 22 (2) pages 157 - 165

(See table page IV/23)

COMPOSITION OF THE EXPERIMENTAL DIETS

D. BOURDON (op cit)

	For growing pigs 30-60 kg		For pigs inthe final stages 60-90 kg	
	with normal Maize Soya	with OPAQUE 2 Maize Soya	with normal Maize Soya	with OPAQUE 2 Maize Soya
Theoretical contents in :				
Proteins %	16,5	16,5	14,5	14,5
Lysine %	0,8	0,8	0,65	0,65
Normal Maize	76	-	82	-
Opaque 2 Maize	-	79	-	85
Soya cake 44	21	16	15	10
Maize gluten	-	2	-	2
Vitaminize mineral mixture	3	3	3	3
	100	100	100	100
i.e. relative contribution of Soya Cake	100	76	100	66,7

MAIZE

1/ It would seem that the hectare yields for Opaque 2 maize are 10-15% below those of normal maize.

2/ Studies carried out by linear programming with chicks, meat chickens and pigs feed show the economic interest of maize by fixing its threshold price (1).

In a study carried out in 1971, BRETTE (3) writes : "It is interesting to note that the computer is prepared to offer for maize Opaque 2 only 1 FF (0.18 u.a.) more per 100 kg than for normal maize.

In 1973 the author carried out a similar calculation :

Feeds	Threshold price of Opaque with normal maize at 55 FF/q (9.9 u.a./q), of soya cake 50 at :(2)		
	115 F/q (20,7 UC/q)	200 f/q (36 UC/q)	300 F/q (54 UC/q)
Young pig	-	58,3(10,5 UC)	58,3 (10,5 UC)
Chick first-stage	58,7 à 60,2 (10,6 à 10,8 UC)	-	-
Chicken fattening	-	62,8(11,3 UC)	67,7 (12,2 UC)
Laying hen	58,5 à 59,9 (10,6 à 10,8 UC)	-	

In this way, this threshold price is higher than the price of normal maize according to the feeds by 3 FF/q to 12 FF/q (0.54 u.a./q to 2.16 u.a./q).

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(1) The "threshold price" has been defined in Annex I (page AN/6)

(2) Soya cake 50 reached this price in France during the "crisis of June/August 7[illegible]

(3) Competition between the various sources of proteins in animal feeding. The economic aspect.
Paper presented to the 12th International Zootechnical Congress, Paris-Versailles, 20/23 July 1971.

TABLE I

GLOBAL COMPOSITION (1)

		ORDINARY MAIZE	OPAQUE 2 MAIZE
Humidity	%	8,7	9,2
Protéines	%	9,34	9,03
Lipides	%	4,5	4,5
	%	1,33	1,35
Xanthophylles	mg/kg	18,0	15,0
Carotène	mg/kg	4,5	3,3

TABLE II

AMINO ACIDS	For 100 kg of product	
	Normal Maize	Opaque 2 maize
Aspartic acid	0,83	1,05
Thréonine	0,44	0,41
Sérine	0,58	0,48
Acide glutamique	2,54	1,93
Proline	1,09	0,65
Glycine	0,43	0,48
Alanine	0,91	0,70
Valine	0,56	0,51
Cystine	0,18	0,25
Méthionine	0,27	0,21
Isoleucine	0,41	0,34
Leucine	1,64	1,00
Tyrosine	0,58	0,45
Pénylalanine	0,63	0,47
Lysine	0,29	0,40
Histidine	0,36	0,36
Arginine	0,57	0,73
Tryptophane *	0,047	0,070

(*) The tryptophane was dosed by microbiologic method according to the technique of J. Adrian, the other amino acids by the method of Moore and Stein using the Technicon autoanalyser.

(1) According to J. Abraham and colleague. Note préliminaire sur la composition chimique et la valeur nutritionnelle d'un Maïs "OPAQUE 2" d'origine française (preliminary memo on the chemical composition and nutritional value of an Opaque 2 maize of French origin). (Report of the French Academy of Agriculture n° 11 - Year 1969).

7/ THE ALGAE (1)

The idea of cultivating algae on an intense scale emerged towards the 1950's. Research has been developed mainly in the United States and Japan and then in Czechoslovakia, Germany, the USSR and France beginning 1963.

ADVANTAGES OF THE CULTURE OF ALGAE.

In relation to the growing of superior types of plants we may mention :

- Certain algae are very good protein sources from the quantitative point of view (up to 65% of the dry matter) and from the qualitative point of view (a good amino acid composition (see Table)
- No croping land is needed for their growing
- The speed of growth is very high : yields of the order of 140 kg of dry matter/ha/day are easy to obtain with open-air culture.
- They assimilate the carbon of carbonic gas (chlorophylian assimilation) a cheap substance (combustion of petroleum products).
- They live in an aqueous environment, hence easy feeding with nutritive elements dissolved in the water.
- Easy control of growth to obtain the best yield, since it is a matter of artificial culture in a synthetic environment.

DRAWBACK

Much sunshine is needed.

LARGE-SCALE CULTURE

This is possible particularly with an alga of the Spiruline species (consumed naturally by the natives of Chad, who harvest it in certain pools and dry it in the sun). Growing is in basins with a large surface and low volume. A product with the following composition is obtained :

Proteins	60/65%	in relatio to the dry matter
Glucides	18/20%	
Lipides	2/3%	

(1) According to C. Meyer, Etude d'une culture d'Algues en vue d'une production à grande échelle. Study of an algae crop with a view to large-scale productic Revue des Industries Alimentaires Agricoles, n° 11, November 1969.

Table - Comparative composition of SPIRULINE in animo acids (in g/hg of protein)

Animo acids %	MILK	cakes SOYA	cakes GROUNDNUTS	SPIRULINE Algae
Isoleucine	6,4	5,3	4,1	6,0
Leucine	9,9	7,7	6,0	8,0
Lysine	7,8	6,3	3,5	4,6
Methionine	2,4	1,4	0,9	1,4
Methionine + Cystine	3,3	3,2	2,4	1,8
Phenylalanine	4,9	5,0	5,0	5,0
Threonine	4,6	4,0	2,7	4,6
Yryptophane	1,4	1,5	1,1	1,4
Tyrosine	5,1	3,2	3,6	4,0
-Valine	6,9	3,5	4,9	6,5

CONCLUSION

This protein source, because of its possible places of production (warm regions) and of the fact that its growing does not require considerable investments, would seem to be particularly suitable for the human populations of the developing countries. It is doubtful whether the quantities available can be channelled towards animal feeding.

N.B. Certain algae harvested naturally, in particular laminairia or fucus are traditionally used in animal feeding, but their composition is quite different:

- Dry matter 85/90%
- Proteins 7 à 10 %
- Mineral substances 17 à 25%

so that their utilization is essentially motivated by their contribution in mineral oligoelements (in particular iodine).

B/ INDUSTRIAL SUBSTITUTION PRODUCTS

These may be classed into four main categories :

1/ - The synthetic amino acids
- 11. Methionine
- 12. Methionine Hydroxy Analogue MHA
- 13. Lysine Monochlorhydrate
- 14. Tryptophane and Leucine

2/ - The non-proteic nitrogen compounds which contain :

. either urea nitrogen
- 21. Urea
- 22. Biuret
- 23. Zootechnical biuret
- 24. DUIB
- 25. Phosphate of urea

. or ammonia nitrogen
- 26. Ammonia salts

3/ - The sources of proteins synthesize by unicellular organisms :
- 31. Yeasts on alkans
- 32. Bacteria meals

4/ - Miscellaneous products
- 41. Concentrated juices of green fodder
- 42. Raw fodders treated chemically
- 43. Animal dejections.

1/ Synthetic amino acids

11/ - Methionine (or DL methionine) (1)

. As a raw material this is the amino acid whose importance is greatest in animal feeding because it is the "primary limiting factor" (2) of the majority of animals for table poultry and laying poultry. In fact, as may be seen from the two Tables below, cereals and middlings have methionine contents which are rather below the requirements of the monogastric animals (3). Naturally, the cereals are supplemented by cakes or animal meals, but their energy value, which is almost always lower, and their high protein contents limit their use.

. Historically speaking, it is first amino acid placed at the disposal of feedingstuff manufacturers in industrial quantities in the EEC.

In 1974 world resources in synthetic methionine are estimated at nearly 120 000 metric tons and those of the EEC at 50.000.

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(1) Commercial methionine is obtained by chemical synthesis under its DL form or racemic. Its purity is 98 %. Animals are able to use DL methionine and poultry transformed into L methionine in the proportions of about 85 %.

(2) The notion of limiting factor, primary secondary or tertiary is very well illustrated by a barrel whose staves are of unequal dimentions. The height of the liquid cannot be greater than that of the smallest stave, which therefore constitutes the primary limiting factor. The stave of a height immediately above corresponds to the secondary limiting factor, and so on.

(3) As we will see later, only the monogastric animals require certain "indispensable" amino acids, 10 in number, because they are incapable of synthesizing them. The most important in practice are : lysine, methionine and cystine. The requirements for the 7 others can be easily met by the raw materials. Save exceptions, which we will not speak about here (cases which are disputed moreover), the polygastric animals on the other hand are capable of synthesizing them thanks to the bacteria of their rumen.

TABLE 1

Methionine Requirements

Animal species	Percentage requirements of Methionine + Cystine (4)
Piglet of 8 kg to 25 kg	0.70 / 0,80
Piglet of 12 kg to 25 kg	0,65 / 0,68
Growing piglet - Young pig (from 25 to 65 kg)	0,58 / 0,60
Fattening pig of more than 65 kg	0,50 / 0,55
Chick up to 4 weeks	0,85 / 0,87
Chicken between 3 weeks and slaughter (8 weeks)	0,80 / 0,83
Young turkey up to 28 days	0,90 / 1,05
A turkey cock in the final stages from 8 weeks to 12 weeks	0,70 / 0,80
Young Guinea fowl up to 28 days	0,90 / 1,00
Guinea poult from 8 weeks to 12 weeks	0,70 / 0,80
Laying hen	0,50 / 0,56
Young hen before laying	0,50

Methionine and Cystine contributions of raw materials

TABLE 2

Raw material	% contents of Methionine	% contents of Methionine + cystine
Wheat	0,16	0,43
Maize	0,17	0,39
Barley	0,18	0,41
Fine wheat bran	0,14	0,36
Groundnut cake	0,58	1,35
Cotton cake	0,66	1,52
Soya 44 cake	0,63	1,35
Soya 50 cake	0,70	1,50
Sunflower 43/14 cake	0,93	1,60
Fish meal 65	1,95	2,57
Fish meal 72	2,00	2,70
Meat meal 50	0,65	1,17

(4) Methionine and Cystyne are generally associated, since the latter amino acid can cover methionine requirements in the proportion of :
40% at the maximum for chickens
55 to 65% for pigs

USE

The indispensable nature of methionine can be proven : first of all with 2 examples of a formule.

	Complete feeds for :	
	Chick Start-up	A young pig from 2(to 65 kg.
Wheat	6	40
Maize	60	12
Molasses	-	6
Fine wheat bran	-	22
Soya 50 cake	30	17
Suet	1	-
Vitamins, minerals, phosphate salt	3	3
	100	100
Methionine + Cystine in the raw materials %	0,710	0,550
Requirements %	0,860	0,600
Deficit to be covered by the synthesized methionine %	0,150	0,050
i.e. in g/q	150	50

Then with a substitution. In the EEC countries large quantities (1 300 000 to 1 350 000 metric tons approximately in 1972) of fish meals. However, if we except the compound feeds for fish (trout, salmon, carp, etc.) for cats, and strictly speaking a few feeds for all young animals, their presence in the feeds for monogastric animals seems far from indispensable to everybody. It is possible to make important savings with the following substitution. (1)

(1) According to Brette : Concurrence entre les diverses sources de proteines dans l'Alimentation Animale - Aspect Economique.
(Competition between the various sources of protein in animal feeding - the economic aspect).
Paper read to the 10th International Zootechnical Congress - 23 july 1971.

Prix		Raw materials		Cost	
FF/q	UA/q(1)			FF/q	UA/q(1)
300	54,01	Fish meal 65	1,000	3,00	0,54
		replaced by			
115	20,70	Soya cake 50	0,650	0,75	0,13
55	9,90	Bicalcic phosphate	0,150	0,08	0,01
140	25,21	Beef suet	0,185	0,26	0,05
720	128,63	Methionine 98 %	0,015	0,11	0,02
		Total	1,000	1,20(2)	0,21(2)

However, of the 1 350 000/metric tons of fish meal consumed by the EEC countries 900 000 to 950 000 are imported. (3) These imports could be avoided by the supplementary utilization of 13 500 to 14 000 kg of methionine, which would, of course, also involve an increase in the consumption of soya cake (4)

---

(1) 1 FF = 0.180044

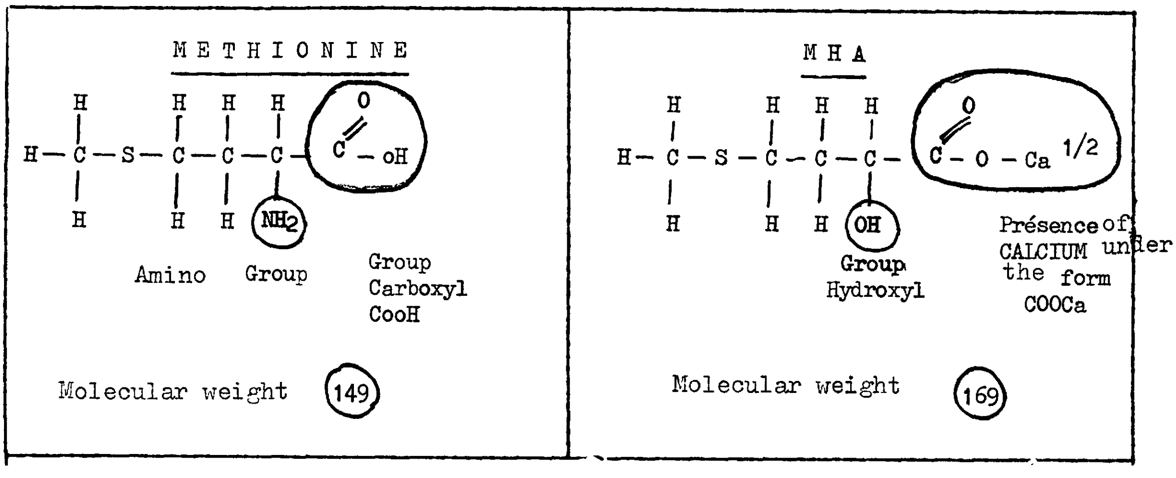
(2) The prices of the other raw materials remaining constant, substitution remains a paying proposition as long as the price of fish meal is above 120 FF/q or 21.60 ua/q metric.

(3) Import of animal meals, 964 000/tons in 1972 of which it may be estimated that about 95 % are fish meal.

(4) But, as fish meal 65 % contains roughly 5.3 % of lysine and soya cake 50 only about 3.2 %, this substitution is not acceptable, unless the formule substituted still remains sufficiently rich in lysine (see paragraph 13, page iV/35).

12/ - Methionine gydroxy analogue or MHA

The American industry (1) produces a substance known as "analogue" of methionine and called Methionine Hydroxy Analogue or MHA (camcium salt). Its molecule differs very little from that of methionine but is not an animo acid since it does not contain the radical NH_2.



N.B. The chemical differences have been ringed round.

In the same way as for methionine, the synthesis of NHA produces the two molecular forms : isomere D (Dextrogyre and isomere L (Levogyre).

The American commercial product contains 90 % of active substance.

UTILIZATION BY ANIMALS

This is only possible because the animals transform it into methionine by a series of complex reactions (2).

---

(1) Monsanto Company

(2) Which may be cuttlined as follows :

- removal of radicals NH_2 of proteins from the feed thanks to diastases(disaminases
- transfer of these radicals into the blood
- reaction between these radicals and the MHA thanks to other diastases (transaminases) to form the methionine.

Only the coefficient of equivqlence "MHA - METHIONINE" (1) has been discussed between producers of MHA and of Methionine. We will not enter into this discussion and merely quote the two points of view.

POINT OF VIEW OF THE MANUFACTURER OF MHA

MHA, a calcium salt, if it were pure would contain 88 % of MHA

As the commerciam product, if 90 % pure, it contains only :

88 x 90 % = 79.2 % of active L methionine

As commercial 98 % methionine has 87 % of active L methionine,

to replace 1000 g. of methionine 98 we need $\frac{87.0}{79.2}$ = 1 100 g og MHA

POINT OF VIEW OF THE MANUFACTURER OF 98 % METHIONINE

MHA, calcium salt, contains 79.2 % of active product

Methionine 98 contains 98 % of active product.

thus, to replace 1 000 of methionine 98, we need $\frac{98.0}{79.2}$ = 1 250 g of MHA

In practice, in the EEC countries, it is above all methionine 98 % which is utilised. Any formulator who would use MHA wold be free to incorporate it on the basis of the equivqlence of his choice.

(1) Or the quantity of MHA to be given to an animal to cover 100 g of methionine requirements, for example.

13/ - Industrial lysine

As an essential amino acid lysine is very important in animal feeding. Lysine deficiencies are the cause of retarded growth.

As an industrial raw material lysine has so far been of little importance in terms of weight unfortunately because of its price.

PRODUCTION

Synthetic lysine is known as"L Lysine monochlorhydrate".

. It is an L Lysine (1) for it is the form L which is the only one utilisible by animals and which alone has the character of an essential amino acid. The Isomere D (2) is not utilised by the organism. Natural lysine always has the form L.

. It is a monochlorhydrate lysine, that is to say that the commercial presentation is a lysine salt which contains only 78.4 % of pure lysine. As the purity of this salt is 97/98 % in the last analysis it contributes only 76 % of pure lysine. It is therefore extremely important not to confuse in discussions or calculations of cost price :

- The natural lysine of the raw materials with 100 % lysine
- Industrial lysine with 76 % lysine

THE DIFFERENT PROCESSES OF PRODUCTION

a/ - Synthesis by chemical means

This leads to a mixture of the forms D and L called in chemistry "a racemie". Obviously, it must then be transformed into L lysine, a supplementary and very costly operation.

Towards the end of the Sixties, several firms, particularly one in the Netherlands, were together making about 500-1000 metric tons year. But it is probable that the high production costs have led these companies to stop production.

---

(1) L for Levogyre, a chemical term which means that these substances deviate polarised light to the left.

(2) D for Dextrogyre, which means in similar fashion that these substances deviate polarised light to the right.

b/ - Synthesis by biological or fermentation process

For some years now two Japanese enterprises (1) have been engaged on direct production of L Lysine with the aid of fermenting bacteria (Corynebacterum glutamicum), which are cultivated by nourishing them with molasses, ammonia, salts (a source of nitrogen) and mineral substances.

(See the outline of production attached)

Production early in 1972 was estimed at around 10 000 metric tons/year. It had to be reduced - temporarily it would seem - in October 1972 to 200 - 250 tons/year to cut down the effects of the pollution caused by the disposal of the effluents in the sea. In 1973 it is between 16 and 18 000 metric tons by year. The outlook for 1974 should be more than 5 000 - 7 000 tons/year. To this amount be added the small production (1 000 tons/year) of an American firm. In all, scarcely 20 000 metric tons.year for all animal feeding, leaving aside possible production in the East bloc countries, in particular Czechoslovakia which has at least reached the stage of tests.

USE

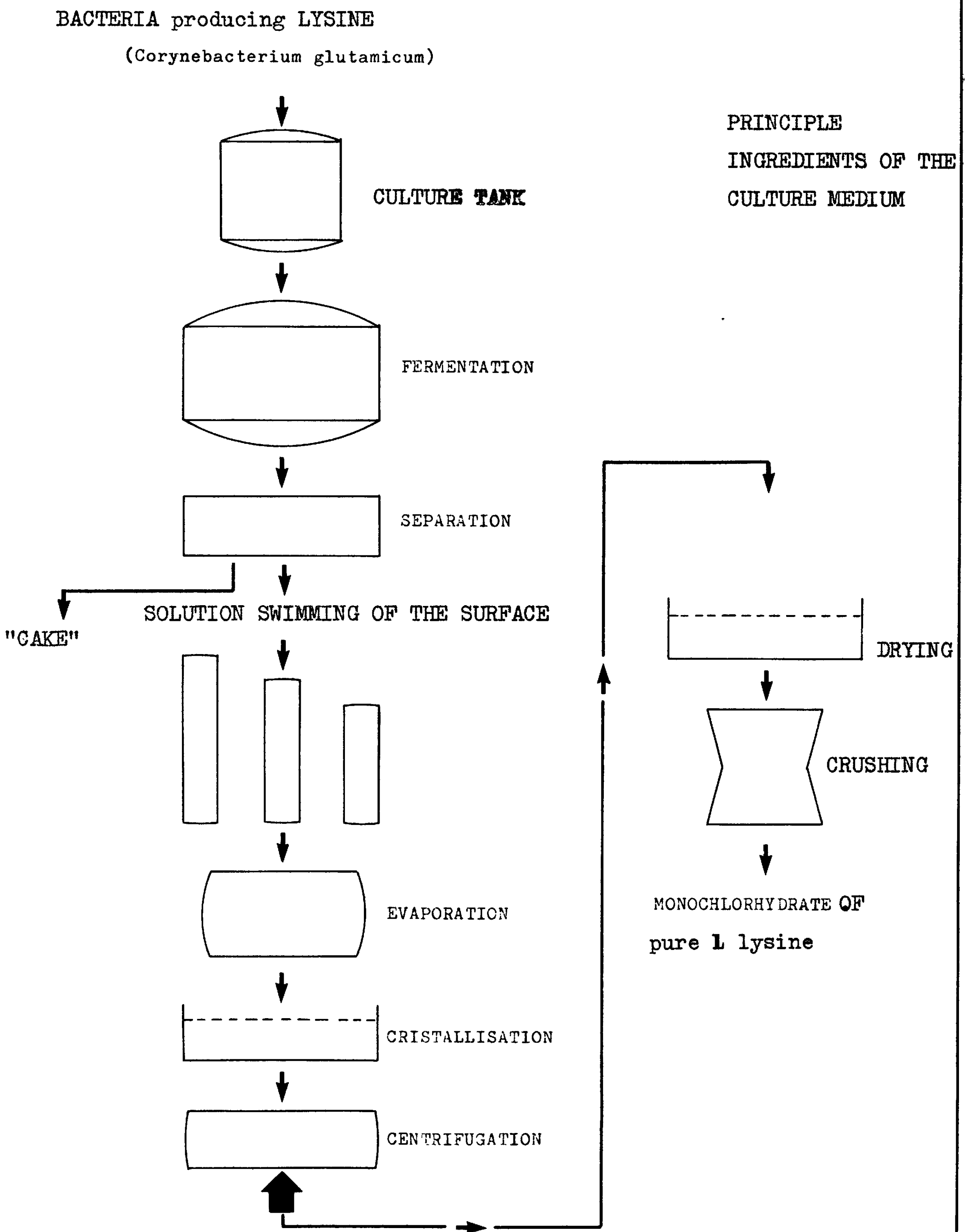
a/ - Past and Present

As we said earlier, the quantities consumed for animal feeding are small. For the formulation of the majority of animal feeds, and country to the case of methionine, it is relatively easy to obtain levels corresponding to reauirements thanks to the use of protein-rich raw materials in particular : meat meal, soya 44 and 50 cakes (see Table 1 and 2).

Manufacturers have therefore generally done without lysine because of the abundance of protein sources and the relatively low price of these which gave the lysine they contained a highly competitive position vis-à-vis industrial lysine. The use of computers therfore rejected synthetic lysine. Precise calculations by computer in October 1972 have shown that , whereas in 1972 (and 1973) this lysine cost about 10 FF/kg (1.8 ua/kg) (2), its threshold price varied according to the formulae from :

7.65 GG/kg, or 1.38 ua/kg (2) in feeds for chickens, piglets and final stage pigs
8.30 FF/kg, or 1.49 ua/kg (2) in feeds for starting chicks
0.15 FF/kg, or 0.03 ua/kg (2) in feeds for chickens at the final stage
5.65 FF/kg, or 1.02 ua/kg (2) in feeds for young starting turkeys, young growing turkeys and turkeys in the final stage

(1) The AJINOMOTO and KYOWA companies (2) 1 FF = 0.180044 ua.



Procedure for the industrial production of Monochlorhydrate of L Lysine by KYOWA

CCE-DG VI-G/2-7405.80

Summing up, the present use of lysine generally comes down to :

. Feeds for all young piglets in which a rate of lysine corresponding to the requirements could be obtained with the current raw materials, but a high protein rate, which may nutritionists are hesitant to choose because of the risk of digestive accidents (diarrhoeas). Furthermore, since it is a matter for feeds for animals before weaning which consume very little concentrated nourishment per head, their high price is more radily accepted by breeders if it is accompanied by safe use.

. Guckling feeds for calves (often called "replacement milks") although if these are made from powdered skim milk of very good quality, the need to add lysine may be doubted.

B/ - Potential use

This is very considerable. People often take pleasure in simplify to the extreme the problem of protein supply by saying that it is easy to replace :

Soya cake by cereals + Lysine + Methionine

BRETTE (op cit) propose the following substitution :

" 1 kg of 50 % soya = 0.950 kg of wheat
0.011 kg of DL Methionine
0.038 kg of L Lysine monochlorhydrate 97 %

In this way, to save 1 million metric tons of soya cake it would suffies to use :

11 000 tons of Methionine
38 000 tons of Lysine HCL " (1)

(1) Or monochlorhydrate lysine

Table 1 - LYSINE REQUIREMENTS (1)

Animal species	% Lysine requirements
Piglet of 8 kg to 25 kg	1,00 / 1,20
Piglet of 12 kg to 25 kg	0,85 / 0,90
Growing piglet, young piglet 25 to 65 kg	0,75 / 0,85
Fattening pig of more than 65 kg	0,65 / 0,70
Chick up to four weeks	1,10 /1,15
Chicken from 4 weeks to slaughter(8 weeks)	1,05
Young Turkey up to 28 days	1,55 /1,60
Turkey in the final stage from 8 to 12 weeks	1,00 /1,15
Young Guinea fowl up to 26 days	1,25 /1,40
Guinea poult from 8 12 weeks	0,75/0,90
Laying hen	0,50/ 0,62
Young hen before laying	0,60/ 0,66

(1) The lysine requirements published by researchers are very variable because they are calculated in the light of the age of the animals, methods of feeding (ad libitum or semi ad libitum or restrictive feeding), of the sexes (males, females, or castrated males), of the nergy levels of the ration, of the breeds, stocks, etc.

The average figures shown above are only meant to give an order of magnitude. They are the result of a compilation by the author based on the data of about a dozen researches or American, British, French and German research organisations.

Table II - CONTENTS SOME RAW MATERIALS LYSINE

Raw Material	% Lysine content
Wheat	0,31
Maize	0,26
Barley	0,36
Fine wheat bran	0,39
Groundnut cake	1,83
Cotton cake	1,64
Soya 44 cake	2,80
Soya 50 cake	3,20
Sunflower 43/14	1,55
Fish meal 65	5,33
Fish meal 72	5,40
Meat meal 50	2,70

Our calculations lead us to an equation which is practically indentical :

100 kg of 50 soya cake	=	95 kg of WHEAT
		3.850 kg of Lysine Hcl 97 %
		1.150 kg of Methionine 98 %

We also have :

100 kg of Soya 50 cake	=	95 kg of MAIZE
		3.870 kg of Lysine Hcl 97 %
		1.130 kg of Methionine 98 %

Any economic consideration apart, in the present state of knowledge and in most of the pig and poultry feeds (which contain about 10 % - 30 % of soya cake), we can apply one of these two substitutions using only four to 5 kg of soya cake in 100 kg of feed.

Soya 50 cake	=	Wheat	+ Lysine	+ Methionine
100 kg	=	95,000 kg	+ 3,870 kg	+ 1,130 kg
4 kg	=	3,800 kg	+ 0,155 kg	+ o,045 kg
5 kg	=	4,750 kg	+ 0,194 kg	+ 0,056 kg

From the economic point of view, taking the following prices (September 1973)

Soya 50 cake	115	FF/q, or 20,71 UA/q (1)
Wheat	52	FF/q, or 9,36 UA/q (1)
Methionine	7,17	FF/q, or 1,29 UA/q (1)

we deduce from the first equation f that Lysine is not profitable unless its price doesnot exceed 15 FF/kg approximately (2.70 UA/q). It is evident that at the time pf the "soya crisis" the latter having reached and exceeded the price of 250 FF/q (45 UA/q (1) the same calculation would have given for lysine a threatshold price (2) of 49.70 FF/kg (% 8.95 UA/kg) (1)

The table below shows :

1/ that in May 1972, lysine was too dear, since :

Market price	10 FF/kg, or 1.80 UA/kg (1)
Threshold price	7,7 FF/kg or 1,39 UA/kg (1)

Therefore no substitution was made

2/ That in July/August 1973 lysine could very well have been used

(1) 1 FF = 0.180044 UA

(2) See definition of threshold price at Annex I (page AN/6

Calculation of the threshold prices of lysine

Date	Market price						Threshold price	
	Soya 50 cake		Wheat					
	FF/q	UA/q(1)	FF/q	UA/q(1)	FF/q	UA/k(1)	FF/k.	UA/k(1)
May 72	70	12,60	50	9,50	6,50	1,17	7,71	1,39
July/August (1973)	250	45,01	52	9,36	7,17	1,29	49,70	8,95
September (1973)	115	45,01	52	9,36	7,17	1,29	15,11	2,72

Market price 15 to 20 FF/kg or 2.70 to 3.60 UA/kg (1)

Threshold price nearly 50 FF/kg or 9,50 UA/kg (1)

but production being very much lower than demand

no substitution was therefore made

3/ In September 1973

The market price is very close to the threshold price (15 FF/kg or 2.70 UA/kg) (1) but a sharp rice is expected and, in any case demand still being very much higher than supply, it is impossible to make the substitution.

(1) 1 FF = 0.180044 UA

The calculations quoted above, obtained on a computer, to ascertain the threshold prices in October 1972, had made it possible to establish an approximate balance-sheet of the economies of soya cake following the employment of L Lysine in a few feeds in the event of its maximum price having been 5 FF/kg, or 0.90 UA/kg(1)

F e e d	Use of 76% Lysine %	Reduction in the use of soya cake per 100 kg of feed	Increase in the use of cereals per 100kg of feed
1/ PIGS			
Piglet	0,13	3,6 kg	2,6 kg
Young pig	0,17	4,8 "	3,6 "
Fattening pig	0,09	2,6 "	1,9 "
2/ TABLE CHICKENS			
Starting Chicks	0, 11	3,2 kg	3,7 kg
Chicken in the finishing stage	nil (1)	nil (1)	nil (1)
3/ TURKEYS			
Starting	0,25	6,9 kg	7,9 kg
Growing	0,02	0,6 "	0,7 "
Finishing	0,14	3,8 "	4,5 "

If we take 3 % as the average figure for the soya cake saving, and EEC consumption having been around 8 million metric tons in 1972, this corresponds to saving of about 240.000 tons.

---

(1) 1 FF = 0.180044 UA

(2) We come up against the satisfaction of the THREONINE requirement, which makes it impossible to carry out this substitution.

CONCLUSIONS

These are very simple to formulate :

1°/ - It is doubtful whether in the years ahead, and taking into account the considerable increase in requirements for soya cake, that the latter will retrun to its prices of May 1972 for example. This being so, the present price of monochlorhydrate of lysine is very close to its profitability price (1)

2°/ - It is practically no longer price considerations which prevent the substitution :

Soya 50 cake = Cereals + lysine + methionine

from being made, but the fact that the production of industrial lysine in the world is already lower than present potential requirements.

3°/ - The French company RHONE POULENC is due to launch shortly (before the end of 1973) a production of 1 300 metric tons/year and should shortly decide also to manufacture on a greater scale (5 000 tons/year).

(1) The threshold price (page III/15 has been defined as being the price beyond which a raw material is too dear to be chosen by a computer. But at a price equal to this threshold price it could happen that the computer would use only ridiculously low percentages (for example, 0.03 % for a cake). It is therefore necessary to define a "profitable price" which is the one with in practice allows the raw materials to be incorporated in percentage which are not negligible. Il is below the threshold price and can be obtained either empirically or by the method of successive approximations.

14/ - Tryptophan and Trhronine

We have seen in paragraph (11) concerning methionine that the requirements of the majority of animals are higher than the methionine content of the raw materials currently used in animal feeding. In this way, methionine is the first limiting factor, or primary limiting factor, and requirements are covered by adding synthetic methionine.

In paragraph (13) dealing with lysine, we saw that, if it is desired to reduce by a few points in most of the formulae the rate of incorporation of soya cake (ipso facto reducing the protein rates) lysine appears as the secondary limiting factor.

This happens in such a way that, similarly, the covering of the requirements for this amino acid can be achieved only by adding synthetic lysine. We have also seen that in a formula, for example the following substitution :

Soya cake $\longrightarrow$ Cereals + Lysine

was impossible because one would not be able to meet the threonine requirements. In this way threonine appears as the tertiary limiting factor.

In other formulae this part could be played by TRYPTOPHANE.

THEORETICAL POINT OF VIEW

Thus, the covering of the requirements (as they are at present known) for threonine or tryptophan, in formulae in which the rates of soya cake and of protein would be further reduced, would only be possible with an addition of these amino acids.

PRACTICAL POINT OF VIEW

Unfortunately, these two amino acids, which are at present produced for the pharmaceuticals industry, are not available for animal feeding, both for reasons of quantitative production and for economic reasons (price levels are too high (1). Two European firms are studing their industrial production for animal feeding and the same thing is goind on in the USSR.

---

(1) Threonine about : 300 FF/kg
Tryptophan about : 130 FF/kg

In addition, the requirements for these aminio acids are perhaps not very well known, for according to recent experiments with table chickens, the animals receiving rations theroretically short on threonine, are reported not to have reacted to the supplementing of this amino acid, which would seem to create doubt regarding our knowledge of their requirements.

IN CONCLUSION, the reduction in the rates of proteins by the substitution :

Soya cake ——— cereals + synthetic amino acids has its limits :

either the price of the lysine, the secondary limiting factor
or the price and industrial availability of threonine or tryptophane, tertiary limiting factors.

2/ - The non-protein nitrogenated compounds

Among these urea has been longest used in animal feeding (United States). In different parts of the world the following ure compounds are being produced or are under study.

- BIURET in South Africa
- Zootechnical BIURET in the United States
- DUIB in Japan
- UREA PHOSPHATE in Istael

DEFINITION :

NON-PROTEIN NITROGENATED COMPOUNDS are raw materials which contain nitrogen and thus nitrogenated substances but do not contain proteic nitrogen (that is to say no free amino acids, no polyppetides, no peptides and no proteins).

They contain nitrogen forms which are designated as "non noble" or of inferior quality in animal nutrition.

DESTINATION

As we have already pointed out (Chapter III), in practice their use does not concern (1)

- either the monogastric animals (poultry, pigs, young non-ruminant animals).
- nor animals with a very developed caecum sometimes called "pseudo ruminant", (the horse, rabbits).

They are of interest only to the ruminant polygastrics (bovine cattle, sheep goats, adult or weaned), and not that these do not require amino acids indispensible for their nutrition, but because they possess in their rumen a bacterial flora which fabricates these for them by synthesis on the basis of ammonia.

UTILIZATION

The very simplified scheme includes several stages (2)

1° - Ingestion by the polygastric animal of a ration containing very varied nitrogen sources : (proteins
(polypeptides
(peptides
(non-proteic nitrogenated compounds.

2° - Breakdown of the non proteic nitrogenated compounds (and possibly of a part of the proteins, peptides, etc (3) in the rumen into ammonia.

3° - This ammonia follow several paths :

31/ Utilization by the bacteria, which transform it, by synthesis into their own bacterial proteins.

32/ Passage of the surplus ammonia into the liver, where it is transformed into urea. Three possible fates are open to this urea :

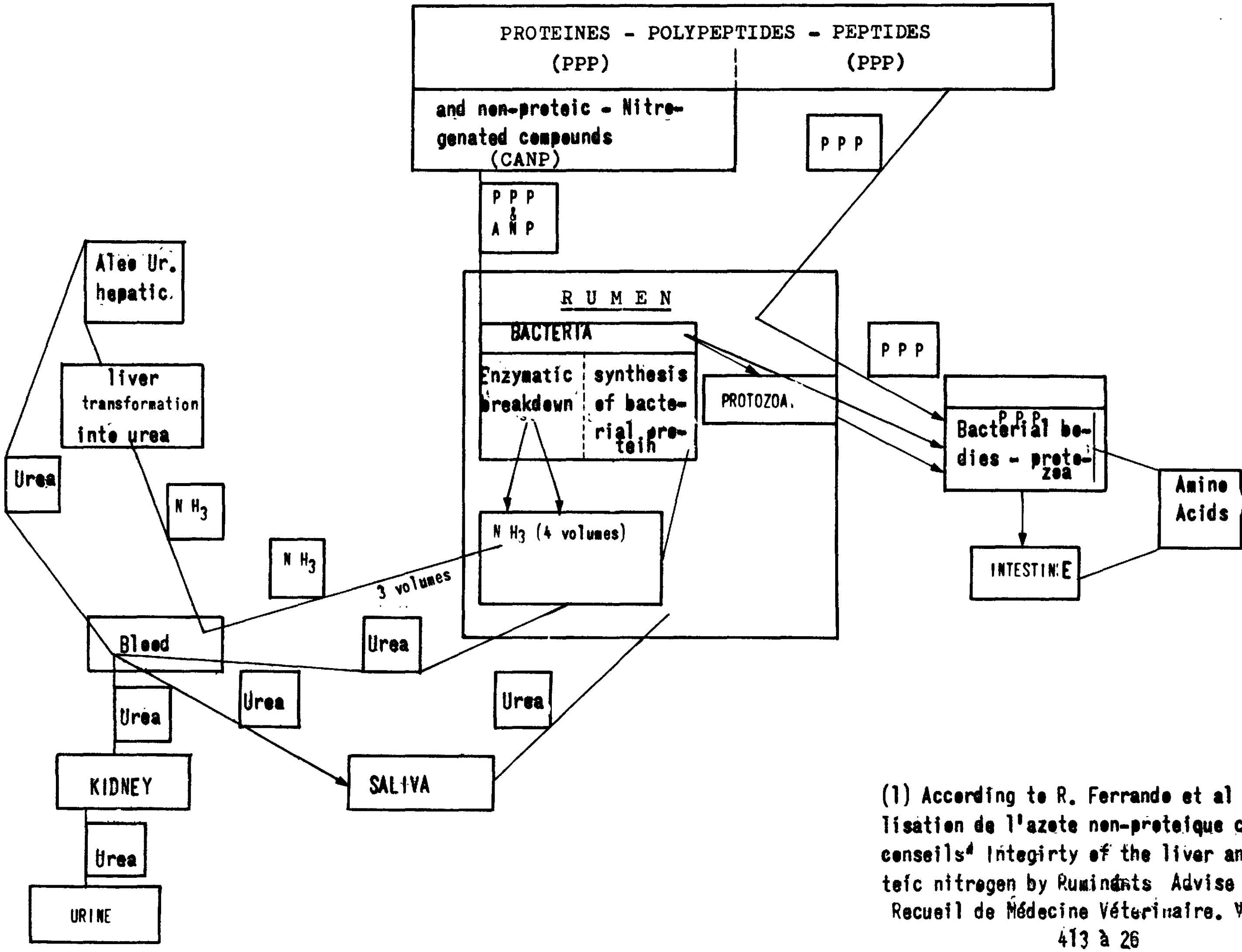
Metabolic Recycling (
- evacuation through the kidneys into the urine;
- passage into the bloods then return to the rumen through the intermediary of the saliva;
- passage into the blood, then direct return to the rumen by penetration through its wall.

