UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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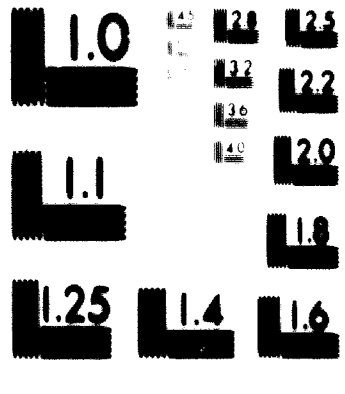

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Tropical Products Institute

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WORLD-WIDE STUDY ON THE VEGETABLE OILS AND FATS INDUSTRY

A Study undertaken by the Tropical Products Institute
for the United Nations Industrial Development Organisation

Volume 1: Interim Report, October 1976

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Preface

In considering the establishment of a new international economic order, and the contribution to be made by industrial development, the Second General Conference of the United Nations Industrial Development Organization (UNIDO) held at Lima, Peru on 12-26 March, 1975, adopted the "Lima Declaration and Plan of Action on Industrial Development and Co-operation", an important feature of which was the recognition that while the developing countries constituted 70% of world population they generated less than 7% of industrial production. In consequence, the Declaration adopted the target that by the year 2000 this figure should be raised "as far as possible to at least 25%" of total world industrial production, making every effort at the same time to ensure that the growth so achieved is distributed among the developing countries as evenly as possible. The Declaration went on further to emphasize the importance of promoting agro-based or agro-related industries, which would both stimulate food production activities and provide an incentive for the establishment of further natural resource - based industries, helping at the same time to arrest the rural exodus.

The Plan of Action emphasized the need for the highest degree of interaction between industry and other sectors of the economy, particularly agriculture, and called for more on-the-spot processing of raw materials, together with encouragement of small and medium-scale rural industries, and the achievement of greater efficiency in import substitution processes. In carrying out the details of the Plan of Action a central role was accorded to UNIDO, which is required to include among its activities a system of continuing consultations with developed and developing countries on the re-deployment of certain production capacities, especially those relating to industries processing raw materials exported by developing countries, and which should result in concrete proposals for inclusion in the development programme of participating developing countries in due course.

It was recognized that if the targets are to be achieved then studies would have to be undertaken and specific action programmes formulated for different sectors of industry. To this end, and since the publication of the Declaration, UNIDO has identified certain groups of commodities which merit detailed study, and a number of independent consultants have been retained in order to provide UNIDO with background papers.

One such commodity group is vegetable oils and oilseeds, and the Tropical Products Institute has been commissioned to supply UNIDO with a World-Wide Study on the Vegetable Oils and Fats Industry. The objective of this Study is to provide developing countries with information to assist them in making decisions regarding the role which the vegetable oils and fats industries might have in their economies for the implementation of the Lima Declaration and Plan of Action. Specifically, to discuss the nature and state of activity in the industry, possible growth points and constraints on development, with particular reference to the contribution which the vegetable oils and fats industries might make to rural development.

The terms of reference for the Study are as follows:-

1. To describe production levels of the 10 major oilseeds, areas of production, prices, production trends and plans.
2. To analyse utilization in terms of international trade, domestic usage, the basis of demand for specific oilseeds, edible and technical oils, by-products, cakes, meals, trend of demand.
3. To give indication of comparative production capacity in developed and developing countries and the trend of development.
4. To discuss the share of developed and developing countries in international trade for oilseeds and their products and in local markets.
5. To describe changes in demand in relation to new forms of products and trends in technological innovations.
6. To discuss constraints on development of vegetable oils and fats industry in developing countries (a) technical and (b) economic, including capital requirements, management, skilled labour.

Note: The oilseeds to be dealt with are: oil palm, palm kernels, coconut, groundnuts, cottonseed, rapeseed, sesame, soya, sunflower, safflower.

CHAPTER 1

THE PRODUCTION OF OILSEEDS

Geographical Distribution of Oilseeds Production

1.1 The world's oilseed economy continues to expand at a comparatively rapid rate. Global production of oilseeds has shown a dramatic increase in the last decade increasing from 123.2 million tons in 1965 to 176.5 million tons in 1975; an increase of some 43%.

Table 1.1 illustrates the level of production and relative importance of the major oilseeds over the past decade.

Table 1.1

Production of Selected Oilseed Crops

million met. tons

	1965			1970			1975		
	Quantity	% Total	Index (1965)	Quantity	% Total	Index (1965)	Quantity	% Total	Index (1965)
Soyabeans	36.5	29.6	100	46.5	32.7	127	64.8	36.7	177
Coconuts (nuts)	26.4	21.5	100	26.3	18.6	99	31.2	17.7	118
Cottonseed	22.1	17.9	100	22.2	15.6	100	26.5	15.0	120
Groundnuts (in shell)	16.0	13.0	100	18.4	12.9	115	18.1	10.3	113
Oil Palm (F.F.B)	6.8	5.5	100	9.2	6.6	135	14.2	8.0	209
Sunflower seed	7.9	6.4	100	9.9	6.9	125	10.6	6.0	134
Rape/Mustard seed	5.3	4.3	100	6.7	4.7	126	7.9	4.5	149
Sesame seed	1.7	1.4	100	2.2	1.5	129	2.1	1.2	123
Safflower seed	0.5	0.4	100	0.7	0.5	140	1.1	0.6	220
TOTAL	123.2	100.0		142.1	100.0		176.5	100.0	
TOTAL INDEXED TO 1965	100			115			143		

1.2 In volume terms, the order of dominance has remained remarkably constant between 1965 and 1975. Soyabean remains the largest crop with 36.7% of global production, twice the proportion of coconuts, the next most important, which accounted for 17.7% of global production in 1975. Cotton seed and groundnut are also important crops and jointly accounted for 25.3% of global oilseeds production. Oil palm, sunflower and rape/mustard seed provided a further 18.5% of total production with sesame and safflower accounting for the remainder.

1.3 Despite the comparatively constant ranking of the relative degree of importance over the last decade Table 1.1 shows that there have been large production increases of certain oilseeds. In particular, soyabean and oil palm, with increases of 77% and 109% respectively, have far exceeded the average. In the case of soyabean the bulk of the increased production has been from the USA and in that of oil palm from Malaysia. Of the less significant oilseeds, in volume terms, there have been important production increases in rape/mustard seed and safflower. Output of the former has expanded 49% since 1965, predominantly in India and Canada, whilst that of safflower, the least important of these oilseeds in volume terms, has shown a 120% increase due mainly to increased production in Mexico and India.

1.4 All of the remaining oilseeds have also shown steady increases in production of the order of 15% to 30%. Coconut production, until very recently, has remained fairly stable with the major increase coming from the Philippines. Cottonseed production has expanded by 20% but the share of the developing countries has declined. Sunflower seed production rose by 34% with the bulk of this increase (over 80%) coming from the centrally planned economies. Sesame production increased by 23%, the bulk of production, over 80%, remaining in the developing countries, but groundnut production, which is also a predominantly developing country oilseed, has undergone the smallest increase of all in percentage terms. The following discussion considers in greater detail the production trends for each individual seed, commenting upon geographical distribution and the major producers.

Soyabeans

1.5 Soyabeans have dominated the world's oilseed economy throughout most of the period under review, usually providing around 30% of total production of the oilseeds mentioned. Total production has increased from 36.5 million tons in 1965 to an estimated 64.8 million tons in 1975. This growth of soyabean production has been largely instrumental in the expansion of the world's oilseed economy during this period.

1.6 To the extent that it is dominated by the USA, world soyabean production remains a predominantly developed country oilseed. Table 1.2 shows that USA production has been as high as 66% of world production but in 1974 and 1975 declined to around 60%.

China and Brasil account for the vast proportion of the remaining production. There appears to be some divergence of opinion as to the sise of China's soyabean crop but the majority view favours a total production of between 11 and 12 million tons. Brasilian production has expanded rapidly; in 1965 Brazil produced little more than 1% of world production but by 1975 this figure had risen to almost 15% and is predicted to increase further.

1.7 The remaining principal producers are of comparatively little significance in global terms. Countries where soyabeans have expanded to a marked degree, but still remain relatively insignificant, include Mexico and Colombia; both countries are continuing to encourage soyabean growing. Indonesia remains a significant minor producer but production in the USSR and Japan appears to be falling away from the levels achieved in earlier years.