(1) In practice, for research shows that small percentages of urea for example can be used by the monogastric animals (studies on the goose in particular, the horses, rabbits, chickens, hen) and make it possible to economise non-essential nitrogen.

(2) See also the outline diagram

(3) The third part finds its way directly from the rumen into the abomasum without being attacked by the bacteria.

OUTLINE OF THE COURSE OF THE NON-PROTEIC AND PROTEIC NITROGEN COMPOUNDS IN THE ADULT RUMINANT



(1) According to R. Ferrando et al "Intégrité du foie et utilisation de l'azote non-protéique chez les Ruminants. Quelques conseils" Integirty of the liver and utilization of non-proteic nitrogen by Ruminants Advise on a few points.
Recueil de Médecine Véterinaire. Vol CYLIX January 73
413 à 26

4°- Absorption of a considerable part of the bacteria by the protozoaire of the rumen and passage of the bacteria and protozoaire into the second stomach or abomasum.

CONDITIONS FOR PROPER UTILIZATION OF THE NON-PROTEIC NITROGENATED COMPOUNDS

a/ Presence in the ration of a source of glucides (energy-producing elements) easily usable by the bacteria :
in preference starch of wheat, barley or oats,
if not, maize starch, or molasses.

b/ Balance between the non-proteic nitrogen contribution and the proteic nitrogen contribution.

In practice, the total ration (and not the concentrated feed) must have a non-proteic nitrogen content not in excess of 30 % of the total nitrogen content.

In addition, and under French law for example (1), the quantities of non-proteic nitrogenated compounds may not exceed the following daily doses:

Type pf Polygastric adult ruminants	Converted to 100 kg of live weight	Converted to an animal weighting 150 kg of live weight
Milking animals	30 g.	150 g.*
Animals for slaughter	40 g.	200 g.

* For example, a cow weighting 500 kg should not consume more than 5 kg = 500 g of concentrated feed containing 3 % of non-proteic nitrogenated compound daily. (On condition, of course, that its fodder ration does not already contain some of this).

c/ Supplementing of the sulphur ration because the bacteria have proteins which are poor in sulphur:

$$\frac{\text{Sulphur}}{\text{Nitrogen}} = \frac{1}{8} \text{ to } \frac{1}{10}$$

(1) According to the Council Directive of 23 November 1970, Article 4, as amended by the Directive of 28 April 1973, the Mmeber States are authorized by derogation to use on their territory non-proteic nitrogenated compounds for ruminants on condition that experiments have that, when incoporated into the feeds of the animal production.

See at Annex II (pages AN/16 to AN/19)the national laws on urea and the non-proteic nitrogenated compounds in the Community.

d/ Supplementing of the ration by various elements (phosphorous) and mineral oligo-elements (copper, zinc, cobalt, manganese).

e/ Contribution to the concentrated feed of lucerne meal (acting favourably in all probability through its mineral constituents (cobalt) and its indispensable amino acids.

f/ Integrity of the liver (absence of lesions), otherwise this organ is incapable of preventing intoxication of the organism by transforming the surplus ammonia into urea.

g/ High acidity of the rumen. If the rumen has an alkaline reaxtion, the ammonia freed can well pass into the blood too quickly, thus provoking intoxication.

h/ Observance of several days' time-limit to enable the bacteria of the rumen to get used to the extra elements. This rules out over-rapid transition from a feed WITHOUT to a feed WITH.

21/- U R E A

This is an organic compound with a very simple chemical constitution :

formula Co (NH_2) 2 or CO $\begin{matrix} \diagup NH_2 \\ \diagdown NH_2 \end{matrix}$ It has been used for a very long time now as a nitrogenated fertilizer and more recently as a source of nitrogen for animal feeding.

ANALYTICAL COMPOSITION

In the pure state urea contains 46.6% of nitrogen. For animal feeding, according to the particular manufacturer, the figure is from 43 to 46 % (urea is sometimes mixed with anti-binding mineral products which make possible storage in the factory without mass returns.) It takes the form of meal or small balls of varying diameter (roughly a pin's head).

Using the multiplying factor 6.25, which makes it possible to transform by cal culation a nitrogen content into a protein content (1),urea is characterized by a great richness in nitrogenated substances (or more exactly in protein equivqlent).

Nitrogen content %	Equivalent proteic content %
44	272,5
45	281,25
46	287,5

Let us take the figure of 275 %. In this way, one kg of urea contributes as much proteic equivqlent (2) as :

- 5.3 kg of groundnut cake
- 5.6 kg of soya 50 cake
- 6.25 kg of 44 cake
- 8.0 kg of colza or linseed cake
- 13 to 15 kg of copra or palm kernel cake
- 18 kg of wheat bran

USE IN ANIMAL FEEDING

Economic point of view : It is a raw material characteriwed by a very advantageous cost in relation to other sources of nitrogenated substances, in particular cake.

In September 1973, in FF/q (in UA/a) (3)

Urea 44 : 45/46 (8.10)	Soya 44 cake : 100 (18.00)
Groundnut cake : 105 (18.90)	Colza cake : 75/70 (13.50/12.60)
Soya 50 cake : 115 (20.78)	Wheat bran : 48 (8.64)

---

(1) A model prtoein is considered as containing 16% of nitrogen. In this way :

Nitrogen	Corresponding protein (or proteic equivqlent)
16 g	100 g
1 g	$\frac{100}{16}$ g = 6,25 g
X g	6,25 X g

(2) This equivqlence of course concerns only the nitrogen (or the proteic equivalent) and none of the other nutritional elements, in particular energy. Urea does not contribute any energy.

(3) 1 FF = 0.180044 UA.

<u>Nutrition point of view</u> : its use must conform with the rules previously mentioned for non-proteic nitrogenated compounds.

- <u>Its advantage</u> derives essentially from its low cost of introduction

- <u>Its drawbacks are</u> :
  - It is a raw material which is nuappetizing. For this reason the feed concentrated contain doses which are generally lower than the legal limits.
  - Its nitrogen breaks down rapidly into ammonia, thus involving risks of toxicity. To avoid these, a certain number of precise conditions must be supplemented with urea, staggered in time, which is impossible when the milking cows consume their feed concentrate in the milking parlour (where they remain the shortest possible time).
  - The consumption by a ruminant <u>at the same time</u>
    - of fodder (maize silage) enriched with urea
    - of concentrated feed with urea

    can lead to a total urea intake which is above the limit doses.

In this way, a ruminant weighthing 600 kg can consume :

	UREA (g/day)
30 kg of silage at 5 kg or urea per metric tons	150
5 kg of concentrated feed at 3% of urea	150
Total :	300
whereas the legal French limit dose is.......	180 g

- Its use demands a high incorporation of cereals. However, since cereals are costly in the EEC countries, there are many milking cow feeds of low energy content which contain small quantities of them.

- A certain reticence on the part of breeders with respect to urea, which is more or less justified,(unappetizing nature of the feeds - urea equals fertilizer et)

THE FUTURE OF UREA

In the EEC countries, its present use is restricted (1)

In 1972 :	Germany	3,5 to 4 thousand metric tons (1974 forecast : 10 to 15 thousand metric tons)
	France	10 to 12 thousand metric tons (1974 forecast : 15 000 metric tons)
	Italy	1.5 to 2 thousand metric tons
	Un.Kingdom	20.000 to 25 000 metric tons

In Belgium, its use was forbidden up to January 1973 (2)

A longside these figures let us quote those of the United States :

1968/69	500.000 metric tons
1971/72	Almost 750 000 tons corresponding the protein contribution of 4.5 million tons of soya cake (2)

Basing oneself on the numbers of milking cows and of adult cattle fattened for meat production and on a consumption of 30 g of urea per day and per 100 kg of live weight, the figure of 2 million 500 000 metric tons per year is obtained as maximum consumption for the EEC countries. It would seem that :

. the considerable increase in the price of cakes,

. the rise in the price of beef and veal in relation to that of cereals,

are two factors which should lead to an increase in the production of meat of young bovine cattle, and consequently a higher consumption of urea,

. either by breeder farmers producing maize silage (poor in proteins) which they enrich in nitrogen with a "mineral corrector" generally contributin urea.

. or by the animal feedingstuffs industry.

Unless the latter is not more tempted in the future to use other sources of non-proteic nitrogenated compounds, perhaps dearer but more reliable in their use.

In the following pages we look at some of these :

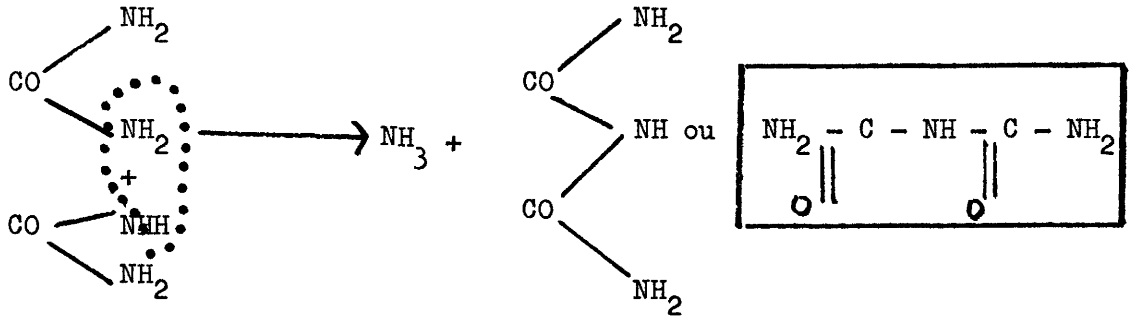
(1) According to OECD statistics. It is very difficult to obtain precise figures from the producers because of the dual use of urea (fertilizer, animal feeding)

(2) Ministerial order of 13 July 1972 published in the Moniteur Belge of 19 January 1973.

(3) According to an OECD document.

22/ - BIURET

As the name indicates (but not the spelling,which could more logically be "BIUREA"). This is a "double" product of urea, obtained by the concentration of two urea molecules with the loss of an ammonia molecule.



UREA BIURET

Characteristics Chemical	It is less rich in nitrogen than urea (40.7% instead of 46.6%)
NUTRITIONAL	It has the advantage of liberating its ammonia more smowly in the first stomach of the animals and therefore it is less dangerous than urea.
ECONOMIC	It is dearer than urea, and its nitrogen is therefore two times less profitable than that of urea.
INDUSTRIAL	There is no production in the EEC and no offers from abroad (1)
LEGAL	Authorized in the EEC countries since November 1972 Authorized in France since September 1972.

(1) There is production in South Africa by the Company "AFRICAN EXPLOSIVES AND CHEMICAL INDUSTRIES LIMITED " of JOHANNESBOURG, which sels BIURET particularly in the form of a proteic concentrate "PROSUP 220" with 22% of proteic equivalent.

23/ - Zootechnical BIURET or KEDLOR 230

This is the trading name of a product manufactured by the American Company DOW CHEMICAL and consisting of :

		for example
Biuret	65% maximum	66
Urea	11% maximum	
Cyanuric acid (	21 % maximum	(26
Triuret (	-	(
Water		8
Total :		100

Characteristics

CHEMICAL — Nitrogen content 37% (guaranteed minimum 35%)

NUTRITIONAL — Like urea, it has the advantage of a slow liberation of ammonia by hydrolisis because of its low solubility.

ECONOMIC — The price is high. In 1971 it was offered at about :

- 200 dollars per metric tons (price per 1000 t)
- 250 dollars per metric tons (price per 20 t)
  or between 110 to 140 FF/q
  or 19.80 to 25.20 UA/q (1)

Thus, its nitrogen has two reasons for being dearer than that of urea.

INDUSTRIAL — For the time being, the American company is reserving all its home production to the requirements of the US market. The future of this product is therefore unknown for Europe

LEGAL — Authorized by European legislation.

FUTURE

Assuming that American production increase to the extent that there will be availabilities for the European market, this raw material would be a profitable proposition because :

- of the high price of cakes
- of its technical characteristics.

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(1) 1 FF = 0.180044

24/ - DUIB or Di Urea Iso Butane or Di Uredo Butane (1)

This product is obtained by the reaction, followed by condensation between Isobutyraldehyde and urea in the presence of an acid playing the role of catalyst.

MANUFACTURER : The Japanese Company"MITSUBISHI CHEMICAL INDUSTRIES LIMITED"

Characteristics

CHEMICAL

The commercial product contains :

- 98.94 % of DUIB
- 0.64 % of UREA
- 0.57 % of BIURET
- 32 % of NITROGEN (30% minimum guaranteed)

NUTRITIONAL

It has less drawbacks than urea because :

- it is perfectly well accepted by the animals at 3 or 4 %.
- it is less toxic than urea.
- in the rumen it becomes transformed into urea and then into ammonia, more slowly than urea into ammonia by hydrolysis, and this because of its low solubility. For the bacteria of the rumen it necessitates a shorter adaptation time (10/15 days) than for biuret (10/25 days)

ECONOMIC

The price is high, at present about 135 - 140 FF/f (24.3 to 25/20 UA/q) (2)
Its nitrogen has therefore two reasons to be dearer than that of urea.

INDUSTRIAL

The quantities offered for Europe are at present very limited : 5000 metric tons year(Japanese production in 1973 : 24.000t Forecast for 1974 about 50.000 t/year.

LEGAL

Authorized by European legislation.

FUTURE

Very promising despite its high price.

Of all the analogue of urea it would seem to be one of the most interesting because of its nutritional charaxteristics.

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(1) Also called IBDU or Iso Butylene Di urea

(2) 1 FF = 0.180044.

25/ - PHOSPHATE OF UREA

A compound made up essentially of molecule of urea and one molecule of phosphoric acid.

MANUFACTURERS : The Israel Company "CHEMICALS AND PHOSPHATES"
The British Company "IMPERIAL CHEMICAL INDUSTRIES"

Characteristics

CHEMICAL

Formula : $NH_2 - CO - NH_2 - H_3\ PO4$

It contains :

- Phosphorous 18/19 %
- Nitrogen 16/17 %
- Proteic equivalent 100/106 %

NUTRITIONAL

Because of its sourness, it conferrs a certain acidity (reduction of the PH (1) from 7 to 6) to the environment of the rumen, and this slows down the passage of the ammonia into the blood and therefore diminishes the toxicity of the urea.

It can be used jointly with urea and exercise a retarding effect on the latter. In this way, the following mixture can be given :

- one part of urea coming from the phosphate for 3 or 4 parts of pure urea.

ECONOMIC

Its high price (about 125/130 FF/q,i.e. 22.50 to 23.40 UA/q (2) and its low rate of nitrogen mean that its introduction cost is high in relation to that of urea.

INDUSTRIAL

The production capacity of the plants is still relatively low about 400 to 500 metric tons/month in 1973 (perhaps 700/800 tons/month in 1974).

LEGAL

Authorized by European legislation.

FUTURE

Very interesting from the nutritional point of view, but its low nitrogen content could handicap it from the economic angle in relation to DUIB for example, or zootechnical BIURET.

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(1) PH, initials of hydrogen pressure the traditional chemical measurement of acidity.

(2) 1 FF = 0.180044 UA.

26/ - Ammoniacal salts or salts of ammonium

These are the salts resulting from the reaction of an acid on the ammoniacal basis NH_4OH. They have the advantage that they break down into ammonia less rapidly than does urea.

Ammonium sulphate

This is profitable by reason of its sulphur contribution, but it is unappetizing and the results obtained on animals are generally no higher than those with urea. It could be utilized in association with urea.

Phosphate of ammonium or triammoniacal phosphate $[(NH_4) PO4]$

This has the advantage :

- of being a source of phosphorus
- of liberating its ammonia even more slowly than the above

The drawbacks

- it is unappetizing
- it is often less effective than urea as a source of nitrogen
- it contains little nitrogen : 28/29 %

Monoammoniacal phosphate $[(NH_4) H_2 PO_4]$

- unappetizing
- very poor in nitrogen : 12 % 4 times less than urea.

This is much more a source of phophorus (27%) than of nitrogen. In this way in order to contribute to a milking cow feed 0.50% of phosphorus, for example, one could use (provided that it is well taken by the animals) :

2 % of monoammoniacal phosphate, which will contribute only 0.24% of nitrogen.

3/ - THE SOURCES OF PROTEINS SYNTHESIZED BY UNICELLULAR ORGANISMS.

Whereas the non-proteic nitrogenated compounds were products of chemical synthesis, the unicellular organisms are products of biochemical synthesis. For nutritionists the difference is negligible. (1)

The organisme most widely used are the yeasts. This is no innovation. For a very long time animal feeding has been using yeasts, moreover in very varied proportions. Thus, in the period prior to about 1955, ignorance both of the real amino acid requirements of poultry for meat production and of the amino acid content of the raw materials, and the absence of soya cake on the markets of the West, led the nutritionists to compose formulae by multiplying the sources of quality proteins, lactic casein, dry lactoserum, dry skimmed milk, yeast,fish and meat meals, and to consider that the animals had a specific requirement for "animal" meals (2). We have learnt since then that this is not the case (3). The animals need proteins and their amino acids as nergy from wherever they come. However, this may be, the animal feedingstuffs industry in the years 1945/55 had two categories of yeasts at its disposal.

a/ - Salvage yeasts, that is to say yeasts utilized in the processing industries :
- breadmaking yeasts
- brewery yeasts
- distillery yeasts (sugar beet alcohol)

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(1) It has been seen, moreover, a propos of lysine that htis amino acid could be produced equally well by chemical synthesis or by biosynthesis.

(2) Although yeast belong to the vegetable kingdom (mocromushrooms) it was current at that period to differentiate, the sources of proteins into "vegetable" (generally poor in lysine) and "animal" in which the yeasts were included because of their richness in essential amino acids.

(3) It is only honest to point out that certain nutritionists or certain producers of ish meals notably continue to affirm with supporting proof that these animal meals contain unknown growth factors which render their use indispensible for monogastric animals.

B/ – Cultivated yeasts : Yeasts are "cultivated", "raised", or "nourished" on industrial liquids which are :

- either unusable in animal feeding
- or difficult to use because of their liquidity

Examples :

• liquid lactoserum	Lactic yeasts
• wood fibre attacking juice for the manufacture of paper pulp by sulphite washings	wood yeasts = cellulose yeasts
• residuary liquor from sugarbeet	Torula Utilis yeasts
etc.	wash yeasts

After about 1955, the use of yeasts began to decline because its price (2) was no longer competitive with soya cake possibly supplemented by methionine. At present its use is extremely limited, and its production also (European production estimated at 30 000 t/y of which 16 000 to 18 000 for France and Germany).

In addition, anti-pollution problems arise for the industries. A french paper pulp factory which used to produce about 2 300 metric tons/year of wood yeast per month, stopped production in June 1973 because of the exaggerated financial burden which the measures to be taken against pollution would have represented.

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(1) It must be pointed out that there is a great analogy with the breeding of bovine cattle. The bovine animal which eats fodder unconsumable by man and whose products we eat (meat, milk) serves as a "relay" between the vegetable kingdom (pasture, grass, hays, silage, root crops etc. and man.
The cultivated yeast which consumes liquids unusable by the feeding industry serves as a "relay" for example between the sulphite and this animal feeding industry.

(2) In May 1972 approximate prices in France :

- Soya cake with 50% of crude protein : 70 FF/q or 12.60 UA/q
- Wood yeast with 50% of crude protein: 110FF/q or 19.80 UA/q
- Distillery yeast with 38/40% of crude protein: 86FF/q or 15.48 UA/q
- Distillery yeast with 42% crude protein: 98FF/q or 17.64 UA/q

31/ - YEASTS ON ALKANES (1) (2)

Numerous countries have been studying for several years the production of yeasts on petroleum substrata : France, Great Britain, Japan, the East block countries in particular Czechoslvakia, USSR, the United States, Swizerland, etc. The most advanced project for the production of yeast for animal feeding (3) is that of the British company BRITISH PETROLEUM and of its French subsidiary the SOCIETE DES PETROLES BP.

Why make this call on yeasts ? Because these organisms have extremely high growth rates corresponding to generation times of the order of 1 hour and consequently, 100 or 1000 times faster than those of plants or the higher animals(4). In this way, the production of proteic materials is remakable in its yield. The weight of cellular matter doubles in 3 or 4 hours. (5)

TABLE 5

Living organisms	Weight (kg) of living matter produced daily by 100 kg of living matter
Yeast	2 000 to 2 400
Chicken	4
Pig	0,4
Ox	0,1

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(1) The alkanes are hydrocarbones or straight chain paraffins. This term, chosen by the technician is more precise and less sinister than that of petroleum yeast which we exclude. It is evident that the presence of this latter word on the labels of feeds for poultry or pigs could shock journalists and consumer associations.

(2) The term'petroleum proteins ' is to be completely rejected :
- on the one hand, because yeast on alkane is no more a protein than is fish meal. It contains only 60 to 70% approximately of this product.
- On the other hand, because it permits the supposition that petrol contains proteins which it is sufficient to extract like oil from a seed .

(3) Yeast, which is a noble protein, rich in essential amino acids would be a very good arm in the struggle against proteic hunger in the developing countries whose inhabitants mainly consume glucides (cereals,manioc, etc.)

(4) Professor J.C. SEMEZ - Place et Potentiel des levures cultivées sur Alcanes Symposium at Aix-on-Prevocen - February 1973.

(5) According to Mr. Pasero - Sté Française de Petrole BP - Conference in Dec. 1967.

a/- PRESENT ACHIEVEMENTS : The Alkane yeast of the BP company (1)

The research undertaken by the Société BP at Lavera (near Marseilles,France) with the help of the team of Professor SENEZ of the Bacterial Chemistry Laboratory of the CNERS, began in 1959. Initially, it was a question of solving an industrial problem. As it was known since 1890 that yeasts can develop in hydrocarbons, thought was given to them for deparaffining these hydrocarbons. It was only later tha the idea occured of using the products obtained for animal feeding.

The team established that the yeasts (special selected stocks) placed in an aqueous milieu containing the elelents necessary for their growth, were capable of assimilating these elements, including the carbon and the hydrogen of the alkanes and proliferating with extreme rapidity (2). Then it was decided to make use of two distinct ideas leading to the production of yeasts by two processes

French process from Lavera (Bouches-du-Rhône, France). This consists "of cultivating yeasts on the basis of a traditional petroleum fraction (in this particular case alkane). These yeasts then select the paraffins that they metabolize. (2)

British process from Grangemouth (Scotland, Great Britain) This consists of first separating the paraffins by an appropriate refining treatment, and then giving them as a feed to the yeasts, which consume them completely. (2)

Thus, in the French process, the yeasts are nourished with paraffins gas-oil.

In the British process they are nourished with paraffins of gas-oil.

It can be said in both cases that the yeasts feed on paraffins and not really on petroleum.

POTENTIAL PRODUCTION

After having installed a large pilot unit which was to produce 500 kg per day at Lavera in 1963, the following outputs were planned for 1971 (2).

- Cap Lavera plant : 16 000 to 20 000 t/year
- Grangmouth plant : 4 000 t

Should the results live up to hopes, the Société B.P. envisaged building other plants in Western Europe.

Present outputs are (April 1973) :

- 3 000 to 3 500 t/y for the Grangemouth plant
- 6 500 to 6 600 t/y for the Lavera plant (25 t/day)

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(1) Marketing in France under the name of TOPRINA

(2) According to TOPRINA Proteine B.P. - La Documentation Agricole - France Special n° June 1971.

USE IN ANIMAL FEEDING

Numerous experiments have been carried out, either on behalf of the BP Company (1) or in association between it and a leading cattle feed manufacturers particularly in France.

- on Chicken (2) — Rate of yeasts used
  - Zero – 7.5% – 10 % – 15 %
  - 10% then 7.5% (at 5 weeks)
  - 15% then 10% (at 5 weeks)

  comparitively to the soya/fish diets and possibly Torula yeasts.

- on laying hens (2) — Rate of yeasts utilized zero – 10 % – 20 %
- on breeding hens (2) or laying hens previously inseminated artificially
- on pigs (3)

Sows	Rate of yeast	. zero – 10 %
under the mother	" " "	. Zero – 15 %
Fattening pigs	" " "	. Zero – 7.5 % – 15 %

Without entering into the details of the statistical conclusions of these numerous experiments, we may say ;

1°/ – that the rates utilized were :

- either relatively low 7,5 – 10% could quite well be chosen for feeds of commercial type.
- or higher (15 to 20%) than those utilizable in practice, but intended to bring out the effects which may result from incorporating too much in practical conditions (3)

2°/– that at these rates, practical or excessive, the performances of the animals on the whole have been comparable with those of the check sample lots which did not receive the BP proteic concentrate but traditional proteic concentrates.

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(1) By the private Netherlands Research Institute ILOB Wageningen Netherlands.

(2) Concentré Protéique cultuvé sur gas-oil – Son utilisation dans l'alimentation des volailles by B.J. Van Weerden et al. 8th International Nutrition congress Prague, September 1969;

(3) Concentré Protéique cultivé sur gas-oil – Son utilisation dans l'alimentation des Porcs by P. Van der Wal et al. 8th. International Nutrition Congress Prague, September 1969.

Comparative composition of the YEASTS

a/ - Fodder analysis

Composition %	Alkane yeast (1) %French L	Scottish G	Soya cake 50% (2)	Sunflower 42/14 (2)	Fish meal 65 (2)
Humidity	8,0	3,0 - 7,0	10	10	8
Crude protein (nitrogen x 6.25)					
p.cent of dry matter	68 - 70	60 - 62	54,5	46,6	70,7
p. % of crude product	62,6-64,4	57 - 59	49,0	42,0	65,0
Lipides after hydrolysis	1,5 - 2,5	8 - 10	1,0	2,0	7,0
Mineral substances(ash)	7,9	6,0	6,0	6,0	15,0
Phosphorus	1,5	1,6	0,60	1,20	2,50
Calcium	0,3	0,01	0,25	0,25	4,50
Digstibility coefficient with chlorhydric pepsin	80 min.	80 min.	-	-	-

b/- Amino acid contents (in g per 16 g of nitrogen or 100 g of protein

Amino acids	Levures d'Alcanes (1) Française L	Ecossaise G	T. de Soja (1)	T. de Tournesol 42/14 (2)	F. de Poisson (1)
Arginine	5,0	5,1	7,7	8,5	5,0
Cystine	0,9	1,1	1,4	1,55	1,0
Histidine	2,1	2,1	2,4	2,5	2,3
Isoleucine	5,3	5,1	5,4	4,6	4,6
Leucine	7,8	7,4	7,7	6,4	7,3
Lysine	7,8	7,4	6,5	3,6	7,0
Methionine	1,6	1,8	1,4	2,1	2,6
Phenylalanine	4,8	4,3	5,1	4,8	4,0
Threonine	5,4	4,9	4,0	3,6	4,2
Tryptophane	1,3	1,4	1,5	1,2	1,2
Tyrosine	4,0	3,6	2,7	2,8	2,9
Valine	5,9	5,8	5,0	5,7	5,2

(1) According to C.E Shacklay - Sté BRISISH PETROLEUM PROTEINS Ltd PIG INTERNATIONAL 1975
(2) Document n° 111 of the Sté A.E.C. - COMMENTRY (FRANCE)

Thus, there is no major technical problem for the incorporation on alkane yeasts for cattle feed manufacturers at rates of 5 to 10 %. For higher rates the hypothesis of the responsibility of an imbalance $\frac{\text{Lysine}}{\text{arginine}}$ (too high ratio) in the animals has been evoked provoking more liquid dejections than are normal(1) It would seem in reality that the responsible factor is more likely to be potassium.

THE ECONOMIC PROBLEM

Although there is no technical problem for the animal feed manufacturer, there is a serious economic obstacle to the use of the alkane yeasts of the B.P. Company. During the years preceding the placing on the market of TOPRINA, and according to the statements of several members of that Company raw material was to be sold at a price competitive with that of other protein sources (in particular fish meals, soya cake, other yeasts). However, the prices September 1973 are as follows : (2)

. Soya 50 cake	115 FF/q	or 20.71 UA/q	(1 FF/q =
. Soya 44 cake	100 FF/q	or 18.00 UA/q	(0.180044 UA
. Cellulose or wood yeast	115/120 FF/q	or 20.71/21/61 UQ/q	(

. Alkane yeast, quality S (poor in iron, specially produced for slaughter calves)

quality L (current)

Thus, for reasons which depend,

- either on the increase in production costs, which have finally become very much higher than foressen,
- or on the small size of present production, the Société BP seems to have ceased proposing TOPRINA as a product for monogastric animals (pigs and poultry) and is presenting it solely as a substitute for skimmed milk powder and destining it for the manufacture of lacto replacers, or compound suckling feeds for battery calves for slaughter or for breeding calves, future reproducers or future producers of bovine meat.

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(1) This is grave problem for "industrial" breeding, whether on the ground (wood chip litter) or is battery (solid dejection cleaning chain)

(2) We deliberately put aside fish meal whose present price is abnormally high. (230/235 FF/q for the 65 type for example; or 41.41 to 42.31 UA/q) because of :
- the lasting stoppage of fishing off PERU
- the aftermath of the soya crisis

Obviously, it may be said that at present (September 1973) the price of BP yeast is almost competitive with that of fish meal but :
- the price of BP yeast was fixed before the soya crisis
- fish meal also has a price at presant (Sep. 1973) not competitive with that of soya cake.

From this angle obviously, and taking into account the high price of skimmed milk powder (September 1973 : 222 FF/q approximately, that is to say : 367 FF/q less denaturing premium 145 FF/q) the price of TOPRINA recovers a certain competitiveness.

B/ - THE PROJECTS

It is very difficult to obtain precise information on this subject. (2)

In FRANCE

Two petrol companies, after joint technical study with a professional research institute are at present working a small pilot plant producing 200 kg/day and plan for the future (3 years the construction of a factory for 30 000 to 100 000 t/year.

They have undertaken toxicoligical and nutritional tests with the French National Agronomic Institute pending the time when they will ask important manufacturers of feeds to carry out experiments.

In JAPAN

Three undertakings are reported to be interested. (3). Two plants were initially planned for 1974 with a total capacity of 180 000 metric tons by year (120 000 t/y + 60 000 t/y). The latter was to have achieved 250 000 to 300 000 t/year towards 1976/1977, but it would seem that the Japanese consumer organizations have succeeded, in the name of an anti-pollution campaign, in exerting pressure to have these projects stopped. In any case, Japanese requirements for alkane yeasts, according to the technician of one of these companies, are estimated at 10 million metric tons per year, so that any possible Japanese production would be more than absorbed by the internal market for many years to come.

In the U.K

Three undertaking are interested, one of them exclusively for human nutrition. One plant already existing could be enlarged, and another project envisages/

- towards 1974, the creation of a unit to produce 10 000 to 15 000 t/y.
- towards 1976-77 its extension to about 100 000 t/y.

In ITALY

Three enterprises are interested because of the proximity of Lybian crude petroleum. The ENI company is planning the installation (July 1973) in Sardinia, at Sarroch, in the Provence of Cagliari of a factory to producer 100 000 t/y on the basis of the production of normal paraffins by the Sara Chemica Company.

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(1) 1 FF = 0.80044 UA

(2) The above information largely comes from the Directorate for Agriculture of OECD.

(3) One of which with the Societe BP patent.

The company LIQUICHIMICA S.P.A. is in the process of building near Reggio Calabria a plant for a production of 100 000 t/y on LIQUIPRON, or protein concentrate.

C/ - DISCUSSION ON THE FUTURE OF ALKANE YEASTS

It is evident that,

- on the one hand the rising living standards of the Western countries are leading them incrasingly to consume animal products, thus necessiting ever greater output of cattlefeeds and therefore of protein-rich raw material.

- on the other hand, numerous countries of the THIRD WORLD have high protein requirements for human consumption.

For the short term future and as regards animal feeding, very restrictively the present price levels do not permit their generalized use for the monogastric animals. Perhaps the play of competition will make it possible to bring htem down.

It is however, evident that in the longer term, the production of yeasts of alkanes like that of similar products, such as bacteria meal, could constitute, among others, an a source of indispensible protein.

D/ - INCIDENCE ON THIS PRODUCTION OF THE RECENT SITUATION OF THE PETROLEUM MARKET

The Directors of the Ste des Petroles BP (1) do not believe that the eventuality of a limitation of supplies and the considerable rise in crude petroleum prices are likely to have a serious influence on the pursuit of their production programme. "There is no problem of raw material availability since the paraffin used for the production of proteins is a residue from the refining of petrol. However, even in the case of a very appreciable reduction of supplies of crude, there will remain sufficient paraffin for an industrial production of protein.
" As to the cost of the n ergy necessary for this production, this should not penalise this sector more than others, such as soya, maize, fish cake etc."

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(1) PROTEINES de PETROLE : Le programme continue = Le FIGARO 2/3 February 1974.

32/ - Bacteria meals

For several years a British company has been studying the possibility of producing a bacteria meal from natural gas by biosynthesis. The principle, as in the case of alkane yeasts, consists of cultivating a living organism of the vegetable kingdom on methano (alcohol) obtained from the methane gas CH^4.

MODE OF PRODUCTION

The mode of production in very broad outline, consists of injecting vats containing methanol into fermentation oxygen and nutritive mineral oligoelements. A suspension of bacteria is then extracted and coagulated by chemical treatment, centrifuged and dried by pulverisation (SPRAY process). The great advantage of this technique is that it is continuous and uses methane, which is a very elementary source of carbon and can be the cheapest substratum.

QUANTITATIVE PRODUCTION

in 1972 : 15t/year
in September 1973, probably 1000 t/y (forecasts at the end of Dec. 1972)
in 1976, if everything goes well : 100 000 t/year.

COMPOSITION

See Table attached.

This meal is charaterised by a protein weight (about 80 %) and a rate of sulphurated amino acids (methionine and cystine which is definitely higher than that of the alkane yeasts. On the other hand the Lysine contents are comparable.

The comparative composition
of the meals of bacteria and of alkane yeasts

Nutritive elements (in percentage of the crude prod.)	Bacteria Meal (1)	Alkane yeast French L	(2) Scottish G
Humidity	5	8,0	3,0 - 7,0
Crude protein (nitrogen x 6.25	$\boxed{78,9}$	62,6 - 64,4	57 - 59
Average	-	$\boxed{63,5}$	$\boxed{58}$
Lipids (Fats)	7,0	1,5 - 2,5	8 - 10
Crude cellulose	inférieure à 0,05	-	-
Clucides	3,2	-	-
Mineral substances (ashes)	8,2	7,9	6,0
of which (Phosphorus	2,75	1,5	1,6
(Calcium	0,13	0,3	0,01
(Iron	moins de 10 ppm	-	-
(Sodium	0,16	-	-
(Potassium	1,3	-	-
Arginine	3,6	3,2	3,0
Cystine	0,5	0,7	0,6
Histidine	1,4	1,3	1,2
Isoleucine	3,2	3,2	3,0
Leucine	4,9	4,7	4,3
Lysine	4,5	4,7	4,3
Methionine	$\boxed{2,1}$	1,1	1,0
Methionine + Cystine	$\boxed{2,6}$	1,8	1,6
Phenylalanine	2,7	2,7	2,5
Threonine	3,2	3,1	2,8
Tryptophane	0,7	0,9	0,8
Tyrosine	2,4	2,3	2,1
Valine	3,9	3,7	3,4

(1) Average of several samples of meal produced by the same bacteria. This composition could change as the research carried out by this company progresses.
(2) According to HYDROCARBON FERMENTATION - New source of Protein
C. A. SHACKLADY - Pig International - July 1973.

UTILISATION IN ANIMAL FEEDING

Experiments have been carried out, in particular by a Scottish research scientist (1) with two sources of bacteria (with 56 % and 62 % of protein only) to ascertain the nutritional value of these stocks in the feeding of chickens. He compares the following diet :

Components %	n° 1	n° 2	n° 3
Maize	60.7	65.6	75.6
Soya cake	32.0	17.0	17.0
Bacteria	-	10.0	-
Dry lactoserum	3.0	3.0	3.0
DL Methionine	0.16	0.10	0.10
+ Vitamine Minerals	q.s.p. 100	q.s.p. 100	q.s.p. 100
Crude protein %	20,6	20,4	15,5

The results show that direct number 2 gave :

- performances comparable to those of diet n°1 (reference)
- performances higher than those of diet n°3 (hyper-nitrogenated)

"The results of growth, of the consumption index (2) and of nitrogenated retention suggest that the bacteria utilising methane are potential sources of proteins useful for monogastric animal".

CONCLUSION

This production therefore seems promising. Of course, in the actual state of the studies published, it would be premature to draw a positive conclusion regarding the long-term innocuousness of this raw material in the feeding of poultry and pigs.

(1) J.P.F. D'MELLO "The use of Methane - utilising bacteria as a source of Protein for young chicks" British Poultry Science, 1973, 14 291-301

(2) Weight of concentrated feed necessary to produce 1 kg of increase in the live weight of the animal. Also known as "conversion factor".

4/ MISCELLANEOUS PRODUCTS

41/ - The juice of concentrated green fodders (or leaves)

Several green fodders are used in animal feeding after dehydrated, in particular lucerne and fodder maize (and also fodder sorghum). The following is the approximate composition of dehudrated lucerne.

. Humidity	12 %
. Protein	16/20 % (1)
. Cellulose	22/28 % (1)

The simple figures show that dehydrated lucerne,

- is avery important source of protein (comparable to an oil seed cake of the poor type such as copra or palm kernel)
- is very rich in cellulose and this is its major drawback. This richness in cellulose and consequently relative poverty in energy destines dehydrated lucerne above all for ruminant polygastric animals, horses and goats and accessorily for laying hens and adult pigs
  - exceptionaly for other monogastric animals, in particular table poultry and fattening pigs.

The idea therefore occurred of concentrating the lucerne into proteins in order to improvish it in fibrous elements and thus to obtain a much more noble product.

PRODUCTION

Research work has been carried out in Great Britain, the United States, Belgium, Hungary (2), Israel, France (in particular by lucerne dehydration cooperative companies and by a company manufacturing extracts of xanthothylles for animal feeding). In the United States, the research centre of the United States Department of Agriculture at Albany has studied this problem and lodged a State patent. A US citizen has exploited this patent. Previously he exported dehydrated lucerne to Japan, Central America and South America but he thought that it would be more justified, in view of the high freight costs, to rid the lucerne cellulose ballast.

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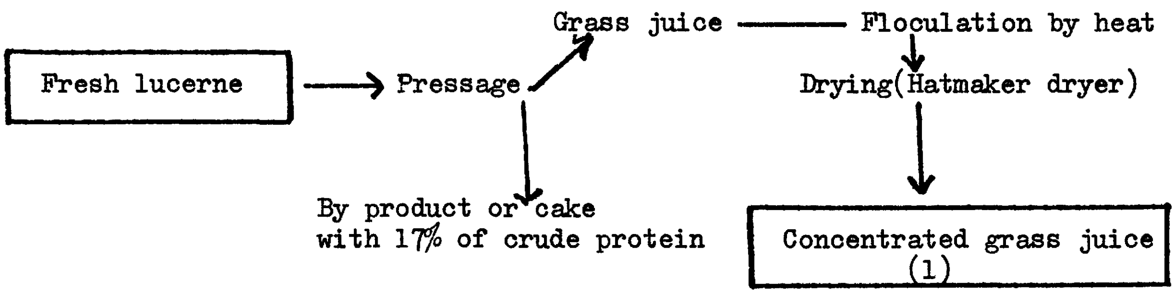
(1) This composition varies with the age of the plant at the time of cutting and more precisely with the relative percentage of leaves and stalks. Young lucerne cut in the spring are rather rich in protein and poor in cellulose. Lucernes of the third or fourth cutting have the inverse composition.

(2) Produits concentrés a base de plantes vertes a haut pouvoir biologique en tant que sources potentielles de proteines et de matières nutritives".
J. HOLLO and L. KOCH - 1969.

HIGHLY SIMPLIFIED OUTLINE OF MANUFACTURE



In this way we get two raw materials :

- concentrated grass juice a noble product intended for the monogastric animals.
- the by-product rich in cellulose, or cake perfectly usable by the poly-gastric animals (or by rabbits).

In a report on the latest situation, which constitutes both a bibliographical review and an account of personal work R. FERRANDO (2) who publishes the attached outline of preparation writes :

" With a French production of about 400 000 metric tons of dry lucerne, or in round figures, 2 600 000 tons of fresh lucerne, we can obtain, in addition to the usual dry fodder, nearly 30 000 tons of a proteic concentrate containing from 40 to more than 50 % of MPB, a figure which can even attain and exceed 60% after decoloration of the precipitate.

However,we estimate that the artificial fodders harvested in France alone, if treated according to the method we employed, would make it possible to obtain 200 000 tons of proteic concentrate of grass containing on the average 40-50% of protides. In this way, at least the same quantity of soya cake would be saved. The import price of these cakes represente a value of about 185 million units of account (1970). However, one cannot prejudge other possible economies of imported products at the level of the preparation of complets feeds from pressure residues".

CONCLUSION

To our knowledge, there does not yet exist any industrial production of concentrated lucerne juice or of proteic concentrate of lucerne. Doubtless, the facility with which dehydrated lucerne sells in the EEC countries in its natural state is hardly likely to be an incentive to industrialists to make costly investments.

(1) The American product is sold under the name of X PRO

(2) Les Proteines extraites des herbes et des feuilles. R. FERRANDO - Annales de Nutrition et de l'Alimentation - 1970,24 n°6, 145-166.

Traditional dehydration treatment → 100 kg of fresh lucerne containing → Classic dehydrations Crushing and cubing → 17-19 p 100 MS
18.4 p 100 MPB
29.6% Cellulose

New treatment → More or less fine crushing following by more or less complete extration by pressure

Crude lucerne juice
66.7 kg per 100 kg
(cf. NB)

Precipitation
separation by
centrifuging
Washing

Lucerne serum
82-91 p.100 (*) of the crude juice 1.6-1.8 p 100 of MPB per 100 ML

↓

Possible production of yeasts of antibiotics or direct consumption by pigs, etc.

Fresh proteic concentrate 9-18 p 100

↓

Pulverisation

↓

8.8-15.5% of the fresh concentrate and 1.4-1.6 by the fresh lucerne

Lucerne residue or cake
30-32 kg per 100 kg of lucerne

Dessification

Residu or cake of dry lucerne → Content of this residue 12.2 to 17 per 100 (*) MPB 32-37 p. 100(*) Cellulose.
This protein content may be reduced by finer grinding permitting a more complete extraction of the juices.

N.B. Under certain conditions - the last cuts - direct pulverisation of the total lucerne juice is possible. In this case we obtain 6 kg of dry powder, i.e. a yield of 7.1% with the juice of the first cut the presence of sugars makes pulverisation more difficult caramel forms.

(*) According to the time of the lucerne harvest : always before flowering, but first second or last cut. The last cut is less rich in proteins and in glucides.

Fig. 1.- Outline of the preparation of protein concentrates from lucerne, green fodders or leaves (The yields indicated here are based on the treatment of lucerne of average value.

REFERENCE: LES PROTEINES EXTRAITES DES HERBES ET DES FEUILLES
R. FERRANDO - Annales de la Nutrition et de l'Alimentation - 1970,24 n°6,145,166.

42/ - "Rough" fodders treated chemically.

There are a great number of "rough" fodders, i.e. fodders rich in cellulosic substances and whose use is very limited or even non-existant because of this in concentrated feeds, in view of their very low energy value : Example :

. maize cobs	cellulose content %	30/33
. wheat straw		35/40
. rice straw		33/35
. sorghum stalks		30/40
. sugar cane stalks		45/47
. sugar caneheads		30

Chemical treatments can be used to "delignify" these fodders and also increase their digestibility. Delignifying agents which are know in the various processes for the manufacture of paper pulp are used. The first studies go back to 1921 in Germany and a comparative study (1) has been carried out in a laboratory :

- with the raw materials mentioned above
- with the following agents :
  - Sodium sulphate Na_2S
  - Sodium sulphide $Na_2S_2O_3$
  - Caustic soda Na OH
  - Sodium carbonate
  - 50% caustic soda and 50% sodium carbonate
  - Bleshing powder (2)
  - Oxygenated water H_2O_2

(1) Suresh GHANDRA et al "A study of various chemical treatments to remove lignin from roughages and increase their digestibility" - The Journal of Agricultural Science, August 1971, 77, part 1 11-17

(2) Bleaching powder in the original text without any other detail or any corresponding scientific name.

. At rates varying from 0 to 12 and 15 %.

The deligniying agents are dissolved in small quantities of water which then serve to moisten the fodder.

RESULTS

- Caustic soda been seen to be the most effective agent : at 10% the lignin content of the maize cobs was reduced by 26% and the digestibility of the dry matter in the rument increased by 100 %.

- The bleaching powder (2) is equally effective but must be discarded for the residual chloride inhibits mircobial disgestion in the rumen.

The fodders treated whose initial digestibilities were very different acquire a comparable digestibility after treatment with 4% or more of soda.

COMPARATIVE TABLE OF THE DIGESTIBILITY OF DRY MATTER IN THE RUMEN (1)

Fodder	Contribution of soda %			
	0	3.3	6.7	10
Maize cobs	46	66	78	93
Wheat straw	51	67	80	89
Rice straw	57	69	82	89
Sorghum stalk	58	68	83	87
Sugar cane heads	56	65	78	86

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(1) According to S. CHANDRA - op cit

(2) Bleaching powder in the original text without any other detail nor any corresponding scientific name.

the residual quantities of soda in the fodder treated increase rapidly with the quantity of soda utilised.

Soda treatment (g/100 g of fodder)	Maize cobs	Wheat straw
from 0 to 2	(in percent of the soda added)	
from 0 to 2	from 0 to 2	from 0 to 2
from 3 to 6	from 3 to 12	from 8 to 24
from 8 to 15	from 21 to 32	from 36 to 40

This residual quantity falls off very slightly with time :

for example :

after 5 minutes	23 and 32 %
after 30 minutes	22 and 30 %
after 1 hour	20 and 29 %
after 8 hours	19 and 27 %

CONCLUSION

Such treatments are therefore possible. They seem to concern particularly those countries which lack fodder resources because of arid soils or climates with insufficient rainfall, or because of their economic context.

As far as the experts know these operations have not begun to be carried out in the EEC countries.

43/ - ANIMAL DEJECTIONS - Dehydrated poultry droppings

It may appear paradoxical to consider the dejections of animals as possible raw materials as possible raw materials for animal feeding. However, these dejections (and particularly the droppings of poultry, which are a mixture of solid faccal excrets and urinary liquids) consist of substances which precisely have escaped digestions in the digestive tract.

In reality it must be noted :

1°/- that the ruminant polygastrics are perfectly capable of using the banal forms of nitrogen, ammonia, urea, etc comparable to those which may be found in the dorppings;

2°/ that the dejections of any animal organism do not consist solely of vaste : who has not seen birds picking in horse dung to find non-digested oats grains ? Whole grains of cereals are to be found in most animal dejections such as those of pigs bovine cattle or horses when they have consumed then under this form.

NATURAL PRODUCTION OF DEJECTIONS

For a country like France the annual quantity of poultry droppings is estimated at 180 000 tons of dry matter (1).

USE IN ANIMAL FEEDING

Cerain countries, and particularly Great Britain and the United States, currently use dehydrated poultry droppings, not only in the feeding of young fat cattle and sheep but also for monogastric animals : rabbits,pigs and poultry.

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(1) MESSEA et al. Review of some public health problem resulting fròm the distribution of chickens litter in the ration of animals, microbiological and chemical parameters. - Poultry Science 1971 50, 874-881.

In Great Britain four years ago a firm perfected a product known as TOPLAN made from the droppings of battery-bred laying hens (1). Its composition is a follows :

. Humidity	8,4 %
. Crude proteins	27,6 %
. True proteins	14,9 %
. Crude cellulose	10,5 %
. Glucides	38,0 %
. Organic substances	75,5 %
. Mineral substances	15,9 %

and the Ministry of Agriculture is said to have given a favourable opinion on it on 9.12.1969 since no pathogenic element or antibiotic had been found in it.

USE IN ANIMAL FEEDING

Without joining in the polemics "for" and "against" its use, we may say very briefly :

- That this is a raw material already in use although in France, for example employment is completely advised against (but not legally forbidden) for manufacturers of cattle feeds, there is nothing to prevent a breeder of bovine cattle from feeding then partially with the dried dejections of his hens. Numerous manufacturers of dehydrated droppings expose these, put them on sale and make publicity for them.

- That the tonnages produced, which are at present generally thrown away (pollution)are not negligible.

- That the problem of the guarantee of the health of the consumer who will eat pig or poultrymeat, beef or veal or eggs from animals from animals which have consumed droppings must not be skated round. In fact these substances are remarkable in their power to concentrate drugs or additives given to the animal, for these act often at the level of the intestins (and therefore are indigestible or digestible only with difficulty), or the pesticides polluting the raw material.

(1) It is obvious that outside breeding would lead to the collection of a mixture of wood chips, used as litter and of droppings.

(2) J.C. PEYRAUD : La deshydratation des fientes de volailles - Une mode qui risque de prendre - L'ELEVAGE 1972, May N° 7 - 48-53.

. that outside of animal feeding or of rejections as rubbish there is hardly any possible utilisation.

" As fertilisers crude droppings have the same drawbacks as liquid manure : an excess of nitrogen and potassium and a lack of phosphorus and calcium. The humus fashions them only slowly and numerous intermediaries remain the vitnesses to incompleted reactions. These interlediaries are found agin in rivers after washing. (1)

CONCLUSIONS

It is to be hoped that on this point the lawmakers of the EEC countries will adopt a single position neither too conservative nor too daring.

(1) R. FERRANDO et al. : A propos de la valeur alimentaire des fientes de volailles
Energie métabolisable de ces produits
Les Industries de l'Alimentation Animale 1973,n°6 7 to 16

GENERAL CONCLUSION

In this Chapter we have given information on a certain number of agricultural or industrial prodcuts for which one could :

- either relaunch or promote their growing
- or undertake or intensify industrial production

It is evident that this sum of information is not limitative. Other potential sources of protein are known which are not (or not always, or not yet) exploited, for example :

- blood in slaughter houses is not always transformed into blood meal
- the red waters of potatoe starch factories are most often thrown away on sevage farms, because their dehydration has so far presented technical and economic problems which are difficult to resolve.(this industry works only two to three months per year) However, several starch factories are at present actively studying these salvage procedures because they are obliged to do this in order to avoid pollution.

In addition, it may also be envisaged to "cultivate" yeasts, mushrooms, bacteria and algae on a whole number of organic wastes such as :

- sewage waters
- domestic refuse, particularly paper
- animal dejections produced by intensive breeding of poultry, pigs and cattle
- waste from the harvesting andtreatment of vegetable production, particularly of potatoes, peas and sugarbeet.
- waste and effluents produced by slaughter-houses and the treatment of meat and the by-products of its production.
- wastes and effluents of the dairy industry, especially those from cheese manufacture.
- by-products and effluents from brewing and distilling
- effluents from the foodstuffs and confectionery industry.
- wastes from the forestry and saw-milling industry
- wastes from the treatment of wood
- wastes and effluents from the manufacture of paper pulp and paper
- wastes from the treatment of leather and textiles

In the attached document will be found a non-exhaustive list of the different living organisms which can be used for the transformation of these organic wastes.

ORGANISMS APPROPRIATE FOR THE UTILISATION OF ORGANIC WASTES

Class	Species	Nutritive source	Comments
YEASTS	Saccharamyces Cerevisiae	Molasses	The substratum is a readily available product of the sugarindustry
	"	Cereals	The yeast is a by-product of the brewing industry
	Candida Utilis	Sulfitic liquers of hydrolised wood and of paper, house hold rubbish and cane bagasse	This organism can utilise sugars with six and five carbons present in wood products
	Saccharamyces Fragilis	Lactoserum	It utilises in speficic fashion the lactose of this dairy byproduct
	Candida lipolytica and analogous species	N-paraffin	A process originally studied to remove from gas oil the undesirable N-paraffin. It has not become a commercial process used specifically for the production of proteins.
MUSHROOMS	Fusarium sp	Glucides, starch etc	Used commercially by the company RANKS HARVIS MCDOUGALL; Starch-base products of good quality and cheap or wastes.
	Boletus Edulis Marchella esculenta etc. etc.	Various organic sources	Growing of macrobiological mush- (for ex. cultivated mushrooms)
BACTERIA	Escherichia Coli and other species	Hydrolysate of glucides and numerous simples organic compounds	So far mainly of a theorectical interest without practical applications.
	Oxidants of methane	Methane from sewer water or natural gas	Extensively studied but without any clear success because the yield is too small
	Oxydants of methanol	Methanol produced chemically from methane	This is an interesting way of converting methane into proteins
	Oxidants of hydrogen	Hydrogen obtained by electrolysis	This could be the basis of a system which would permit human life in outer space by utilising urine and other human waste
	Producers of methane	Hydrolysed glucides etc.	A strictly anaerobic process. Takes place naturally in the rumens of cows and in the reservoirs for the anaerobic treatment of sewer waters
	Pseudomonas	Cyanures	For the transformation of waster originated from the treatment of metals for galvanoplastic plants.

Class	Species	Nutritive source	Comments
ALGAE	Various	Oxidation products of sewer waters and sunlight	Growth with bacteria for the treatment of wastes in flat oxiding basins
	Chorella sp Scenedeamus sp Spirulina maxima	Any cheap source of CO2 and sun light	Photosynthetic organisms which grow easily wherever there is an abundance of light and of CO2

Translated from a table of :

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1 9 7 2

ANNEX

REDUCTION OF THE NITROGENATED CONTRIBUTION AND CONSECUTIVE DECLINE IN PRODUCTION

It is interesting to know that a reduction of the contribution obeys what is called "the law of declining yields" according to which "below the requirement (for an amino acid, for example), the reply of growth (or of production) is less then proportional to the percentage of coverage of this requirement (1) This law of declining yields reveals itself in an efficacité of the proteins which is all the better if the latter are less well represented in the feed. (1)

Briefly, a reduction of contributions by 10% will lead to a fall off of growth or production generally less than 10 %.

1/ - For table poultry, CALET (1) quotes GUILLAUME (1969) who has published a table showing the influence of a lysine deficit on the gain in weight and the consumption index.

EFFECTS OF A DEFICIT IN RELATION TO THE NORMS in the light of the age on ARBOR ACRE small cocks.			
Age in weeks	0 to 2 1/2	$2\frac{1}{2}$ à 5	5 à 8
Lysine deficit in relation to the standard %	24	25	21
Deficit in gain of weight in relation to the reference %	30	19	9
Excess in the consumption index in relation to the reference %	19	10	6

In addition, GUILLAUME (1969), using foreign experimental data, established an equation which makes it possible to calculate the fall in yield for a situation of the lysine contribution.

"It can then be established according to these data that a deficit of 5% in the covering of the lysine requirement causes a delay of 4 % during the start-up period and 2 % only during the finishing period.

For a 10 % lysine deficit, these values become 9-10 % and 4 % respectively.

(1) C. CALLET : Les normes azotées des volailles en croissance Possibilité de reduction - pages 51-54

INFORMATION SEMINAR ON NITROGENATED FEEDING OF ANIMALS PARIS 21/22.11.73

2/ - <u>For the LAYING HEN</u> according to LECLERCQ (2)

"The fall-off in performance is not a linear function of the intensity of the deficiency. However, between 0.55 and 0.40 % of lysine, it may be estimated tant on the average any reduction of 0.5 % in the lysine content entails :

. a fall in the average weight of the egg of 1.5 grms and/or
a 4 % reduction in layings.

(2) B. LECLERCQ : Les normes azotées
Possibilité de reduction
Cas des futurs reproducteurs - pages 55 - 68 (INFORMATIONS SEMINAR ON NITROGENATED FEEDING OF ANIMALS PARIS 22/22.11.73

B/ Examination of the T E C H N I C A L A S P E C T S (cont'd)

CHAPITRE V

PROBLEMS POSED BY THE CONTROL OF THE HARMLESSNESS OF THE NEW INDUSTRIAL PRODUCTS FOR THE HEALTH OF CONSUMERS

METHODS FOLLOWED and

RESULTS OBTAINED

Until 1953/55, in Europe, cattle feedingstuffs industries manufacture their feed with "natural" raw materials, such as cereals or industrial by-products, which ha dlong been used directly by breeders, (by-products of cereals, cake, yeasts, etc.). The problem of whether the ingestion of these raw materials by the animals endagered the health of the consumer of the animal products or not therefore did not arise.

It was towards the years 1953/1955 that European industrialists, following the example of the United States, began to incorporate antibiotics and anti-coccidie into the feed of pigs and poultry.

. either as treatment (
. or as preventive measure (for certain diseases
. or as growth promoters (

The use of "additives, to use the legal therm, has grown continuously since this date with the industrialization of breeding and group methods of feeding and prevention (1), and the emergence of new types of feeds, for example, adaptation feeds and medical feeds.

In this connection, special government Commissions have been set up in some EEC countries in order to authorize, regulate or forbid the use of these additives. It is these bodies which are also responsible for studying the use of "replacement products", that is to say products which are not traditionally used in animal feeding, such for example as yeasts on alkanes or dejections of poultry.

1/- THE DIFFERENT OFFICIAL BODIES IN THE MAIN EEC COUNTRIES.

- GERMANY - FGR (2)

The admission and the use of additives come within the competence of the Federal Ministry for Food, Agriculture and Forests. Before decreesing any measures, the Ministry obtains the opinion of the Committee for Opinions. The Ministry of Youth, Family and Health is also heard.

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(1) A breeder of 100 000 layers cannot make use (save exceptions) of veterinary treatments which would oblige him to handle the animals one by one.

(2) Information kindly supplied by the FEFAC - Brussels.

The Commission of Opinions consists of :

1/ - A President and a alternate Vice-President. These are appointed from among the officials of the Federal Ministry for Food, Agriculture and Forests.

2/ - Nine members representing Agriculture, stations for agronomic researche and the control of animal feedstuffs industries and this in the proportion of two members per sector, as well as applied nutritional science, the central agricultural cooperatives and rural trade - one representative per sector. These members are appointed one proposal from their trade organizations.

- BELGIUM (1)

There exists an "Advisory Committee on raw materials for Agriculture" which comes under the Ministry for Agriculture, (Economic Sciences Administration). This Committee is called upon to give its opinion on certain questions concerning the marketing of seeds, of plants of all kinds of fertilizers, of changes to the soil, of subtances intended for the feeding of animals and of plants protection pharmaceuticals.

However, attention should be drawn to the fact thst even in the event of a favourable opinion by the Advisory Committee, the approval of the Ministry of Public Health is required.

- DANEMARK (1)

In this country there is nof official body responsible for the preparatory study of applications to use additives.

There are a few unofficial working parties under the aegis of the Ministry of Agriculture.

- FRANCE

Since February 1960, a "Interministerial and Interprofessional Committee on Aniaml feeding" has been in existence. This Committee has to give opinions on problems concenring :

. the addition to feeding stuffs for breeding animals, save for veterinary purposes, of chemical or biological substances and also the utilisation of treatments or manufacturing techniques susceptible of modifying the chemical or biological composition of the said feedingstuffs.

. the administration to breeding animals, by any procedure whatsoever, and with the exception of veterinary tratments, of chemical or biological substances likely to involve drawbacks :

a) for the health of human beings consuming the flesh or prodcts obtained from the said animals.
b) for the health of the animals themselves.
c) for the quality of the flesh or of the products obtained from the animals in question.

(1) Information kindly supplied by the FEFAC - BRUSSELS.

. the various problems which arise in the matter of animal feeding, on the subject of which the administration asks this Committee for its opinion.

. in a general way the rules and regulations to be issued concerning feeding-stuffs for all animals.

GREAT BRITAIN

(United Kingdom of Great Britain and Northern Ireland) (1)

Responsibility for the safety, quality and efficacity of veterinary products rests with the Veterinary Products Committee. It is this Committee which gives an opinion and establishes a report for the authority competent to authorize the product, that is to say either the Ministry of Health or the Ministry of Agriculture or both.

ITALY

Applications for the inclusion of a substance in the list of authorized additives for animal feeding is simultaneously of the competence of the Minister of Health, the Minister of Agriculture and Forests, and the Minister of Industry, Trade and Crafts, after consultation of a Technical Committee consisting of representatives of the administration and sectore concerned.

Examination of these substances is the business of a group of experts consisting of University Professors and officials of the Higher Institute of Health, a State body whose task is to pronounce on the hygienic and health aspects connected with the utilization of the substance to be authorized.

IRELAND

In the last three years, two temporary Committee have been set up :

- one constituted by the Ministry of Agriculture and Fisheries.
- the second by the Ministry of Health, which studies the dossiers of additives.

NETHERLANDS (1)

An advisory Committee on animal feedingstuffs under the aegis of the Ministry of Agriculture has been created. Members of the Committee are representatives of the Ministry of Agriculture, the Ministry of Heath, the University Agricultural Science Research Institutes and independent experts as well as representatives of the animal feedingstuffs industry. However, the governmental element clearly predominates.

The admission of additives is only possible when the above-mentioned Committee has given a favourable opinion. The regulation of the 3produktschap voor veevoeder" (Office for animal feedingstuffs) must then be amended, and this again requires government approval.

Withdrawal of an additive may occur after the Committee has given its opinion. But also without this opinion, in which case the "Produktschap" decides alone.

(1) Information kindly supplied by the FEFAC -BRUSSELS.

In this way, up to the present, each EEC country has set up or not set up a special Committee to study these problems, and each Committee, of course, acts in isolation without any apparent relations with those of the other countries and the EEC. This state of affaires, unfortunately, is hardly propitious for harmonization of legislation or any genuine safeguarding of the health of consumers.

2/ THE STUDIES UNDERTAKEN BEFORE AUTHORIZATION TO USE

Among all the "substitution products" which we have studied in Chapter IV we can immediately set aside :

- All the agricultural products because these have been or are long since in use in animal and human feeding : Field beans, peas, soya bean, algae, maize (rich in lysine), sunflower, etc.
- The synthetic amino acids for which logically no authorization to use needed to be given, because these amino acids have long been and are skill used in animal feeding supplied by all the proteins of the raw materials. The molecule of industrial lysine, although "synthetic", has the same chemical configuration as the molecule of fish meal or wheat lysine.

As regards the non-proteic nitrogenated compounds, urea, DUIB, urea phosphate Biuret, etc. authorization to use these has been given by the EEC in the light of the inumerable scientifice studies carried out on the first among them (urea, Biuret) and the long experience in their use abroad. (United States, South Africa) and also probably because of the particular way in which the digestive system of ruminants functions - it degrades (or can degrade) down to the ammoniac stage either a protein used in human nutrition (milk) or urea.

Finally, it must no be forgotten that urea is normally "manufactured" by the liver of the ruminants on the basis of ammonia and that it circulates normally in the blood. It cannot therefore be said that nutritional urea is a product which is extraneous to the ruminant. The product which will engage our attention are dejections of poultry and above all yeasts on alkanes.

---

(1) According to the Council Directive of 23 November 1970, Article 4, amended by that of 28 April 1973, the Member States are authorized by derogation to use on their territory non-proteic nitrogenated compounds for ruminants on condition that experiments have shown that incorporated into the feed of the animals, these have a favourable effect on the characteristics of this feed or on animals production.

21/ - Dejections of poultry

In Chapter IV, we have studied the possible use of these products. It is quite regrettable that they should be authorized in Great Britain and forbidden (or not authorized) in France. In this way, the concern of the French Committee to safeguard the health of the French consumer comes up against the fact that the latter can nevertheless quite well consume animal products obtained from animals which have ingested dehydrated dejections :

- either because these products are imported from Great Britain,
- or because the French breeders have themselves produced their feedingstuffs on the farm and incorporated into them the dehydrated dejections of one of their herds.
- or because they come from other EEC countries or non-member countries which have not issued any special legislation against these raw materials.

22/ - YEASTS ON ALKANES

Very numerous studies have been undertaken of this raw material by the B.P. company with a view to submitting applications for authorization to use in France and Great Britain. Annex 1 (pages V/7 to V/9) gives the list of these analytical, toxicological (accute toxicity in the short and long-term) and zootechnical tests, the latter on pigs, poultry,rabbits, calves and trout.

3/ - THE RESULTS OBTAINED ON ALKANES

There exist very numerous publications and communications of the B.P.Cy. We will mention only two, i.e. :

a) "Yeast cultivated on a substratum containing hydrocarbons as a raw material for the feeding of eating chicken".
Paper presented to the 14th World Aviculture Congress - MADRID,Sept. 1970.

b) "Safety of use and nutritional value of proteins of microbial origin"
By C.A. SHACKLADY, B.P.L. Company, London.
Paper presented to the 3rd International Congress of Food Technology WASHINGTON - 14 August 1970.

These publications prove :

- the interest of yeast alkanes as a raw material for animal feeding
- the total absence of any special taste in the animal products (eggs, ham, poultrymeat, pigmeat, turkeymeat) obtained from animals having consumed yeast in their diet.

. the harmlessness of these animal products for human health, to such a point that the direct consumption of yeast by the human population has been envisaged.

These studies have been judged satisfactory by sole EEC countries, since (1)

a/ in GERMANY (F.G.R.)

The authorization to use was given on 16 november 1972 for pigs and poultry for a yeast having the following analytical characteristics :

. Proteins	65 % min.
. Fats	1 % max.
. Humidity	4 % max.

Official approval for use with calves is at present being obtained.

b/ in BELGIUM

Authorization given on 27 March 1973 ..... for a product obtained by the drying and purification of yeast (candida tripicalis) cultivated on alkanes. The following norms are imposed on this dried yeasts : crude protein min. 67 % - digestible crude protein min. 85% of the total crude protein content, laid down for packaging and labelling.

C/ DANEMARK

No authorization needs to be given.

"Possibility of sale without official **registration**".

d/ FRANCE

Authorization given in July 1970, lade official on 4 January 1973, so that the first fabrication of yeasts cultivate on alkanes produced on an industrial scale by the B.P. company's CAP LAVERA plant may be marketed and freely utilised in animal feeding.

e/ GREAT BRITAIN

(United Kingdom of Great Britain and Norther Ireland).

Adocument of the Ministry of Agriculture, Fisheries and Food dated 25 November 1971 atteste the possibility of sale without any official registration.

f/ITALY

The application for authorization is at present being examined but the Government does not seems inclined to give a favourable reply very rapidly (for reasons which have nothing to do with the technical problem).

g/ IRELAND

The B.P. Company has not lodged any application

h/ NETHERLANDS

The Minister of Agriculture and Fisheries authorized unrestricted use in animal feedingstuffs on 15 November 1972.

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(1) Information and documents obligingly supplied by the Company B.P. France.

According to the Sté FRANCAISE de PETROLES BP
Mocrobiology Department

APPLICATION FOR AUTHORIZATION TO USE THE BP PROTEIC CONCENTRATE IN ANIMAL FEEDING

I. DEFINITION of the PRODUCT

- Characteristics and interest of the product
  + Characteristics of the gas-oil used
- Specifications and methods of analysis
- Bacteriological purity
- Procedures and doses for use
- Recognition of the product in a mixture
- Comparison with other products used as sources of nutritional proteins
+ Supplementary information (unsaponifiable, aromatic, polycyclic)

II. PROCEDURES FOR THE TESTS

A. PROCEDURES FOR THE TOXICOLOGICAL TESTS

- Accute toxicity tests on rats
- Short-term tests on rats
- Long-term tests on rats
- Determination of the cancerogenic capacity on rats
- Determination of the cancerogenic capacity onmice
- Reproduction and fertility tests on rats
- Determination of the relay toxicities eggs on rats
- Determination of the relay toxicities (liver or meat) on rats
- Studies of gas-oil toxicity on rats with a study of the gas-oil balance sheet.
- Long-term gas-oil toxicity tests on rats and mice with the determination of cancerogenic capacity.

B. PROCEDURE FOR THE ZOOTECHNICAL TESTS

- Tests on pigs at Wageningen (1)
- Tests on poultry at Wageningen (1)
- Nutritional tests carried out by the animal feedstuffs industry (on pigs, poultry, rabbits, calves etc.)
- Organoleptic tests

(1) Carried out at the Dutch ILOB or Institut voor Lambouw Kundig Onderzoek Van Biochemische Production.

ANNEX 1 (cont'd)

III. RESULTS OF THE TESTS

A. RESULTS OF THE TOXICOLOGICAL TESTS

- Acute toxicity tests on rats
- Short-term tests on rats
- Long-term tests on rats
- Determination of the cancerogenic capacity on rats
- Determination of the cancerogenic capacity on mice
- Reproduction and fertility tests on rats
- Determination of the relay toxicities eggs on rats
- Determination of the relay toxicities (liver or meat) on rats
- Studies of gas-oil toxicity on rats with a study of the gas-oil balance sheet
- Long-term gas-oil toxicity tests on rats and mice with the determination of cancerogenic capacity.

B. RESULTS OF THE ZOOTECHNICAL TESTS

- Tests on pigs at Wageningen (1)
- Tests on poultry at Wageningen (1)
- Nutritional tests carried out by the animal feedstuffs industry (on pigs, poultry, rabbits, calves trout, etc.).
- Organoleptic tests.

JUNE 1970

(1) Carried out at the Dutch ILOB or Institut voor Lambouw Kundig Onderzock Van Biochemische Production.

ANNEX 1 (cont'd)

PART I - DEFINITION OF THE PRODUCT

1 - Example of a typical analysis of a heavy gas-oil

2 - Method utilized for determining the amino acids content

3 - Results of the arsenic analysis

4 - Analysis of the unsaponifiable substances

5 - Analysis of the aromatic polycyclic compounds

PART III - RESULTS OF THE TESTS

A - Acute toxicity tests on rats

B - Short-term tests on rats

C - Long-term tests on rats

D - Determination of the cancerogenic capacity on rats

E - Determination of the cancerogenic capacity on mice

F - Reproduction and fertility tests on rats

G - Determination of the relay toxicities eggs on rats

H - Determination of the relay toxicities (liver or meat) on rats

I - Studies of gas-oil toxicity on rats with a study of the gas-oil balance sheet

J - Long-term gas-oil toxicity tests on rats and mice with the determination of cancerogenic capacity.

K - Tests on pigs (ILOB) (1)

L - Tests on poultry (ILOB) (1)

M - Nutritional tests carried out by the animal feedstuffs industry

N - Organoleptic tests

O - Results published on the occasion of International Congresses :

- Second International Congress of Applied Microbiology, ADDIS ABBEBA - November 1967
- Second World Conference on Animal Production , MARYLAND - July 1968
- Eight International Nutrition Congress - PRAGUE - September 1969
- Third International Congress on Applied Microbiology , BOMBAY - December 1969
- International Meeting on Animal Feeding Techniques - MAJORCA - May 1970

P. Results published in the Bulletin of the National Academy of Medicine

- Paper presented by Professor J. VERNE in November 1969.

C/ Examination of the E C O N O M I C A S P E C T S

CHAPITRE VI

THE UTILISATION OF FODDER PRODUCTS IN ANIMAL FEEDING IN THE COURSE OF THE BASE PERIOD 1970 - 1971

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A - Statistical sources

In the course of recent years important studies have been undertaken regarding fodder product resources and utilization.

The Statistical Office of the European Communities (SOEC Internal Document) has established for the 1970-1971 season and for each of the Member Countries except Ireland, an estimate of total fodder product resources. Those among those products which are "concentrates" capable of being used in the manufacture of compound feedingstuffs are shown in Table I (1).

On the other hand the European Federation of Manufacturers of Compound Feedingstuffs (FEFAC) has published a certain enquiries which make it possible to establish for the calendar year 1970 :

a) Amounts of compound feedingstuffs manufactured per animal species (Table 2)
b) The average composition of milking feeds (Table 3) and
c) The utilisation of the various concentrated feedingstuffs in the manufacture of compound feeds (Table 4) (2)

N.B. In Chapter VI and VII the following definitions have been adopted.

Concentrated products : raw materials intended for animal feeding and having a strong or average nutritional value. The opposits of non-concentrated products. (grass, liquid milk etc.)

Compound feedingstuffs :Crushed products mixed by the compound feedingstuffs industry.

Simple feedingstuffs : Concentrated products consumed by the compound feedingstuffs industry. They can be used on the producing farm, procured on the market and, if required, mixed on the farm.

Fodder utilizations : a synonim for utilization for animal feeding.

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(1) In this table the resources of Urea and Lysine supplied by industry have been taken from the CECD study entitled "Manufacture and Utilization of Nitrogenous Products of Agricultural, Maritime and Industrial origin in animal feeding". Paris 1973.

(2) Important differences exist between Tables 2 (outputs of the compound feedingstuffs industry)and 4 (Inputs of this same industry). These differences which may have many causes have been incorporated into the simple foodstuffs (Table 5) for the rest of the study.

Table 1

CONCENTRATED PRODUCTS AVAILABLE FOR ANIMAL FEEDING IN 1970-1971 (SOEC internal document)

(in 1000 tons of products weight)

Raw materials		GERMANY (F.R.)	FRANCE	ITALY	NETHERLANDS	B L E U	UN. KINGDOM	IRELAND	DENMARK	Total of the 8 countries
CEREALS		15.049	14.939	10.515	3.205	2.944	12.906	Données non disponibles	5.646	65.204
of which	Wheat	(3.058)	(3.824)	(320)	(305)	(506)	(3.874)		(153)	(12.040)
	Barley	(4.216)	(4.747)	(1.301)	(266)	(789)	(6.306)		(4.514)	(22.139)
	Maize	(2.101)	(3.754)	(8.156)	(1.846)	(688)	(1.497)		(3)	(18.045)
	Sorghum	(128)	(89)	(24)	(506)	(488)	(76)		(227)	(1.538)
	Others	(5.546)	(2.525)	(714)	(282)	(473)	(1.153)		(749)	(11.442)
MEALS	Fish	518	86	96	85	118	385		80	1.368
	Meat	70	83	10	93	37	205		96	594
FEEDCAKES		3.972	2.255	2.977	1.794	947	1.257		1.015	14.217
of which	Soya	(2.133)	(1.315)	(941)	(1.100)	(499)	(483)		(545)	(7.016)
	groundnut	(130)	(365)	(43)	(5)	(64)	(328)		(0)	(935)
	sunflower	(145)	(72)	(64)	(73)	(54)	(69)		(109)	(586)
	rape/colza	(153)	(177)	(104)	(73)	(55)	(100)		(24)	(686)
	linseed	(0)	(160)	(56)	(231)	(54)	(46)		(24)	(571)
	others	(1.411)	(166)	(1.769)	(312)	(221)	(231)		(313)	(4.423)
	maize cake /gluten	136	15	135	0	58	-		-	344
FATS		41	96	-	186	58	45		-	426
BRANS and MIDDLINGS		1.230	1.040	2.851	801	653	1.441		233	8.249
Other by-products		2.217	758	34	1.064	190	1.591		978	6.832
Sugar		62	37	25	35	15	7		-	181
Melasses		431	143	65	380	110	414		44	1.587
Dextrose		-	-	-	11	-	-		-	11
Starch		-	23	-	-	-	-		-	23
Maniec		557	32	-	523	278	-		-	1.390
Grass meals		244	355	17	229	65	-		-	910
Dehydrated sugarbeet pulp		932	292	1.750	610	388	108		-	4.080
Whole milk powder		42	-	128	-	-	21		-	191
Skim milk powder		163	415	-	190	51	-		36	855
Lactoserum powder		-	10	-	78	-	8		-	96
Urea		4	10	2	-	-	14		-	30
Lysin Hcl (tons)		(593)	(370)	(45)	(197)	(4)	(535)		-	(1.744)
Oilseeds		-	-	-	100	-	-		-	100
TOTAL		25.668	20.589	18.605	9.384	5.912	18.402		8.128	106.688

Table 2

PRODUCTION OF COMPLETE AND COMPLEMENTARY COMPOUND FEEDS BY ANIMAL SPECIES IN 1970 (Source F. E. F. A. C.)
(in 1 000 tons)

	German F.R.	FRANCE	ITALY	NETHERLANDS	BLEU	U.K	IRELAND	DENMARK	Total of the 9 countries
Feeds for :									
Heavy cattle	2 309	1 090	1 090	2 058	732	4 044	93	674	12 090
Calves (1)	210	617	254	352	74	40	50	20	1 617
Pigs	3 360	2 780	650	3 310	2 190	2 591	570	1 210	16 661
Poultry	3 660	2 600	1 510	2 030	1 120	4 165	240	570	15 835
Others	185	580	127	102	103	224	7	68	1 396
Total	9 724	7 667	3 631	7 852	4 219	11 004	960	2 542	47 599

VI/3

Table 3

AVERAGE COMPOSITION OF FEEDINGSTUFFS FOR SUCKLING ANIMALS IN 1970(Source FEFAC)

	Skim milk powder	Powder of lactoserum and other by-products of milk	Seeds	Miscellaneous
German F.R.	50/72 %	5/30 %	8/23 %	5/15 %
France	60/70 %	5/10 %	20 %	5/10 %
Italy	55/70 %	10 %	18,5 %	9,5 %
Netherlands	50/60 %	10/20 %	20 %	0/10 %
Belgium	62/72 %	4 %	19 %	9 %

(1) CALVES and all other animals consuming suckling feedingstuffs (or milk repalcement feeds)

Table 4

CONCENTRED PRODUCTS USED IN THE MANUFACTURE OF COMPOUND FEEDS IN 1970 (Source FEFAC)

(1000 tons)

RAW MATERIALS		GERMANY F.R.	FRANCE	ITALY	Netherlands	B L E U	UN. KINGDOM	IRELAND	DK	Total of the 8 countries
CEREALS		3.623	3.927	1.694	2.714	1.906	6.207	875	Données non disponibles	20.946
of which	Wheat	(1.121)	(1.323)	(-)	(641)	(-)	(-)	(-)		
	Barley	(605)	(1.007)	(-)	(241)	(-)	(-)	(-)		
	Maize	(1.423)	(1.789)	(-)	(1.403)	(-)	(-)	(-)		
	Sorghum	(11)	(1.218)	(-)	(118)	(-)	(-)	(-)		
	-Others	(363)			(311)					
MEALS	Fish	350	115	-	114	116	493	47		1.528
	Meat	75	140	-	78					
FEEDCAKES		2.610	1.989	855	2.222	818	1.050	100		9.644
of which	Soya	(1.550)	(1.167)	(-)	(1.010)	(-)	(-)	(-)		
	Others	(1.060)	(821)	(-)	(1.212)	(-)	(-)	(-)		
	Maize gluten	350	50	73	88	-	-	-		561
FATS		110	140	74	153	35	45	-		557
BRANS and other by-products		1.130	600	258	724	586	1.301	110		4.709
SUGAR		(62)	(37)	(25)	(71)	(15)	(7)	-		(217)
Melasses		200	110	60	360	135	378	-		1.243
-Starch		-	-	-	(11)	-	-	-		11
		-	50	-	-	-	-	-		50
Manioc		580	11	-	100	263	-	-		954
Grass meals		180	176	-	-	-	-	-		356
Sugarbeet pulp		24	30	-	-	-	-	-		54
Whole milk powder		200	-	206	-	-	29	-		1.238
Skim milk powder			410		164	88				
Lacteserum powder			85		56					
Urea		(4)	(5)	-	-	.	74	-		23
Lysine Hcl (tons)		(593)	(370)	(45)	(197)	(4)	(535)	-		(1.744)
Minerals		250	190	138	170	?	?	?		748
_Oilseeds		-	-	-	100	-	-	-		100
Total		9.748	8.065	3.383	7.125	3.962	9.524	1.132	(2.542)	42.939

Although these sources of documentation present several defects.