1.8 Soyabean production is therefore becoming increasingly dominated by the American continent and seems likely to continue to do so. Developing countries are sharing in the increased production, particularly Brasil, Colombia and Mexico, but it seems probable that for the majority of developing countries soyabeans are not a particularly appropriate oilseed upon which to base any major expansion of their oilseed economies given the range of agronomic and economic constraints involved. However, they could be significant in specific regions at comparatively modest levels of production.

Table 1.2

Soyabeans - Principal Producers

'000 met. tons

	1965	% of total	1970	% of total	1974	% of total	1975 (estimated)	% of total
U.S.A.	23014	63.0	30675	66.0	33569	59.1	39463	60.9
China	11036	30.4	11645	25.0	11860	20.9	11860	18.3
Brazil	523	1.4	1509	3.2	7500	13.2	9600	14.8
U.S.S.R.	421	1.2	595	1.2	375	0.7	375	0.6
Indonesia	410	1.1	498	1.1	550	1.0	575	0.9
Japan	230	0.6	126	0.3	135	0.2	140	0.2
Canada	219	0.6	283	0.6	301	0.5	333	0.5
Korea D.P.R.	200	0.6	228	0.5	260	0.5	260	0.4
Korea Rep.	174	0.5	232	0.5	260	0.5	260	0.4
Mexico	58	0.1	215	0.5	410	0.7	575	0.9
Colombia	50	0.1	96	0.2	156	0.3	156	0.2
Others	170	0.4	372	0.9	1428	2.5	1203	1.9
World	36505	100.0	46474	100.0	56804	100.0	64800	100.0

Coconuts

1.9 In terms of the volume of raw material produced the coconut is second only to soyabeans in world oilseed production. It differs from soyabeans and all other major sources of vegetable oil, except palm oil, in that it is almost entirely produced in developing countries. Total world production during the last decade generally remained remarkably stable in the range of 25.0–27.0 million tons but recently increased sharply and seems likely to increase further over the next few years following extensive replanting with hybrid varieties.

1.10 Table 1.3 shows the relative production levels of the principal producers from 1965–1975. In terms of the volume of production, Asia is dominant, producing approximately 80 per cent of world output. Within the Asian continent over one third of regional production is produced in the Philippines which has consolidated its position as the world's principal coconut producer and where production is expected to increase substantially over the next few years.

Three other countries, namely, India, Indonesia and Sri Lanka contribute most of the remaining Asian production. Indian production expanded steadily until the early 1970's, but has since maintained a plateau around 4.4 million tons. Similarly, Indonesian production has grown rather slowly to about 5.8 million tons, not much more than the level a decade ago.

In the case of Sri Lanka, coconut production declined continuously between 1965 and 1974, but appears to have made a major recovery in 1975.

1.11 Outside Asia and the Far East, coconut production is of comparatively minor importance. On the American continent Mexico and Brasil are the main producers but their respective 1975 outputs of 930,000 and 300,000 tons are minor in a global context. Similarly, no African country produces more than half a million tons annually.

Table 1.3

Coconuts - Principal Producers

'000 met. tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975 (estimated)	% of total
Philippines	7089	26.9	6484	24.7	7384	27.6	10142	32.6
Indonesia	5588	21.2	5413	20.6	5872	21.9	5857	18.8
India	3741	14.2	4514	17.2	4400	16.4	4375	14.1
Sri Lanka	2017	7.6	1882	7.2	1350	5.0	2030	6.5
Thailand	1217	4.6	967	3.7	750	2.8	750	2.4
Mexico	1115	4.2	998	3.8	1036	3.9	932	3.0
Malaysia	945	3.6	1071	4.1	860	3.2	896	2.9
Papua New Guinea	710	2.7	776	3.0	800	3.0	818	2.6
Brazil	265	1.0	320	1.2	301	1.1	301	1.0
Fiji	260	1.0	249	0.9	273	1.0	253	0.8
New Hebrides	209	0.8	227	0.9	178	0.7	165	0.5
Ghana	229	0.9	201	0.8	280	1.0	280	0.9
Mozambique	275	1.0	407	1.5	416	1.6	416	1.3
Tanzania	274	1.0	321	1.2	300	1.1	300	1.0
Others	2438	9.2	2443	9.3	2574	9.6	3580	11.5
World	26373	100.0	26275	100.0	26774	100.0	31095	100.0

Groundnuts

1.12 Groundnuts are grown by a large number of countries including developed, developing and centrally planned economies; over 30 produce significant commercial quantities. World output since 1965 has been relatively stable, ranging from 16.0 million to 19.3 million tons. The highest production level was attained in 1971, since when adverse weather conditions in many African producing countries have contributed to a decline in world output. Selected annual world production data over the period 1965-1975 are summarised in Table 1.4.

In 1965 the developing countries accounted for slightly over 75 per cent of world production while the developed and the centrally planned countries produced approximately 9% and 16% respectively. In 1975, however, while the share of the centrally planned countries remained virtually the same the developed countries increased their share to 14% and the proportion of the developing countries declined to 70%.

1.13 Among the developing countries India is the largest producer and consistently maintains her position as the world's largest groundnut producer. Indian production increased from 4.3 million tons in 1965 to an estimated 5.4 million tons in 1975 and the country's share of world production increased from 26.6% in 1965 to 29.8% in 1975. This was a relatively bad year for groundnut production in India, however, owing to adverse weather conditions; much higher production figures of 6.1 and 6.2 million tons were reached in 1970 and 1971 respectively. Nevertheless, India on average still produces at least double the quantity of groundnuts from any other source. China is generally regarded as the second most important groundnut producer, with about 15% of world output. Chinese production is thought to have increased steadily but slowly over the decade allowing her to maintain a constant proportion of total world output.

1.14 The most noteworthy change in groundnut producing countries since 1965 has been the decline of the West African countries. Since 1971 Nigeria, Senegal and Niger, the major producers, have suffered from varying degrees of drought conditions. Their aggregate production has declined from around 3.3 million tons in 1965 to 1.5 million tons in 1975 thereby reducing their share of world production from 21% to 10%. Senegal's production appears to have recovered reasonably well in 1975 but Niger and Nigeria continued to suffer a marked fall in output.

Table 1.4

Groundnuts – Principal Producers

'000 met. tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
India	4263	26.6	6111	33.2	5000	28.4	5400	29.8
China	2426	15.1	2772	15.0	2700	15.4	2800	15.4
Nigeria	1978	12.3	1581	8.6	600	3.4	300	1.7
Senegal	1121	7.0	583	3.2	850	4.8	1210	6.7
U.S.A	1084	6.8	1351	7.3	1664	9.5	1750	9.6
Brazil	743	4.6	988	5.0	479	2.7	335	1.8
Indonesia	405	2.5	468	2.5	530	3.0	530	2.9
Argentina	439	2.7	235	1.3	290	1.6	375	2.1
South Africa	197	1.2	318	1.7	561	3.2	260	1.4
Cameroon	141	0.9	178	1.0	200	1.1	200	1.1
Burma	288	1.8	529	2.9	459	2.6	459	2.5
Niger	277	1.7	220	1.2	180	1.0	25	0.1
Thailand	131	0.8	190	1.0	230	1.3	260	1.4
Malawi	157	1.0	190	1.0	190	1.1	190	1.0
Mali	153	1.0	158	0.9	190	1.1	170	0.9
Others	2235	13.9	2616	14.2	3466	19.7	3873	21.4
World	16038	100.0	18428	100.0	17589	100.0	18137	100.0

Cottonseed

1.15 Cottonseed production grew from 22.0 million tons in 1965 to 26.5 million tons in 1975. Four countries, namely USA, USSR, China and India, contribute over 60% of total world output. The latter two countries have maintained their shares, 16% and 9% respectively, of world production but since 1965 the USA and USSR have virtually exchanged positions in the list of principal producers. Table 1.5 illustrates these changes.

In 1965 the USA was the world's leading producer but since then its cottonseed output has declined by about a quarter. Conversely USSR's output has increased by a similar amount.

1.16 Taking the developing countries, the region with the largest production of cottonseed is Asia, producing 3.79 million tons in 1975, followed by Latin America with 3.23 and the Near East and Africa with 2.93 million tons and 1.16 million tons respectively.