- they concern slightly different periods of time,
- they show some anomalies (utilisations sometimes greater than the resources etc.)

they nevertheless make it possible to carry out a certain number of useful analytical studies, in particular for any forecast study concerning relations between fodder resources and animal production.

B - COMPOUND FEEDINGSTUFFS AND"SIMPLE"CONCENTRATED FEEDINGSTUFFS(or RAW MATERIALS

The differece between :

- Total concentrated resources of fodder products (cereals, proteic concentrates, dried milk products,manioc,etc) of which the SOEC has made a census, and
- the utilizations inventoried by the FEFAC (Statistics of Industrial Compound Feedingstuffs)

can give an approximate idea of direct utilization by breeders in the form of simple concentrated feeds : cereals produced on the farm, take supplied to ruminants in winter, by-products bought in the trade for feeding to pigs and laying hens etc. (Table 5).

The probable composition of these semple concentrated feeds is very different from that of the compounds feeds. The concentrated products supplied direct by breeders to their animals include many more cereals (particularly barley and oats) by-products of industry with a high cellulous content (bran etc.) and pulped dried sugarbeet. On the other hand the compound feedingstuffs which are intended to supply either complete nourishment or feed supplementary to that supplied in the simple state (1) and including less cereals but more products high protein content (feed cakes, animal meals and powdered milk products for young animals) (Table 6)

It would seem that the average gross protein content of compound feedingstuffs for the Community as a whole was 19.2 % as against 12.1% for the simple concentrated feeds around 1970-1971.

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(1) Breeders administer in the simple state concentrated products and products of law energy value (grass liquid milk etc.) The compound feedingstuffs are either complete or complementary to simple concentrated feeds (for example, two cereals) or complementary to products of low energy value (for example, grass).

Table 5

QUANTITIES OF CONCENTRATED FEEDS USED IN SAMPLE FORM IN ANIMAL FEEDING (1)

in 1970 - 1971

Raw materials		Germany F.R.	France	Italy	Netherlands	B L E U	Un. Kingdom	Ireland	DK	Total of the 7 countries
CEREALS of which		11.426	11.002	8.821	490	1.038	6.699	Données non disponibles	Données non disponibles	39.476
	Wheat	(1.937)	(2.501)	(-)	(-336)	(-)	(-)			
	Barley	(3.611)	(3.740)	(-)	(25)	(-)	(-)			
	maize	(678)	(2.365)	(-)	(443)	(-)	(-)			
	Sorghum	(117)	(2.696)	(-)	(388)	(-)	(-)			
	-Others	(5.083)		(-)	(- 29)	(-)	(-)			
MEALS	Fish	168	-	106		39	97			410
	Meat	-	-							
FEEDCAKES of which		1.362	256	2.122	-528	129	207			3.548
	Soya	(583)	(138)	(-)	(90)	(-)	(-)			
	Others	(779)	(119)	(+)	(-618)	(-)	(-)			
BRANS and other by-products		2.317	1.198	2.627	1.141	257	1.731			9.771
Soya		0		0	0	0	0			0
Molasses		231	33	5	-	-	36			305
Dextrose		-	-	-	-	-	-			-
Starch		-	-	-	-	-	-			-
Maniec		-	21	-	423	-	-			444
Grass meal		64	179	17	229	460	-			949
Sugarbeet pulp		908	262	1.750	610	-	108			3.638
Whole milk powder		-	-	-	-	-	-			-
Skim milk powder		-	-	-	26	-	-			26
Lactoserum		-	-	-	22	-	-			22
Urea		-	5	-	-	-	-			5
Lysine Hcl		-	-	-	-	-	-			-
Oilseeds		-	-	-	-	-	-			-
TOTAL		16.476	12.956	15.448	2.413	1.923	8.878			58.094

(1) The figures in this Table were obtained by the difference between total resources (Table 1) and the utilisation in the manufacture of compound seeds (Table 4).

AVERAGE COMPOSITION OF THE COMPOUND FEEDINGSTUFFS AND OF THE SIMPLE FEEDINGSTUFFS SUPPLIED TO ANIMALS IN 1970 AND 1970-1971

RAW MATERIALS	COMPOUND FEEDING-STUFFS (9 countries less Denmark	SIMPLE FEEDINGSTUFFS (9 countries less Denmark and Ireland
Cereals	48,8	68.0
Animals Meals	3.6	0.7
Feedcake oilseeds and maize gluton	24.0	6.1
Fats	1.3	-
Brans and other by-products	11.0	16.0
Sugar molasses and dextrose	3.5	0.5
Manioc	2.2	0.8
Grass meals	0.8	1.6
Pulped dehydrated sugarbeet	0.1	6.2
Milk powders	2.9	0.1
Urea	0.05	0.01
Lysine Hcl	ε	-
Minerals	1.7	ε
	100.0	100.0

Comparison between the data given in Tables I and 4 shows that the relative importance of the utilization of compound feedingstuffs, that is tosya their degree of penetration of the market is a tpresent very varied according to the countries within the Community.

SHARE OF CONCENTRED PRODUCTS CONSUMED IN THE FORM OF COMPOUND FEEDS IN 1970

Netherlands	75.9 %
B L E U	67.0 %
UNITED KINGDOM	51.8 %
France	39.2 %
Federal German Republic	37.8 %
Denmark	31.3 %
Italy	18.2 %

The wide differences seen above are apointed to the feeding habits of breeders, who may either :

a) Use mainly simple concentrated fodders produced on the farm or bought in the trade and purchased only small quantities of compound feeds with the probable risk of obtaining unproductive results (for example Italy)

b) Use a great deal of simple products supplementing than by considerable quantities of compund feeds and particularly, of complementary mixtures of cereals, or finally :

c) Use mainly complete compound feeds and mixtures of complementary grass feeds (for example the Netherlands).

Between 1965 and 1972 Community prodcution of compound feeds went up by 58.1%, rising from 33.4 to 52.8 thousands of tons. On the other hand,utilization of the main concentrated products - cereals, feedcake and animal meal including consumption by the compound feedingstuffs industry, only increased in all by 22.0%, rising from 67.8 to 82.7 thousand tons (Chapter 1).

In the course of the recent period, the manufacture of compound feeds has apparently accounted for an every important share of the total of available fodder resources and it is probable that this trend will continue in the coming years. It will probably be more rapid in those countries where the utilization of complete and complementary compound feeds is still small (particularly in Italy) than in those where the penetration of compound feeds can be considered as having attained almost a maximal level (the Netherlands for example.)

It is regrettable that the available documentation does not make it possible to observe the evolution in time of the volume of concentrated products used by breeders in simple form. From the analysis fo the data which the OECD had available for its study on "The factors of utilization of cereals in animal feeding", it could be deduced that these volume must have undergone minor variations in the course of the years.

In a forward study it will therfore be necessary to content oneself with considering them as relatively fixed and to have that part of the concentrated feedingstuffs used in the form of compound very in the light of the different animal productions.

C - UTILIZATION OF THE CONCENTRATED PRODUCTS CONSUMED BY THE COMPOUND FEEDING-INDUSTRY IN TERMS OF THE DIFFERENT PRODUCTIONS.

The available documentation does not make it possible to determine what raw materials have been utilised for the manufacture of complete or complementary compound feedingstuffs in terms of the main animal productions, calves, adult cattle, pigs poultry and others. In fact the FEFAC statisties reveal only by country on the one hand total utilizations of raw materials for all the forms of production together, and on the other hand the breakdown of manufacture according to the animal species for which the products are intended. It is probable long time in view of the fact that a breakdown of the uses of raw materials according to animal species would demand considerable work on the part of the accounting services of the enterprises.

However, use of the methods of formulation described in Chapter 3 affords the possibility of making plausible breakdons of the utilisations of raw materials by animal species by calculating examples of coherent formulae by which the totality of national resources can be allocated.

This breakdown has been established as follows :

- for each country and for the base period
- taking account of the national characteristics concerning :

a)-The importance of the complementary compound feeds and the nature of the simple products to be supplemented. (rough fodder, grass, potatoes, liquid skin milk, etc. or concentrated products such as bran and cereals).

b)-The types of animal production and in particular the yields, the weights and ago at the time of slaughter, the production yellow meat poultry or tinted yellow eggs, all of which are factors which necessarily influence the nutritional requirements of the animals and the corresponding formulae.

c)-The probalities of an economic nature as regards the use of raw materials. From the nutritional point of view there is no reason not to use wheat, sunflower cake or fish meal in the feeding of ruminants. However, these raw materials have been allocated to monogastric animals when there existed elsewhere sufficient resources of cereals with a higher cellulose content such as barley eats, and of copra or palm plant feedscakes more suited to the feeding of bovine cattle than of monogastric animals.

On the other hand, this breakdown is to some extent imprecise because of uncertainly factors such as the following :

a) - The FEFAC statistics make no distinction between productions of feeds for laying hens and for table poultry. A breakdown of feeds for poultry A breakdown of feeds for poultry has been calculated in the light of the proportions observed in each country of the production of eggs and of table poultry and taking into account the production of meat from culled hens.

b) - The "other animals" can be as varied as turkeys and rabbits and, for this reason, consume very different compound feeds. Their formulae have been established by taking as far as possible of national productions of these animals.

c) - For certain countries, for example, Denmark, the statistical data were insufficient or non-exsitent.

X

X X

In the annexed Tables (1-8), are shown the plausible formulae thus calculated and also the corresponding volumes. Comparison between the totals and the data shown in Table 4 reveals that practically all the materials used in the manufacture of compound feedingstuffs in the course of the base period have been broken down by animal species according to coherent formulae with the available resources, the habits of breeders and the structure of animal production in each of the countries.

It did not appear legitimate from a statistical point of view (1) to add together the volumes corresponding to the presumed uses in compound feedingsfuffs intended for adult cattle, calves, pigs, chickens, poultry etc. It is therefore not possible to give Community totals.

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(1) The weighted averages of formulae established for the same animal species in each country would in particular not have any meaning from a technological point of view.

B R E A K D O W N   O F   T H E   U T I L I S A T I O N S

OF

R A W   M A T E R I A L S

consumed by the

C O M P O U N D   F E E D I N G S T U F F S   I N D U S T R Y

in 1 9 7 0

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Below : A N N E X E S 1 to 8

FEDERAL REPUBLIC GERMANY

		HEAVY CATTLE		CALVES(1)		PIGS		CHICKENS		LAYING HENS		OTHER		TOTAL
		%	1000t	%	1000t	%	1000t	%	1000t	%	1000t	%	1000t	
CEREALS	Wheat					10,3	345,0			23,5	705,0	38,4	71,0	1121,0
	Barley	3,5	80,0			15,6	523,0							603,0
	Maize					5,0	168,0	24,3	162,0	35,9	1077,0	8,6	16,0	1423,0
	Sorghum									0,4	12,0			12,0
	Others	7,5	173,0			4,1	138,0	22,7	151,0					462,0
	Total	11,0	253,0			35,0	1174,0	47,0	313,0	59,8	1794,0	47,0	87,0	3621,0
MEALS	Fish					5,0	168,0	6,0	40,0	4,5	135,0	5,0	9,0	352,0
	Meat					1,3	44,0			1,0	30,0			74,0
FEEDCAKES	Soya	9,8	226,0			26,2	879,0	25,0	167,0	8,0	240,0	20,0	37,0	1549,0
	Groundnut	5,5	127,0											
	Sunflower									4,8	144,0			
	Colza	34,0	785,0											1056,0
	Lonseed													
	Others													
	Total	49,3	1138,0			26,2	879,0	25,0	167,0	12,8	384,0	20,0	37,0	2605,0
BY-PRODUCTS OF MAIZE	Gluten							6,7	45,0	5,0	150,0	4,0	7,0	350,0
	Cake seed	6,4	148,0											
Fat - Suet				11,0	21,0	0,3	10,0	5,0	33,0	1,3	39,0	3,0	6,0	109,0
Bran middlings and by-products		17,0	393,0			16,0	537,0			5,0	150,0	10,0	19,0	1099,0
Sugar						1,8	60,0							60,0
Molasses		8,6	200,0											200,0
Starch Maniec						12,0	403,0	8,8	59,0	3,6	108,0	5,0	9,0	579,0
Grass meal		5,0	115,0							2,0	60,0	2,0	4,0	179,0
Sugarbeet pulp		1,0	23,0											23,0
Urea		0,2	4,0											4,0
Lysine						p.m.	0,6							0,6
Minerals		1,5	35,0			1,4	47,0	1,5	10,0	5,0	150,0	4,0	7,0	249,0
Skim milk				89,0	168,0									202,0
Whey						1,0	34,0							
Oilseeds														
TOTAL		100,0	2309,0	100,0	189,0	100,0	3356,6	100,0	667,0	100,0	3000,0	100,0	18[illegible]	9706,0

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

Annex 2

F R A N C E

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HESN		OTHER		Total
		%	1000 t	%	1000t	%	1000t	%	1000t	%	1000t	%	1000t	
CEREALS	Wheat	8,5	92,7			23,0	644,0	20,0	329,0	15,0	175,5	9,5	55,1	1296,3
	Barley	20,0	218,0			25,0	700,0					7,0	40,6	958,6
	Maize					3,0	84,0	42,5	699,1	47,5	555,8			1338,9
	Sorghum											32,0	185,6	185,6
	Others							2,5	41,1					41,1
	Total	28,5	310,7			51,0	1428,0	64,5	1069,2	62,5	731,3	48,5	281,3	3820,5
MEALS	Fish					1,0	28,0	3,0	49,4	2,0	23,4	1,5	8,7	109,5
	Meat					3,5	98,0	1,0	16,4	2,0	23,4			137,8
FEEDCAKES	Soya	4	43,6			18,0	504,0	24,0	394,8	7,5	87,8	10,0	58,0	1088,2
	Groundnut	8	87,2			5,0	140,0			2,0	23,4	10,0	58	
	Sunflower									3,0	35,1	7,0	40,6	
	Colza	9	98,1			3,0	84,0							819,3
	Linseed	9	98,1											
	Others	14,2	154,8											
	Total	44,2	481,8			26,0	728,0	24	394,8	12,5	146,3	27,0	156,6	1907,5
BY-PRODUCTS OF MAIZE														
	Gluten							2,0	32,9					32,9
	Cake seeds	2	21,8											21,8
Fat - Suet				16,2	93,0			2,7	44,4					137,4
Bran middlings and by-products		13	141,7			11,0	308,0			12,0	140,4			590,1
Sugar						1,3	36,4							36,4
Molasses		7	76,3			1,2	33,6							109,9
Starch				4,0	23,0									23,0
Maniec						0,5	14,0							14,0
Grass meal		1	10,9			0,5	14,0	0,9	14,8	3,0	35,1	20,0	116,0	190,8
Sugarbeet pulp		2	21,8									1,0	5,8	27,6
Urea														
Lysine		0,5	5,4											5,4
Minerals		1,8	19,6			2,5	70,0	1,4	23,0	6,0	70,2	2,0	11,6	194,4
Skim milk				69,4	400,0	0,5	14,0							414,0
Whey				10,4	60,0	1,0	28,0							88,0
Oilseeds														
TOTAL		100,0	1090,0	100,0	576,0	100,0	2800,0	100,0	1644,9	100,0	1170,1	100,0	580,0	7861,0

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

Annex 3

I T A L Y

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYENS HENS		OTHER		Total
		%	1000 t	%	1000t	%	1000t	%	1000t	%	1000t	%	1000t	
CEREALS	Wheat Barley Maize Sorghum Others													
	Total	33,3	338,0			60,0	365,4			64,0	898,6	70,0	82,6	1684,6
MEALS	Fish Meat													
FEEDCAKES	Soya Groundnut Sunflower Colza Linseed Others													
	Total	42,5	451,4			15,0	91,4			22,0	308,9	20,0	23,6	875,3
BY-PRODUCTS OF MAIZE	Gluten									2,2	30,9	5,0	5,9	36,8
	Cake seeds	3,7	37,6											37,6
Fat - suet				18,6	44,1					1,8	25,3	3,0	3,5	72,9
Bran middlings and by-products		12,5	126,9			15,0	91,4			4,0	56,2			274,5
Sugar						4,0	24,4							24,4
Molasses		5,5	55,8											55,8
Starch														
Manioc														
Grass meal														
Sugarbeet pulp														
Urea														
Lysine						0,007 pm								
Minerals		2,5	25,4			2,5	15,2			6,0	84,2	2,0	2,4	127,2
Skim milk				62,1	147,2	3,5	21,3							192,2
Whey				10,0	23,7									
Oilseeds														
TOTAL		100,0	1035,1	90,7	215,0	100,0	609,1			100,0	1404,1	100,0	118,0	3381

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

NETHERLANDS

		HEAVY CATLLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		OTHER		TOTAL
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS	Wheat					6,0	177,2	35,0	312,9	18,0	166,1	10,2	9,4	665,6
	Barley					8,0	236,2							236,2
	Maize					34,0	1004,0	5,0	44,7	37,3	344,3	44,0	40,5	1433,5
	Sorghum							7,0	62,6	7,0	64,6			127,2
	Others	14,0	257,5							3,0	27,7			285,2
	TOTAL	14,0	257,5			48,0	1417,4	47,0	420,2	65,3	602,7	54,2	49,9	2747,7
MEALS	Fish					1,5	44,3	5,0	44,7	2,0	18,5	3,5	3,2	110,7
	Meat					2,0	59,1	1,0	8,9	1,5	13,8			81,8
FEEDCAKES	Soya					18,0	531,5	32,8	293,2	17,0	156,9	28,0	25,8	1007,4
	Groundnut Sunflower Colza Linseed Others	55,5	1020,6							6,0	55,4	12,0	11,0	1087,0
	Total	55,5	1020,6			18,0	531,5	32,8	293,2	23,0	212,3	40,0	36,8	2094,4
BY-PRODUCTS OF MAIZE	Gluten							2,5	22,4					22,4
	Cake seeds	3,5	64,4											64,4
Fat - suet				20,0	70	0,7	20,7	6,0	53,6	1,0	9,2			153,5
Bran middlings and						12,0	354,4							354,4
by-products		11,0	202,3			6,0	177,2							379,5
Sugar						2,5	73,8							73,8
Molasses		9,5	174,7			5,5	162,4							337,1
				3,0	11,0									11,0
Starch Maniec						2,1	62,0	4,0	35,8					97,8
Grass meal Sugarbeet pulp														
Urea Lysine														
Minerals		2,0	36,8			1,7	50,2	1,7	15,2	7,2	66,5	2,3	2,1	170,8
Skim milk				48,0	168,0									168,0
Whey				20,0	70,0									70,0
Oilseeds		4,5	82,8											82,8
TOTAL		100,0	1839,1	91,0 + 9 divers	319,0	100,0	2953,0	100,0	894,0	100,0	923,0	100,0	92,0	7020

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

BELGIUM – LUXEMBOURG

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		OTHER		TOTAL
		%	1000 t	%	1000t	%	1000 t	%	1000 t	%	1000t	%	1000t	
CEREALS	Wheat													
	Barley													
	Maize													
	Sorghum													
	Others													
	Total	38,0	278,2			46,0	932,9	60,0	138,6	62,0	500,4			1850,1
MEALS	Fish					1,6	32,0	2,0	4,6	1,0	8,1			44,7
	Meat					2,0	40,6	3,0	6,9	2,0	16,1			63,6
FEEDCAKES	Soya					15,0	304,2	20,0	46,2	12,0	96,9			447,3
	Groundnut Sunflower Celza Linseed Others	38,0	278,2			4,0	81,1	5,0	11,6	4,0	32,3			403,2
	Total	38,0	278,2			19,0	385,3	25,0	57,8	16,0	129,2			850,5
BY-PRODUCTS OF MAIZE	Gluten													
	Cake seeds													
Fat - Suet				20,0	13,8			5,0	11,6	1,0	8,1			33,5
Bran middlings and by-products		16,0	117,1			16,0	324,5			15,0	121,0			562,6
Sugar						0,5	10,1							10,1
Melasses		8,0	58,6			3,0	60,8							119,4
Starch Manioc						10,4	210,9	5,0	11,6	3,0	24,2			246,7
Grass meal -Sugarbeet pulp														
Urea Lysine														
Minerals														
Skim milk Whey				72,0	49,7	1,5	30,4							80,1
Oilseeds														
TOTAL		100,0	732,1	100,0	63,5	100,0	2027,5	100,0	231,1	100,0	807,1			3861,3

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds;)

Annex 6

UNITED KINGDOM

		HEAVY CATTLE		CALVES(1)		PIGS		CHICKENS		LAYING HENS		OTHER		TOTAL
		%	1000 t	%	1000t	%	1000 t	%	1000 t	%	1000t	%	1000t	
CEREALS	Wheat	10,0	347,8			40,0	891,2	66,0	708,8	25,0	583,5	55,0	106,2	2637,5
	Barley	13,0	452,1			10,0	222,8					6,0	11,6	686,5
	Maize					11,0	245,1			51,0	1190,3	24,0	46,3	1481,7
	Sorghum							2,0	21,5	2,5	58,4			79,9
	Others	33,0	1147,7											1147,7
	Total	56,0	1947,6			61,0	1359,1	68,0	730,3	78,5	1832,2	85,0	164,1	6033,3
MEALS	Fish					3,0	66,8	5,0	53,7	4,0	93,4			484,0
	Meat					5,0	111,4	5,0	53,7	4,5	105,0			
FEEDCAKES	Soya					5,0	111,4	15,0	161,1	7,0	163,4	11,0	21,2	457,1
	Groundnut					8,0	178,2	3,0	32,2	4,0	93,4	4,0	7,7	311,5
	Sunflower									2,0	46,7			46,7
	-Colza	3,0	104,3											104,3
	Linseed													
	Others	4,0	139,1											139,1
	Total	7,0	243,4			13,0	289,6	18,0	193,3	13,0	303,5	15,0	28,9	1058,7
BY-PRODUCTS OF MAIZE	Gluten	20,0	695,6											800,3
	Cake seeds					4,7	104,7							
Fat - suet				17,0	4,9			4,0	43,0					47,9
Bran middlings and by-products		8,0	278,2			10,0	222,8							501,0
Sugar						0,3	6,7							369,1
Melasses		8,5	295,6			3,0	66,8							
Starch														
Maniec														
Grass meal														
Sugarbeet pulp														
Urea		0,5	17,4											17,4
Lysine						0,0024	p.m.							
Minerals														
Skim milk				83,0	24,1									24,1
Whey														
Oilseeds														
TOTAL		100,0	3478,0	100,0	29,0	100,0	2228,0	100,0	1074,0	100,0	2334,0	100,0	193,0	9336,0

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

Annex 7

I R E L A N D

		HEAVY CATTLE %	HEAVY CATTLE 1000 t	CALVES(1) %	CALVES(1) 1000 t	PIGS %	PIGS 1000 t	CHICKENS %	CHICKENS 1000 t	LAYING HENS %	LAYING HENS 1000 t	OTHER %	OTHER 1000 t	TOTAL
CEREALS	Wheat -Barley Maize Serghum Others													
	Total	53,5	50,0			78,0	464,0	75,0	60,0	83,3	134,0			708,0
MEALS	Fish Meat					5,0	30,0	5,0	4,0	3,0	5,0			39,0
FEEDCAKES	Soya Groundnut Sunflower Colza Linseed Others					7,0	42,0							42,0
	Total	21,5	20,0			7,0	42,0	20,0	16,0	13,7	22,0			100,0
BY-PRODUCTS OF MAIZE	Gluten Cake seeds													
Fat - Suet														
Bran middlings and b-products		25,0	23,0			10,0	59,0							82,0
Sugar Melasses														
Starch Maniec														
Grass meal Sugarbeet pulp														
Urea Lysine														
Minerals														
Skim milk Whey														
Oilseeds														
TOTAL		100,0	93,0			100,0	595,0	100,0	80,0	100,0	161,0			929,0

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds.)

DENMARK

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		OTHER		TOTAL
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS	Wheat							30,0	96,0	15,5	37,0	30,0	21,0	154,0
	Barley	20,6	138,0			67,0	837,0	4,0	13,0	10,0	24,0			1012,0
	Maize													
	Sorghum							36,0	115,0	36,0	87,0	34,0	23,0	225,0
	Others									8,5	20,0			20,0
	Total	20,6	138,0			67,0	837,0	70,0	224,0	70,0	168,0	64,0	44,0	1411,0
MEALS	Fish					4,0	50,0	5,0	16,0	3,0	7,0	5,0	3,0	76,0
	Meat					6,0	75,0	2,0	6,0	4,0	10,0	3,0	2,0	93,0
FEEDCAKES	Soya	10,0	67,0			20,0	250,0	23,0	73,0	13,0	31,0	28,0	19,0	440,0
	Groundnut													
	Sunflower									10,0	24,0			24,0
	Colza	3,5	24,0											24,0
	Linseed	3,5	24,0											24,0
	Others	46,4	313,0											313,0
	Total	63,4	428,0			20,0	250,0	23,0	73,0	23,0	55,0	28,0	19,0	825,0
BY-PRODUCTS OF MAIZE														
	Gluten													
	Cake seeds													
Fat - Suet				20,0	4,0									4,0
Bran middlings and by-products		8,0	54,0			1,4	17,0							71,0
Sugar														
Melasses		8,0	54,0											54,0
Starch														
Maniec														
Grass meal														
Sugarbeet pulp														
Urea														
Lysine														
Minerals														
Skim milk				80,0	16.0	1,6	20,0							36,0
Whey														
Oilseeds														
TOTAL		100,0	674,0	100,0	20,0	100,0	1249,0	100,0	319,0	100,0	240,0	100,0	68,0	2570 t

(1) Calves or all other animals consuming suckling feeds (or milk replacement feeds).

C/ EXAMINATION OF THE ECONOMIC ASPECTS (Continued)

CHAPTER VII

OUTLOOK FOR 1977-78

A - GENERAL CONSIDERATIONS

Despite the statistical difficulties and certain technical inexactitudes, the experts nevertheless carried out simulation exercises, some of which (Hypothesis II below) were deliberately irrealistic. The essential purpose of these exercises was to light up provide the technical aspect of the subject, the aim being to preserve and reconstitute within projections the links of compatibility between resources in cereals, feedcake, animal meals, industrial nitrogenated products, etc, and animal production. The exercises would not have been possible without the statistical inventory of fodder resources established by the SOEC for the base period (1970-1971). In the course of this period there existed technical links between the structure of fodder availabilities and animal production. Within each Community member country, the breeding of calves, heavy cattle, pigs and poultry which supplied certain quantities of meat, milk and eggs was only possible because the fodder resources were available with which to nourish these animals and to obtain from them yields which differed, moreover according to the countries by reason of their varying breeding methods.

The exercise which will be undertaken in this chapter consists of reconstituting the technical links between the two structures of animal production and fodder resources at the end of the period of the forecast (1977-1978). In the course of this period the structure of animal production is to undergo transformations. Certain forms of production will develop more rapidly than others. In addition, the animals will not continue to receive the same nourishment because breeding techniques and the yields of the animals will evelve and available resources and raw materials prices will change, causing manufacturers of compound feedingstuffs to make substitutions in the choice of the fodder products. The reconstitution of the technical links between the two projected structrues of animal production and fodder resources can be effected by calling once again on the method of linear programming. This has the advantage of making it possible to measure volumes of utilisation without taking into account price levels fixed a priori (1). It is sufficient to introduce supplementary constraints into the programme (for example, imposed maximum or minimum utilisations) or arbitrary prices (for example, 1 for a product whose utilisations it is planned to maximise (1). Of course the field or application of this method it limited to the compound feedingstuffs, whose importance however is constantly growing within the body of fodder resources.

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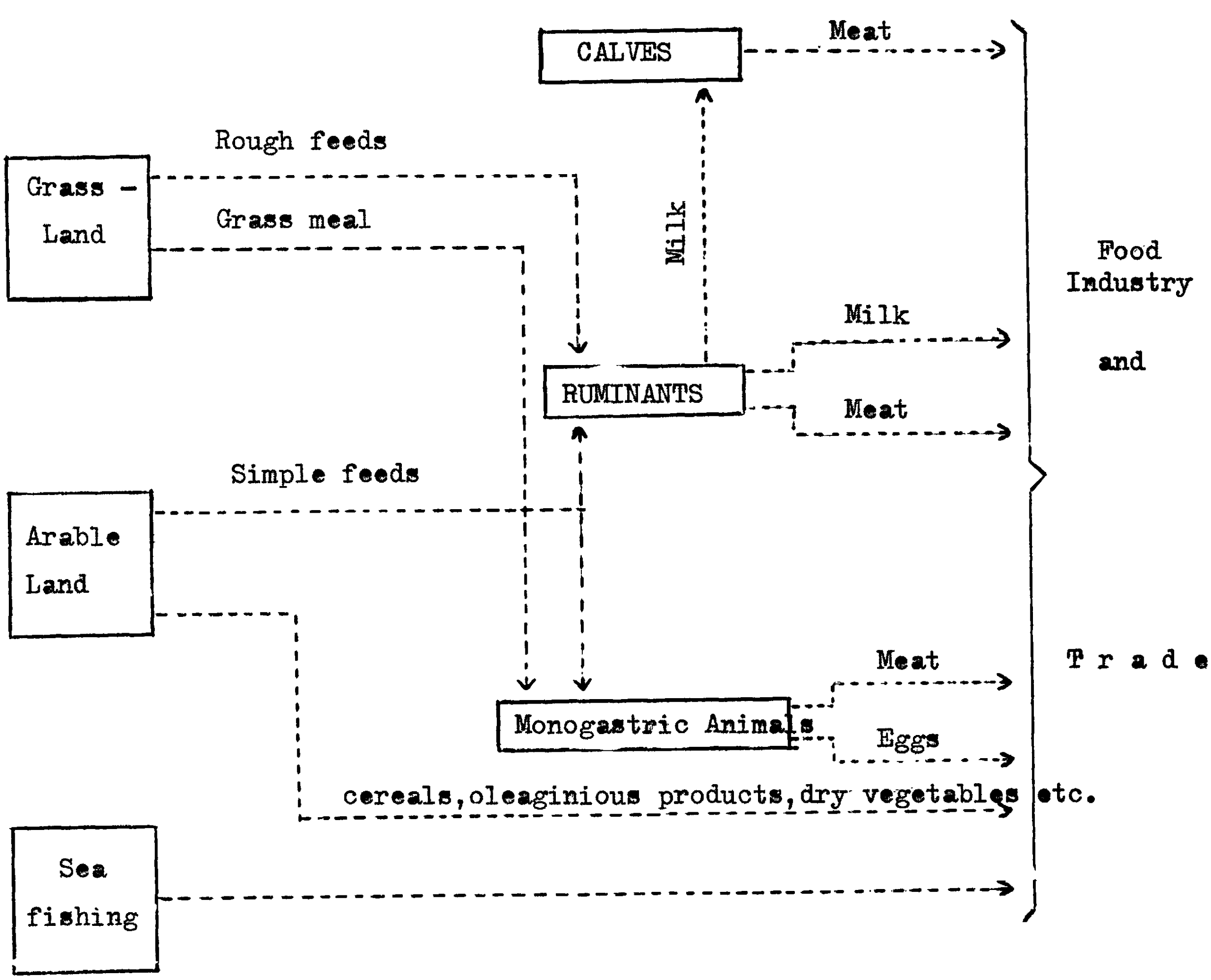
(1) On the other hand, linear programming makes it possible to calculate "interesting" prices that is to say, those below which these volume will reply be utilised by the industry. Knowledge of these "interesting" prices can be important in defining price policy for cereals proteic concentrates and nitrogenated products supplied by industrtn, etc.

The exercise proposed in this chapter is particularly important in a forward planning study. It makes it possible to give coherency to the balance-sheets projected for the various products which are dependent on each other through the intermediary of animal feeding : cereals, fats, meat, eggs, milk products, etc. In this way, thanks to this exercise, it is possible to take account of the extremely important fluctuations which are typical of the relations existing between the productions of the soil, sea-fishing, breeding, industry and the foodstuffs trade and finally, human consumption of food.

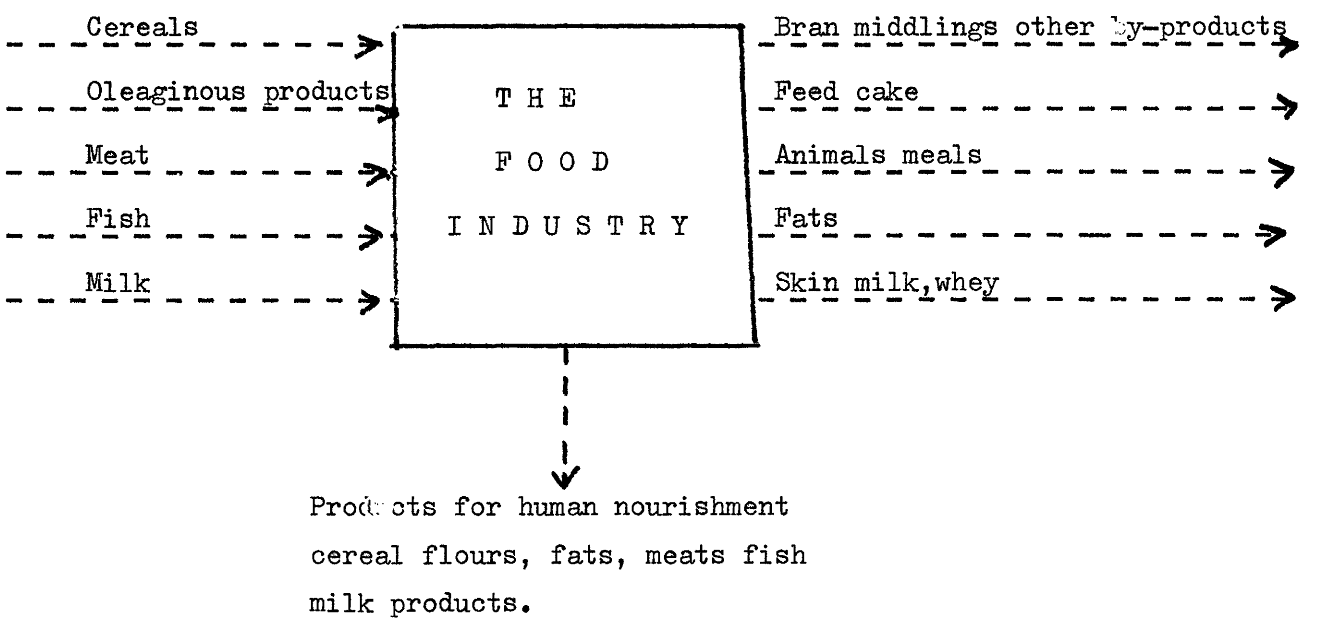
These relations, which are extremely complex, can be outlined by means of a few diagrams. The relations between the production of grasslands, arable land and the sea are the subject of an initial protein circuit which leads to the supply of rough fodder and simple concentrated products to heavy cattle and to the monogastric animals. The remainder of the products of the arable land and all those of the sea are destined for the food industry and trade.

CIRCUIT I



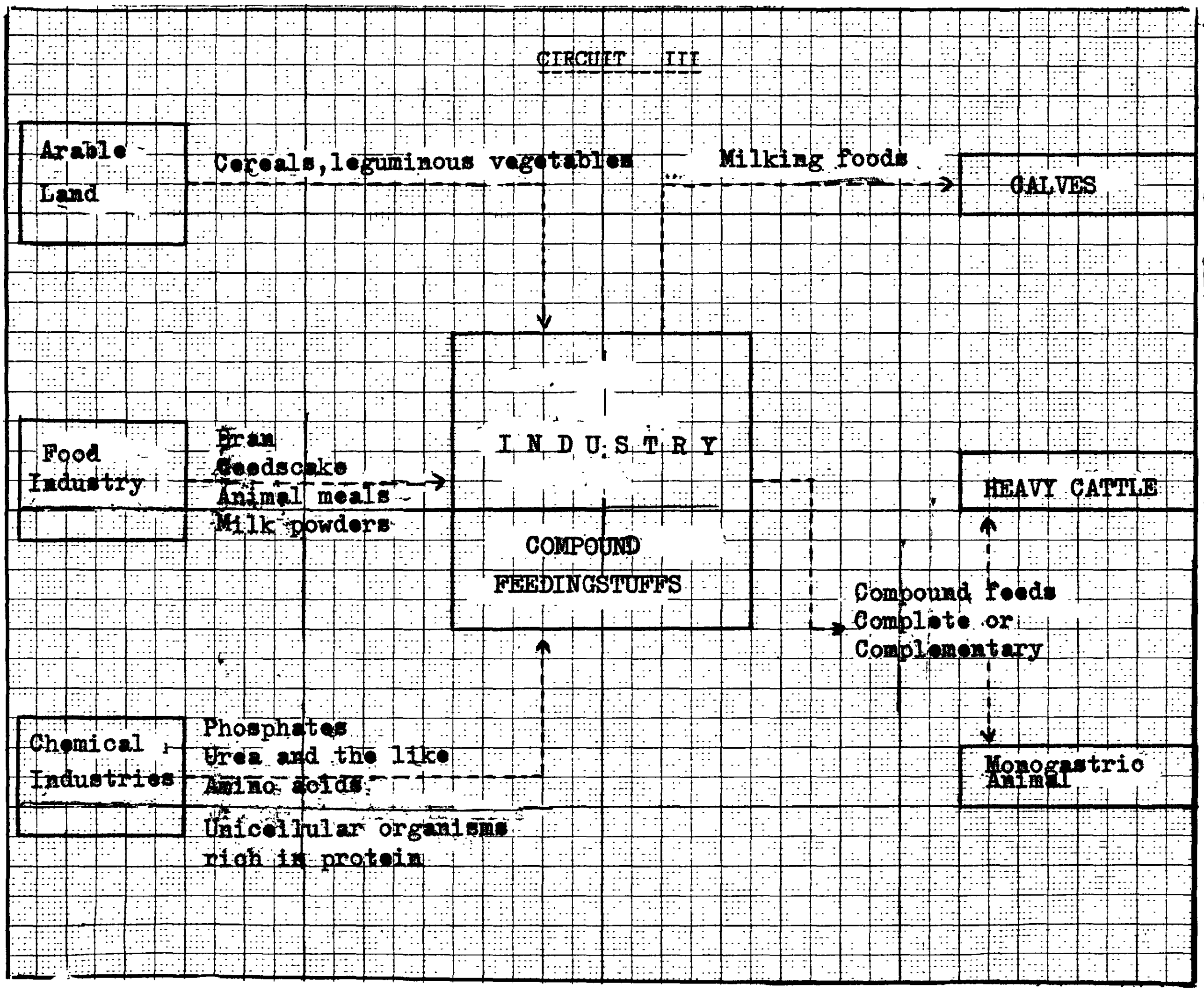
The various food industries received whole products and their work consists roughly of separating these products into two parts, one for human nourishment and one for animal (1).

CIRCUIT II

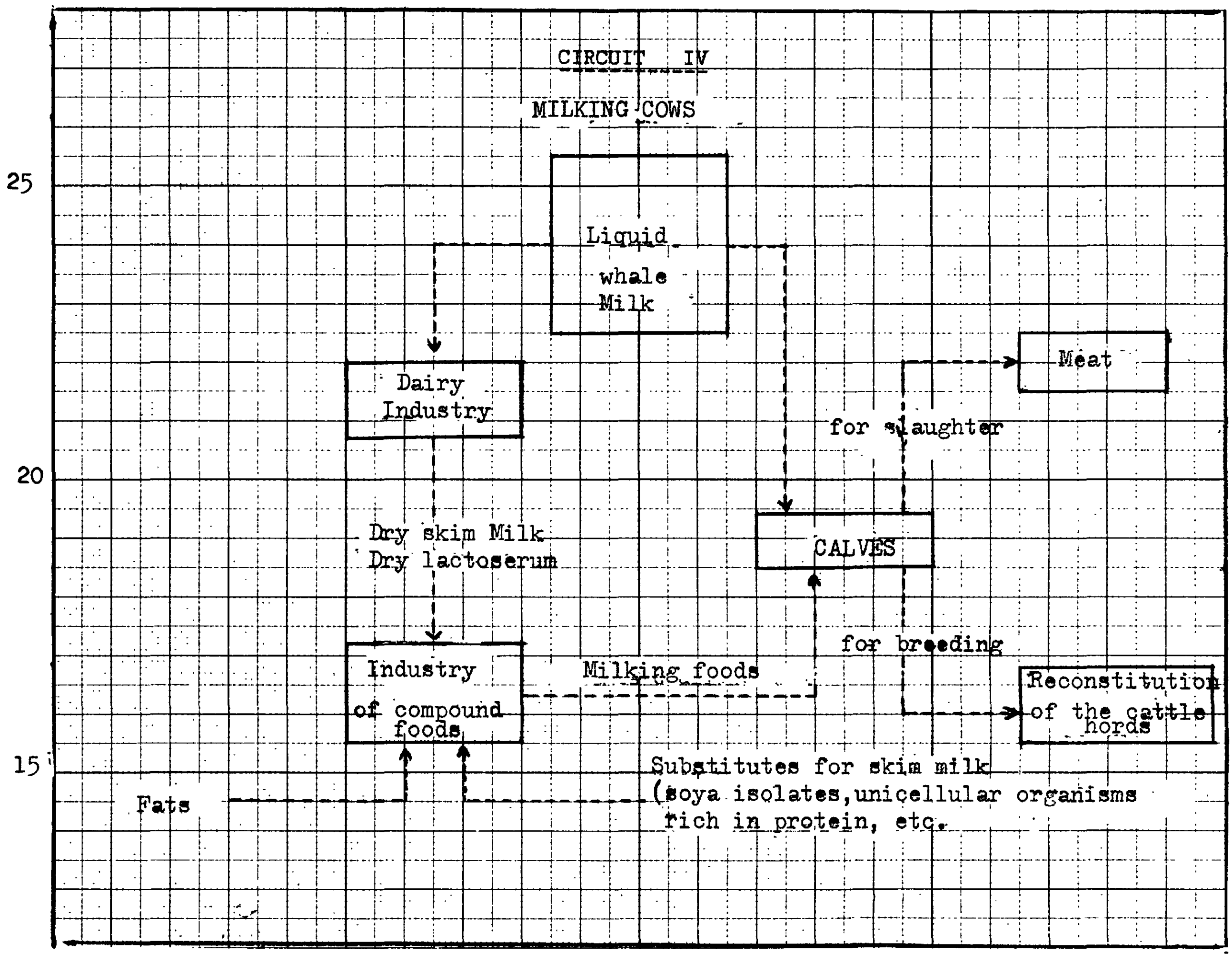


(1) For the clarity of the account no mention will be made here of the new products for human consumption whose importance is ceaselessly growing and which are extracted by industry from raw materials hitherto considered as by-products exclusively utilisable in animal feeding : artificial meats and milks, meals intended to be mixed with bakery and pastery products and extracted in particular from oil cakes.

The compound feedingstuffs industry, receives from growers their products in the natural state and also by-products of industry, and of the nitrogenated products manufactured by the chemical industry, makes mixtures at the least cost and supplies feeds whose compositions very according to whether they are intended for calves, heavy cattle, pigs, table poultry or laying hens, and whether they have to be distributed to the exclusion of rough or simple feed (compound feed known as complete) or whether they have to supplement the latter (compound feed known as complementary).



Because of their complexity, the exchanges to which the feeding of slaughter and breeding calves gives rise deserve to be illustrated by a separate diagram representing a fouth protein circuit within which the natural products supplied by the milking cows are progressively replaced by raw materials which are cheaper :



All the circuits just described can already be measured in units, such as the crude proteins and the yields (animal production, corresponding consumption) calculated, and for example, the share of external trade at each of the points of the general protein circuit.

B - OUTLOOK FOR THE PRODUCTION OF THE DIFFERENT CATEGORIES OF COMPOUND FEEDINGSTUFFS AND CHOICE OF THE HYPOTHESIS CONCERNING THE CORRESPONDING UTILISATION OF RAW MATERIALS

The forecasting work undertaken in this Chapter has been carried out at two levels :

- determination of the forecast volumes of manufacture of compound feeds by the regression method,
- breakdowns of the corresponding uses by the method of linear programming.

B A/ FORECAST CONCERNING MANUFACTURE OF COMPOUND FEEDINGSTUFFS

The volume of manufacture of compound feedingstuffs seems to be linked to two factors :

a) The time needed to measure their market penetration and

b) The corresponding animal production.

It must be considered that two distinct forms of animal production can correspond to a particular category of feeds. This is the case of certain feeds intended for heavy cattle which can be used both for the production of milk and for that of beef and veal (slaughter and culled cattle). Similarly, the statistics concenrning feedingstuffs for poultry cover products both for the production of eggs and for poultry meat.

In order to establish production forecasts for the different compound feedingstuffs, the relations existing between the annual trend (from 1965 to 1972) in each country of the production of each of the compound feedingstuffs and in each case two explicatory variables were first calculated (1).

- As regards the milking feeds for calves, the production of veal and the time T.
- As regards feedingstuffs for heavy cattle, the production of beef and of milk
- As regards pigsfeeds, the production of pigment and time T.
- As regards poultry feed, the production of eggs and poultry meat.

(1) This work could not be done for Denmark and Ireland, for which the volume of manufacture of compound feedingstuffs were not known far enough into the past. Furthermore, it should be pointed out that some of the factors affecting the variables concerning animal production could be negative when the values of the time T representing the market penetration of the product and the constant were high.

The extrapolations were made taking into account the new values of T in 1977-78 and also volumes of production which had been chosen by the independent experts who carried out a study for the Directorate General of Agriculture of the European Communities (Table 1). The production outlocks for the different compound feedingstuffs obtained by this method are shown in Table 2.

If we suppose that the volume of feedingstuffs furnished in the simple state do not undergo any variations in 1977-78 in relation to 1970-71, breeders in the Community countries would use a total of 125.6 million tons of concentrated products, as against 107.8 millions in the course of the base period. These volumes would therefore increase at an average annual rate of 2.2%. The share of the composite feedingstuffs produced would rise from 44.7 to 61.9 million tons in seven years, i.e. an annual rate of 6.6%.

B B/ <u>FORECASTS CONCERNING THE USE OF RAW MATERIALS</u>

<u>HYPOTHESIS I</u> : This hypothesis corresponds to an immediate reaction on the part of the compound feedingstuffs industry to the supply and price situation at the end of 1973 :

- A slight fall in the protein rates to keep closer to the standards of nitrogen requirements and to avoid vaste.
- Maximum utilisation of urea (a cheap source of nitrogen) of flour meal and of powdered lactoserum as a substitute for skin milk.
- Diminution of the uses of wheat (reduction of the denaturing premium) of oats, and of fish meal.
- Suppression of the utilisation of sugar in animal feeding (because of the excessive prices).

The uses of bran and barley must very to a slight extent in order to take account of the relative stagnation of the production of barley and of the activity of the milling industry. The utilisation of maize, sorghum, oilseed cake, meat meal, fats, and industrial amino acids are left free, and it is to these raw materials that the computer must appeals in order to complete and balance the formulae sought for. This hypothesis has been established on the basis of the same market price relations as at the end 1973. The details of it will be found on page VII/11. It is not established at constant prices and does not exclude an upward trend of price which proportionately affecting all raw materials would maintain the price relations obtaining at the end of 1973.

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(1) These two totals include the simple feed used in all the countries including Denmark to the exclusion of these used in Ireland. The difference between the total volumes of utilisation of the concentrated products and of the manufacture of composite feeds can unfortunately not be calculated because of the divergences mentioned above between Tables 2 and 4 of Chapter VI.

Table I

(a) MAIN FORMS OF ANIMAL PRODUCTION DURING THE BASE YEAR

(b) PRODUCTION OUTLOOK FOR 1977-1978

(in '000 inclus Tons)

	German F.R.		France		Italy		NETHER-LANDS		BLEU		U.K.		Denmark		Ireland		Total 9 countries	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Beef	1244	1416	1217	1362	668	747	222	218	232	210	884	1051	212	258	209	480	4888	5742
Veal	85	50	358	450	111	115	104	132	26	34	9	7	85	13	-	-	778	801
Pigmeat	2279	2642	1115	1580	478	563	642	711	482	640	941	832	738	853	141	112	6816	7933
Poultrymeat	267	386	787	970	640	817	307	410	116	126	583	849	79	125	30	40	2809	3723
Eggs	891	961	680	715	611	615	254	250	254	243	906	990	87	80	41	30	3724	3884
Whole milk	215	216	288	316	100	117	834	91,0	39,1	42,6	13,9	4,4	3,7	6,3	3,7	6,2	747,5	811,4

Table II

PRODUCTION OF COMPOUND FEEDS IN 1970 (a) and
PRODUCTION OUTLOOK FOR 1977-78 (b)
(in '000 metric tons of product weight)

Type of feeds	German F.R.		France		Italy		Nether-Lands		BLEU	
	a	b	a	b	a	b	a	b	a	b
Feed for suckling calves	210	255	617	1009	254	441	352	515	74	80
Heavy cattle	2310	2684	1010	1211	1090	741	515	2431	790	764
Pigs	3360	5274	2780	6224	650	959	3310	4706	2190	3819
Poultry	3606	3921	2834	3500	1454	1938	2188	2366	1110	1125
Total (1)	9730	12319	7580	12524	3630	4197	7850	10110	4280	5788

Type of feeds	U.K		Denmark (2)		Ireland (2)		Total 9 countries	
	a	b	a	b	a	b	a	b
Feed for suckling calves	40	36	20	20	50	50	1617	2406
Heavy cattle	3980	5351	674	700	93	100	12017	13982
Pigs	2591	3609	1210	1200	570	730	16661	26521
Poultry	3904	3850	562	700	258	350	15916	17790
Total (1)	11010	13079	2570	2688	970	1230	47620	61935

(1) This total includes feedingstuffs for the other animals (horses, rabbits, etc.) assumed to be equal to the volumes of the base period.

(2) Very approximate estimates for Denmark and Ireland for 1977-1978.

HYPOTHESIS II : In this hypothesis the existence of a far-reaching and prolonged scarcity in protein supplies leading to very high costs for feedcake and animal meals has been assumed. Substitution raw materials susceptible of being produced within the Community have been introduced. They include in particular bread beans and unicellular organisms rich in proteins, in addition to grass meal urea, cloza cake and industrial amino acid. These substitution products have been incorporated in maximum doses.

HYPOTHESIS III : As hypothesis II was probably likely to lead to estimates of use appreciably in excess the Community production capacities, hypothesis III admite a reduction of the use of the substitution proteic products which must be used by priority in the formular in which "interesting" prices are the highest (a million tons of broad beans, 700 thousand tons of unicellular organisms, etc). In the two hypothesis II and III, the maximum market price levels necessary to allow of the utilisations imposed (maximum in hypothesis II limited in hypothesis III) have been supplied by calculation on the computer. The price levels corresponding to Hypothesis II the unrealistic one, have not been reproduced here. Those of Hypothesis III are shown on page VII/43. This Table and the annexed Tables of Hypothesis III must be understood in the following fashion. If, in 1977/78, the prices of cereals, soya cake, groundouts, etc are the same as in November 1973, it will be possible to incorporate 1% of fish meal with 65% protein content in feeds for table poultry in France, (page VII/45) on condition, however, that the price of this fish meal does not exceed 32.00 UA/q (Table on page VII/43). In November 1973, this price was 35.00 UA/q(page VII/11 and first comumn of the Table on page VII/43). If, in 1977/78, this fish meal costs more than 32 UA/q (the prices of cereals and feed cake being those of 1973) it will not be used in the manufacture of feedingstuffs for table chickens in France.

The calculations corresponding to each of the hypothesis have obviously be made with an eye to all the different technical contraints proper to each category of animals, total proteins, cellulose, methionine, lysine, energy,phosphorous, calcium, chlorides, etc.

N.B. As for the Tables annexed to Chapter VI, it did not seem legitimate to add up the results obtained for each animal species in the Community Member countries. The result is that the Community totals of utilisation of raw materials for bovine cattle or pigs, etc are not available. Apart from the fact that the uses of simple feeds have not been the subject of a breakdown,to add formulae applicable to very different system of production(predominance of milking cows, of very high yield in one country,of young cattle in another or of hens of heavy breed in one country and of light breed in another etc) would have no meaning.

PRICES OF RAW MATERIALS

(In units of account/quintals (1))

TABLE III

CEREALS	Oats	9.83	DEHYDRATED MEALS		
	Wheat	10.47		Lucerne 17% FB	7,64
	Maize	10.47		Lucerne 18/250 (2)	7.83
	Barley	10.08		Lucerne 20/400 (3)	8.10
	Sorgho-Milo	10.47	ANIMALS MEALS		
GLUCIDE PRODUCTS				Dry lactoserum	21.60
	Molasses (cane	6.84		Dry skin milk	43.31
	Manioc	9.72		Fish meal 65% PB	32.50
WHEAT MIDDLINGS				Fish meal 72% PB	36.08
Fine bran of soft wheat		7.76		Meat meal 50% PB	18.00
FEED CAKES			AMINO ACIDS		
	De-oiled ground	17.10		Lysine 76 %	216.00
	De-oiled copra	10.80		Methionine 98%	126.00
	De-oiled copra	12.61	Miscellaneous		
	Maize seeds	12.61		Suet for poultry feeds	22.51
	De-oiled linseed	17.14		Vitaminized mineral mixture	35.00 (4)
	Soya 44	17.10			
	Soya 48.5	19.80		Urea 44% of Nitrogen	9.00
PROTEINACEDUS PRODUCTS			MINERALS		
	Field beans	12.28		Calcium carbonate	1.44
	Maize	28.81		Bicalcic phosphate	13.50 (5)
	Gluten 65% PB	50.41		Salt	2.76
	Yeasts on alkanes				

(1) Prices ruling in November 1973 (according to the french prices)

(2) At 18% of PB and 250 ppn of Xanthophyllis, the quality for table poultry feeds

(3) At 20% of PB and 400 ppn of Xanthophyllis the qualityfor table poultry feeds

(4) Price fixed arbitrarily for all animal species

(5) The price of phosphates has gene up by about 100% with effect from January 1974
No ccount was taken of this exercise, which was carried out at the end of 1973.

C – UTILISATIONS OF FODDER PRODUCTS UNDER HYPOTHESIS I

The results of the calsulations made by computer may be found in the Tables at Annex 1.1. to 1.8, for each of the countries and each of the main categories of composite feedingstuffs and furthermore for all utilisations, including simple feeds.

Unfortunately, it is rather difficult to compare the reuslts obtained by methods proposed and applied to the date concerning the base period. The difficulty arises essentially from the fact the SOEC statistics (total utilisations of fodder products) did not include Ireland and that hose of the FEFAC (utilisations in compound feedingstuffs) supplied precise and complete data for three countries only : Germany, France and the Netherlands.

Below are to be found commentaries based on the examination of date as comparable as possible.

1/ As regards the product with a high protein non-proteic nitrogen content (the case of Urea) hypothesis I had lead to :

11/ A sharp fall in the utilisations of fish meal and a considerable increase in that of meat meal.

In the absence of fish meal, meat meal has been recognised as an outstanding source of phosphorus.

Raw Materails	1970–71	1977–78 P	Variations
Fish meal	1368	794	– 42.0 %
Meat meal	594	1127	+ 89.7 %

(1) All the volumes mentioned below are expressed in thousands of metric tons.

12/ <u>A considerable increase in the utilisation of urea and of grass meals</u> :

Raw materials	1970 - 71	1977 - 78 p
Urea	30 (1)	418 (2)
Dehydrated meals of leguminous vegetables and of graminaceae	910	2547

(1) including the simple feedingstuffs
(2) compound feedingstuffs only
(3) excluding Ireland

13/ A relatively small increase in the utilisation of feed cakes, with

- at least a doubling of the utilisation of colza cake
- an increase in that of soya cake by nearly 20%
- a decline in the use of other cakes (among them cakes originating from the tropical countries, less rich in certain amino acids which are very costly to add).

As regards brans, middlings and other by-products, their total utilisations have remained stable in conformity with the constraints which had been introduced into the programme.

Raw materials	1970 - 71	1977 - 78 p	Variations
C A K E S (total without Ireland)	14 217	15 769	+ 10,9 %
OFWHICH SOYA (total without Ireland)	7 016	8 380	+ 19,4 %
OF WHICH COLZA (total without Ireland)	686 (1)	1 283 (2)	+ 87,0 %
OTHER CAKES	6 515	6 106 (3)	- 6,3 %
BRANS, MIDDLINGS OTHER BY-PRODUCTS (without Ireland)	15 081	15 196	+ 0,8 %

(1) Total utilisations including in simple feedingstuffs.
(2) Result of the linear programming for 1977-78 in the compound feedingstuffs only.
(3) To contain colza cakes classed in the somple state.

2/ As reagrds milk products, Hypothesis I included two types of formulae for milking feeds according as the breeding of the calves was mainly for the production of meat or was breeding in the strict sense (replacement animals).

Raw materials	formula Type 1 Slaughter type	Formula type 2 Breeding type
Soya	8 %	6 %
Fats (suet)	21 %	16 %
Starch	6 %	2 %
Minerals	1 %	1 %
Skin milk	29 %	35 %
Lactoserum	35 %	40 %
	100 %	100 %

As foreseen, this hypothesis has led to strong substitution of lactoserum for skim milk.

Milk Products	1970 - 71	1977 - 78 P	Variations
Skim milk (without Ireland	855	865	+ 1,2 %
Lactoserum (without Ireland)	96	975	+ 915, 6 %

3/ As regards cereals, Hypothesis I had led, taking into account the reductions imposed by the utilisations of wheat and oats, to a sharp increase in these of maize and serghum (see note).

Raw Materials	1970 - 71	1977 - 78 P	Variations
Total cereals (without Ireland	65 204	69 586	+ 6,7 %
Of which Wheat (1) (2)	10 484	6 548 (2)	- 37,5 %
Of which Maize plus Serghum (2) (3)	21 902	32 207	+ 47,0 %
Other cereals (2) (4)	32 818	30 831	- 6,1 %

(1) Without Italy or Ireland

(2) Only utilisation calculated in the compound feedingstuffs for BLEU, the United Kingdom and Danmark

(3) Including all the cereals for Italy, and only the utilisation calculated in the compound feedingstuffs in the U.K and Danmark.

(4) Includes a few quantities of wheat and maize.

4/ As reagrds glucidic products, energy products and certain ballasts, we note a diminution of the uses of manioc, starch and dry sugarbeet pulps. On the other hand those of fats and molasses rise sharply.

Raw Materials	1970 - 71	1977 ÷ 78 P	Variations
Starch and manioc (without Ireland)	1 413	1 001	- 29,2 %
Dry sugarbeet pulp	4 080	3 644	- 10,8 %
Fat(without Ireland)	426	858	+ 101,4 %
Molasses	1 587	2 420	+ 52,5 %

N.B. These cereals are the only two which can be substituted for each other almost weight forweight without requiring any great changes in the formulae.

CONCLUSION CONCERNING HYPOTHESIS I

In general way this hypothesis leads to the production of mixture containing more and more pure products and less and less cellulose (less cats, bran, tropical feedcakes, etc.). The reduction imposed in the uses of skim milk, sugar, wheat, fish meal has logically lead to an increase - sometimes a spectular one - in the requirements for certain products the offer of which may be elastic and whose advance was expected by the industrial circles concerned, (for example, whey and molasses) but of which others may pose special supply problem (meat meal, fat).

Finally, this hypothesis I confirms the trend already observed in the course of these recent years as regards the diminution of the volume of tropical oilseed cakes in the feeding of animal breedings establishments in the Community.

N.B. The last column of Tables 1 to 8 of the Hypothesis I, II and II comprises all the compound feedingstuffs, including feeds for heavy cattle (idential in the three hypotheses) and the feeds for the other animals (identical to those of the base period), apart from the cimple feeds (identical to those of the base period).

Table Annex
I 1

1977-1978
Hypothesis I

FEDERAL REPUBLIC OF GERMANY

		Heavy Cattle		Calves (1)		Pigs		Chickens		Laying Hens		TOTAL (including) simple feeds
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat					5,0	264					2 201
	Barley	3,5	94			14,0	738					4 514
	Maize					27,2	1 435	37,5	345	66,4	1 992	4 466
	Sorghum							23,0	212			329
	Others	7,0	188			5,0	264					5 535
	TOTAL	10,5	282			51,2	2 701	60,5	557	66,4	1 992	17 045
MEALS:	Fish							3,5	32	2,0	60	269
	Meat					1,5	79			1,0	30	109
FEEDCAKES:	Soya Groundnut	4,9	132	6,0	15	27,9	1 471	21,8	201	6,5	195	2 634
	Sunflower									5,0	150	
	Colza	25,0	671									1 868
	Linseed Others	10,0	268									
	TOTAL	39,9	1 071	6,0	15	27,9	1 471	21,8	201	11,5	345	4 502
By-products of maize	Gluten							6,0	55	5,0	150	212
	Seedcakes	7,0	188									188
Fat - Suet				16,0	41	0,3	16	5,0	46			109
Bran middlings and by-products		15,0	403			15,0	791			2,5	75	3 605
	Sugar											
	Molasses	10,0	268									499
	Starch			2,0	5							5
	Maniac											9
Grass meal		10,9	293							2,5	75	436
Sugarbeet pulp												908
	Urea	3,0	81									81
	Lysine											
	Methionine							0,05	5			5
	Minerals	3,7	99	1,0	3	3,1	163	3,15	29	9,1	273	574
	Skim milk			35,0	89							89
	Whey			40,0	102	1,0	53					155
Seedgrains												
	TOTAL	100,0	2 685	100,0	255	100,0	5 274	100,0	925	100,0	3 000	28 800

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annex
I 2

FRANCE

1977-1978
Hypothesis I

		Heavy Cattle		Calves (1)		Pigs		Chicken		Laying Hens		TOTAL (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat	4,0	48			9,0	560					3 164
	Barley	18,0	218			23,0	1 432					5 431
	Maize	12,4	150			25,9	1 612	61,5	1 415	70,0	840	6 382
	Sorghum							2,0	46			
	Others											2 928
	TOTAL	34,4	416			57,9	3 604	63,5	1 461	70,0	840	17 905
MEALS:	Fish							1,0	23	1,0	12	44
	Meat					3,5	218	1,0	23	2,0	24	265
FEEDCAKES :	Soya			8,0	81	11,5	716	25,8	593	5,6	67	1 653
	Groundnut					5,0	311			4,9	59	
	Sunflower					5,0	311			3,0	36	1 220
	Colza	8,6	104									
	Linseed											
	Others	15,0	182									
	TOTAL	23,6	286	8,0	81	21,5	1 338	25,8	593	13,5	162	2 873
By-products of maize												
	Gluten							2,0	46			46
	Seedcakes											
Fat - Suet				21,0	212			3,8	87			299
Bran middlings and by-products		12,0	145			10,0	622			1,1	13	1 978
	Sugar											
	Molasses	10,0	121			2,0	124					278
	Starch			6,0	61							61
	Maniec											21
Grass meal		13,4	163			1,0	62	0,5	12	3,5	42	574
Sugarbeet pulp												268
	Urea	3,0	36									41
	Lysine											
	Methionine							0,1	2	0,05	0,1	2,1
	Minerals	3,6	44	1,0	10	2,6	162	2,3	53	8,85	106	387
	Skim milk			29,0	293	0,5	31					324
	Whey			35,0	353	1,0	62					415
Seedgrains												
	TOTAL	100,0	1 211	100,0	1 010	100,0	6 223	100,0	2 300	100,0	1 200	25 781

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds)

Table Annex
I 3

I T A L Y

1977–1978
Hypothesis I

		Heavy Cattle		Calves (1)		Pigs		Chicken		Laying Hens		TOTAL (including simple feed
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat											
	Barley											
	Maize	31,5	233			69,9	670			58,7	1 138	2 124
	Sorghum											
	Others											
	TOTAL	31,5	233			69,9	670			58,7	1 138	10 945
MEALS :	Fish											96
	Meat											10
FEEDCAKES:	Soya											
	Groundnut	19,6	145	8,0	35	10,8	104			13,3	258	542
	Sunflower											
	Colza											
	Linseed											
	Others	2,9	21									21
	TOTAL	22,5	166	8,0	35	10,8	104			13,3	258	2 709
By-products of maize												
	Gluten									2,0	38	44
	Seedcakes											
FAT - SUET				21,0	93							97
bran middlings and by-products		12,0	88			13,0	125			16,8	326	3 166
	Sugar											
	Molasses	10,0	74									79
	Starch			6,0	26							26
	Maniac											
Grass meal		16,9	125									142
Sugarbeet pulp												1 750
	Urea	3,C	22									22
	Lysine											
	Methionine									0,05	1,0	1
	Minerals	4,1	30	1,0	4	3,3	32			9,15	177	245
	Skim milk			29,0	128	3,0	32					160
	Whey			35,0	154							154
Seedgrains												
	TOTAL	100,0	738	100,0	440	100,0	963			100,0	1 938	19 646

(1) Calves or any other animals consuming suckling feeds (or mil replacement feeds).

Table Annex
I 4

NETHERLANDS

1977-1978
Hypothesis I

		Heavy Cattle		Calves (1)		Pigs		Chickens		Laying Hens		TOTAL (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat					3,0	141	15,0	205			19
	Barley					8,0	376					401
	Maize					38,2	1 798	37,0	505	52,8	528	3 315
	Sorghum							10,0	137	10,0	100	625
	Others	15,0	365							3,0	30	366
	TOTAL	15,0	365			49,2	2 315	62,0	847	65,8	658	4 726
MEALS:	Fish							3,0	41	1,0	10	54
	Meat					2,0	94	1,0	14	1,5	15	123
FEEDCAKES:	Soya Groundnut	16,0	388	8,0	41	17,8	838	23,5	321	16,4	164	1 868
	Sunflower									6,0	60	} 366
	Celza	10,0	243									
	Linseed	5,6	136									
	Others	22,0	534									
	TOTAL	53,6	1 301	8,0	41	17,8	838	23,5	321	22,4	224	2 234
By-products of maize :	Gluten							2,5	34			34
	Seedcakes											
Fat - Suet				21,0	108	0,5	24	5,0	68	0,67	7	207
Bran middlings and by-products		10,0	243			20,0	940					2 324
	Sugar Molasses	~~10,0~~	243			8,0	376					619
	Starch			6,0	31							31
	Manioc											423
Grass meal		5,0	121									350
Sugarbeet pulp												610
	Urea	2,9	70									70
	Lysine											
	Methionine					0,05	3	0,1	1	0,03	0,3	4,3
	Minerals	3,5	88	1,0	5	2,45	115	2,9	40	8,6	86	333
	Skim milk			29,0	149							175
	Whey			35,0	180							202
Seedgrains												
	TOTAL	100,0	2 431	100,0	514	100,0	4 705	100,0	1 366	100,0	1 000	12 519

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds)

Table Annex I 5

BLEU

1977-1978
Hypothesis I

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat											
	Barley	33,1	253			11,0	420					673
	Maize							18,6	60			60
	Sorghum					35,4	1 352	44,7	145	60,8	486	1 983
	Others											
	TOTAL	33,1	253			46,4	1 772	63,3	205	60,8	486	3 754
MEALS :	Fish							1,0	3	1,0	8	11
	Meat					2,0	76	3,0	9	2,0	16	140
FEEDCAKES :	Soya											
	Groundnut			8,0	6	14,0	535	20,9	68	13,1	105	714
	Sunflower											
	Celza	2,0	15			5,0	191	5,0	16	1,8	14	236
	Linseed											
	Others	15,0	115									244
	TOTAL	17,0	130	8,0	6	19,0	726	25,9	84	14,9	119	1 194
By-products of maize :	Gluten											
	Seedcakes											
Fat - Suet				21,0	17			5,0	16	2,97	24	57
Bran middlings and by-products		15,0	115			15,0	573			10,0	80	1 025
	Sugar											
	Molasses	10,0	76			3,5	134					210
	Starch			6,0	5							5
	Maniec					10,0	382					382
Grass meal		18,7	143									603
Sugarbeet pulp												
	Urea	3,0	23									23
	Lysine											
	Methionine					0,06	2,2	0,15	0,5	0,10	0,8	3,5
	Minerals	3,2	24	1,0	1	2,54	97	1,65	5	8,23	66	193
	Skim milk			29,0	23	1,5	57					80
	Whey			35,0	28							28
Seedgrains												
	TOTAL	100,0	764	100,0	80	100,0	3 819	100,0	323	100,0	800	7 709

(1) Calves or any other animals consuming sickling feeds (or milk replacement feeds).

Table Annex I 6

UNITED KINGDOM

1977–1978
Hypothesis I

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat	4,5	241			16,0	577			10,0	240	1 164
	Barley	12,0	642			18,4	664					1 318
	Maize					24,8	895	20,6	307	57,9	1 390	2 638
	Sorghum							46,0	685	5,0	120	805
	Others	22,1	1 183									1 183
	Total	38,6	2 066			59,2	2 136	66,6	992	72,9	1 750	13 807
MEALS:	Fish					1,0	36	2,0	30	3,0	72	235
	Meat					5,0	180	5,1	76	5,0	120	376
FEEDCAKES:	Soya			6,0	2	7,7	277	20,7	308	1,3	31	639
	Groundnut					8,0	288			5,0	120	416
	Sunflower									5,0	120	120
	Colza											
	Linseed											
	Others	4,0	214			4,0	144					358
	TOTAL	4,0	214	6,0	2	19,7	709	20,7	308	11,3	271	1 533
By-products of maize :	Gluten											
	Seedcakes	15,0	803									803
FAT - SUET				16,0	6			4,0	60			66
Bran middlings and by-products		18,0	963			9,0	324					3 018
	Sugar											
	Molasses	10,0	535			4,0	144					679
	Starch			2,0	1							37
	Maniec											
Grass meal		7,6	407									407
Sugarbeet pulp												108
	Urea	3,0	160									160
	Lysine					0,01	0,4					0,4
	Methionine					0,04	1,4	0,2	3,0	0,04	1,0	5,4
	Minerals	3,8	203	1,0	-	2,05	74	1,4	21	7,76	186	484
	Skim milk			35,0	13							13
	Whey			40,0	14							14
Seedgrains												
	TOTAL	100,0	5 351	100,0	36	100,0	3 605	100,0	1 490	100,0	2 400	21 746

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annex

I 7

DENMARK

1977-1978
Hypothesis I

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (2) (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat											
	Barley	20,0	140			68,2	818			10,0	25	1 004
	Maize							2,2	8			8
	Sorghum							67,0	234	48,9	122	379
	Others									5,0	13	13
	TOTAL	20,0	140			68,2	818	69,2	242	63,9	160	1 404
MEALS:	Fish					3,0	36	4,0	14	2,0	5	58
	Meat					6,0	72	2,0	7	4,0	10	91
FEEDCAKES:	Soya			8,0	2	17,6	211	19,8	69	11,7	29	330
	Groundnut	41,2	288									288
	Sunflower									8,0	20	20
	Colza	4,2	29									29
	Linseed											
	Others	8,1	57									57
	TOTAL	53,5	374	8,0	2	17,6	211	19,8	69	19,7	49	724
By-products of maize:	Gluten											
	Seedcakes											
Fat - Suet				21,0	4			3,3	12	2,8	7	23
Bran middlings and By-products		8,0	56			2,0	24					80
	Sugar											
	Melasses	8,0	56									56
	Starch			6,0	1							1
	Maniec											
Grass meal		5,0	35									35
Sugarbeet pulp												
	Urea	3,0	21									21
	Lysine											
	Methionine							0,2	0,7	0,03	0,1	0,8
	Minerals	2,5	18	1,0	-	1,7	20	1,5	5	7,57	19	62
	Skim milk			29,0	6	1,5	18					24
	Whey			35,0	7							7
Seedgrains												
	TOTAL	100,0	700	100,0	20	100,0	1 199	100,0	350	100,0	250	8 173

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds)

(2) The total includes simple feeds whose composition is unknown.

Table Annex
I 8

I R E L A N D

1977–1978
Hypothesis

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (2) (including simple feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat											
	Barley	56,2	56			67,0	489			53,7	107	652
	Maize					3,0	22	68,1	102	14,7	29	153
	Serghum											
	Others					10,0	73			7,4	15	88
	TOTAL	56,2	56			80,0	584	68,1	102	75,8	151	893
MEALS:	Fish					3,0	22	3,0	4	0,5	1	27
	Meat					1,0	7	1,0	2	2,0	4	13
FEEDCAKES:	Seya			6,0	3	0,5	4	22,7	34	2,6	5	46
	Greundnut					3,6	26			10,0	20	46
	Sunflewer											
	Celza											
	Linseed											
	Others											
	TOTAL			6,0	3	4,1	30	22,7	34	12,6	25	92
By-preducts ef maize :	Gluten											
	Seeds											
Fat - Suet				16,0	8			2,9	4			12
Bran middlings and by-preducts		22,0	22			9,0	66					88
	Sugar											
	Melasses											
	Starch			2,0	1							1
	Maniec											
Grass meal		14,8	15									15
Sugarbeet pulp												
	Urea	3,0	3									3
	Lysine											
	Methienine							0,1	0,2	0,08	0,2	0,4
	Minerals	4,0	4	1,0		2,9	21	2,2	3	9,02	18	46
	Skim milk			35,0	18							18
	Whey			40,0	20							20
Seedgrains												
	TOTAL	100,0	100	100,0	50	100,0	730	100,0	150	100,0	200	1 228

(1) Calves er any ether animals censumings suckling feeds (er milk replacement feeds).

(2) The teal includes only the cempeund feeds.

D/ UTILIZATIONS OF THE FODDER PRODUCTS UNDER HYPOTHESIS II

It should be recalled that this hypothesis , a deliberately unrealistic one, consisted of including the maximum doses (from both the technical and physiological points of view) of substitution products without taking into account the Community's production capacity. Apart from urea (already introduced into the formulae calculated in connection with Hypothesis I), the exercise comes down to maximizing the utilizations of colza cake, of grass meal, of field beans and of unicellular organisms rich in proteins,leaving the utilization of the amino acids manufactured by the chemical industry free.

It was possible to achieve the aim pursued by introducing new maximum and minimum constraints for the utilization of these products and then allowing the computer to balance the formulae mainly by the use of maize, sorghum, oilcake meat meals, mollasses, fats, etc.

1) As regards substitution products of high protein content, Hypothesis II lead to the follosing figures :

. Colza cake :	Utilization of 1 700 000 tons in 1977/78 purely in the compound feeds for heavy cattle and chickens,(as against 680 000 tons in 1970/71 for all feeds, including simple feeds).
. Grass meal :	4 463 000 tons (as against 910 000 tons)
. Meat meal :	1 093 000 tons (as against 775 000 tons)
. Field beans:	5 741 000 tons (as against 775 000 tons)
. Unicellular organisms:	4 664 000 tons (as against 4 000 tons during the base period and 23 000 tons in 1973/74.

Taking into account the increase in the utilization of urea (+ 390 000 metric tons between 1970/71 and 1977/78), the substitution products would see their utilization grow by nearly 16 000 000 metric tons for the compound feeds alone in the course of the projection period. It is recalled in particular that the colza cakes, the unicellular organisms and the field beans are particularly rich in and that their maximum use - always in this unreal game - should logically reduce that of fixh meal, soya cake and industrial lysine.

2) As regards the concentrated protein fodder products, the results have confirmed this supposition, for their utilization fall sharply under Hypothesis II:

• <u>Fish meal</u>	:	390 000 tons (as against 1 368 000 in the course of the base period)
• <u>Soya cake</u>	:	2 193 000 metric tons (as against 7 016 000)
• Cakes other than <u>Soya and Colza</u>	:	a maximum of 5 220 000 metric tons(against a total of 6 515 000 in 1970/71)

In addition, the requirements for industrial lysine appear to be practically nil.

3) <u>Cereals</u> : Similarly, Hypothesis II show a slight fall-off in the utilization of cereals, the total of which would decline from 65. 2 million tons in 1970/71 to 63.8 million in 1977/78. Uses of wheat would fall by half in seven years those of maize and sorghus would go up by nearly 38%, and those of the other cereals would decline by 13%.

4) The important substitutions revealed by Hypothesis II have been made possible by the strong increase in the utilization of fats (984 000 metric tons, as against 426 000 in 1970/71), of starch and of manioc (2 284 000 metric tons, as against 1 413 000). In addition, methionine requirements would be higher than in Hypothesis I.

5) <u>Other products</u> : Finally, the utilizations of the other products (bran and various by-products, sugarbeet pulp, skim milk, etc.) are identical under Hypothesis I and II. Only the utilization of <u>lactoserum</u> is lower in Hypothesis II in relation to Hypothesis I under the influence of the introduction of unicellular organisms into suckling feed for calves.