In Asia, production is dominated by India and Pakistan with output in the former tending to fluctuate around 2 million tons while in the latter it has gradually increased from 830,000 tons in 1965 to 1.3 million tons in 1975. The only other developing country to exceed over 1.0 million tons of production in 1975 was Brazil; an increase from 860,000 tons in 1965. Other major Latin American producers are Mexico, Colombia and Argentina. The apparent decline in the Mexican output is misleading since production there has tended to fluctuate in relation to the returns obtainable from competing crops, and a downward trend does not seem to be indicated.

1.17 In the Near East the traditional producers are Egypt and the Sudan; these countries remain dominant, though production in the former has declined slightly and may have reached a plateau. In the Sudan production has fluctuated markedly over the past decade but around a predominantly increasing trend. Other major producers in the region are Turkey, Iran and Syria.

Table 1.5

Cottonseed - Principal Producers

'000 met. tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
U.S.A.	5522	25.0	3690	16.7	4233	16.3		
U.S.S.R.	3725	16.9	4416	19.9	5710	22.0		
China	3298	14.9	3992	18.0	4295	16.5		
India	1994	9.0	1988	8.6	2428	9.4		
Brazil	855	3.9	1277	5.8	1135	4.4		
Mexico	998	4.5	550	2.5	725	2.8		
Egypt	961	4.4	884	4.0	840	3.2		
Pakistan	834	3.8	1114	5.0	1280	4.9		
Turkey	527	2.4	640	2.9	880	3.4		
Syria	296	1.3	234	1.1	235	0.9		
Sudan	289	1.3	467	2.1	432	1.7		
Iran	273	1.2	288	1.3	420	1.6		
Argentina	260	1.2	249	1.1	240	0.9		
Peru	218	1.0	153	0.7	144	0.6		
Nicaragua	207	0.9	112	0.5	225	0.9		
Others	1797	8.1	2181	9.8	2733	10.5		
	22062	100.0	22155	100.0	25953	100.0		

Sunflower seed

1.18 Sunflower seed is produced in significant commercial quantities in at least twenty countries dispersed among the developed, developing and centrally planned countries. Production has fluctuated in recent years but there has been a general tendency for it to increase. Between 1965 and 1973, the peak year, production increased from around 8 million to about 12 million tons. In 1974, however, production fell to 11.1 million tons and an estimate from the USDA indicates a further decline in 1975. Selected annual world production data by major producers for sunflower seed is given in Table 1.6.

In 1965 the developed, developing and centrally planned economies accounted for 5.1%, 12.9% and 82.0% of world production respectively. However by 1975 the centrally planned countries' share had fallen to 72.8% while the developed and developing countries increased their shares to 12.4% and 14.8% respectively.

1.19 World sunflower seed production is dominated by the USSR which accounts for virtually 60% of the total. This share is tending to decline, primarily due to a renewed interest in sunflower production in other countries rather than any marked fall in production in the USSR. Countries such as Turkey, South Africa, Spain, Australia and the USA have all made significant strides in extending sunflower cultivation in recent years. The developed countries seem likely to increase their interest in the crop still further. For example, the USA target for 1976 is 625,000 tons of seed compared with 20,000 tons in 1965. Canada is also contemplating sunflower as an alternative oilseed crop to rapeseed with an expansion programme planned initially for the province of Saskatchewan.

1.20 Very few developing countries produce sunflower in significant quantities although India has established a target of 1 million hectares by 1979. Several other countries have conducted trials, particularly some of the Middle East countries and one or two in East Africa. However, the degree of success has been limited and it seems unlikely that the developing countries will contribute a significant proportion of world sunflower production in the foreseeable future .

Table 1.6

Sunflower – Principal Producers

'000 met. tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
U.S.S.R.	5449	68.5	6144	62.0	6761	60.7	6300	59.3
Argentina	757	9.5	1140	11.5	970	8.7	780	7.3
Turkey	160	2.0	375	3.8	520	4.7	520	4.9
South Africa	73	0.9	96	1.0	276	2.5	221	2.1
Bulgaria	357	4.5	407	4.1	480	4.3	505	4.8
Romania	564	7.1	770	7.8	671	6.0	700	6.6
Yugoslavia	265	3.3	264	2.7	298	2.7	375	3.5
Spain	9	0.1	159	1.6	316	2.8	416	3.9
U.S.A.	20	0.3	86	0.9	291	2.6	450	4.2
Others	305	3.8	476	4.8	555	5.0	351	3.3
World	7999	100.0	9917	100.0	11138	100.0	10618	100.0

1.21 Yield performances of the USSR and Eastern Europe as a whole have been consistently better than the rest of the world or any other single major producing area. In the Argentine production is extensive, but yields are relatively low because sunflowers are often planted as a second crop following wheat. In the United States scientists are developing hybrid sunflowers that reportedly exhibit improved yields and disease resistance. The US Agricultural Research Service geneticists expect yields to increase up to 40% from hybrids that are more self-fertile, that mature uniformly, and make insect management and harvesting more timely and effective. Hybrids, however, are generally more sensitive to changes in normal weather patterns and thus present a greater risk of loss as a consequence of adverse weather. It is likely that the unpredictable weather pattern in the USSR sunflower growing region may be responsible for their lack of interest in hybrids. Significant advances in research in better yielding varieties have also been made in India and Canada.

Palm Oil

1.22 The global distribution of palm oil production has changed markedly in the past decade. In 1965, 73% of world production was produced in Africa, 23% in the Far East, and 3% in Latin America, whereas by 1975 over 52% was produced in the Far East and 43% in Africa, with 4% in Latin America. The distribution by major producing country is shown in Table 1.7.

The prime reason for this change in distribution has been the dramatic increase in Malaysian production since 1965. From a country with 11% of world output, Malaysia has grown to dominate world palm oil production with at present a 43% share of global production. Simultaneously, Indonesian output has also doubled but remains on a more modest scale. Together these two factors account for the growing dominance of the Far East in the world palm oil economy.

1.23 In contrast Nigeria, which in 1965 was the world's leading producer, experienced its worst decline during the late 1960's and production there has tended to fluctuate throughout the 1970's. However in other African

Table 1.7

Palm Oil – Principal Producers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nigeria	574	42.4	488	26.5	450	16.8	450	15.4
Indonesia	157	11.6	217	11.8	334	12.5	370	12.7
Malaysia	150	11.1	431	23.4	1047	39.2	1252	43.0
Zaire	120	8.9	180	9.8	180	6.7	171	5.9
Ivory Coast	18	1.3	50	2.7	135	5.0	145	5.0
Cameroon	44	3.2	54	2.9	60	2.2	60	2.1
Ghana	37	2.8	60	3.3	65	2.4	65	2.2
Angola	32	2.4	80	4.3	72	2.8	72	2.5
Colombia	2	0.1	27	1.5	51	1.9	57	2.0
Sierra Leone	39	2.9	48	2.6	55	2.1	55	1.9
Dahomey	27	2.0	36	2.0	47	1.8	47	1.6
Others	155	11.4	173	9.4	178	6.7	170	5.8
World	1355	100.0	1844	100.0	2674	100.0	2914	100.0

countries, notably Zaire and the Ivory Coast, production has tended to rise; the Ivory Coast, in particular has expanded rapidly and continuously to become an important international producer.

1.24 World production of palm oil is therefore expected to continue to expand. In part, increased output is predetermined for a number of years because of planting decisions taken in previous years. Considerable areas were planted in West Malaysia in the 1960's and with palms continuing to fruit for 20-30 years, production is assured for some time. Similar effects are to be expected from those countries like Indonesia and the Ivory Coast which entered the field more recently. This explains the results of economic studies in Malaysia which show that the areas under new plantings, rather than actual production, have an influence upon price movements.

Palm Kernels

1.25 World production of palm kernels does not completely mirror palm oil production. The country production trends are shown in Table 1.8 Total world production between 1965 and 1975 rose from 1.14 million tons to 1.27 million tons but the rise was not continuous, with declines in 1967 and 1973. Nigeria remains the dominant producing country with 24% of world production, closely followed by Brazil and Malaysia with similar shares of about 19%. Although African production of 749,000 tons in 1974 was larger than that of any other area, this did however, represent a decline from 828,000 tons in 1965. Latin America's share of world production rose gradually between 1965 and 1975 from 20% to 23% but the most dramatic increase has been in the Far East where an increase from 6% to 21% is recorded.