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In conclusion this hypothesis, which is unrealistic, for it takes no account either of the conditions of international trade or of the supply capacity of Community agriculture and industry, nevertheless has the advantage of drawing attention to three important points :

a) - The proteic substitution products are generally rich in lysine but poor in methionine. The development of their utilizations therefore increase the openings for industrial methionine but not for lysine. In fact it would seem, indeed, that the manufacturers of lysine were attentive, early in the 70's, to the progress of substitution products, and particularly to that of the unicellular organisms, when establishing their investment plans.

b) - The development of the utilization of substitution products is not incompatible withthe fall in those of cereals. When the formulae of the manufacturers of compound feeds include important quantities of field beans, of grass meal and of unicellular organisms, the use of cereals can even diminish fairly strongly and sometimes more sharply than that of cake in the feedingstuffs administered to pigs. In this case the computer completed the corresponding formulae by including larger quantities of products with a high-energy content, such as suet and manioc and also industrial methionine.

On condition that the other proteic substitution products and the energy-supplying products should be simultaneously available in sufficient quantities and a reasonable price, it is therefore possible for the Community to develop in particular its production of field beans while limiting the utilization of cereals. The problem of the area to be used for these protein products would thus be facilited.

Examples of variations (%) occurring in some formulae of feedingstuffs for PIGS between Hypothesis I and Hypothesis II

Raw Materials	Germany	France	Netherlands	BLEU	United Kingdom
Field beans	+ 20	+ 18	+ 18	+ 18	+ 18
Unicellular proteins	+ 10	+ 10	+ 10	+ 10	+ 10
Grass meals	+ 6,7	+ 5,25	+ 5	+ 5,6	+ 5
Manioc	-	+ 10	+ 10	+ 5	-
Suet	- 0,3	-	+ 0,6	-	+ 1,7
Minerals	+ 0,2	+ 0,2	+ 0,25	+ 0,36	+ 0,35
Methionine	+ 0,02	+ 0,05	+ 0,07	+ 0,04	- 0,04
Lysine	-	-	-	-	- 0,01
Fish meal	-	-	-	-	- 1
Feed cakes	- 24,4	- 17,5	- 17,8	- 19	- 7,7
Cereals	- 12,2	- 26	- 26,1	- 20	- 26,3

c) - Hypothesis II finally corresponds to a very considerable diminution of resources in vegetables oils and this feature aggravates, if there were any need for this - its purely theoretical character. The utilization of feed cake resulting from Hypothesis II corresponds approximately to vegetable oil resources of the order of 5.9 million metric tons, as against 7.1 million during the base period and 7.7 million in 1977/78 under Hypothesis I. An intolerable diminution of vegetable oil resources thus constitutes a brake in the long-term on any excessive expansion of utilizations of substitute protein products.

Table II Annex 1

FEDERAL REPUBLIC OF GERMANY

Hypothesis II

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat			5,0	264					2201
	Barley			10,0	527					4303
	Maize			24,0	1266	48,7	449	68,7	2061	4470
	Sorghum			-	-	10,1	93			210
	Others			-	-					5271
	Total			39	2057	58,8	542	68,7	2061	16455
Field beans				20,0	1055	5,0	46	5,0	150	1251
MEALS	fish									177
	Meat			1,5	79			1,0	30	109
FEEDCAKES :	Soya	6,0	15	3,5	185	1,5	14	0,1	3	969
	Groundnut									
	Colza					10,0	92			1810
	Others									
	Total	6,0	15	3,5	185	11,5	106	0,1	3	2779
By-products of Maize										
	Gluten					6,0	55	1,0	30	92
	-Seedcakes									188
Fat - Suet		16,0	41			5,0	46			93
Bran middlings and by-products				15,0	791					3530
Melasses										499
Starch		2,0	5							5
Maniec										9
Grass meal				6,7	353	1,1	10	5,0	150	874
Sugarbeet pulp										908
Urea										81
Unicellular organisms		10,0	26	10	527	10,0	92	10,0	300	945
Lysine						0,02	0,18			0,18
Methionine				0,02	1,1	0,08	0,74	0,07	2,1	3,94
Minerals		1,0	2	3,3	174	2,5	23	9,13	274	579
Skim milk		35,0	89							89
Whey		30,0	77	1,0	53					130
TOTAL		100,0	255	100,0	5275	100,0	921	100,0	3000	28797

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annex

II 2

FRANCE

Hypothesis II

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compounds feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat									2604
	Barley			15,0	934					4933
	Maize			16,9	1052	61,4	1412	69,2	830	5809
	Sorghum					2,0	46			232
	Others									2696
	Total			31,9	1986	63,4	1458	69,2	830	16274
Field beans				18,0	1120	5,0	115	5,0	60	1295
MEALS :	Fish									9
	Meat			3,5	218	1,1	25	2,0	24	267
FEEDCAKES:	Soya	8,0	81			1,3	30			307
	Groundnut			4,0	249					
	Celza					10,0	230			983
	Others									
	Total	8,0	81	4,0	249	11,3	260			1290
By-products of maize:	Gluten					2,0	46			46
	Seedcakes									
Fat - Suet		21,0	212			4,8	110			322
Bran middlings and by-products				10,0	622					1965
Melasses				2,0	125					279
Starch		6,0	61							61
-Maniec				10,0	622					643
Grass meal				6,25	389			5,0	60	907
Sugarbeet pulp										268
Urea										41
Unicellular organisms		10,0	101	10,0	622	10,0	230	10,0	120	1073
Lysine						0,01	0,2			0,2
Methionine				0,05	3,1	0,13	3,0	0,05	0,6	6,7
Minerals		1,0	10	2,8	174	2,3	53	8,75	105	398
Skin milk		29,0	292	0,5	31					323
		25,0	252	1,0	62					314
TOTAL		100,0	1009	100,0	6223	100,04	2300	100,0	1200	25782

(1 Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annex
II 3

I T A L I E

Hypothesis II

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compounds feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat Barley Maize Sorghum Others			43,3	415			58,5	1134	10686
	Total			43,3	415			58,5	1134	10686
Field beans				18,0	173			5,0	97	270
MEALS:	Fish Meat									96 10
FEEDCAKES:	Soya Groundnut Colza Others	8,0	35							180 2167
	Total	8,0	35							2347
By-products of maize :	Gluten Seedcakes							2,0	39	45
Fat - Suet		21,0	93							97
Bran middlings and by-products				13,0	125			10,0	194	3034
Melasses										79
Starch Maniec.		6,0	26							26
Grass meal Sugarbeet pulp				9,3	89			5,0	97	328 1750
Urea Unicellular Lysine Methionine		10,0	44	10,0	96			10,0 0,03	194 0,6	22 334 0,6
Minerals		1,0	4	3,4	33			9,45	183	252
Skim milk Whey		29,0 25,0	129 110	3,0	29					158 110
TOTAL		100,0	441	100,0	960			99,98	1939	19645

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annex
II 4

NETHERLANDS

Hypothesis II

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	(all simple compound feeds
CEREALS:	Wheat									- 327
	Barley									25
	Maize			23,1	1088	48,6	664	50,4	504	2740
	Sorghúm					10,0	137	10,0	100	625
	Sôrghum							3,0	30	366
	Total			23,1	1088	58,6	801	63,4	634	3429
Field beans				18,0	847	4,0	55	5,0	50	952
MEALS :	Fish									3
	Meat			2,0	94	1,0	14	1,5	15	123
feedcakes :	Soya	8,0	41			6,0	82	4,6	46	673
	Groundnut									
	Colza					10,0	137			443
	Others									
	Total	8,0	41			16,0	219	4,6	46	1116
By-products of maize :	Gluten					2,6	36			36
	-Seedcake									
Fat - Suet		21,0	108	1,1	52	5,5	75	1,6	16	251
Bran middlings and by-products				20,0	941					2325
Melasses				8,0	376					619
Starch		6,0	31							31
Maniec				10,0	471					894
Grass meal				5,0	235			5,0	50	635
Sugarbeet pulp										610
Urea										70
Unicellular organisms		10,0	52	10,0	471	10,0	137	10,0	100	760
Lysine										
Methionine				0,12	5,6	0,11	1,5	0,06	0,6	7,7
Minerals		1,0	5	2,7	127	2,2	30	8,84	88	337
Skim milk		29,0	149							175
Whey		25,0	129							151
TOTAL		100,0	515	100,0	4708	100	1369	100,0	1000	12525

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table II Annex 5

Hypothesis II

BLEU

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat									
	Barley									253
	Maize			26,4	1008			23,7	190	1198
	Sorghum					65,7	214	44,9	359	573
	Others									1038
	Total			26,4	1008	65,7	214	68,6	549	3062
Field beans				18,0	687	4,0	13	5,0	40	740
MEALS:	Fish									
	Meat			2,0	76	3,0	10	2,0	16	141
FEEDCAKES:	Soya									
	Groundnut	8,0	6			0,1	0,3			6
	Colza					10,0	33			48
	Others									244
	Total	8,0	6			10,1	33,3			298
By- products of maize :										
	Gluten									
	Seedcakes									
Fat - Suet		21,0	16			5,5	18	0,7	6	40
Bran middlings and by-products				15,0	573					945
Melasses				3,5	134					210
Starch		6,0	5							5
Maniec				15,0	573					573
Grass meal				5,6	214			5,0	40	857
Sugarbeet pulp										
Urea										23
Unicellular organisms		10,0	8	10,0	382	10,0	33	10,0	80	503
Lysine										
Methionine				0,1	3,8	0,22	0,72	0,1	1	5,52
Minerals		1,0	1	2,9	111	1,5	5	8,6	69	210
Skim milk		29,0	24	1,5	57					81
Whey		25,0	20							20
TOTAL		100,0	80	100,0	3819	100,0	327	100,0	801	7714

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

Table Annexe
II 6

UNITED KINGDOM

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat			5,0	180			8,0	192	719
	Barley			10,0	361					1015
	Maize			17,9	646	57,7	860	59,1	1418	2979
	Sorghum					7,0	104			104
	Others									7882
	Total			32,9	1187	64,7	964	67,1	1610	12699
Field beans				18,0	650	4,0	60	5,0	120	830
MEALS :	Fish									97
	Meat			5,0	180	5,0	75	4,0	96	351
FEEDCAKES :	Soya	6,0	2							23
	Groundnut			8,0	289	5,0	75			372
	Colza					5,45	81			81
	Others			4,0	144					358
	Total	6,0	2	12,0	433	10,45	156			834
By--products of maize :										
	Gluten									
	Seedcakes									803
Fat - Suet		16,0	6	1,7	61	4,35	65	0,7	17	149
Bran middlings and by-products				9,0	325					3019
Molasses				4,0	144					679
Starch		2,0								36
Manioc										
Grass meal				5,0	180			5,0	120	707
Sugarbeet pulp										108
Urea										160
Unicellular organisms		10,0	4	10,0	361	10,0	149	10,0	240	754
Lysine										
Methionine						0,18	2,7	0,07	1,7	4,4
Minerals		1,0		2,4	87	1,3	19	8,1	194	503
Skim milk		35,0	13							13
Whey		30,0	11							11
TOTAL		100,0	36	100,0	3608	100,0	1491	100,0	2399	21757

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds)

Table Annex
II 7

DENMARK

Hypothesis II

		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (2) all simple compound feeds
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat									
	Barley			39,0	468			10,0	25	654
	Maize			11,9	143					143
	Sorghum					62,3	218	48,25	121	362
	Others							5,0	12	12
	Total			50,9	611	62,3	218	63,25	158	1 171
Field beans				19,2	230	4,0	14	5,0	12	256
MEALS :	Fish					0,2	1	1,5	4	8
	Meat			5,0	60	2,0	7	4,0	10	79
FEEDCAKES :	Soya	8,0	2			3,6	13	0,4	1	35
	Groundnut									288
	Colza					10,0	35			64
	Others									57
	Total	8,0	2			13,6	48	0,4	1	444
By-products of maize										
	Gluten									
	Seedcakes									
Fat - Suet		21,0	4			6,0	21	3,0	7	32
Bran middlings and by-products				2,0	24					80
Molasses										56
Starch		6,0	1							1
Manioc										
Grass meal				9,0	108			5,0	12	155
Sugarbeet pulp										
Urea										21
Unicellular organisms		10,0	2	10,0	120	10,0	35	10,0	25	182
Lysine										
Methionine				0,01	0,1	0,21	0,7	0,06	0,2	1
Minerals		1,0		2,4	29	1,7	6	7,8	20	73
Skim milk		29,0	6	1,5	18					24
Whey		25,0	5							5
TOTAL		100,0	20	100,0	1 200	100,0	351	100,0	249	8 174

(1) Calves or any other animals consuming suckling feeds (or milk replacement feeds).

(2) The total includes simple feeds whose composition is unknown.

Table II Annex I

I R E L A N D

Hypothesis II

		CALVES (1) %	CALVES (1) 1000 t	PIGS %	PIGS 1000 t	CHICKENS %	CHICKENS 1000 t	LAYING HENS %	LAYING HENS 1000 t	TOTAL (2) (all simple compound feeds
CEREALS :	Wheat									
	Barley			31,4	229					285
	Maize			19,9	145	62,4	94	53,4	107	346
	Sorghum							5,0	10	10
	Others									
	Total			51,3	374	62,4	94	58,4	117	641
Field beans				18,0	131	4,0	6	5,0	10	147
MEALS:	Fish									
	Meat			1,0	7	1,0	2	2,0	4	13
FEEDCAKES :	Soya	6,0	3			4,8	7			10
	Groundnut							5,0	10	10
	Colza					10,0	15			15
	Others									
	Total	6,0	3			14,8	22	5,0	10	35
By-products of maize	Gluten									
	Seedcakes									
Fat - Suet		16,0	8			5,35	8			16
Bran middlings and by-products				9,0	66					88
Molasses										
Starch		2,0	1							1
Manioc										
Grass meal				7,4	54			10,8	22	91
Sugarbeet pulp										
Urea										3
Unicelluoar organisms		10,0	5	10,0	73	10,0	15	10,0	20	113
Lysine										
Methionine						0,14	0,2	0,03	0,1	0,3
Minerals		1,0	-	3,3	24	2,3	3	8,8	18,0	49
Skim milk		35,0	18							18
Whey		30,0	15							15
TOTAL		100,0	50	100,0	729	100,0	150	100,0	201	1 230

(1) Calves or any other animals consuming suckling feeds for milk replacement feeds.

(2) The total includes only the compound feeds.

E - UTILIZATIONS OF FODDER PRODUCTS UNDER HYPOTHESIS III

The situation created in the setting of hypothesis III is in a way intermediary between the two previous ones. Breeders and manufacturers of cattle feeds would suffer supply restrictions brought about,

- either by the long-term evolution of production (barley, oats) and of industrial processing (brans, middlings)
- or by Community decisions (wheat, sugar)
- or again by the emergence of deficit situations at world level (fish meal).

As in the previous situations, they could make wide use of urea (420 000 t) colza cake, grass meal and synthetic amino acids, and procure without difficulty maize, soya cake, meat meal, fats, molasses and manioc.

They would certainly desire to extend their utilizations of field beans and unicellular organisms, but inadequate supply would oblige them to limit the use of these raw materials.

In the setting of this exercise the utilizations of field beans and unicellular organisms had been limited respectively to 1 000 000 and 700 000 metric tons per year and for all the Community countries. In addition, formulae were sought in which these raw materials would find the most economic use on the basis of the interesting prices determined by the linear programming (1). In this way, it had appeared that the volumes of field beans available would find an outlet particularly in the formumae for feedingstuffs for PIGS, and the unicellular organisms in the formulae for TABLE POULTRY.

The use of these new sources of protein was therefore suppressed in the other feedingstuffs, and particularly in milking feed for calves.

The formulae chosen for these feeds in Hypothesis III are therefore identical to those of Hypothesis I.

---

(1) Regarding the base prices and the threshold prices chosen by the computer for Hypothesis III (this hypothesis is the same as I and II for the feedingstuffs intended for heavy cattle) see the Annex at the end of this Chapter.

In this hypothesis, the utilisations of cereals would in theory amont to 68.2 million metric tons in 1977/78, or an annual average increase of 0.6%. Taking into account the stagnation of the production of barley and the fall off of wheat and oats resources, the utilizations of maize and sorghum would attain 33.2 million metric tons (+ 6.2% per year).

As regards the proteic concentrates supplied by agriculture and sea-fishing, the linear programming exercise yielded the highest results for meat meal (1 135 000 metric tons)and colza cake (2 237 000 metric tons for the compound feeds alone). On the other hand, the utilizations of fish meal would not exceed a half a million tons and those of cake would return approximately to the same level as during the base year (in all 14 705 000 metric tons, of which 6 889 000 of soya cake, against 14 217 000 and 7 016 000 respectively in 1970/71.

As in the other hypothesis it is above all the feeds cake of tropical origin which would be ousted by the field beans unicellular organisms and colza cake. The use of cakes other than colza and soya would, at the maximum, be only 5.6 million metric tons in 1977/78 (as against 6.6. million in 1970/71.

Vegetable oil supplies would be easier than under Hypothesis II and utilizations of cake within the Community would correspond to a production of oil slightly in excess of 8 000 000 metric tons in the countries exporting or importing oilseeds (as against 7.1 million in 1970/71 and 5.9 million in 1977/78 under Hypothesis II).

It should be pointed out that, as in the previous hypotheses, the requirements of stockbreaders for industrial lysine would remain low, in view of the fact that the substitution products are all rich in this amino acid. On the other hand, the extra demand for industrial methionine would apparently be as large as under Hypothesis I.

As regards the other concentrated products used for animal feeding, Hypothesis III led in general to results which do not call for any comments in addition to those previously made.

UTILIZATION OF THE OTHER CONCENTRATED PRODUCTS ACCORDING TO HYPOTHESIS III

(in thousands metric tons)

Fats (without Ireland)	904
Brans middlings and other by-products (without Ireland)	14 919
Molasses (without Ireland)	2 271
Starch and manioc (without Ireland)	1 001
Grass meal (without Ireland)	4 419
Beat pulp (without Ireland)	3 644
Skim milk (without Ireland)	963
Lactoserum	975

CONCLUSION

The main conclusion which emerges from Hypothesis III is that the marketing of a million metric tons of field beans 700 000 of unicellular organisms, of a little more than 2 000 000 of colza cake, 1.1 million of meat meal and 4.5 million of grass meal would be compatible with the maintenance of the utilizations of soya cake at the same level as in 1970/71 and, possibly, with a reduction in the utilizations of fish meal of nearly two-thirds. This quite a strong rise in the price of proteins and, in particular, of those of fish meal and, at the same time, by the rather rapid development of agricultural and industrial production in the Community.

(1) It should be noted that the method used in this Chapter, which consists of calculating by linear programming the utilizations of raw materials corresponding to particular forms of animal production, can also be employed in the opposite direction. In this case the problem to be solved consists of calculating the animal productions which could correspond to a complex of fodder resources imposed. This procedure by iteration can be used in a more complex model than the one in this study, for example to correct projections of animal production and make them coherent with limited utilizations of certain raw materials.

Table 1

RECAPITULATION OF THE RESULTS OF THE PROJECTIONS FOR THE WHOLE OF THE EUROPEAN ECONOMIC COMMUNITY (EXCEPT IRELAND IN THOUSAND OF METRIC TONS OF PRODUCT WEIGHT AND IN ANNUAL RATES OF INCREASE BETWEEN THE BASE YEAR (1970/71) AND THE PROJECTION YEAR(1977/78)
(Compound feeds plus simple feeds of the base period)

=====================

	1970/71	1977 / 78		
		Hypothesis 1	Hypothesis 2	Hypothesis 3
Cereals	65.204	69.586 (+ 0,9 %)	63.776 (- 0,3 %)	68.219 (+ 0,6 %)
of which Wheat (1)	10.484	6.548 (- 6,5 %)	5.197 (- 9,5 %)	6.295 (- 8,0 %)
Maize and Sorghum (2)	21.902	32.207 (+ 5,6 %)	30.131 (+ 4,7 %)	33.174 (+ 6,1 %)
Other cereals	32.818	30.831 (- 0,9 %)	38.448 (- 2,0 %)	28.750 (- 1,8 %)
Fish meal	1.368	794 (- 7,5 %)	390 (-15,0 %)	501 (-12,7 %)
Meat meal	594	1.127 (+ 9,5 %)	1.093 (+ 9,1 %)	1.135 (+ 9,7 %)
Feeds cakes	14.217	15.769 (+ 1,5 %)	9.109 (- 6,1 %)	14.705 (+ 0,5 %)
of which Soya	7.016	8.380 (+ 2,6 %)	2.193 (-14,5 %)	6.889 (- 0,2 %)
Colza (4)	686	1.283	1.285	2.237
Other feed cakes	6.515	6.106 (+ 0,4 %)	5.631 (- 0,6 %)	5.579 (+ 1,2 %)
Fats	426	858 (+10,5 %)	984 (+12,7%)	904 (+11,3 %)
Brans, middlings and other by-products of feedingstuffs ind.	15.081	15.196 (+ 0,1 %)	14.898 (- 0,2 %)	14.919 (- 0,2 %)
Field beans (6)	775	775 (-)	5.741 + 775 (+34,8 %)	1.071 + 775 (+13,2 %)
Molasses	1.587	2.420 (+ 6,2 %)	2.421 (+ 6,2 %)	2.271 (+ 4,6 %)
Starch and Manioc	1.413	1.001 (- 4,9 %)	2.285 (+ 7,1 %)	1.001 (- 4,9 %)
Grass meals	910	2.547 (+15,8 %)	4.463 (+25,7 %)	4.419 (+25,3 %)
Dry sugarbeet pulp	4.080	3.644 (- 1,6 %)	3.644 (- 1,6 %)	3.644 (- 1,6 %)
Urea	30	418 (+43,2 %)	418 (+43,2 %)	418 (+43,2 %)
Unicellular organisms	4	- -	4.664 -	691 -
Lysine (7)	?	+ 0,4 -	+ 0,4 -	+ 0,4 -
Methionine (7)	?	+22,5 -	+30,1 -	+24,2 -
Milk powders (8)	1.046	865 (- 2,7 %)	863 (- 2,7 %)	863 (- 2,7 %)
Lactoserum powder	96	975 (+37,9 %)	741 (+32,8 %)	975 (+37,9 %)

NOTES TO THE RECAPITULATORY TABLE N° 1

(1) Without Italy and including only utilizations in compound feeds where BLEU and the United Kingdom are concerned.

(2) Including all the cereals used in Italy

(3) Above all barley and oats.

(4) Including simple feedingstuffs in 1970/71. Only utilization calculated in compound feedingstuffs in 1977/78. The percentages of increase cannot therefore be calculated.

(5) Included colza cake used as a simple feed in 1977/78. For all the years, mainly linseed, groundnuts, sunflower, cotton, copra.

(6) The utilizations in 1970/71 in simple feeds amounted to 775 000 tons for all dry vegetables. To these must be added the utilizations projected for 1977/78 in compound feedingstuffs.

(7) Utilizations not known for 1970/71. Quantities calculated for 1977/78 correspond to increase in utilization of the main compound feeds. To these are added non-quantifiable utilizations in compound feeds of less importance, for example for turkeys.

(8) In principle, skim milk powder. The figure for 1970/71 includes 191 000 tons of whole milk powder.

COMPARISON OF BASE PRICES AND THRESHOLD PRICES
(in units of account/q)

for certain RAW MATERIALS

See Table 2 attached

1/ BASE PRICE : Prices chosen under the Hypothesis I - II and III with which the raw materials were offered to the computer (see page 7/11)

2/ THRESHOLD PRICES : Two possible cases

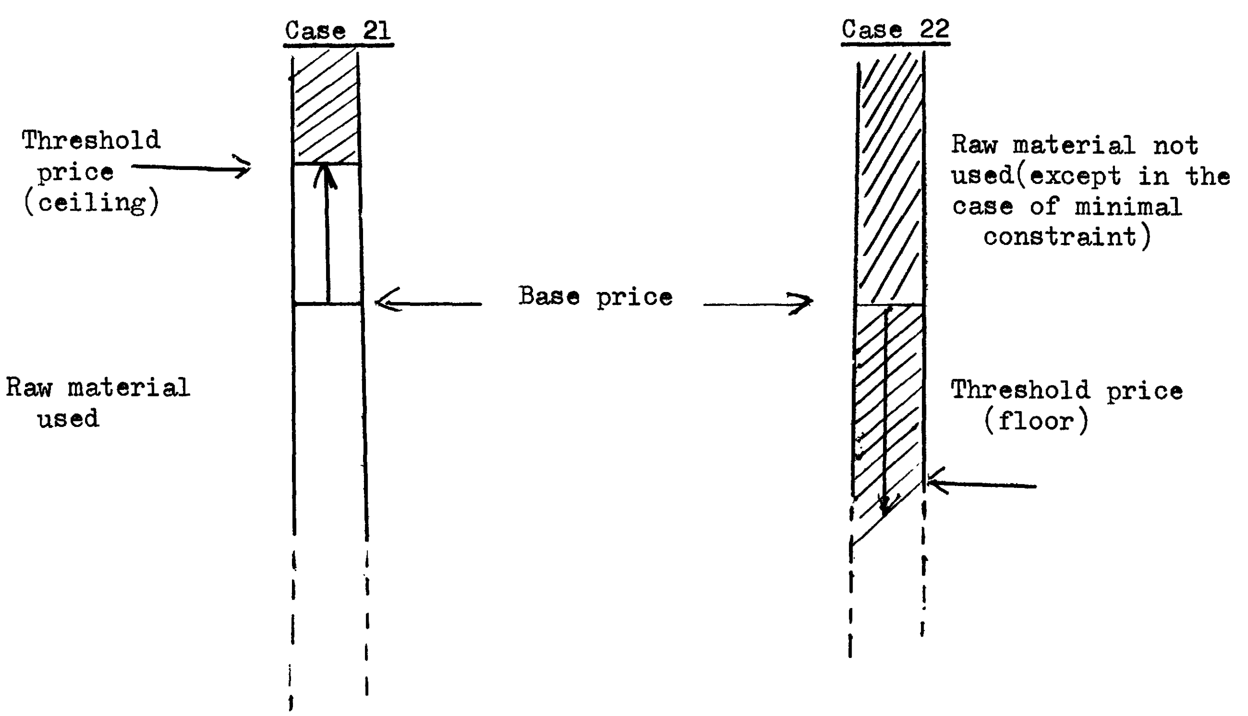
21/ The threshold price is higher than the base price

This is a "ceiling price". The computer chooses to use this raw materials as long as its price does not exceed the base price.

Special case : the threshold price is infinite (1). This happens when the computer chooses to use the raw materials at a rate equal to that of the minimum use constraint.

22/ The threshold price is below the base price

This is now a " floor price". The computer will not choose this raw material for such time as its price does not fall to the level of the floor price, unless it is obliged to do so by a minimal constraint (see above).



(1) Or arbitrarily equal to 10 000 UA/q.

BASE PRICES CHOSEN FOR EACH RAW MATERIAL IN THE CALCULATIONS OF LINEAR PROGRAMMING (column 1) AND PRICES DETERMINED BY THIS METHOD FOR THE CHIEF RAW MATERIALS INTRODUCED INTROCUDED INTO THE DIFFERENT COMPOUND FEEDS IN EACH COUNTRY (columns 2 to 9)

RAW MATERIALS	Base Price UA/q	Threshold price (1) (UC/q)							
		Germany F.R.	France	Italy	Nether Lands	Belgium Luxembourg	U.K	ireland	Denmark
1/ CATTLE Feeds - Hypothesis I - II									
Urea 44	9,00	20,15	47,00	59,12	15,40	48,66	10,85	10,31	27,41
Dehydrated Lucerne 17	7,64	15,76	10,65	8,91	3,24	9,68	8,21	8,82	- 3,28
2/ PIG Feeds - Hypothesis III									
Fish Meal 65	32,50	-	25,19	-	-	-	-	-	-
Fish meal 72	36,08	27,12	-	-	28,39	27,97	29,42	28,76	26,97
Field beans	12,28	13,75	13,75	13,75	13,30	13,38	14,11	14,21	13,80
Dehydrated lucerne 18	7,83	9,47	9,47	9,47	8,61	9,17	±10000	8,84	9,66
Lysine HcL 76.5	216,00	1,44	1,44	1,44	-0,21	1,21	184,01	179,28	1,91
Methionine 980	126,00	1,44	1,44	1,44	482,47	178,43	126,10	344,69	1,91
Colza cakes	12,61	-	15,75	-	-	16,35	-	-	-
3/ TABLE POULTRY Feeds - Hypothesis III									
Fish meal 65	32,50	-	32,00	-	-	-	-	-	-
Fish meal 72	36,08	33,65	-	-	32,54	33,30	23,40	32,54	32,76
Field beans	12,28	-	-	-	-	-	-	-	-
Alkane yeasts	50,41	27,84	27,64	-	25,80	27,33	19,01	25,80	25,90
Dähydrated lucerne 20	8,10	7,01	6,93	-	7,13	6,97	7,30	7,13	6,93
Lycine Hcl 76.5	216,00	269,62	264,19	-	-4,90	178,59	-0,85	-4,90	-5,30
Methionine 980	126,00	219,81	192,83	-	268,62	268,62	207,74	645,01	268,62
Colza cakes	12,61	14,64	14,80	-	14,91	14,82	13,09	14,91	14,82
4/ LAYING HENS FEEDS - Hypothesis III									
Fish meal 65	32,50	-	30,53	-	-	-	-	-	-
Fish meal 72	36,08	32,34	-	-	33,02	33,35	33,02	31,71	31,95
Field beans	12,28	-	-	-	-	-	-	-	-
Alkane yeast	50,41	-	-	-	-	-	-	-	-
Dehydrated lucerne 18	7,83	6,24	7,87	7,43	5,48	5,15	5,48	7,52	0,50
Lysine Hcl 76.5	216,00	-3,24	202,11	-0,98	-4,69	-5,28	-4,69	202,11	-14,10
Methionine 980	126,00	243,00	332,53	234,89	416,54	403,31	416,54	585,53	432,73

(1) Threshold price : See definition at Annex I (page AN/ 6)

Table Annex
III 1

FEDERAL REPUBLIC OF GERMANY

1977–1978
Hypothesis

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat					5,0	264					2201
	Barley	3,5	94			10,0	527					4303
	Maize					29,3	1545	52,3	484	67,4	2022	4745
	Sorghum							10,4	96			213
	Others	7,0	188									5271
	YOTAL	10,5	282			44,3	2336	62,7	580	67,4	2022	16733
Field beans						4,0	211					211
MEALS :	Fish							1,0	9	0,5	15	201
	Meat					1,5	79			1,0	30	109
FEEDCAKES :	Soya	4,9	132	6,0	15,0	24,8	1308	2,4	22	15,6	468	2565
	Groundnut											
	Colza	25,0	671					10,0	93			1811
	-Others	10,0	268									
	Total	39,9	1071	6,0	15,0	24,8	1308	12,4	115	15,6	468	4376
By-products of maize:	Gluten							6,0	55	1,25	38	100
	Seedcakes	7,0	188									188
Fat - Suet				16,0	41			4,3	40			87
Bran middlings and by-products		15,0	403			15,0	791					3530
Molasses		10,0	268									499
Starch				2,0	5							5
Manioc												9
Grass meal		10,9	233			6,5	343			5,0	150	854
Sugarbeet pulp												908
Urea		3,0	81									81
Unicellular organisms								10,0	93			93
Lysine								0,02	0,18			0,18
Methionine								0,06	0,55	0,06	1,8	2,35
Minerals		3,7	99	1,0	3	2,9	153	3,5	32	9,15	274	568
Skim milk				35,0	89							89
Whey				40,0	102	1,0	53					155
TOTAL		100,0	2685	100,0	255	100,0	5274	99,98	925	99,96	2999	28799

(1) Calves or anyother animals consuming suckling feeds.

Table Annex
III 2

F R A N C E

1977–1978
Hypothesis III

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compounds feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat	4,0	48			9,0	560					3164
	Barley	18,0	218			15,0	233					4931
	Maize	12,4	150			27,6	1718	63,9	1470	69,5	834	6537
	Sorghum							2,0	46			232
	Others											2696
	Total	34,4	416			51,6	3211	65,9	1516	69,5	834	17560
Field beans						4,0	249					249
MEALS :	Fish							1,0	23	0,5	6	38
	Meat					3,5	218	1,1	25	2,0	24	267
FEEDCAKES:	Soya			8,0	81	8,9	554	2,2	51	6,5	77	959
	Groundnut					5,0	311			6,4	77	446
	Colza	8,6	104			5,0	311	10,0	230			987
	Others	15,0	182									
	Total	23,6	286	8,0	81	18,9	1176	12,2	281	12,9	154	2392
By-products of maize :	Gluten							2,0	46			46
	Seedscakes											
Fat - Suet				21,0	212			4,6	106			318
Bran middlings and by-products		12,0	145			10,0	622					1965
Molasses		10,0	121			2,0	124					278
Starch				6,0	61							61
Manioc												21
Grass meal		13,4	163			6,0	373			5,85	70	901
Sugarbeet pulp												268
Urea		3,0	36									41
Unicellular organisms								10,0	230			230
Lysine								0,01	0,23			0,23
Methionine								0,11	2,5	0,07	0,8	3,3
Minerals		3,6	44	1,0	10	2,5	156	3,2	74	9,2	110	406
Skim milk				29,0	293	0,5	31					324
Whey				35,0	353	1,0	62					415
TOTAL		100,0	1211	100,0	1010	100,0	6222	100,12	2304	100,02	1199	25784

(1) Calves or any other animals consuming suckling feeds.

I T A L Y

1977-1978
Hypothesis III

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat											
	Barley											
	Maize	31,5	233			60,0	578			59,2	1147	1958
	Sorghum											
	Others											
	Total	31,5	233			60,0	578			59,2	1147	10862
Field beans						4,0	39					39
MEALS :	Fish											
	Meat											
FEEDCAKES :	Soya	19,6	145	8,0	35	8,0	77			13,2	256	513
	Groundnut											
	Colza											2167
	Others	2,9	21									
	Total	22,5	166	8,0	35	8,0	77			13,2	256	2680
By-products of maize:												
	Gluten									2,0	39	45
	Seedcakes											
Fat- Suet				21,0	93							97
Bran middlings and by-product		12,0	88			13,0	125			11,1	215	3055
Molasses		10,0	74									79
Starch				6,0	26							26
Manioc												
Grass meal		16,9	125			9,0	87			5,0	97	326
Sugarbeet pulp												1750
Urea		3,0	22									22
Unicellular organisms												
Lysine												
Mehtionine										0,05	1	1
Minerals		4,1	30	1,0	4	3,0	29			9,4	182	247
Skim milk				29,0	128	3,0	29					157
Whey				35	154							154
TOTAL		100,0	738	100,0	440	1.00,0	964			99,95	1937	10646

(1) Calves or any other animals consuming suckling feeds.

Table Annex
III 4

NETHERLANDS

1977
Hyposis III

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS:	Wheat					3,0	141					- 186
	Barley											25
	Maize					44,2	2080	50,4	688	48,8	488	3739
	Sorghum							10,0	137	10,0	100	625
	Others	15,0	365							3,0	30	366
	TOTAL	15,0	365			47,2	2221	60,4	825	61,8	618	4569
Field beans						4,0	188					188
MEALS:	Fish							1,0	14	0,5	5	22
	Meat					2,0	94	1,0	14	1,5	15	123
FEEDCAKES:	Soya	16,0	388	8,0	41	14,6	687	6,4	87	20,6	206	1525
	Groundnut											
	Colza	10,0	243					10,0	137			441
	Others	27,6	670									
	Total	53,6	1301	8,0	41	14,6	687	16,4	224	20,6	206	1966
By-products of maize:												
	Gluten							2,5	34			34
	Seedcakes											
Fat - Suet				21,0	108	0,1	5	5,4	74	1,6	16	203
Bran middlings and by-products		10,0	243			20,0	941					2325
Molasses		10,0	243			5,0	235					478
Starch				6,0	31							31
Manioc												423
Grass meal		5,0	121			5,0	235			5,0	50	635
Sugarbeet pulp												610
Urea		2,9	70									70
Unicellular organisms								10,0	137			137
Lysine												
Methionine						0,06	2,8	0,10	1,4	0,06	0,6	4,8
Minerals		3,5	83	1,0	5	2,05	96	3,17	43	8,9	89	316
Skim milk				29,0	149							175
Whey				35,0	180							202
TOTAL		100,0	2426	100,0	514	100,01	4705	99,97	1366	99,96	1000	12512

(1) Calves or any other animals consuming suckling feeds.

Table Annex III 5

BLEU

1977–1978
Hypothesis III

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat											
	Barley	33,1	253									253
	Maize							7,3	24			24
	Sorghum					40,8	1558	60,3	194	65,0	520	2272
	Others											1038
	Total	33,1	253			40,8	1558	67,6	218	65,0	520	3587
Field beans						4,0	153					153
MEALS:	Fish							1,0	3	0,5	4	7
	Meat					2,0	76	3,0	10	2,0	16	141
FEEDCAKES :	Soya			8,0	6	11,0	420	0,5	2	12,0	96	524
	-Groundnut											
	Colza	2,0	15			5,0	190	10,0	32	5,0	40	277
	Others	15,0	115									244
	Total	17,0	130	8,0	6	16,0	610	10,5	34	17,0	136	1045
By-products of maize :												
	Gluten											
	Seedcakes											
Fat - Suet				21,0	17			5,3	17	1,85	15	49
Bran middlings and by-products		15,0	115			15,0	573					945
Molasses		10,0	76			3,3	126					202
Starch				6,0	5							5
Manioc						10,0	382					382
Grass meal		18,7	143			5,5	210			5,0	40	853
Sugarbeet pulp												
Urea		3,0	23									23
Unicellular organisms								10,0	32			32
Lysine												
Methionine						0,08	3,1	0,2	1	0,09	0,7	4,8
Minerals		3,2	24	1,0	1	1,8	69	2,35	8	8,5	68	170
Skim milk				29,0	23	1,5	57					80
Whey				35,0	28							28
TOTAL		100,0	764	100,0	80	99,98	3817	99,95	323	99,94	800	7707

(1) Calves or any other animals consuming suckling feeds.

Table Annex
III 6

UNITED KINGDOM

1977-1978
Hypothesis III

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat	4,5	241			16,0	577			8,0	192	1116
	Barley	12,0	642			10,0	361					1015
	Maize					23,9	863	66,8	995	55,7	1337	3241
	Sorghum									5,0	120	120
	Others	22,1	1183									7882
	Total	38,6	2066			49,9	1801	66,8	995	68,7	1649	13374
Field beans						4,0	144					144
MEALS :	Fish							1,0	15	0,5	12	124
	Meat					5,0	180	5,0	75	5,0	120	375
FEEDCAKES :	Soya			6,0	2	7,6	274			7,8	187	484
	Groundnut					7,7	278	4,9	73	5,0	120	479
	Colza							6,2	92			92
	Others	4,0	214	6,0	2	4,0	144					358
	Total	4,0	214			19,3	696	11,1	165	12,8	307	1413
By-products of maize :												
	Gluten											
	Seedcakes	15,0	803									803
Fat - Suet				16,0	6	1,3	47	4,0	60	0,15	4	117
Bran middlings and by-products		18,0	963			9,0	325					3019
Molasses		10,0	535			4,0	144					679
Starch				2,0	1							37
Maniec												
Grass meal		7,6	407			5,0	180			5,0	120	707
Sugarbeet pulp												108
Urea		3,0	160									160
Unicellular organisms								10,0	149			149
Lysine												
Methionine						0,07	2,5	0,16	2,4	0,08	1,9	6,8
Minerals		3,8	203	1,0	-	2,4	87	1,9	28	7,8	187	505
Skim milk				35,0	13							13
Whey				40,0	14							14
TOTAL		100,0	5351	100,0	36	99,97	3607	99,96	1489	100,03	2401	21748

(1) Calves or any other animals consuming suckling feeds.