1.26 The dramatic increase in Far Eastern production of palm kernel is directly linked with the expansion of palm oil production in Malaysia and Indonesia, and the production of palm kernels in the region is dominated by these two countries. In both cases production has increased uninterruptedly, in recent years. However, although palm oil production in Malaysia has outstripped that of Nigeria this has not been the case with palm kernels, mainly since the hybrid type of palm planted in

Table 1.8

Palm Kernels – Principal Producers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nigeria	462	40.5	295	24.1	300	22.0	305	24.0
Brazil	186	16.3	235	19.2	240	17.6	245	19.3
Zaire	75	6.6	132	10.8	95	7.0	93	7.3
Sierra Leone	54	4.7	65	5.3	55	4.0	62	4.9
Dahomey	50	4.4	57	4.6	52	3.8	70	5.5
Cameroon	48	4.2	56	4.6	60	4.4	60	4.7
Malaysia	35	3.1	92	7.5	215	15.8	240	18.9
Indonesia	33	2.9	49	4.0	72	5.3	70	5.5
Ivory Coast	17	1.5	20	1.6	55	4.0	64	5.0
Mexico	25	2.2	28	2.3	30	2.2	30	2.4
Others	156	13.7	197	16.1	187	13.7	30	2.4
World	1141	100.0	1226	100.0	1361	100.0	1269	100.0

Malaysia in recent years has a comparatively insignificant kernel.

1.27 Nigeria's production, while lower in 1975 than in 1965, has managed since 1968 to remain above the low point of that year of 225,000 tons. Other African countries have increased production over the period but none has done so on a continuous basis and all of them have been subject to fluctuations. As with other oilseeds there is no common pattern over the decade, which perhaps indicates that local conditions are an important factor in production changes.

In Africa generally, palm kernels are traditionally of greater domestic importance than elsewhere and are still utilised in a large number of countries. The greater dominance of African countries in the palm kernel economy gives rise to rather more uncertainty over future supplies than in the case of palm oil where future supplies are comparatively assured.

1.28 In Latin America the biggest producer is Brasil which has slightly strengthened its position as the world's second largest producer, raising its share from 16.3% in 1965 to 19.3% in 1975. Colombia, Latin America's largest producer of palm oil, is an insignificant producer of palm kernels, being outranked by Mexico and Paraguay.

Rapeseed

1.29 Between 1965 and 1974 world production of rapeseed increased from 5.2 million tons to 7.2 million tons with an estimated production of 7.9 million tons in 1975. Table 1.9 shows production by the major producers. Over 70% of world output is provided by four countries, India, China, Canada and Poland. Apart from the two former countries rapeseed production generally is dominated by the developed countries, particularly Europe and Canada.

1.30 Of the developing countries India is the only really major rapeseed producer with an estimated 2.0 million tons, or 78% of developing countries' production. This figure is an appreciable increase on the 1.4 million tons of 1965, but there have been considerable fluctuations around this rising trend. The only other developing country producers of any significance are Pakistan, which has increased its output on a more definite trend from 215,000 tons in 1965 to 305,000 in 1975, and Bangladesh, which currently produces about 90,000 tons. Bangladesh production rose up to and including 1971, but political unrest and natural hazards have limited the recent rate of expansion. Chile is the only other country in this group with a significant production volume, averaging 62,200 tons between 1965 and 1974.

1.31 The largest producer in the developed countries is Canada, with 1.5 million tons in 1975 compared with only 513,000 in 1965. In the USA very little rapeseed is produced and the country is not important in world production. Other major producers of the developed world are in Western Europe with France the leader, producing 600,000 tons in 1975. This is nearly double the 1965 figure and is part of a definite upward trend. Other European producers have also shown an upward trend, though not without fluctuations. In 1975 the next largest producer in Western Europe was Sweden, with 300,000 tons, followed by the Federal Republic of Germany with 250,000 tons.

1.32 Of the 2.21 million tons produced in centrally planned countries over 56% is grown in China, with the remainder being grown in Eastern Europe. Poland produced 760,000 tons in 1975, but output has fluctuated frequently since 1965 when production was 504,000 tons. The other major producer in the area is the German Democratic Republic, which has increased output steadily since 1969, producing 250,000 tons by 1975.

Table 1.9

Demand - Principal Consumers

'000 met. tons.

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
India	1474	28.1	1564	23.4	1692	23.4	2000	25.3
China	1145	21.8	992	14.8	1252	17.3	1267	16.0
Canada	515	9.8	1657	24.5	1200	16.6	1580	20.0
Poland	504	9.6	566	8.5	524	7.2	760	9.6
France	334	6.4	592	8.9	604	9.5	600	7.6
Sweden	216	4.1	192	2.9	340	4.7	300	3.8
Pakistan	215	4.1	250	3.7	295	4.1	305	3.9
Germany DR	214	4.1	180	2.7	257	3.6	250	3.2
Germany FDR	107	2.0	185	2.8	308	4.3	250	3.2
Others	535	10.1	531	7.9	679	9.4	600	7.6
World	5255	100.0	6689	100.0	7229	100.0	7912	100.0

1.33 In summary, Far East production is dominated by India; centrally planned production by China and Eastern Europe, and in the developed regions by Canada and Western Europe. Rapeseed therefore remains of comparatively little significance in the developing world but is otherwise geographically wide-spread, performing best in more temperate zones.

Sesame

1.34 Sesame is produced in commercial quantities in over 60 countries dispersed among the developed, developing and centrally planned countries. Unlike some other oilseeds, fluctuations in annual production have not been marked. There has been a slow but relatively steady growth in world supply with production increasing from 1.7 million tons in 1965 to 2.1 million tons in 1975, as shown in Table 1.10.

In 1965 the developing countries accounted for 77.5% of total world supply while the centrally planned and developed countries produced 21.9% and 0.6% respectively. By 1975 the developing countries had increased their share to 80.6% while the shares of the centrally planned and developed countries fell to 19% and 0.4% respectively.

1.35 India, China and Sudan are the main producers with an aggregate 58.4% of the total 1975 production. India has been the largest sesame producer for many years, with around a quarter of world production. Very little is known about Chinese sesame output, but Sudan has continued to encourage the crop, thereby steadily increasing its share of global output. Similarly, Ethiopia appears to be developing a major interest in the crop.

1.36 On the whole, however, the impression gained is of a widely dispersed interest in sesame growing, particularly amongst developing countries, but with the exception of the countries mentioned, plus possibly Mexico, their interest is a comparatively marginal one.

Table 1.10

Sesame - Principal Producers

'000 met. tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
India	424	25.0	562	25.7	475	24.4	480	23.3
China	368	21.7	367	16.8	367	18.9	372	18.1
Sudan	160	9.4	297	13.6	271	13.9	350	17.0
Mexico	154	9.1	179	8.2	165	8.5	155	7.5
Burma	62	3.7	132	6.0	125	6.4	130	6.3
Nigeria	61	3.6	60	2.7	65	3.3	66	3.2
Colombia	58	3.4	28	1.3	28	1.4	35	1.7
Venezuela	54	3.2	125	5.7	72	3.7	75	3.6
Turkey	34	2.0	36	1.6	24	1.2	25	1.2
Ethiopia	33	1.9	81	3.7	110	5.7	130	6.3
Uganda	30	1.8	17	0.8	17	0.9	17	0.8
Afghanistan	34	2.0	30	1.5	40	2.1	42	2.0
Egypt	22	1.3	20	0.9	23	1.2	25	1.2
Bangladesh	24	1.4	27	1.2	29	1.5	29	1.4
Saudi Arabia	18	1.1	17	0.8	18	0.9	18	0.9
Thailand	18	1.1	20	0.9	31	1.6	33	1.6
Others	140	8.3	190	8.7	84	4.3	76	3.7
World	1694	100.0	2188	100.0	1944	100.0	2058	100.0

Safflower

1.37 The commercial production of safflower seed is limited to less than ten countries. The production data reveal significant annual fluctuations, although there has been a tendency for production to increase. Between 1965 and 1971 production increased from 469,000 tons rising again to 1,123,000 tons by 1975. Table 1.11 gives the annual production data in greater detail for the principal producing countries.