Table III Annex 7

DENMARK

1977–1978
Hypothesis III

		HEAVY CATTLE %	HEAVY CATTLE 1000 t	CALVES (1) %	CALVES (1) 1000 t	PIGS %	PIGS 1000 t	CHICKENS %	CHICKENS 1000 t	LAYING HENS %	LAYING HENS 1000 t	TOTAL (2) (all simple compound feeds)
CEREALS :	Wheat											
	Barley	20,0	140			39,4	472			10,0	25	658
	Maize					16,7	200					200
	Sorghum							63,9	224	46,9	117	364
	Others									5,0	12	12
	Total	20,0	140			56,1	672	63,9	224	61,9	154	1234
Field beans						4,0	48					48
MEALS :	Efsh							1,0	3	2,0	5	11
	Meat					6,0	78	2,0	7	4,0	10	97
FEEDCAKES :	Soya			8,0	2	20,2	242	4,3	15	16,3	41	319
	Groundnut	41,2	288									288
	Colza	4,2	29					10,0	35			64
	Others	8,1	57									57
	Total	53,5	374	8,0	2	20,2	242	14,3	50	16,3	41	728
By-products of maize :	Gluten											
	Seedcakes											
Fat - Suet				21,0	4			6,0	21	3,0	8	33
Bran middlings and by-products		8,0	56			2,0	24					80
Molasses		8,0	56									56
Starch												
Maniec				6,0	1							1
Grass meal		5,0	35			8,0	96			5,0	12	143
Sugarbeet pulp												
Urea		3,0	21									21
Unicellular organisms								10,0	35			35
Lysine												
Mehtienine								0,2	0,7	0,05	0,1	0,8
Minerals		2,5	18	1,0	-	2,16	26	2,65	9	8,7	22	75
TOTAL				29,0	6	1,5	18					24
				35,0	7							7
		100,0	700	100,0	20	100,0	1199	100,0	350	100,0	250	8173

(1) Calves or any other animal consuming suckling feeds.

Table Annex
III 8

I R E L A N D

1977–1978
Hypothesis

		HEAVY CATTLE		CALVES (1)		PIGS		CHICKENS		LAYING HENS		TOTAL (all simple compound feeds)
		%	1000 t	%	1000 t	%	1000 t	%	1000 t	%	1000 t	
CEREALS :	Wheat											
	Barley	56,2	56			21,3	155					211
	Maize					33,9	247	64,4	97	57,5	115	459
	Sorghum											
	Others					12,9	95			5,0	10	105
	Total	56,2	56			68,1	497	64,4	97	62,5	125	775
Field beans						4,0	29					29
MEALS :	Fish							1,0	1	0,5	1	2
	Meat					1,0	7	1,0	2	2,0	4	13
FEEDCAKES :	Soya			6,0	3	4,4	32	5,0	8	6,1	12	55
	Groundnut					3,1	23			5,9	12	35
	Colza							10,0	15			15
	Others											
	Total			6,0	3	7,5	55	15,0	23	12,0	24	105
By-products of maize :	Gluten											
	Seedcakes											
Fat - Suet				16,0	8			5,2	7			15
Bran middlings and b-products		22,0	22			9,0	66			9,1	18	106
Molasses												
Starch				2,0	1							1
Manioc												
Grass meal		14,8	15			7,0	51			5,0	10	76
Sugarbeet pulp												
Urea		3,0	3									3
Unicellular organisms								10,0	15			15
Lysine												
Mehtionine						0,01	0,1	0,12	0,2	0,07	0,1	0,4
Minerals		4,0	4	1,0	-	3,36	24	3,2	5	8,9	18	51
Skim milk				35,0	18							18
Whey				40,0	20							20
TOTAL		100,0	100	100,0	50	100,0	730	100,0	150	100,0	200	1229

(1) Calves or any other animals consuming suckling feeds

(2) The total includes simple feeds whose composition is unknown.

PROPOSALS BY THE COMMISSION OF THE COMMUNITIES

as regards products for animal feeding

In the document entitled "Adjustment of the common agricultural policy" (1) the Commission has brought together the results of the reflections which are briefly recalled below :

CEREALS

1/. Temporarily no increase in the price of soft wheat and relative rise in the price of barley and maize in order gradually to establish a better grading of cereals prices and to arrive at a joint price level taking greater account of the respective nutritional values of these products.

2/. Abolition (with effect from 10 February) of the system of denaturing and possible replacement by measures facilitating the changeover from wheat to fodder crops.

3/. Replacement of the regionalization of intervention prices by a single system of intervention prices for the whole Community for wheat and barley, similar to that of maize, rye and urum wheat.

4/. Abolition of interventions for cereals of qualities inferior to those of the model quality.

5/. Adjustment to the system of export refunds for the following products : maize and wheat starch, potato starch, maize grosts.

6/. Implementationof a complete and coherent storage policy focused on soft wheat and taking account of :

- The needs for regular supplies to the Community market,
- The need to guarantee security of supplies for human consumption (commitments as regards food aid) and possibly animal consumption.

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(1) Commission Memorandum to the Council COM (73) 1850 final - BRUSSELS, 31 October 1973.

7/. More flexible management. For example, change in the opening of the maize season in order to make barley more competitive each year from July to September.

PROTEINS

1/. Establishment of a better ratio between the prices of colza and sunflozer seeds, by a relative increase in those of sunflower, in order to favour expansion of its production (objective 200 000 tons in 1977/78, as against 70 000 in 1973), and not to favour that of colza too much.

2/. Extension to soya seed of the present support system granted to colza and sunflower seeds : adaption of this system in order to exclude any change in the import system (objective : 100 000 tons in 1977/78).

3/. Incentives to the dehydration of fodder plants (in particular lucerne) to increase their availability on the market.

4/. Reduction in the price of selected seeds of leguminous fodder vegetables (peas, field beans) produced in the Community as in third countries.

5/. Establishment of a research programm for the elaboration and development of seed varieties calculated to increase the production of proteins, in particular:

- hybrid field bean seeds
- protein-rich cereals

6/ Uniformization in the Community countries of the rules for the use of urea in animal feeds in order to obtain an economy of proteinaceous products.

7/. The study of any technique making possible the production of proteins, including that of the harmonization of legislation.

OLEAGINOUS PRODUCTS

a/. Revision of the regionalization of prices so as to abolish the supplementary aid for colza seeds processed in Italy.

b/. Establishment of programme of research and diffusion of selected colza seeds with characteristics eliminating the obstacles at present limiting their utilization.

MILK

1/. Introduction of a temporary production contribution on milk delivered to dairies to discourage milk production for the time being.

2/. Change in the ratio of fat to nitrogenated and substance with the aim of a relationship passing from 58/42 to 50/50, and an intervention price for powdered skim milk of 76.80 UA/100 kg, as against 66.00 at present.

- -

5/. Making of various technical adjustments to the common market organization to increase its flexibility,

- for example : more latitude in the fixing of aid to milk powder.

Recapitulatory tables by countries (in 1000 metric tons)

GERMANY F.R.

		Utilisations 1970-71	Forecast utilizations in 1977-78		
			Hypothesis I	Hypothesis II	Hypothesis III
Cereals	Wheat	3.058	2.201	2.201	2.201
	Barley	4.216	4.514	4.303	4.303
	Maize	2.101	4.466	4.470	4.745
	Sorghum	128	329	210	213
	Others	5.546	5.535	5.271	5.271
	Total	15.049	17.045	16.455	16.733
Field beans		106	106	1.251	211
Meals	Fish	518	269	177	201
	Meat	70	109	109	109
Feedcakes	Soya	2.133	2.634	969	2.565
	Groundnut	130	)	?	?
	Colza	153	) 1.868	92 (1)	764 (1)
	Others	1.420	)	1.718	1.047
	Total	3.836	4.502	2.779	4.376
By-products of maize	(Gluten	)	212	92	100
	(Seed cakes	) 136	188	188	188
Fat suet		41	109	93	87
Bran middlings and other by-products		3.447	3.605	3.530	3.530
Molasses		431	499	499	499
Starch		-	5	5	5
Manioc		557	9	9	9
Grass meals		244	436	874	854
Dry beet pulps		932	908	908	908
Urea		4	81(1)	81(1)	81 (1)
Unicellular organisms		-	-	945(1)	93 (1)
Lysine		0,593	-	0,18	0,18
Methionine		?	5	3,94	2,35
Mineral		?	574	579	568
Skim milk		163	89	89	89
Whey		-	155	130	155

(1) Compound feeds only

Recapitulatery Tables by countries (in 1.000 metric tons)

FRANCE

		Utilisations 1970-71	Forecast utilizations in 1977-1978 Hypothesis I	Hypothis II	Hypothesis III
CEREALS :	Wheat	3.824	3.164	2.604	3.164
	Barley	4.747	5.431	4.933	4.931
	Maize	3.754	6.382	5.809	6.537
	Sorghum	89	-	232	232
	Others	2.525	2.928	2.696	2.696
	Total	14.939	17.905	16.274	17.560
Field beans		49	49	1.295	249
Meals	Fish	86	44	9	38
	Meat	83	265	267	267
Feedcakes	Soya	1.315	1.653	307	959
	Groundnut	365	)	?	446
	Colza	177	) 1.220 (1)	230 (1)	645 (1)
	Others	383	)	753	342
	Total	2.240	2.873	1.290	2.392
By products of maize	(Gluten (Seedcakes	)) 15	46 -	46 -	46 -
Fat - Suet		96	299	322	318
Bran, middlings and other products		1.798	1.978	1.965	1.965
Melasses		143	278	279	278
Starch		23	61	61	61
Maniec		32	21	613	21
Grass meal		355	574	907	901
Dry beet pulp		292	268	268	268
Urea		10	41 (1)	41 (1)	41 (1)
Unicellular organisms		-	-	1.073 (1)	230 (1)
Lysine		0,37	-	0,2	0,23
Methionine		-	2,1	6,7	3,3
Minerals		?	387	398	406
Skim milk		415	324	323	324
Whey		10	415	314	415

(1) Compound feeds only

Recapitulatory tables by countries (in 1000 metric tons)

I T A L Y

		Utilisations 1970-71	Forecast utilizations in 1977-78 Hypothesis I	Hypotheis II	Hypothesis III
Cereals	Wheat	320	?	?	?
	Barley	1.301	?	?	?
	Maize	8.156	2.124 (1)	1.549 (1)	1.958 (1)
	Sorghum	24	?	?	?
	Others	714	?	?	?
	Total	10.515	10.945	10.686	10.862
Field neans		397	397	270	39
Meals	Fish	96	96	96	-
	Meat	10	10	10	-
Feedcakes	Soya	941	542	180	513
	Groundnut	43	-	?	?
	Colza	104	-	?	?
	Others	1.754	21	2.167	2.167
	Total	2.842	2.709	2.347	2.680
By-products of maize	Gluten	135	44	45	45
	Seed cakes		-	-	-
Fat, suet		-	97	97	97
Bran, middlings and other by-products		2.885	3.166	3.034	3.055
Molasses		65	79	79	79
Starch		-	26	26	26
Manioc		-	-	-	-
Grass meals		17	142	328	326
Dry beet pulps		1.750	1.750	1.750	1.750
Urea		2	22 (1)	22 (1)	22 (1)
Unicellular organisms		-	-	334 (1)	-
Lysine		0,045	-	-	-
Methionine		?	1	0,6	1
Minerals		?	245	252	247
Skim milk		- (2)	160	158	157
Whey		-	154	110	154

(1) Compound feeds only

Recapitulatory Tables by countries (in 1.000 metric tons)

NETHERLANDS

		Utilisations in 1970-71	Forecast utilizations in 1977-1978: Hypothesis I	Hypothesis II	Hypothesis III
CEREALS:	Wheat	305	-	- 327 (2)	- 18[illegible] (2)
	Barley	266	401	25	25
	Maize	1.846	3.315	2.740	3.739
	Sorghum	506	625	625	625
	Others	282	366	366	366
	Total	3.205	4.726	3.429	4.569
Field beans		103	103	952	188
Meals	Fish	85	54	3	22
	Meat	93	123	123	123
Feedcakes :	Soya	1.100	1.868	673	1.525
	Groundnut	5	-	?	?
	Colza	73	243 (1)	137 (1)	380 (1)
	Others	616	123	306	61
	Total	1.794	2.234	1.116	1.966
By-products of maize	Gluten	-	34	36	34
	Seedcakes	-	-	-	-
Fat - Suet		186	207	251	203
Bran middlings and other by-products		1.865	2.324	2.325	2.325
Molasses		380	619	619	478
Starch		-	31	31	31
Manioc		523	423	894	423
Grass meal		229	350	635	635
Dry beet pulps		610	610	610	610
Urea		?	70 (1)	70 (1)	70 (1)
Unicellular organisms		-	-	760 (1)	137 (1)
Lysine		0,197	-	-	-
Methionine		?	4,3	7,7	4,8
Minerals		?	333	337	316
Skim milk		190	175	175	175
Whey		78	202	151	202

(1) Compound feeds only

RECAPITULATORY TABLES BY COUNTRIES (in 1000 metric tons)

B L E U

		Utilisations 1970-71	Forecast utilizations in 1970-78 Hypothesis I	Hypothesis II	Hypothesis III
Cereals	Wheat	506	-	-	-
	Barley	789	673	253	253
	Maize	688	60	1.198	24
	Sorghum	488	1.983	573	2.272
	Others	473	-	1.038	1.038
	Total	2.944	3.754	3.062	3.587
Field beans		7	7	740	153
Meals	Fish	118	11	-	7
	Meat	37	140	141	141
Feedcakes	Soya	499	714	6	524
	Groundnut	64	-	-	-
	Colza	55	236 (1)	48	277
	Others	271	244	244	244
	Total	889	1.194	298	1.045
By-products of maize (	Gluten	) 58	-	-	-
(	Seed cakes	)	-	-	-
Fat, suet		58	57	40	49
Bran, middlings and other by-product		843	1.025	945	945
Molasses		110	210	210	202
Starch		-	5	5	5
Manioc		278	382	573	382
Grass meals		65	603	857	853
Dry beet pulps		388	-	-	-
Urea		?	23 (1)	23 (1)	23 (1)
Unicellular organisms		-	-	503 (1)	32 (1)
Lysine		0,004	-	-	-
Methionine		?	3,5	5,52	4,8
Minerals		?	193	210	170
Skim milk		51	80	81	80
Whey		-	28	20	28

(1) Compound feeds only

Recapitulatery Tables by countries (in 1.000 metric tons)

UNITED KINGDOM

		Utilisations in 1970-71	Forecast utilizations in . 1977 1978 Hypothesis I	Hypothesis II	Hypothesis III
CEREALS :	Wheat	3.874	1.164	719	1.116
	Barley	6.306	1.318	1.015	1.015
	Maize	1.497	2.638	2.979	3.241
	Sorghum	76	805	104	120
	Others	1.153	1.183	7.882	7.882
	Total	12.906	13.807	12.699	13.374
Field beans		77	77	830	144
Meals :	Fish	385	235	97	124
	Meat	205	376	351	375
Feedcakes :	Soya	483	639	23	484
	Groundnut	328	416	372	479
	Colza	100	-	81	92
	Others	346	478	358	358
	Total	1.257	1.533	834	1.413
By products of maize	Gluten	-	-	-	-
	Seed cakes	-	803	803	803
Fat - Suet		45	66	149	117
Bran middlings and other by-products		3.032	3.018	3.019	3.019
Molasses		414	679	679	679
Starch		-	37	36	37
Manioc		-	-	-	-
Grass meal		-	407	707	707
Dry beet pulps		108	108	108	108
Urea		14	160 (1)	160 (1)	160 (1)
Unicellular organisms		-	-	754 (1)	149 (1)
Lysine		0,535	0,4	-	-
Methionine		?	5,4	4,4	6,8
Minerals		?	484	503	505
Skim milk		-	13	13	13
Whey		8	14	11	14

(1) Compound feeds only

Recapitulatory Tables by countries (in 1000 metric tons)

D E N M A R K

		Utilisations 1970-71	Forecast utilisations - 1977 - 1978		
			Hypothesis I	Hypothesis II	Hypothesis III
Cereals	Wheat	153	-	-	-
	Barley	4.514	1.004	654	658
	Maize	3	8	143	200
	Sorghum	227	379	362	364
	others	749	13	12	12
	Total	5.646	1.404	1.171	1.234
Fields beans		36	35	256	48
Meals	Fish	80	58	8	11
	Meat	96	91	79	97
Feedcakes	Soya	545	330	35	319
	Groundnut	-	288	288	288
	Colza	24	29	64	64
	Others	446	77	57	57
	Total	1.015	724	444	728
By-products of maize	(Gluten	) -	-	-	-
	(Seed cakes	)	-	-	-
Fat, suet		-	23	32	33
Bran middlings and by-products		1.211	80	80	80
Molasses		44	56	56	56
Starch		-	1	1	1
Manioc		-	-	-	-
Grass meals		-	35	155	143
Dry beet pulps		-	-	-	-
Urea		?	21	21	21
Unicellular organisms		-	-	182	35
Lysine		?	-	-	-
Methionine		-	0,8	1	0,8
Minerals		?	62	73	75
Skim milk		36	24	24	24
Whey		-	7	5	7

(1) Compound feeds only

IRELAND

		Utilisations in 1970-71	Forecast utilizations - 1977-1978 Hypothesis I	Hypothesis II	Hypothesis III
CEREALS	Wheat	?	-	-	-
	Barley		652	285	211
	Maize		153	346	459
	Sorghum		-	-	-
	Others		88	10	105
	Total	708	893	641	775
Field beans		?	?	147	29
Meals	Fish	39	27	-	2
	Meat		13	13	13
Feedcakes	Soya	?	46	10	55
	Groundnut		46	10	35
	Colza		-	15	15
	Others		-	-	-
	Total	100	92	35	105
By-products of maize	Gluten	?	-	-	-
	Seed cakes		-	-	-
Fat - Suet		?	12	16	15
Bran, middlings and other products		82	88	88	106
Melasses		?	-	-	-
Starch		?	1	1	1
Manioc			-	-	-
Grass meal		?	15	91	76
Dry beet pulps			-	-	-
Urea		?	3 (1)	3 (1)	3 (1)
Unicellular organisms			-	113 (1)	15 (1)
Lysine			-	-	-
Methionine			0,4	0,3	0,4
Minerals		?	46	49	51
Skim milk		?	18	18	18
Whey			20	15	20

(1) Compound feeds only.

CHAPTER VIII

D/ SUMMARY AND CONCLUSIONS

SUMMARY AND CONCLUSIONS

I. Summary

In the course of the long period which has gone by, animal production in the member countries of the European Economic Community has developed largely thanks to the research carried out into animal feeding, to the progress of genetics, and to the nature of the resources in feedingstuffs available to Community producers. The price ratios feedcake have been particularly favourable to the intensive use of cereals proteins. Thes two factors have helped to give rise to many new problems, linked, for example, with the organization of production based on the running of high-performance animals and the Community's supplies of fodder products. Cereals requirements have gone up slightly. On the other hand, imports of concentrated protein products, of which the Community at present produces practically none, have not ceased to swell to the point of causing a great dependance for soya cake on the United States, which is the main exporter of this product. In addition, pigmeat and poultry meat have strengthened their competitive character in comparison with beef and veal. The area of grassland and pasture has again fallen little by little and some of it has constituted a reserve of land for other forms of farming.

THE ANIMAL FEEDINGSTUFFS INDUSTRY

The manufacture of compound feeds for animals has assumed considerable importance in recent years thanks to the trend of the market for animal feedingstuffs. As there does not exist in Nature any raw material able to cover all the energy, protein, vitamin and oligoelements requirements of an animal species, it has been necessary to call on compound feedingstuffs. The result has been the gradual abandonment - still too slow sometimes - of old nutritional customs of artisan and irrational modes of feeding and greater elasticity of demand for the main fodder products. Practically all the undertakings belonging to this industry have equipped themselves with powerful calculation media for the purpose of establishing formulatea of compound feeds, least costly and at the same time best balanced to cover the numerous known nutritional requirements of the different categories of animals. The result has been an extreme sensitivity to the variations of market prices.

THE DIALOGUE BETWEEN MANUFACTURERS AND THE PUBLIC AUTHORITIES

It is sometimes difficult to inaugurate such a dialogue when the objectives on the two sides do not concord. This is the case, for example, when the objective of the manufacturers consists, with the aim of improving the profitability of animal production, in countering the defects of the fixing of the price of certain raw materials in the setting of the Common Agricultural Policy by importing "substitutes" whose prices are formed freely on the world market and which do not pay any levy when they enter the Community. This is what has happened, for extra-Community manioc which has been a competitor for precisely to throw light on the aims and strategy of these undertakings.

THE COMMUNITY'S PROTEIN DEFICIT

With a view to reducing this deficit in the long term an effort could be undertaken to increase the production of a few agricultural raw materials some of which have lost a great deal of important in recent years (for example field beans) or have never been exploited on a scale corresponding to a large immediate production potential (for example soya beans, sunflower, dehydrated meals of leguminous vegetables and graminaceae) others again (like lysine-rich maize) are entirely new, and in this report we have endeavoured to determine the levels of prices above and below which their production could be a profitable business for farmers and their utilization for the manufacturers of compound feeds, in certain formulae and taking into account the prices of other raw materials obtaining at the end of 1973.

AID FROM THE CHEMICALS INDUSTRY

The chemicals industry, too, can help to reduce the European deficit by supplying mainly three categories of raw materials :

1/. Urea, or more exactly "non-proteic nitrogenated compounds" which are better adapted than urea to the conditions of European stock breeding, with the idea of drawing the maximum profit from the gastric flora of ruminants and its capacity to synthesize the majority of the amino acids and to reduce, as in the United States, the consumption of feed cake in the neurichment of ruminants.

2/. Amino acids, including :

a) Methionine, which has already contributed to reducing the primary limiting factor caused by its deficiency in the majority of vegetable products, including soya make, and

b) Lysine, which makes it possible to reduce a secondary limiting factor and to substitute in part a mixture of cereals and amino acids for feed cakes.

c) Tryptophane. It should be noted that several undertakings, of which one at least within the Community, are today planning to manufacture this on an industrial scale in order further to enlarge the possibility of substitution (researches are even studying the distribution to the animals of complets seeds which would no longer contain any protein concentrates.

3/. Unicellular organisms such as fungi, algae, yeasts from agricultural industries (distillery yeasts, lactic yeasts, molasses yeasts, etc.) mushrooms, bacteria yeasts cultivated on different substrata desulphuration lees of the paper industry, domestic vaste, petroleum products, etc.

The problems of the tolerance of the unicellular organisms by the monogastric animals (calves, pigs, poultry) and by the human consumer (if the optimus quantities to be introduced into mixtures of compound feeds, have given rise to very long and very important studies. Using as a basis reasonable rates of incorporation chosen after numerous tests in vivo, it would seem that the Community countries could use up to 4.5 million tons (corresponding to 2.5/3 million tons of protein or the equivalent of 5.5/7 millions tons of soya cake) of these products towards 1977/78. Obviously this quantity is far in excess of the production capacities at present being built.

REVISION OF THE NITROGENATED STANDARDS

Finally, the possibility, which cannot be excluded, of new protein crises in the long term makes it compulsory to envisage a reduction of the rates of these nutrients in the formulae of cattle feeds. It would indeed seem that, in animal feeding as in other fields (concumption of petrol, electricity, etc). we realize today that we have lived these recent years in a civilization of "waste".

When one reviews the causes of the present over-consumption of proteins, their diversity is striking. Already (early 1974) savings have been achieved. Others can be by the application of relatively simple measures. It must not be forgotten, for example, that in a formula containing 30% of soya cake and contributing 21% of proteins, a reduction of the latter rate to 20% (- 4.8%) for example, makes it possible to reduce the incorporation of the cake to 27.5%, or a saving of 9.2% (1).

In this example the contributions of lysine and methionine + cystine still remain in conformity with the present standards after the reduction of the soya cake. This dimunition of contributions must not lead to a reduction of animal performances. On the other hand, if there is reduction below the standards, a fall-off in performances must be expected but because of the existence of decreasing yield in the utilization of the proteins, the yields of the animals fall to a certain threshold, less than proportionally to the reduction in the availability of the amino acids.

PROJECTIONS FOR 1977-79 : THE VARIOUS HYPOTHESES

Taking into account the projections of the different forms of animal production in each of the Community countries for the period 1970/71 - 1977/78 and the gradual penetration of the different categories of compound feeds, it may be admitted that in the medium term the utilizations of concentrated fodder products will increase in all by 2.2% and those of the compound feeds alone by 5.6% annually (as against 2.9% and 6.8% respectively between 1965 and 1972).

(1) Formula for table chicken :

Protein rate	21 %	20 %
Wheat	55	58
Soya cake	30	27,5
Suet	10	9,5
Miscellaneous	5	5
TOTAL	100	100
Energy	3 200 K calories	3 200 K calories

The outlook for the utilization of the different raw materials for animal feeding has been established under different hypotheses concerning, in particular :

- the possibility of increasing utilizations of urea and grass meals;
- the possibility of substituting lactoserum for dry skim milk in the feeding of calves,
- the more or less considerable diminution of subsidies for the utilization of wheat and sugar in fodder,
- the increasing scarceity of fish meal,
- the stagnation of availabilities of barley, cats, brans and other by products of the human foodstuffs industry.

Hypothesis I, built up on the above basis, leads to increases in the utilization of maize and soya cake of + 5.6 and + 2.5% per year respectively on condition that the production of colza is doubled in 7 years and that there exists an adequate supply of meat meal, fats and molasses.

Hypothesis II, which is deliberated unrealistic, shows that imports of proteic concentrates could be greatly reduced only if several million metric tons of field beans and unicellular organisms rich in protein were produced by agriculture and industry.

Finally, Hypothesis III, shows that, if Community production of replacement products were the subject of very stimulating measures, and were in particular sheltered from the ups and downs of the market, imports of soya cake, which would remain free, would be situated in the coming years within the same limits as during the basis period. However, the Community's maize requirements would grow by 6.1% yearly.

II. Conclusions concerning the technical, economic and political aspects of this study :

The growing demand for animal products, the rising prices for fodders originating in the Community, the emergence of "industrial" techniques of animal production, have brought about, in recent years, certain changes in the structure of animal feeding and production. These changes have been seen mainly in the introduction, on an ever-increasing scale, of raw materials not produced in the Community and even, at present, by the use of products of industrial origin. The recent world proteins crisis and the considerable rise in raw materials prices, call into question a certain number of equilibria and in particular that of animal feeding and the structure of present-day live stock breeding. In the recent past edifice was built within the Community resting on the following four columns : Community cereals production, free imports of complementary products indsutrial processing at the most favourable cost and animal production based on an intensive method. The result of this structure has been to make animal production dependent on fodder resource which are largely imported - its main item of expenditure - and to make Community animal production hypersensitive to the crises which have shaken the world market in the last two years. In this way, new problems arise at the level of :

- the proceducers of fodder raw materials in the Community (cereals, milk and proteinaceous products,
- the producers of fodder raw materials of other than agricultural or maritime origin (amino acids, nitrogenated non-protein products and unicellular organisms)
- Community livestock breeders,
- Manufacturers of compound feeds.

II.1. Problems concerning producers of cereals, milk and proteinaceous products within the Community.

In order to safeguard Community livestock breeding from the foreseeable shocks to the markets for fodder products, the different forms of Community production have to be watched over more closely from the angle of animal feeding. This action should be carried on by priority in the three fields of cereals milk products and proteinaceous products.

II.1.i. Cereals :

The hypothesis according to which the uses of wheat in animal feeding would decline in the future does not appear satisfactory. Availabilities of oats and barley being stagnant or diminishing, one is led to envisage an increase, which is manifestly too strong, in the utilization of maize : between + 4.7% (Hypothesis II) and + 6.1% (Hypothesis III) annually between 1970-71 and 1977-78, whereas the Community already has a large deficit (net imports of the order of 11 million metric tons per year in 1971-1972) and its production is increasing only slowly (+ 2.5% on the average per annum between 1965-1966 and 1971-1972). This hypothesis appears all the more out of place since the diffusion of high-yield varieties of fodder wheat at present nakes it possible to hope for very considerable availabilities of this cereal, whose incorporation into the aniaml feeding formulae presents the dual advantages of reducing protein concentrates requirements when the wheat is substituted for maize, and reducing requirements in fats when it is substituted for barley.

The hypothesis of a reduction in the fodder u tilization of wheat has been chosen under the influence of the conditions which obtained during the 1972-73 season; the world prices for wheat led to its denaturing premium being reduced to 0 in 1974. It would seem dangerous to raise a decision which was motivated only by short-term economic considerations to the rank of a principle of medium or long-term policy in the present state of the Common Market organizations. Let us recall that if, for example, the decision to reduce the denaturing premium had been taken in the middle of a protein crisis, say during the summer of 1973, it could have had grave consequences by further increasing the protein requirements of manufacturers of compound feeds.

This example shows how difficult it can be to establish price schedules for cereals applicable both at the production and the utilization stage while the prices of the complementary and substitute products for cereals have fluctuated freely within more or less wide limits over the last two seasons.

If, in future, the prices of proteic concentrates are destined to increase more rapidly than those of the energy products, manufacturers of compound feeds will be prepared to pay more than its value for wheat which is richer in protein than maize, comparing the two products at present on the market. The contray state of affaires can occur if the prices of fat or manioc become tight. It would then be a pity if, under such conditions, the rigidity of a system of prices established essentially in the setting of a medium-term production policy should lead to the creation of surpluses of one of these cereals and of extra import requirements for the other.

Taking into account the practice of the animal feedingstuffs industry it is desirable, in order to ensure better balance between Community availabilities and needs, to replace the price gradient at present of common prices (a threshold price and an intervention price applying to all cereals). By abolishing the compartmentation of prices between the cereals used in animal feeding, this system would make it possible to provide livestock farms and manufacturers of cattle feeds with a range of products placed in the same conditions of competition when allowance is made for the fluctuations in the prices of the other complementary raw materials (fat, manioc, cake, middlings etc.) The gap between the intervention price and the threshold price would need to be sufficiently wide for the market prices of the different cereals to fluctuate freely in order to ensure a better balance between supply and demand, which would also have a beneficial effect on the income of European cerals producers.

A policy of administration of the availabilities should normally have the effect of eliminating purchases at the intervention prices at least for as long as the Community remains an importer of cereals. However, it would appear that the present system will have to be reviewed in the event that we should see high world prices, above the Community prices, becoming a permanent feature of the situation. In addition, we may note an aggravation of the distortion of cereals prices between producer and deficit countries within the Community, inter alia because of rising transport costs. Recourse to a stocking policy on world scale, in which of course, the E.E.C. would participate, could also be envisaged.

Finally, and again as regards cereals, it would seem doubtful that lysine-rich maize can, under the present economic conditions, find important markets in view of its higher prime cost. At a period when soya cake was very cheap, it had been calculated that OPAQUE 2 maize could not be offered to manufacturers of compound feeds at a priceexceeding that of ordinary maize by more than 1/FF/q (0.10 UA/q) a level obviously inadequate to offset the small yields of the improved maize. Even under the economic conditions chosen in this study (September 1973), this extra price would only be from 4 to 5 FF/q (0.72 UA to 0.90 UA/q) for a limited market (chicks). It would only be in the event of soya cake reaching 200 FF/q (36 UA/q) that manufacturers could enviage paying a sufficiently high extra price for this maize (+ 7.80 FF/q or 1.40 UA/q) and offering it a sufficiently important market (fattening chickens). There is reason to hope that seeds will rapidly be perfected which will make it possible to produce this new maize but with yields comparable to ordinary maize.

II.1.ii. Milk products (skim milk powder, dry lactoserum)

The solubility of skim milk powder has been the determining factor in its value for the feeding of calves, and particularly of those intended for slaughter. However, because of the high price of skim milk, research has been going on for several years with a view to reducing its utilizations in the feed of suckling animals. The manufacturers of these feedingstuffs have thus managed to bring down the proportion of milk powder from about 80 to 65% between 1965 and 1970 for the Community as a whole. The present study has adopted the hypothesis that this proportion would fall to about one third in 1977/78. In the course of the period covered by the forecast manufacture of suckling feeds would rise from 1.6 to 2.4 million metric tons while, however the utilizations of milk powder would drop from 1 046 000 (including small quantities of whole milk powder) to 965 000. The market loss is all the more sensitive since breeders are still using probably 7/8 million metric tons of whole milk and 7 million of liquid skim milk and grave surplus situation might well result from the reduction of these utilizations in the liquid state, the loss of the market for suckling feeds and a fall - which is always possible - in the outlets for powdered milk on world markets.

In the feeding of calves for slaughter, lactoserum, another soluble product, can partially replace skimmed milk powder. As regards breeding calves, the substitution products, apart from lactoserum, are a special meat of dehusked soya cake, various fish and yeast concentrates, which although not soluble can be placed in suspension. In the event that skimmed milk powder should lose its outlets as suckling food and that surpluses should build up, these would need to be incorporated - as was occasionally done in the past into feeding stuffs for monogastric animals. However, in this case, its price would have to be fixed very low, since its solubility property would no longer be of any interest and the milk powder would be in competition with proteic concentrates which are cheaper and richer in amino acids.

It would seem to be an incoherent and financilly a very costly proceeding to deprive milk powder of its most profitable market - that of suckling feeds - and then subsidies its use in the feeding of the monogastric animals.

II.1.iii. <u>Proteinaceous products of agricultural origin</u> :

<u>Field beans</u>

Contrary this plant, from humid zones and consequently not a competitor for maize. The utilization of the fields bean (one million tons in 1977/78 under Hypothesis III) helps to reduce both that of cereals (in the proportion of about 60%) and that of feedcakes (40%). A cereals deficit could arise from the difference in the hectare yields of the cereals and the field beans if the latter had to be grown on barley or wheat land. This being so, only a high-yield production - of the order of 40 quintals per hectare - should be envisage and supported. The form of support needs to be specified, both at the level of the level of the production of seeds and at that of the utilization of the grain in view of the price at which manufacturers of compound feedingstuffs would be prepared to buy it (less 130 UA/t at the end of 1973).

Soya beans

Within certain limits this oilseed can be produced in the European Community. However, the present objectives of the Commission for 1977/78 (100;000 metric tons of 70 000 of cake) appear negligible; they represent less than 1% of Community consumption in 1972. Larger production would of course be conceivable if growers could get a satisfactory price for it. Unfortunately, there seem to be no pointers to a desirable price at the present time. The target price proposed for the 1974/75 season (222 UA/t) is twice that of maize. It may therefore not be excluded that the objectives and the importance of support for soya production will be reexamined in the light of the results achieved during the coming seasons.

Colza-rape seed and sunflower graine

The amino acid, cellulose, energy and other contents of the cake made from these grains differ fairly widely.

In order to determine the relative interest of colza and sunflower cake, calculations have been carried out on the computer using for the other fodder products the prices obtaining at the end of 1973. The following table shows manufacturers of compound feeds are prepared to pay an extra price for colza cake, save in one case - that of laying hens :

Price below which colza and sunflower
cakes can be used (UA/q)

C a k e s	Pig feed	Poultry feed	Feed for Laying hens
Colza cake	16.32	14.38	15.30
Colza cake			
- with 43% proteins 14% cellulose	14.43	12.59	17.68
- with 36% proteins 20% cellulose	13.15	10.13	14.62

These calculations therefore contradict the trend not to favour colza because of the difficulties of selling the oil. Under Hypothesis III, it seen that colza cake could have a considerable market (2 237 000 metric tons, taking into account the physiological limits of the use of this cake). If the computer calculations did not reveal any hope of similar progress in the utilization of sunflower cake, this was because of the lysine deficit of the latter. The fact is that 80 000 tons of sunflower cake, require an extra 1 200 tons of industrial lysine.

Leguminous vegetables and dehydrated graminaceae

These products find markets both in the feeding of ruminats and of poutry. When their protein and pigmentation elements contents are sufficient, they can also be used in numerous regions of the Community for the production of Guinea fowl, yellow-flesh chicken and coloured-yolk eggs. This study has shown that they can make a substantial contribution to protein supply, since, under Hypotheses II and III, their utilizations would reach 4.5 million metric tons as against less than one million in 1970/71.

In order gradually to attain a substantial increase in productions, two conditions have to be fulfilled :

- the establishment of dhydration plants of adequate size and sufficiently close to the places of productions;

- a direct aid, aimed at stimulating productions, to be distributed to the dehydrating enterprises which would have to pass on this aid to producers irrespective of whether the products are intended for marketing or remain in closed circuit (drying contract).

II.2 . Problems concerning producers of industrial forage raw material (amino acids, non-proteic nitrogenated products and unicellular organism).

II.2 i.Amino acids :

The efforts of Community industrialists make it possible to enusre that manufacturers of compound feedingstuffs can easily obtain supplies of methionine, a valuable element if it should turn out that the Comunity's supplies of proteic material are to be ensured thanks to the contribution of raw materials whic are poor in this amino acid (field bean, colza, soya). As regards lysine tryptophane, their utility has not emerged in the metting of this study, in the hypothesis of easy supply of oilcakes field beans and unicellular organisms rich in these amino acids has been chosen. In the event that world supply should become limited to a considerable extent, and the Community policy of developing production of protein containers should fail, the large-scale manufacture of lysine and tryptophane would have to become a priority objective.

II.2.i.i. Non proteic nitrogenated products

Taking into account the possibility of replacing some of the protein in the feeding of ruminants by non-proteic nitrogen, the Community has every interest in developing to the maximum possible the utilization of urea and of its analogous products by abolishing, through adequate to legislations, the over-severe prohibitions and limitations on their use which still exist in certain countries.

The product best adapted to the conditions of European livestock brading would seem at present to be DUIB, a;product perfected and exported by Japan and whose maximum market, around 1977/78, in view of its nitrogen content, would be of the order of 550 000 tons. This tonnage would easily justify considerable production in several Community countries - production which could do without direct aid.

The supply of a nitrogenated feed cheaper than the traditional mixtures based on cakes would constitute, as xas the case is the United States during the 60's, a favourable factor for the production of beef and veal. In addition, the spread of the promining technique of the transplantation of feoundated ovules in vitro with a view to twin births could make it possible to avoid increasing milk production beyond requirements.

II. 2.i.i.i. Unicellular organisms :

There are numerous industrial projects at present aimed at developing the production of unicellular organisms cultivated on alkanes, a product which seems according to present research to offer sufficient security, and to launch the culture of other organisms. Their first market should normally be that of feeding for table poultry. Rapid development of production is desirable and possible on condition that competitive prices can be achieved. Industrial producers would certainly desire to be ensured under the aegis of the public authorities, of guaranteed outlets during a period long enough to enable them to spread their ammortization oultlay.

The problem of the granting of an aid should then not arise except in the event of the prices of cakes and animal meals falling brutally and temporarily in the course of the period envisaged for the industrial ammortization operations. For their part,the animal feedingstuffs firms will certainly be prepared to absorb the planned production (i.e. about 700 000 metric tons in 1977/78 under Hypothesis III), if they can obtain this cheaper than the cakes and the animals meals.