1.38 In 1965 the developed countries, mainly the USA, with relatively small quantities from Australia and Israel, produced about 60% of the total world supply of safflower seed. The developing countries, mainly India, Mexico, and Ethiopia, produced 39% and the centrally planned countries, mainly USSR, accounted for less than 1%. By 1975 the pattern had changed with the developing countries accounting for 72.8% of total world production, the developed countries 26.5% and the centrally planned countries only 0.7%. In particular, the USA's share of world production declined by 36.7% between 1965 and 1975. In the same period Mexico increased its share by 31.9% and India by 6.3%.

1.39 Safflower yields vary significantly among the producing countries. India accounts consistently for over 50% of the hectarage harvested in the world but yields are relatively low compared with the USA and Mexico where superior yields have resulted from a package of highly improved cultural practices including water control and improved seeds. Since 1974 there has been declining interest in the production of safflower seed in Australia, but interest has been maintained in the USA, as a result of the low level of saturated fatty acids in safflower oil (see chapter 3).

Conclusions

1.40 In the last decade there have been production increases for all of the ten major sources of vegetable oils discussed above. Soyabean remains the dominant oilseed in volume terms, and seems likely to consolidate its position over the next few years. However, except for certain countries in South America the crop does not appear to be particularly suited to developing countries. Coconuts remain important and continue to be produced predominantly in developing countries particularly in Asia, where there is tremendous scope for yield improvement through disease control, plant breeding and the use of better agronomic methods. A significant upturn in coconut productivity seems likely in the short to medium term.

Table 1.11

Safflower – Principal Producers

'000 met. tons.

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
U.S.A.	271	57.8	170	25.6	160	22.7	243	21.6
Mexico	80	17.1	288	43.4	275	39.0	550	49.0
India	75	16.0	142	21.4	196	27.8	250	22.3
Ethiopia	28	6.0	36	5.4	40	5.7	40	3.6
Australia	10	2.0	9	1.4	8	1.1	8	0.7
U.S.S.R.	3	0.6	7	1.1	5	0.7	7	0.6
Israel	1	0.2	0	0	2	0.3	2	0.2
Turkey	1	0.2	1	0.2	1	0.1	1	0.1
Spain	0	0	8	1.2	17	2.4	17	1.5
Others	–	0	2	0.3	2	0.3	5	0.4
World	469	100.0	665	100.0	706	100.0	1123	100.0

Table 1.12

Principal Producing Countries

Oilseed	Developed Economy	Developing Economy	Centrally Planned Economy
Soyabeans	USA	Brasil	China
Coconuts	-	Philippines, Indonesia India, Sri Lanka	-
Groundnuts	USA	India, Nigeria, Senegal	China
Cottonseed	USA	India, Pakistan, Argentina, Turkey	USSR, China
Sunflower seed	-	Argentina, Turkey	USSR, Bulgaria Rumania
Oil Palm	-	Nigeria, Indonesia, Malaysia, Zaire, Ivory Coast	-
Palm kernels	-	Nigeria, Brasil, Malaysia, Zaire	
Rapeseed	Canada, France	India	China, Poland
Sesame	-	India, Sudan, Mexico, Ethiopia	China
Safflower seed	USA	Mexico, India	

Oil palm has grown in importance and is likely to continue to expand when recent plantings come to maturity; the Far East, in particular Malaysia, is likely to continue to be the principal producing area. Cottonseed production continues to increase steadily in volume terms but in relative terms cottonseed is likely to be outstripped by soyabean, oil palm, sunflowers and possibly groundnuts. Groundnut production in India, Senegal and the USA is likely to be sustained but it remains to be seen if the African countries can assume their former importance if drought problems can be overcome and production technology improved.

There is increasing interest in the other, more minor, oilseeds but lack of cultural experience, plus physiological and technical requirements, are likely to limit their expansion to specific countries and it is unlikely that expansion of sunflower seed, rapeseed or safflower seed will have a major impact on the aggregate developing countries oilseed economy.

1.41 It is perhaps surprising, in view of their number and diversity, that oilseed production is comparatively concentrated geographically. Table 1.12 lists the main producers for each oilseed. In aggregate some twenty four countries, of which only sixteen are developing economies, account for over 80% of world oilseed production. Thus, although other countries may still offer the possibility of expanding and upgrading their oilseed processing industries it must inevitably be to those listed in Table 1.12 that one must first look, if any significant impact is to be made by the developing countries as a group upon the global distribution of oilseed processing industries.

Prices of Oilseeds

The price regime of oilseeds associated with the trends in production, previously discussed, is outlined in Table 1.14. The period since 1970 has been a time of much greater unstability of oilseed prices than the previous ten years.

During the first half of the 1960's two distinct price ranges were discernible. The upper range consisted of copra, palm kernels and groundnuts with prices varying from $ 164-225 per ton in the period 1960-65. The lower range, composed of sunflower seed, rapeseed, cottonseed and soyabeans, remained within a comparatively narrow price band of $ 92-128 per ton over the same period.

This situation has changed considerably over the past decade. Table 1.15 indicates the change in relative price levels using an index with 1965 as the base year. It is readily apparent that, at the present time, copra and palm kernels have undergone a comparatively small increase in price since 1965. However, the prices of these two commodities, which are generally closely related, have undergone considerable fluctuations in recent years. If their present competitive position could be maintained it would provide a sound basis for their expansion in World markets. It is difficult to assess the extent to which stability can be maintained but at the moment copra and palm kernels are two of the cheaper oilseed raw materials.

In contrast, sunflowerseed has almost quadrupled in price, making it considerably more expensive than those oilseeds with which its price was formerly comparable. Only sesame seed, which is not normally crushed, presently costs more than sunflower seed.

Of the remaining oilseeds, soyabeans remain highly competitive, together with rapeseed and cottonseed, having approximately double in price since 1965. Groundnut prices have increased at much the same rate, but since they started from a higher base in 1965, the actual price of groundnuts, at $ 462 per ton in 1975, remains high compared with competing raw materials.

Due to their different end uses and particularly their varying oil contents it would be unwise to draw too specific conclusions from these relative changes in oilseed prices. However, the present situation does suggest that a narrowing of the differential between groundnuts and other oilseeds would

Table 1.14

Average Annual European Wholesale Prices for Major Oilseeds

	1960	1965	1970	1972	1973	1974	1975
			Dollars per metric ton				
OILSEEDS:							
Groundnut (1)	198	206	232	326	543	604	462
Cottonseed (2)	97	104	105	106	153	230	
Soybean (3)	92	117	128	140	290	274	222
Sunflowerseed (4)	104	124	208	164	235	481	473
Rapeseed (5)	128	124	148	132	254	374	293
Copra (6)	207	225	223	141	351	670	256
Palm kernels (7)	164	179	179	124	260	463	204
Sesame (8)	-	-	288	323	387	617	647

(1) Nigerian, shelled
(2) Sudanese, bulk
(3) U.S. No 2 yellow
(4) East African, pure
(5) Canadian, 40% bulk
(6) Straits
(7) Nigerian
(8) Sudanese

All prices cif Europe

Table 1.15

Price Indices for Oilseeds 1965, 1970-75

	1965	1970	1971	1972	1973	1974	1975
Groundnuts	100	112	125	158	263	293	224
Cottonseed	100	100	103	103	147	221	-
Soyabeans	100	109	113	119	247	234	190
Sunflowerseed	100	168	142	132	189	388	381
Rapeseed	100	119	114	106	205	301	236
Palm kernels	100	100	81	69	145	258	114
Sesame seed	100	115	125	129	156	246	259
Copra	100	99	83	65	156	298	114

benefit the developing countries in any effort to gain a greater share of world markets for oilseed products and that specific developing countries are now in a position to take increased advantage of the competitiveness of oil palm and coconut products.

CHAPTER 2

Trade in Oilseeds and Oilseed Products

A. Oilseeds

World trade in oilseeds is comparatively small; in 1975 only some 11 per cent of global oilseed production entered international markets in this form. The predominant feature of oilseed trading is its dominance by soyabeans which accounted as shown in Table 2.1 for over 80 per cent of the total volume traded. Although the total volume of oilseeds traded has risen from 12.0 million tons in 1965 to 21. million tons in 1975 the difference is almost entirely due to the growth of soyabean exports. Otherwise, only rapeseed trade has undergone any marked expansion. The volume of other oilseeds traded has either declined or remained comparatively stable.

Soyabeans

Soyabeans are unique amongst the oilseeds in having such a high proportion of their trade in the form of the seed. Tables 2.2 and 2.3 outline the major exporters and importers of soyabeans over the past decade. The vast proportion of traded soyabeans pass from the USA to Western Europe. The USA accounts for 80 per cent of world exports and the EEC for 55 per cent of all imports. The other major importers are Japan and Spain. The one major development in the soyabean trade over the past decade which has affected this pattern has been the emergence of Brazil as an exporter. In 1965 Brazil accounted for about 1 per cent of soyabean exports but by 1975 this figure had risen to 16 per cent. Brazilian exports compete with American soyabeans in the markets of Western Europe but in 1975 Brazil still only had 20 per cent of that market.

Copra

World exports of copra in 1974 were 0.5 million tons compared with 1.36 million tons in 1965. It will be seen later that coconut oil exports have increased in recent years which suggests a change in the structure of coconut exports rather than a sharp absolute decline.

Table 2.1

World Trade in Oilseeds - Exports 1965, 1970, 1974.

million metric tons.

	1965	% of total	1970	% of total	1974	% of total
Soyabeans	6.97	57.7	12.62	72.3	17.81	80.2
Groundnuts	1.36	11.3	0.99	5.7	0.90	4.2
Cottonseed	0.46	3.8	0.48	2.7	0.33	1.5
Copra	1.36	11.3	0.91	5.3	0.52	2.4
Palm Kernels	0.66	5.4	0.46	2.6	0.38	1.8
Sunflower seed	0.24	2.0	0.48	2.7	0.39	1.9
Rapeseed	0.68	5.6	1.23	7.1	1.39	1.5
Sesame seed	0.18	1.5	0.22	1.2	0.26	1.2
Safflower seed	0.18	1.5	0.08	0.4	0.07	0.3
Total	12.09	100.0	17.47	100.0	21.42	100.0

Table 2.2

Soyabean – Major Exporters

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
USA	6196.0	88.8	11839.1	93.8	13940.0	81.1		
China	576.6	8.3	410.0	3.2	340.0	2.0		
Canada	82.6	1.2	28.6	0.2	13.1	0.1		
Brazil	75.3	1.1	289.6	2.3	2724.1	15.9		
Paraguay	1.3	–	0.9	–	100.7	0.6		
Rumania	–	–	–	–	27.0	0.2		
Others	43.4	0.6	53.3	0.4	40.9	0.2		
World	6975.2	100.0	12621.5	100.0	17185.8	100.0		

Table 2.3

Soybeans - Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975 (b)	% of Total
Taiwan	161.4	2.4	618.5	5.1	1179.6	6.7	912.0	5.8
Japan	1847.5	27.8	3244.8	26.5	3244.9	18.5	3334.0	21.3
Belgium	139.9	2.1	334.5	2.7	746.9	4.3	698.0	4.5
Denmark	404.2	6.1	535.4	4.4	472.0	2.7	402.0	2.6
France	109.5	1.6	442.6	3.6	564.0	3.2	416.0	2.7
German Fed Rep	1292.9	19.5	2074.6	16.9	3715.5	21.2	3464.0	22.1
Italy	449.5	6.8	845.3	6.9	1226.6	7.0	1217.0	7.8
Netherlands	392.0	5.9	1105.6	9.0	1590.1	9.1	1282.0	8.2
Spain	340.9	5.1	1230.7	10.1	1588.9	9.1	1737.0	11.1
U.K.	287.0	4.3	365.7	3.0	804.6	4.6	754.0	4.8
Others	1209.4	18.2	1453.5	11.9	2373.4	13.6	1461.0	9.3
World Total	6654.2	100.0	12241.2	100.0	17506.5	100.0	15677.0	100.0

Exports of copra tended to fluctuate up until 1973, showing only a slight and indeterminate downward trend; the main drop in copra trade took place in 1974. The fact that this was not associated with a marked decline in production further suports the view that a greater degree of processing of copra is taking place in the producing countries who then export the oil.

Philippine exports, however, have fluctuated considerably during the past decade, falling as low as 425,000 tons in 1970 and rising as high as 982,386 tons in 1972, before reaching the 1974 low of 267,697 tons. Indonesian exports have also fluctuated again in contrast to their stable production figures. In fact, it would seem that Indonesian copra exports virtually ended in 1974. The general trend of copra exports in all these countries is downward but only in a highly irregular fashion with considerable year to year fluctuations. Only amongst the smaller producers do exports constitute a significant proportion of production, India, the third largest producer in the world, exports very little copra and much the same can be said for Sri Lanka and Malaysia.

In Oceania a high proportion of production is exported and the main countries involved, Papua New Guinea and the New Hebrides, have a comparatively stable trade, and have steadily increased their share of world copra exports to 22% in 1974. The only African exporter of any size is Mozambique. In 1974 exports were 45,000 tons which, when compared with 1965 exports of 28,600 tons represents an increase in its share of world exports from insignificant exporters.

The largest importer of copra is the EEC (specifically W. German, France Netherlands and UK.) which accounts for approximately a half of all imports. This particular trade is tending to be an increasing proportion of a smaller total. In contrast, imports of copra into the USA have declined drastically since 1965 when the USA accounted for 20 per cent of total imports. Today the USA accounts for less than 5 per cent of the trade. Japan, the other major copra importer, has increased its share of the market to 15 per cent but, as in the case of the EEC, the proportion is related to a lower absolute quantity. There are a number of other importers of copra taking small amounts, for example, Scandinavia and Australia, but in aggregate they constitute a significant share of the copra trade. However, the broad impression remains one of many small outlets for a fluctuating but, in the long-term, declining total supply.

Table 2.4

Copra - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Philippines	866.2	63.6	425.2	46.3	267.7	51.1		
Indonesia	126.0	9.2	185.1	20.1	1.5	0.3		
Papua N. Guinea	74.7	5.5	85.6	9.3	82.9	15.8		
Sri Lanka	41.6	3.1	15.5	1.7	0.4	0.1		
New Hebrides	28.7	2.1	31.2	3.4	34.0	6.5		
Mozambique	28.6	2.1	45.1	4.9	45.0	8.6		
Malaysia	24.9	1.8	15.0	1.6	9.8	1.9		
British Solomons	24.9	1.8	21.4	2.3	17.0	3.2		
West Samoa	12.6	0.9	9.8	1.1	15.2	2.9		
Tonga	7.0	0.5	8.0	0.9	8.2	1.6		
Gilbert Is	9.2	0.7	5.8	0.6	6.5	1.2		
Pacific Is	12.7	0.9	14.2	1.5	8.7	1.7		
Others	105.6	7.7	56.8	6.2	26.7	5.1		
World	1362.7	100.0	918.7	100.0	523.6	100.0		

Table 2.5

Copra – Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
USA	278.9	20.6	197.6	22.4	26.6	4.8		
Japan	94.2	7.0	126.9	14.4	86.3	15.7		
Singapore	26.7	2.0	17.2	1.9	11.4	2.1		
France	95.6	7.1	54.5	6.2	48.6	8.8		
German Fed.Rep.	242.5	17.9	150.6	17.1	76.3	13.9		
Netherlands	136.0	10.0	77.9	8.8	107.5	19.5		
Norway	22.1	1.6	19.0	2.2	11.2	2.0		
Sweden	69.4	5.1	55.4	6.3	29.7	5.4		
U.K.	56.5	4.2	32.0	3.6	30.1	5.5		
Australia	33.0	2.4	28.3	3.2	15.0	2.7		
Others	299.5	22.1	123.8	14.0	107.4	19.5		
World Total	1354.4	100.0	883.2	100.0	550.1	100.0		

Groundnuts

Groundnuts are exported both in the shell and as kernels. Groundnuts in shell are intended primarily for direct human consumption. There is also a sizeable trade in groundnut kernels for direct consumption. It is estimated that in 1973 the edible trade accounted for 100,000 tons of groundnuts in shell and 380,000 tons of groundnut kernels. However no attempt is made in this report to distinguish between edible and milling groundnuts. Table 2.6 illustrates the principal exporters and includes trade in both shelled and unshelled nuts. Historically, trade in groundnuts has been well over 1 million tons annually, but in recent years the decline in production of certain West African producers has been associated with a tendency for the groundnut trade to decline. There are a number of exporters each with a significant share of the market.