II.3. Problems concerning Community breeders

The European Community has been able to develop its animal production by replacing the traditional forms of breeding by intensive modes of production which have permitted very considerable savings of fodder products : pigmest and poultrymeat, eggs and, as regards bovine cattle, calves for slaughter and young animals. In producing these feeding onthe basis of concentrated products, including the suckling feeds, represents 70 to 80 % of total costs, the remainder having to cover the cost of the young animals, expenditure on energy, veterinary costs, remuneration for work and investments.

Within the Community,expenditure on animal feeding consists of :

- a fixed element, which is represented by cereals - a dear but also a stable item, whose prices fluctuate but little within a bracket defined in advance;
- a mobile and changing element consisting of products imported at 0 duty and whose prices fluctuate at the will of the international markets.

from time to time, certain products coming under a common market organization which benefit from a temporary denaturing bonus: sugar, butter, milk powder for monogastric animals etc. in the light of the situation of their markets.

The income of European breeders applying intensive feeding techniques consists of a "fattening margin" the size of xhich has hitherto varied sometimes within limits fixed by the production contracts, in the light of the crisis for animal products and of those of the raw materials making up the "mobile" part of the feeding.

As regards the forms of production based on intensive feeding techniques, the present common agricultural policy has not provided for machinery to protect the price of animal products from the variations of those of certain raw materials. The result is that this category of breeders is less well protected than those producing milk or beef and veal obtained according to the traditional methods.

Until the 1972/73 season, these breeders had, however, been able to adapt themselves, at the cost of a few crises, to their insecure situation because the proteic concentrates, which make up the bulk of the "mobile" part of their fodder outlay, were plentiful and cheap, the demand for meat was strong, and the price of beef and veal, their main competitors, was foing up fast.

The outlook for the future is threatening for the producers of intensive animals : rising prices for proteic concentrates and, doubtless, for cereals; perhaps more hesitant demand for meat; increased irregularity of the markets, which could trigger off more and more frequent and deep-seated crises in the production of pigmeat, poultry, calves for slaughter and young cattle.

It is to be feared that the world situation will aggravate the insecure position of breeders using intensive feeding techniques. A more unfavourable treatement of these persons might well lead to the abandonment of lodern feeding techniques and a return to unproductive artisan methods.

II.4. Problems concerning manufacturers of compound feeds.

The manufacturers of compound feeds in the Community have benefited from a long period of prosperity during which they have been able to equip themselves with valuable calculation media in order to face the period of insecurity which began during the winter of 1972. We have seen in Chapter VII a great part of the techniqcl possibilities of substitution on which these industrialists will have to call in the future. More and more the interests of these manufacturers and those of the public authorities will tend to converge. However, we note that the economic and legal conditions have not so far been very favourable to the establishment of sufficiently close relations between them. One of the first efforts to launch this dialogue would seem necessarily to involve the establishment of harmonized legislation whose affect will be to create a genuine community of the manufacture of animal feedingstuffs.

Despite the publication of several Council Directives dealing in particular with Community methods of analysis for cattle feeds and "additives" much still remains to be done, particularly in the field of marketing of the compound feeds and that of the quality standards of the raw materials.

It is important that a single Community legislation for compound feeds should be in force as soon as possible. It would replace all the other national provisions prior to the Community Directives. Some of these provisions, which are far too out of date, are impediments to the capacity of industrialists to react in face of the economic conditions of the market, since they impose on them minimum incorporations of raw materials whic are useless and costly, or forbid them to incorporate others which could bring down the sale prices of the feeds.

True, some industrialists maintian, that, in view of the very small amount of intra-Community trade in cattle feeds, one could very well be content with :

- the maintenance of the national laws for national feeds consumed in the country of manufacture,
- Community legislation only for those products which are traded between the Nine.

Unfortunatly, this argument is illogical because of the greater movement of animal products and it would lead to paradoxical situations. How could one accept, for example, that a German consumer might eat pigmeat produced with feeds manufactured in the United Kingdom and containing an additive which is forbidden in Germany? This is, however the present situation (the example mentioned in Chapter V, page 5 - poultry dejections) and it was the case in the recent past for(urea).

For the raw materials of cattle feeds, or to use the Community language for "simple animal feeds" it seems very desirable to us that, at least for the 25 or 30 most important among these, the following should be promulgated :

- definitions which have been examined and accepted to avoid faulty products and fraud;
- "EEC Standards" or simple analytical definitions enabling feedingstuff manufacturers to benefit from a reduction of hererogeneity of quality and of nalytical composition, and hence a reduction of the costly "security margins".

III. A look at the future

Whatever happens, it seems evident that even a very energetic policy of support to the different forms of production of proteinaceous products will during an initial period achieve no more at the best than containing the dependence of the Community.

The upward trend of world prices points to the emergence of a possible cause of deterioration of the Community's external trade balance. Because of this, manufacturers of cattle feeds and breeders may well have to cope with serious difficulties in obtaining supplies at reasonable prices. The danger of the modern feding methods becoming unpopular and of a return to artisan customs leading to a reduction in livestock productivity cannot be brushed aside, any more than all the other perils which moght result from it, particularly as regards inflationary strains.

However, other solutions can and must be envisaged. Twenty years ago the Community had available at least 7 main sources of protein (fish meals, meat meals, skimmed milk powder, yeasts, groundnut cakes, copra and palm kernel cakes). At present, the major source of protein is the soya cake, supplies of which appear increasingly hazardous as a result on the one hand, of a relative slowdown of American production, and on the other of the considerable growth in the number of consumer countries (Japan, USSR, China and certain developing countries). We must therefore expect that in the future it will be increasingly difficult to meet the world demand for animal products. The problem of the utilization of the available sources of proteins therefore arises. In view of the above, is it logical to consume so much protein in the form of animal products, whereas certain proteins, in particular those supplied by the monogastric animals, have been made from proteins directly consumable by man ? Thus, in order to produce one kilo of live chicken containing about 200 grammes of proteins, two kilos of concentrated feedstuffs containing about 200 grammes of proteins, two kilos of concentrated feedstuffs containing 25%, or 500 grammes of proteins, are needed. The Yield of the other animal products is lower than that of the table chicken. Already, a certain number of industrial achievements are emerging which tend to avoid the animal cycle for the coering of the protein requirements of human nourishment.

Moreover, projections published by the United States Department of Agriculture in 1972 show that, in 1980, texture vegetable proteins could represent the equivqlent of 10 to 21 % of the meat market and between 4 and 10% of that of the milk markets, and lead, in relation to the initial projections to reductions in the production of red meats (beef, pigmeat, mutton) of poultrymeat and of the dairy animal population of respectively, 4/8.5 %; - 1.7 /3.6% and 3/9%.

ANNEX 1

LINEAR PROGRAMMING AND THE COMPUTER

There can be no question here of expounding the mathematical theory of linear programming, but of defining it and explaining it suctenctly. According to DORFMAN and al.(1), over the last 20 years, original methods have been perfected for analysing the linear aspect of economic problems. The three methods most frequently used are :

- the theory of prices, the oldest one (1928)
- the analysis of inter-industrial trade or of the imputs and outputs (1936-1941)
- linear programming thus was born shortly after the end of the last war to resolve the military problems of the United States (plan of the activities of the Army).

DEFINITION

(1) "It is the analysis of problems in which a linear function of a certain number of variables must be maximized (or minimized), these variables being subject to certain restrictions in the form of linear inequalities".

This method has found many applications, particularly in the economic field. In animal feeding it has two advantages :

1/ - It makes it possible to resolve, in very satisfactory fashion the problems of substitutions which have become very complex, of both for monogastric and polygastric animals, although for different reasons. The establisment of a formula for :

MONOGASTRIC ANIMALS is characterized by :

- the need for great precision
- the taking on charge of many feeding stuffs
- " " " " of few raw materials

(few raw materials are "noble" or "energetic enough" to suit these animals, and the choice is quickly made by the nutritionist)

POLYGASTRIC ANIMALS is characterized by :

- the search for average precision
- the taking on charge of few feeding stuffs
- " " " " of many raw materials

2/ -- It minimized the "raw materials cost" of a feed, that is to say that it gives the formulator the certainty that the proposed substitution is the least costly.

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(1) Linear programming and economic management
by R. DORFMAN -P.A. Samuelson - R.M. Socow - Editor, Dunod Paris 1962.

PRACTISE OF THE USE OF THE COMPUTER TO EFFECT SUBSTITUTIONS (1)

a/ - The data available to the formulator are of twao orders which must correspond perfectily with each other, just as a key is adapted to a lock.

1/ We call 1st member, the body of the analytical characteristics of all the raw materials utilized. Generally there are available :

Humidity	Total phospherus	Lysine	Energy for poultry (5)
Crude protein	Available phospherus(2)	Mehtionine	Energy for pigs (4)
Fat	Calcium	Cystine (or methionine + cystine)	Energy for bovine cattle (5)
Cellulose	Total chlorides		Price per quintal
Mineral substances	Magnesium		
Starch	(Xanthophyllis)		

. About 75 to 80 raw materials in current use.

(see below pages AN/3 and AN/4)

All these data (i.e. a total of about 1 500) are fed once and for all (or for a long period) into the computer, which inscribes them in its memory and will call on them at the opportune time.

The constraints are the limitations imposed by the formulator on the computer in the light of imperatives of the following nature :

- nutritional (needs of the animals)
- technological (crushing, granulation)
- supply (scarcity of a raw material)
- or delivery and storage (raw material delivered in bulk or in bags) etc.

Contraints of equality : a given raw material must be utilized exactly, in a given percentage(e.g.Vitaminized mineral compound)

Minimal constraints : for example 50 % of maize minimum

Maximal constraints : e.g. 10 % of molasses maximum
0.50 % of salt maximum etc.

2/ We call 2nd member the requirements of the animals in nutriments, corresponding to those listed above. Their fixationconstitutes the "constraints of the 2nd member" for example :

- methionine 0.80 % minimum
- cellulose 5 % maximum
- etc, etc.

---

(1) Or to establish formulae from A to Z

(2) That is to say "digestible" or utilizable by the animals

(3) Metabolizable energy or productive energy

(4) Fodder value or starch value or gross energy

(5) Fodder value or starch value or net energy.

List of 80 RAW MATERIAL
currently used in animal feeding (1)

Categories	Raw material most frequently employed	Raw material employed in smaller quantities(or less frequently)
CEREALS	Wheat, maize, barley	Oats, winter barley, rye Sorghum (= Dari or Mil)
ANIMAL MEALS	Dry skimmed mils Dry lactoserum Fish meal 65 (Peru) Fish meal 72 (Norway) Meat meal	Blood meal Whale meal Soluble fish concentrates Condensed fish concentrates
MIDDLINGS OF CEREALS	Groats D(low meal of durum wheat) White regrinding of soft wheat) Fine bran of soft wheat Gross bran of soft wheat	Low rice flour Regrinding of durum wheat Bran of durum wheat
CELLULOSIC BALLASTS	Dehydrated lucerne "Ordinary"lucerne (dried in the sun) Apple marc Dehydrated sugarbeet pulp	Dehydrated maize Grape pulp Citric pulp Maize
GLUCIDE RAW MATERIALS	Maize starch Manioc Sugarbeet molasses Cane molasses	Destoned carobs Denatured sugar
MINERALS	Calcium carbonate Bicalcic phosphate Monocalcic phosphate Natural tricalcic phosphate Bone powder Salt	Tripolyphosphate of sodium Dicaphor 20/20 phosphate Alumino ferric phosphate
PROTEINACEOUS PRODUCTS	Draff of maize distillery Maize glutens Cellulose yeasts Distillery yeasts Proteinal-Viprotal (2) Barley radicels Urea	Brewery draff Field beans and broad beans Garden peas DUIB Nitrogenated b-products of maize starch-making Linseed

(1) Excluding vitamins, salts of mineral oligoelements, additives,etc.

(2) Trade names for liquid by-products of the manufacture of glutaminic acid from sugarbeet.

ANNEX 1 (cont'd)

Categories	Raw materials most frequently employed	Raw materials employed in smaller quantities(or less frequently)
"De-oiled" FEED CAKES (or extracts containing solvents)	Groundnut Colza Cotton Linseed Soya 44 - Soya 48/6 Soya 50 - Sunflower	Copra Maize seeds Palm kernels
"De-oiled" CAKES (or pressed cakes (1)	Groundnut Linseed Cotton	Colza Maize Sunflower
MISCELLANEOUS	Copra molasses cake Palm kernel molasses cake Suet	Bran molasses Vegetable oils

(1) Also known as "Expeller cakes".

b/ - The statement of the problem

This is a very delicate matter and requires much experience or flair on the part of the formulator. If he imposes on the computer :

. a small number of constraints, he runs the risk of obtaining a very cheap formula the manufacture of which will pose insoluble problems, or with inadmissible excess quantities of this or that raw material.

. a large number of constraints, he "bridles" his computer and prevents it from looking for the most economical solution, or leads it to find a solution which is so obvious (but dear) that the formulator could have found it alone.

In the pages below, the reader will find a few examples :

n° 1 example of a list of data for an operator having a formula calculated by computer

N° 2 an example of comparative formulae for bovine cattle

n° 3 " " " " " " " "

n° 4 " " " " " " " "

n° 5 " " " " " " " "

n° 6 " " " " " " " "

n° 7 " " " " " " " "

c/ - The advantages of the computer

These are many in number and, of course, depend on the "programme" which is proposed to it, and which can be very simple or of varying complexity as requested. We may mention without this list being in any way exhaustive :

- the possibility of taking into account 20 or 25 elements of the 1st member (nutriments, raw materials prices)
- Possibility of taking into account 150 to 200 raw materials and pre-mixtures (concentrates, additives, mineral compounds)
- Obtaining of the formula at the least cost
- Calculation of the detailed characteristics of the formula in the solution chosen
- Calculation of the maximum of the maximum and minimum prices of the raw materials chosen in the solution
- Calculation of the "cost of the constraint". For example :

If, in stead of demanding that the formula should contain 50% maize at the least, or 5% cellulose at the most, I demanded only 45% of maize at the least or 4.8% of cellulose at the most, by how much the raw material cost of the formula be diminished ?

---

(1) A young pig is a piglet of 20/25 kg to 50/60 kg.

A very important datum, for the raw material cost of a formula, say X, at 5% of cellulose maximum.
can be very close to that, Y of a formula with 4.9% of cellulose, but very different from that Z, of a formula with 4.80% of cellulose.

The variations of the cost are not proportionate to those of the rate of cellulose.

. Calculation of the "threshold price" equals the price beyond which a raw material is too dear to be chosen by the computer in the formula to be established or below which it can be chosen.

This datum is extremely important and its research is constant for the "new" raw materials continually being offered on the cattle feeds market.

Examples : up to what price is manioc interesting in relation to cereals ? . Below what price could barley replace WHEAT (and wheat bran) ?

d/ - The obstacles to full employment of the computer

It only gives satisfaction, as we have seen above, if the constraints are not too numerous. This bad habit can be acquired :

. by the formulator through a lack of experience or qualification,
. by the lawmaker. Certain EEC countries, in particular the Federal Republic, have demanded of their feedstuffs manufacturers
  . the lodging of their formulae
  . constraints in the composition of certain raw materials of some foodstuffs, for example
    . a pig feed must contain at least X % of meat meal
    . a chicken feed must contain at least Y % of fish meal.

In France, the legislator demands that the list of components be shown on the label of each feed, which prevents the manufacturer, if the raw materials prices require it, to make simple and satisfactory solutions of the type (see paragraphe 12 Table page III/7).

. 6 % of fish meal plus 4 % of groundnut cake plus 2 % of wheat bran
= 11.9% of soya cake 50 + 0.1% of methionine 980.
(Unless of course he destroys his stock of labels)

It is clear that such measures, which unfortunately are legal, appear to the nutritionist as aberrant, illogical and outmoded, for they constitute so many obstacles to technical and economic progress.

It will be necessary to find :

- procedures to amend the laws more rapidly to keep pace with the scientific discoveries tested out in practice;
- measures ensuring that, despite everything, the buyer-breeder shall have commercial guarantees of the regularity of the quality of the product sold.

THE EVOLUTION OF SUBSTITUTIONS

This evolution has been a dual one the last 25 or 30 years, for it has operated not only as regards the material means brought to bear (1) to carry it out but also and above all in the philosophy of its conception : it may be said that today the predominance of the importance of the nutritional contributions over that of raw materials is admitted. In other words, if for example, a feed which does not contain the raw material X contributes at least the same nutritional elements recognized as indispensable as another feed which contains 3 or 4 % of it, it will certainly ensure the same performances from the animals.

This is an extremely important concept, for those who deny it and believe in the reality, either of the indispensable character of a gives raw material or of unknown nutritional factors, greatly restrict the play of substitutions by introducing constraints which most often run counter to the obtention of a feed at the least cost.

Limits to substitutions

The above statement must of course be qualified by several considerations which do not take account of the equivalent nutriment contributions.

a/ - certain raw materials are more appetizing for the animals than others. Substitutions for others must be carried out with circumspection.

b/ - the aptitude of the raw materials to be easily ground is very variable. Obviously, those whose grinding is easy and therefore cheap are sought for.

c/ - Suitability for granulation is very variable from one raw material to another: some will be in demand for certain percentages of use (or disgarded when the percentages are too high) because they have a tendency to give feeds in hard or too hard granules, molasses for example. Others, on the contrary, will be in demand at certain percentages because they yield granulates which go well through the press, or will be disgarded at higher percentages because the granulates are likely to be too soft. Examples : Beef suet, very fat raw materials. However, the aim is to obtain a granulate "which behaves well", neither too hard nor too soft, and this is explained by the following considerations similtaneouly :

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(1) From the slide rule, to the electronic computer via the electric calculating machine.

. technological : a granulate which "does not go well through the press" causes, because of the poor yield, a rise in manufacturing costs per metric tons.

. nutritional : a granulate must not be distateful to the animals because it is too hard. This is a very important point for young animals, such as piglets, for whom the presentation of the granulate can condition the early age at which the feed is first consumed : this or that suitable granulate will be taken by the young piglets from the age of 6 or 7 days and will thus give them an advantage for their growth

. commercial : a granulate which is too soft becomes transformed into flour in the course of transport and the various handling operations between the manufacturer's plant and the client's farm, whence losses, complaints, increase in consumption indices.

d/ - The presentation, in particular the colour of the feed, must not vary too much. This is in order to avoid putting off, if not the consuming animal, then purchasing client, who may suspect that the change in the raw materials composition is accompanied by a fall-off in quality (change in the contribution of nutrients).

These three factors are unfortunately difficult to quantify, and therefore difficult for the computer to handle.

ANIMAL FEEDING

POULTRY FORMULAE

ANNEX 2

Feed for Table Poultry

Date : September 1973

Formulator : Mr. Dupont
Manufacturer : Mr. DURAND

High Energy

FORMULAE			S 1		S 2		S 3		S 4	
			Maize of Soya 50		Wheat Suet Soya 50		Wheat barley Suet Groundnut Fish			
CONTRAINTS INGREDIENTS AVAILABEL *	FF/q	/q(1)	Mini	Maxi	Mini	Maxi	Mini	Maxi	Mini	Maxi
Wheat	52	9,36			0	0	0	0		
Maize	55	9,90	0	0	0	55				
Barley	58	10,44					20	0		
Melasses										
Copra melasse										
Fine bran										
Groundnut	95	17,10					5	0		
Soya 50	115	20,71	0	0	0	0	0	0		
Lucerne										
Fish meal 65	275	49,51					5	0		
Sugar										
Suet	139	25,03	0	0	0	0	0	0		
Calcium carbonate	8	1,44	0	0	0	0	0	0		
Bicalcix phosphate	55	9,90	0	0	0	0	0	0		
Salt	13	2,34	0	0	0	0	0	0		
Concentrates	717	129,09								
Methionine 98%	200	36,01	0	0	0	0	0	0		
Vitaminised mixture			1	1	1	1	1	1		

NUTRITIONAL CONSTRAINTS		Mini	Maxi	Mini	Maxi	Mini	Maxi	Mini	Maxi
Raw protein	%	0	0	0	0	0	0		
Fats	%	0	0	0	0	0	0		
Cellulose	%	0	0	0	0	0	0		
Mineral substances	%	0	0	0	0	0	0		
Phosphorus	%	0,70	0	0,70	0	0,70	0		
Calcium	%	0,80	0,95	0,80	0,95	0,80	0,95		
Lysine	%	1,05	0	1,05	0	1,05	0		
Methionine	%	0,45	0	0,45	0	0,45	0		
Methionine + Cystine	%	0,80	0	0,80	0	0,80	0		
Metabolisable energy Calori/Kg		3250	0	3250	0	3250	0		
Total chlorides	%	0,25	0,35	0,25	0,35	0,25	0,35		
Number of ingredients									

* Raw materials at undefined prices : Show them in the list of ingredients (to bring out the apposite price)

Code : 0 : Absence of constraint (1) 1 FF = 0.180044 UA

EXAMPLES OF CALCULATION OF SUBSTITUTED FORMULAE FAT CATTLE FEED SUPPLEMENT OF MAIZE

ANNEX 3

PRICES FF/q	PRICES UA/q(1)	FORMULAE N° / RAW MATERIALS	1 with FEED CAKES	2 with U R E A	3 with DUIB and UREA	4 with UREA PHOSPHATE and UREA
52	9,36	WHEAT	14.00	40.00	44.00	37.80
43	7.74	CANE MOLASSES	5.00	5.00	5.00	5.00
110	19.80	DEHYDRATED GROUNDNUTS	35.00	29.50	20.50	30.00
54	9.72	DEHYDRATED LUCERNE 18	3.00	11.00	13.00	11.00
100	18.00	SOYA 44/7	33.50	0.	0.	0.
58	9.00	UREA	0.	5.00	3.00	3.70
150	27.01	DUIB	0.	0.	5.00	0.
125	22.51	UREA PHOSPHATE	0.	0.	0.	3.20
13	2.34	SALT	2.00	2.00	2.00	2.00
139	25.03	SUET	2.00	2.00	2.00	2.00
55	9.90	BICALCIC PEC	3.00	3.00	3.00	0.
8	1.44	CO3 CA	1.50	1.50	1.50	4.30
100	18.00	VITAMINIZED RAW MATERIALS	1.00	1.00	1.00	1.00
			100.00	100.00	100.00	100.00

CHARACTERISTICS		1	2	3	4
CRUDE PROTEIN	%	36.01	35.[illegible]	36.02	35.73
FAT	%	3.57	3.79	3.79	3.76
CELLULOSE	%	5.76	5.70	5.64	5.66
MINERAL SUBSTANCE	%	10.63	9.50	9.27	10.25
PHOSPHORUS	%	1.04	.91	.88	.97
CALCIUM	%	1.63	1.66	1.67	1.97
CHLORIDES (expressed in MaCl)		2.13	2.23	2.25	2.20
DIGESTIBLE PROTEINS	%	29.84	29.87	29.97	29.66
FODDER VALUE	%	89.82	91.75	92.37	90.93
COST RAW MATERIALS	%	88.86	69.65	69.41	70.98
UA BOVINE CATTLE	%	93.740	86.185	84.[illegible]25	84.330

(1) 1 FF = 0.180044 UA

EXAMPLES OF THE CALCULATION OF SUBSTITUTED FORMULAE

FEED FOR YOUNG PIGS (Piglet of 25 - 65 kg)

FORMULES N°			1	2	3	4
PRICE		RAW MATERIALS	with WHEAT Maize and Soya cake 50	with MAIZE Colza cake Soya cake 50 - Sugar beet	with WHEAT Maize Soya Cake 44 Field beans	with MAIZE Sugarbeet pulp Soya cake 44
FF/q	UA/q (1)					
55	9,90	MAIZE	12.00	40.00	10.00	40.00
52	9,36	WHEAT	40.00	10.00	41.00	10.00
43	7,74	CANE MOLASSES	6.00	6.00	6.00	6.00
48	8,64	FINE BRAN	22.00	14.00	17.80	14.00
85	15,30	FIELD BEANS	0.	0.	5.00	0.
115	20,71	SOYA 50/3	17.00	14.00	0.	0.
100	18,00	SOYA 44/7	0.	0.	17.00	19.00
90	16,20	DE-OILED COLZA	0.	5.00	0.	0.
50	9,00	SUGARBEET PULP	0.	8.00	0.	8.00
55	9,90	BICALCIC PEC	1.10	1.10	1.28	1.10
13	2,34	SALT	.20	.20	.20	.20
8	1,44	CALCIUM CARBONATE	1.00	1.00	1.00	1.00
717	129,09	METHIONINE 980	.10	.10	.12	.10
175	31,50	VITAMINISED R.M	.60	.60	.60	.60
		TOTAL	100.00	100.00	100.00	100.00
CHARACTERISTICS						
		CRUDE PROTEIN %	17.86	16.94	17.60	16.74
		FAT %	2.61	3.09	2.43	3.05
		CELLULOSE %	3.79	5.02	4.34	5.18
		MINERAL SUBSTANCE %	5.57	5.53	5.61	5.45
		PHOSPHORUS %	.78	.67	.78	.66
		CALCIUM %	.82	.91	.86	.91
		CHLORIDES (exp. in NaCl)	.45	.42	.44	.43
		DIGESTIBLE PROTEIN %	15.57	14.36	15.13	14.15
		FODDER VALUE %	102.20	98.55	99.56	98.09
		COST RAW MATERIAL FF/q	62.57	63.58	61.92	61.98
		LYSINE %	.785	.780	.788	.760
		METHIONINE %	.332	.346	.343	.332
		METH. + CYSTINE %	.651	.659	.657	.625
		UF PIGS	97.27	97.95	97.00	98.25
		NET ENERGY PIGS Cal.	2962	2957	2976	3023

(1) 1 FF = 0.180044 UA

ANNEX 5

EXAMPLES OF THE CALCULATION OF SUBSTITUTED FORMULAE

Feed for fattening pigs (more than 65 kg)

FORMULAE		N°	1	2	3	4
PRICE		RAW MATERIALS	with WHEAT, Maize Soya cake 50	with WHEAT, Maize Soya cake 44 Field beans	with MAIZE, Wheat Soya cake 44 Colza cake	with MAIZE Wheat Soya cake 50 Sugarbeet pulp
FF/q	UA/q (1)					
55	9,90	MAIZE	12.00	10.00	40.00	40.00
52	9,36	WHEAT	40.00	43.00	10.00	6.00
43	7,74	CANE MOLASSES	8.00	8.00	8.00	8.00
48	8,64	FINE BRAN	24.00	17.00	22.00	22.00
85	15,30	FIELD BEANS	0.	8.00	0.	0.
115	20,71	SOYA 50/3	13.00	0.	0.	13.00
100	18,00	SOYA 44/7	0.	10.70	12.00	0.
90	16,90	DE-OILED COLZA	0.	0.	5.00	0.
50	9,00	SUGARBEET PULP	0.	0.	0.	8.00
8	1,44	CALCIUM CARBONATE	1.00	1.00	1.00	1.00
55	9,90	BICALCIC PEC	1.00	1.28	1.00	1.00
11	1,98	SALT	.50	.50	.50	.50
165	29,70	VITAMINIZED RAW MAT	.50	.50	.50	.50
717	129,09	METHIONINE 980	0.	.02	0.	0.
		TOTAL	100.00	100.00	100.00	100.00
CHARACTERISTICS						
CRUDE PROTEIN		%	16.26	15.69	16.03	15.58
FAT		%	2.63	2.40	3.24	3.25
CELLULOSE		%	3.84	4.13	4.49	4.97
MINERALS SUBSTANCE		%	5.82	5.79	5.88	5.88
PHOSPHORUS		%	.76	.74	.73	.69
CALCIUM		%	.79	.85	.79	.89
CHLORIDES(expressed in NaCl)		1)	.78	.77	.76	.76
DIGESTIBLE PROTEINS		%	14.16	13.56	13.74	13.22
FODDER VALUE		%	101.71	100.17	100.08	98.57
COST OF RAW MATERIALS		FF/q	58.83	58.78	59.22	59.59
LYSINE		%	.665	.668	.661	.663
METHIONINE		%	.209	.214	.226	.211
METHIONINE + CYSTINE		%	.500	.498	.521	.477
UF PIGS			96.56	97.01	96.97	96.42
NET ENERGY PIGS Cal.		Cal.	2933	2964	2947	2944

(1) 1FF = 0.180044 UA

ANNEX 6

EXAMPLES OF THE CALCULATION OF SUBSTITUTED FORMULAE

(Chicks feed - high energy start up)

FF/q	UA/q (1)	FORMULES N° / RAW MATERIALS	1 with MAIZE (wheat) Soya cake 50	2 with WHEAT (Maize) Soya Cake 50	3 with WHEAT BARLEY (Laize) Soya cake 50	4 with MAIZE, Soya Cake 50 Colza xake (illegible)
52	9,90	WHEAT	2.50	58.00	37.00	0.
55	9,36	MAIZE	62.00	5.00	5.00	63.00
58	10,44	BARLEY	0.	0.	20.00	0.
90	16,20	DE-OILED COLZA	0.	0.	0.	5.00
115	20,71	SOYA 50/3	30.50	28.70	28.50	26.00
139	25,03	SUET	1.00	4.30	5.40	1.70
48	8,64	L.SULPHIDE CA	1.00	1.00	1.00	1.00
55	9,90	BICALCIC PEC	1.30	1.27	1.37	1.60
8	1,44	CAL. CARBONATE	.60	.60	.60	.60
13	2,34	SALT	.30	.30	.30	.30
717	129,09	METHIONINE 980	.15	.18	.18	.15
250	45,01	VITA. RAW MATE.	.65	.65	.65	.65
		TOTAL	100.00	100.00	100.00	100.00

CHARACTERISTICS		1	2	3	4
CRUDE PROTEIN	%	21.43	21.22	20.81	20.80
FAT	%	4.30	6.17	7.25	5.02
CELLULOSE	%	2.28	2.47	2.76	2.74
MINERAL SUBSTANCE	%	4.76	4.72	4.98	5.05
PHOSPHORUS	%	.63	.66	.67	.69
CALCIUM	%	.73	.73	.76	.81
CHLORIDES	Exp. in NaCl	.36	.39	.40	.36
COST RAW MATERIALS	FF/q	75.85	76.07	78.11	75.56
LYSINE	%	1.145	1.111	1.112	1.100
METHIONINE	%	.470	.478	.479	.472
METH. + CYSTINE	%	.857	.875	.864	.863
NET-POULTRY ENERGY	Cal.	3046	3043	3040	3042

COMMENTS : We see :

1 - Formula number 3 : the very limited interest of barley, because of its law energy value (about 2 800 calories, against 3 100 approximately for wheat and about 3 350 for maize).

2 - Formula number 4 : the interest of colza cake, which saves on soya cake 50

(1) 1 FF = 0.180044 UA

EXAMPLES OF THE CALCULATION OF SUBSTITUTED FORMULAE

High-energy table poultry feed

PRIX FF/q	PRIX UC/q (1)	FORMULES N° / RAW MATERIALS	1 with wheat maize Soya cake 50	2 with wheat maize soya cake50	3 with maize wheat Suet and Soya cake 50	with Wheat Barley Suet -fish meal groundnut cake
52	9,90	WHEAT	0.	8.00	43.00	
58	16,44	BARLEY	0.	0.	20.00	
55	9,36	MAIZE	63.20	55.00	0.	
95	17,10	DEHYDRATED GROUND	0.	0.	5.00	
115	20,71	SOYA 50/3	27.70	27.50	15.50	
275	49,51	FISH 65	0.	0.	5.00	
139	25,03	SUET	5.35	5.85	8.80	
8	1,44	CALCIUM CARBONATE	.60	.60	.49	
55	9,90	BICALCIC PEC	1.80	1.70	1.70	
13	2,34	SALT	.20	.20	0.	
717	129,09	METHIONINE 980	.15	.15	.11	
200	36,00	VITA. RAW MAT.	1.00	1.00	1.00	
		TOTAL	100.00	100.00	100.00	

CHARACTERISTICS		1	2	3	
CRUDE PROTEIN	%	19.85	19.85	20.38	
FAT	%	8.60	8.90	10.81	
CELLULOSE	%	2.15	2.18	2.75	
MINERAL SUBSTANCE	%	4.75	4.66	4.40	
PHOSPHOROUS	%	.70	.69	.70	
CALCIUM	%	.81	.79	.80	
CHLORIDES(exp. in MaCl)		.25	.25	.27	
COST RAW MATERIALS FF/q		78.20	78.05	85.95	
LYSINE	%	1.051	1.048	1.059	
METHIONINE	%	.448	.446	.448	
METH. + CYSTINE	%	.809	.809	.803	
NET POULTRY ENERGY	Cal.	3248	3251	3248	

Comments : Formula number 3 is characterised by a very high raw materials cost due to the use of barley which requires a very large contribution of suet.
Such a formula could not be manufactured in granulates (6% of suet maximum), and this shows its complete irrelevance

(1) 1 FF = 0.180044 UA

EXAMPLE OF THE CALCULATION OF SUBSTITUTED FORMULAE

Feed for fattening pigs (more than 65 kg)

FORMULAE		N°	2600 calories/kg		2.700 calories/kg	
			1	2	3	4
PRICE		RAW MATERIALS	with WHEAT, Maize fine bran Soya Cake 50	with WHEAT, MAIZE Soya cake 44	with MAIZE, Wheat SUNFLOWER CAKE Soya cake 50	with MAIZE, Wheat SUNFLOWER CAKE Field beans
FF/q	UC/q (1)					
52	9,90	WHEAT	2.00	64.00	24.00	20.00
55	9,36	MAIZE	60.00	8.00	46.00	50.50
48	8,64	FINE BRAN	12.00	0.	0.	0.
85	15,30	FIELD BEANS	0.	0.	0.	2.50
115	20,71	SOYA 50/3	14.00	0.	12.00	9.00
100	18,00	SOYA 44/7	0.	16.00	0.	0.
83	14,94	SUNFLOWER 36/20	0.	0.	6.00	6.00
54	9,72	DEHYDRATED LUCERNE 18	3.00	3.00	3.00	3.00
8	1,44	CALCIUM CARBONATE	7.00	6.73	7.00	7.00
55	9,90	BICALCIC PEC	1.34	1.60	1.34	1.34
13	2,34	SALT	.10	.10	.10	.10
717	129,09	METHIONINE 980	.06	0.07	.06	.06
175	31,51	VITAM. RAW MATERIALS	.50	.50	.50	.50
		TOTAL	100.00	100.00	100.00	100.00
CHARACTERISTICS						
CRUDE PROTEINS		%	15.42	15.59	15.76	14.90
FAT		%	3.58	2.01	2.98	3.09
CELLULOSE		%	3.50	3.53	3.80	3.88
MINERAL SUBSTANCE		%	10.69	10.32	10.42	10.32
PHOSPHORUS		%	.67	.60	.63	.62
CALCIUM		%	3.18	3.15	3.19	3.18
CHLORIDES(expressed in NaCl)			.22	.24	.22	.22
COST RAW MATERIALS		FF/q	60.14	58.11	60.80	59.87
LYSINE		%	.678	[illegible]	.677	.625
METHIONINE		%	.286	.2[illegible]2	.313	.299
METHIONINE + CYSTINE		%	.566	.604	.616	.586
NET POULTRY ENERGY Cal.			2631	2630	2720	2730

(1) 1 FF = 0,180044 UC

ANNEX II

NATIONAL LAWS IN THE COMMUNITY COUNTRIES CONCERNING UREA AND NITROGENATED NON-PROTEIC COMPOUNDS (1)

United Kingdom of Great Britain and Northern Ireland

Urea is authorized in the rations of ruminants. The rates of incorporation are not limited, but in practice they do not exceed 1 - 1 1/2% of the formula.

When urea is incorporated manufacturers are required to state its protein equivalent on the label.

Federal German Republic

The use of urea is permitted only in feeds for milking cows and fat cattle.

2. The quantities permitted for the feeds mentioned above may not exceed 2%.
3. The crude protein content, not allowing for the nitrogen content, may not exceed 20% for feeds intended for milking cows and 17% for fat cattle.
4. A manufacturer declaring a compound feed containing urea for entry in the register of cattle feeds must produce a expert report from a University Institute or a High School of Animal Feeding certifying the conformity of the composition with what is declared.

   Furthermore, the expert opinion must prove that the addition of urea does not involve any difficulty and that the urea mixed with the feed does not produce any harmful effects on the animals for whom the feed is intended.
5. The global analysis appended to the declaration required by the law must mention in detail the global crude protein content and also the part diriving from the addition of urea. The analysis must also include the percentage in relation to the total mixture.

   When the urea is sold for direct use by the breeder, the seller must indicate that it be used only with ensilaged maize and in a concentration not exceeding 0.5%.

ITALY

The use of urea is authorized in the proportion of 30 grammes per kilo (3%) in feeds for bovine cattle, sheep, goats and buffalo after veaning.

The nitrogen deriving from the urea must not exceed 40% of the total nitrogen in the ration. The rate of urea nitrogen must be declared.

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(1) Source FEFAC.

The Netherlands

Dutch law authorizes the addition of urea to compound feeds for adult ruminants without any particular specification.

Belgium

Belgium allows nutritional urea, parled nutritional urea and nutritional biuret. These products are authorized in feeds for adult cattle with the following doses and conditions :

Ministerial order of 13 July 1972 published in the Moniteur Belge of 19 January 1973, concerning trade in and utilization of substances intended for animal feeding. Urea is authorized in the feeds of adult cattle in the following doses and conditions:

Urea : maiximun 3 % or

Biuret : maximum 3.6 %

Complete compound feeds containing urea or biuret may not, moreover, contain a humidity rate in excess of 13.5% of insoluble mineral substances in the dry matter of 3% and of ballast substances of 12% for the complete compound feed for fattening cattle and 15% for the complete compound feed of milking cattle. These feeds may not contain more than two permitted ballast substances.

The manufacturer of complete compound feeds must provide for a number of kilos of feeds which must not be exceeded per day and per 100 kg of live weight, according to the following details :

A Urea content of the compound feed(complete)	B Biuret content of the compound feed (complete)	C Number of kg which may not be exceeded per day and per 100 kg of live weight
3 %	3.6 %	1 kg
2.5 %	3 %	1.2 kg
2 %	2.4 %	1.5 kg
1.5 %	1.8 %	2 kg
1 %	1.2 %	3 kg

A marketing organization has also been granted for feeding urea containing Kaolin as a dispersing agent. The insoluble mineral substances content may not exceed 4% in the dry matter.

Denmark

On 12 October 1973 a new law came into force by virtue of which a manufacturer who wishes to produce compound feeds containing urea (CO(NH2)2) must obtain a spelicence which costs 5 000 Danish Krowns per year plus VAT (15%). This licence authorises the holder to make only 3 types of feeds for bovine cattle.

1. Compound feeds containing 5 % of urea. Such a feed must have a digestible protein content of 15 %, contrary to digestible crude protein and contain at least 40 % of barley;

2. Compound feeds containing 2.5% of urea. This feed must contain at least 15% of digestible protein and 20% of barley.

3. Compound feeds containing 1% of urea. This feed must have a digestible protein content and contain at least 10% of barley.

Ireland

In this country too, current legislation authorizes the use of urea in the rations of ruminants, but does not lay does not lay down any specifications on the point. The implementing text to the Community directives concerning additives has not yet been published in Ireland. The Irish Association has promised to send us a copy of this text as soon as possible. If is should make any amendments we will inform you of these laster.

C O N T E N T S

Pages