Developing countries comprise the major exporters. In 1965 they were responsible for 85% while the developed and centrally planned countries accounted for 11% and 4% respectively. In 1974 the share of the developing countries had fallen to 60% and that of the developed and centrally planned countries was 37% and 3% respectively. It would appear therefore that the developed nations especially the USA have, within the specified period, substantially increased their share of exports. The major reason for this situation appears to be the drastic reduction in production in some exporting African territories resulting from prolonged and severe drought and from disease problems rather than structural changes in their economies. This trend may therefore be temporary only and could be reversed following, for example, favourable weather conditions.

Between 1965 and 1970 Nigeria dominated world exports although between those years its market share fell from 38% to 29%. In 1974, however, the USA emerged as the major exporter. This was partly due to a five-fold increase in the quantity exported but was also assisted by the drastic decline in West African exports. In addition to Nigeria, Senegal, traditionally the second major exporter, suffered a major production setback and exports declined to a very low level. In contrast, Sudanese production has been comparatively untouched by the drought problems which have affected West African producers their exports have continued to grow steadily since 1970, and in 1974 Sudan ranked second to the USA in the league of groundnut exporters.

Table 2.6

Groundnuts - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nigeria	520.0	38.2	291.2	29.4	30.4	3.4		
Senegal	216.8	15.9	51.4	5.2	18.9	2.1		
Sudan	152.2	11.2	63.9	6.4	149.6	16.5		
Niger	86.4	6.3	131.9	13.3	2.0	0.2		
U.S.A	78.4	5.8	51.2	5.2	254.8	28.1		
China	46.3	3.4	16.2	1.6	29.0	3.2		
Gambia	33.8	2.5	38.1	3.8	42.9	4.7		
Mali	22.2	1.6	17.6	1.8	12.5	1.4		
Brazil	18.4	1.3	53.5	5.4	53.0	5.8		
South Africa	18.8	1.4	70.3	7.1	51.8	5.7		
Cameroon	10.6	0.8	13.4	1.4	23.3	2.6		
Malawi	18.9	1.4	22.5	2.3	20.7	2.3		
India	0.2	—	25.8	2.6	100.0	11.0		
Others	140.0	10.3	144.1	14.5	118.5	13.1		
World	1363.0	100.0	991.1	100.0	907.4	100.0		

Table 2.7

Groundnuts - Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975 (b)	% of Total
Japan	25.1	1.9	58.9	5.6	52.7	6.1	45.0	6.2
Spain	28.6	2.2	26.7	2.5	16.4	1.9	20.0	2.7
France	384.2	30.4	314.3	30.0	236.2	27.5	199.2	27.3
German Fed.Rep.	56.3	4.3	89.2	8.5	57.1	6.7	53.6	7.3
Italy	103.0	7.8	116.1	11.1	79.4	9.2	80.1	11.0
Netherlands	42.2	3.2	42.4	4.0	46.6	5.4	51.6	7.1
Portugal	92.0	7.0	48.0	4.6	41.4	4.8	43.5	6.0
Switzerland	70.6	5.4	80.9	7.7	45.0	5.2	50.1	6.9
U.K.	91.8	7.0	61.6	5.9	65.0	7.6	71.8	9.8
Canada	49.1	3.7	49.0	4.7	59.4	6.9	86.3	11.8
Others	250.9	19.1	161.2	15.4	159.2	18.5	29.3	4.0
World Total	1313.8	100.0	1048.3	100.0	858.4	100.0	730.5	100.0

Another result of the changes that have taken place in the past ten years is that a number of smaller suppliers now have a significant share of the trade. Today, India, Brazil, South Africa and Cameroon account for almost a quarter of the world market whereas in 1965 their exports as a group were insignificant. It may well be that over the next few years this group of countries will consolidate their position in world groundnut markets if the traditional producers continue to experience supply problems.

In similar fashion to exports, groundnut imports have virtually halved since 1965 (see Table 2.7). In the process, although obviously the quantities involved have declined, the broad picture of principal importers has remained remarkably stable. Western Europe is still the major outlet, taking over 70 per cent of the total, France, Italy, UK and West Germany being the major importers. The other main importers are Canada and Japan. Canada's imports, contrary to the overall trend, have almost doubled since 1965.

Palm kernels

A significant but declining proportion of palm kernel production enters world trade. In 1965 the quantity of palm kernels traded internationally was 665,000 tons or approximately 58% of world production. By 1974 only 383,000 tons or 28% of total production was traded.

Since production of palm kernels continues to expand it is evident that a significant move towards a greater degree of processing in producing countries is taking place.

Developing countries comprise the main exporters. Some re-exports occur among developed as well as developing countries but there are difficulties in isolating them.

In 1965 Nigeria exported 422,000 tons or 63% of all palm kernels traded. This had declined to 184,500 tons or 48% of the total in 1974. By comparison other exporters of palm kernels are of minor importance. Sierra Leone, Indonesia, Cameroon and the Ivory Coast together contribute another 30 per cent of total exports. The two former countries are tending to reduce their exports but those of Cameroon have remained fairly stable whilst the Ivory Coast has doubled its output in recent years. This broad pattern of a general African domination of palm kernel exports seem likely to be sustained but some reallocation of trade within African countries is probable.

Table 2.8

Palm Kernels - Major Exporters 1965-75

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nigeria	422.2	63.5	185.3	40.5	184.5	48.1		
Sierra Leone	50.1	7.5	59.9	13.1	29.0	7.6		
Indonesia	32.9	4.9	42.4	9.3	28.5	7.4		
Cameroon	21.5	3.2	22.7	5.0	25.6	6.7		
Togo	15.3	2.3	17.1	3.7	6.0	1.6		
Ivory Coast	14.3	2.2	18.1	4.0	39.0	10.2		
Guinea	12.0	1.8	13.0	2.8	12.5	3.3		
Angola	14.3	2.2	12.5	2.7	9.7	2.5		
Malaysia	0.1	—	5.2	1.1	20.4	5.3		
Others	82.0	12.3	80.9	17.7	28.2	7.4		
World	664.7	100.0	457.1	100.0	383.4	100.0		

Table 2.9

Palm Kernels – Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975
Japan	22.0	3.3	33.0	7.7	40.0	10.1	
West Malaysia	–	–	–	–	22.0	5.5	
Denmark	14.0	2.1	18.0	4.2	22.0	5.5	
France	66.0	9.9	60.0	14.0	17.0	4.3	
German Fed. Rep.	126.0	18.9	76.0	17.7	58.0	14.6	
Netherlands	113.0	17.0	146.0	34.0	149.0	37.5	
Poland	26.0	3.9	13.0	3.0	–	–	
Portugal	17.0	2.6	12.0	2.8	12.0	3.0	
Switzerland	7.0	1.1	4.0	0.9	9.0	2.3	
U.K.	207.0	31.1	38.0	8.8	55.0	13.9	
Others	67.0	10.1	30.0	7.0	13.0	3.3	
World Total	665.0	100.0	430.0	100.0	397.0	100.0	

Although Malaysia and Indonesia have expanded their oilpalm production in recent years their interest in palm kernels remains comparatively marginal largely for the technical reasons mentioned in the chapter on production.

Palm kernel importers, shown in Table 2.9, are predominantly West European; the Netherlands, W. Germany and the UK accounted for over 70 per cent of all imports in 1974. Other European countries, notably Denmark, France, Portugal and Switzerland, take most of the remainder.

Cottonseed

Only a little over 1 per cent of world cottonseed production enters international trade and even this proportion has tended to decline over the past decade. Table 2.10 shows the decline in exports over the period under review. A considerable number of countries export a quantity of cottonseed but only four countries exported more than 30,000 tons in 1974. Nicaragua was the principal exporter in both 1965 and 1974 but between these years the amount traded has fluctuated violently. In 1970, for example, Nicaragua exported only 17,000 tons compared to 138,000 tons in 1965 and 47,000 tons in 1974. The other major exporters are the USA, Ivory Coast and Uganda. All three have built up cottonseed exports from a very low level in 1965. The overall impression remains that of a trade which is subject to major annual fluctuations in the amounts supplied by as many as a dozen countries. Japan is the principal importer of cottonseed; in 1965 and 1974 almost half of world cottonseed exports went to Japan and it is estimated that in 1975 this proportion increased substantially. The only other importers of any note are Lebanon, which has consistently imported from 10-12% of traded cottonseed; Greece, which likewise has been a consistent importer and Mexico, which has built up its cottonseed imports from 1,000 tons in 1965 to over 35,000 tons in 1974. In that year this represented about 13% of all cottonseed imports and made Mexico the second largest importer.

Although from Table 2.11 the pattern of imports appears rather more stable than that of exports the overall impression remains one of comparative unpredictability with several countries exhibiting marked fluctuations in their requirements. A situation in which a slowly rising level of production is associated with a decline in cottonseed trade suggests that cottonseed is perhaps being processed in greater quantities by the main producers, but it seems that if this is so, the beneficiaries are as likely to be developed countries as developing countries.

Table 2.10

Cottonseed – Major Exporters

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nicaragua	138.5	30.3	17.2	3.6	47.7	14.4		
Sudan	65.3	14.3	69.2	14.3	4.9	1.5		
Uganda	-	-	8.1	1.7	30.6	9.2		
Ivory Coast	4.9	1.1	15.6	3.2	31.5	9.5		
Dahomey	1.0	0.2	8.2	1.7	23.6	7.1		
USA	4.8	1.0	22.1	4.6	44.3	13.4		
USSR	-	-	39.5	8.2	20.6	6.2		
Thailand	8.9	1.9	23.7	4.9	7.0	2.1		
Nigeria	71.3	15.6	96.0	19.9	11.1	3.4		
Afghanistan	4.3	0.9	5.2	1.1	20.0	6.0		
Israel	2.1	0.5	19.1	4.0	9.8	3.0		
Others	156.5	34.2	156.9	32.5	80.0	24.2		
World	457.6	100.0	482.6	100.0	331.1	100.0		

Table 2.11

Cottonseed - Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Kenya	1.9	0.4	8.4	1.7	16.6	6.2		
Costa Rica	-	-	4.1	0.8	8.0	3.0		
Honduras	2.1	0.5	0.3	0.1	4.0	1.5		
Mexico	1.0	0.2	32.4	6.6	35.3	13.2		
Japan	217.1	47.4	296.6	60.1	123.3	46.1		
Lebanon	49.8	10.9	49.3	10.0	32.0	12.0		
Czechoslovakia	24.3	5.3	12.0	2.4	-	-		
Greece	28.4	6.2	48.5	9.8	24.3	9.1		
Portugal	7.7	1.7	21.7	4.4	3.0	1.1		
Spain	1.6	0.3	1.5	0.3	1.4	0.5		
Others	124.3	27.1	18.4	3.7	19.4	7.3		
World Total	458.4	100.0	493.2	100.0	267.3	100.0		

Rapeseed

Between 1965 and 1974 the percentage of total world rapeseed production which entered international trade ranged from 13.0% to 25.4%. Exports increased from 683,000 tons in 1965 to 1.9 million tons in 1971, since when there has been a tendency for exports to fluctuate within the 1.2 to 1.4 million tons range.

Developing countries do not feature significantly in rapeseed trade. In 1965, developing countries were responsible for less than 10% of total exports and by 1974 they provided only 0.5% of the total. India, the world's largest producer of rapeseed does not normally export more than a few hundred tons. The main export countries are developed countries. The major exporters and quantities exported in 1965, 1970 and 1975 are given in Table 2.12.

Canada is the largest exporter and has considerably increased its exports from 275,000 tons in 1965 to 676,000 tons in 1975 or about half of total exports. This dominant position has been sustained throughout a decade when the total annual trade in rapeseed has virtually doubled. Historically, France and Sweden have contributed together around 30 per cent of rapeseed exports and although there have been fluctuations this position has been largely maintained. Of recent date, Denmark has also joined the number of minor exporters with 10 per cent of total exports in 1974.

The major importers of rapeseed are again predominantly developed countries. Table 2.13 shows that Japan occupies the principal position; a position that it is tending to consolidate. In 1974 almost half of world rapeseed imports went to Japan and it is estimated that in 1975 this figure will have increased substantially.

The other major importer is West Germany, with almost 16 per cent of the market share in 1974. In absolute terms the amount involved, 218,000 tons, is double the level of 1965 imports into West Germany. Other West European countries with minor shares of rapeseed imports include France, Italy, UK and Netherlands. Together they accounted for slightly less than 20 per cent of total imports in 1974. The latter two countries appear to

Table 2.12

Rapeseed – Major Exporters

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Canada	275.0	40.2	705.8	57.3	684.9	49.2		
France	126.4	18.5	200.4	16.3	259.1	18.6		
Sweden	73.5	10.8	53.5	4.3	166.0	11.9		
German Fed. Rep.	4.8	0.7	36.9	3.0	62.6	4.5		
Denmark	45.2	6.6	28.0	2.3	150.1	10.8		
Others	158.8	23.2	207.1	16.8	68.4	4.9		
World	683.7	100.0	1231.7	100.0	1391.1	100.0		

Table 2.15

<u>Rape and Mustard Seed - Major Importers</u>

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Algeria	59.4	9.3	58.5	5.4	43.0	3.1		
Mexico	0.1	-	12.9	1.2	39.2	2.8		
USA	14.4	2.3	38.2	3.5	35.7	2.6		
Bangladesh	73.2	1.5	89.0	8.2	30.2	2.2		
Japan	108.2	16.9	344.9	31.6	673.1	48.6		
France	4.5	0.7	62.3	5.7	45.7	3.3		
German Fed.Rep.	109.8	17.2	75.1	6.9	218.5	15.8		
Italy	132.5	20.7	216.8	19.9	70.0	5.1		
Netherlands	20.5	3.2	35.7	3.3	51.5	3.7		
U.K.	32.7	5.1	51.3	4.7	68.8	5.0		
Others	85.6	13.1	105.8	9.7	109.5	7.9		
World Total	638.9	100.0	1090.5	100.0	1385.2	100.0		

have had a steadily growing interest in the crop over the past decade. In contrast, Italy, once the leading importer, is now importing little more than half its 1965 requirements and only a third of its peak 1970 imports. Nevertheless, Western Europe, along with Japan, appears likely to dominate rapeseed trade in the foreseeable future.

Sunflower seed

Only a very small proportion of sunflower seed, usually less than 1%, enters international trade. It is evident from Table 2.14 that in 1965 the centrally planned countries dominated the world market with nearly 88% of trade, while the developed and developing countries accounted for 8% and 4% respectively. In 1974, however, although the centrally planned countries remained the largest producing group their share of world exports dropped to 26% while the developed and developing countries claimed 69% and 5% respectively. The share of the developing countries had therefore increased but only to a very small extent. The increase in the share of the developed countries by 1974 was due to increased exports from France, Germany and Canada but especially from the USA where exports increased from under 1,000 tons in 1965 to 185,000 tons in 1974. It seems probable that, following its intention of expanding sunflower production, the USA will continue to be a significant sunflower seed exporter. However, it must be remembered that in terms of total oilseed exports, sunflower seed exports of about 400,000 tons are a relatively minor contribution to world supplies.

Imports of sunflower seed into the major importing countries have fluctuated widely since 1965. From 197,019 tons in 1965 world imports rose to 517,907 in 1970 but declined sharply to 186,000 tons in 1975.

In 1965, East Germany was the largest importer with 65,000 tons or 33% of the world total, with Italy and West Germany taking second and third places with 32% and 16% respectively. By 1974 West Germany had emerged as the largest importer with 120,153 tons or 29% of the world total. East Germany, Czechoslovakia and France took second, third and fourth places respectively. In 1974 substantial increases over previous years were also recorded in the imports of the Netherlands and Portugal.

Table 2.14

Sunflower — Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Bulgaria	91.5	38.3	97.3	20.4	10.0	2.5		
USSR	83.7	35.1	142.7	29.9	63.4	15.9		
Rumania	18.7	7.8	44.3	9.3	2.0	0.5		
Hungary	10.4	4.4	24.1	5.0	23.3	5.9		
Yugoslavia	9.0	3.8	118.4	24.8	13.3	3.3		
Tanzania	6.9	2.9	10.0	2.1	6.3	1.6		
Canada	6.2	2.6	2.6	0.5	21.2	5.3		
China	4.7	2.0	2.3	0.5	2.0	0.5		
USA	–	–	1.8	0.4	184.9	46.5		
France	0.4	0.2	22.2	4.6	15.9	4.0		
Australia	–	–	–	–	14.0	3.5		
German D.R.	0.5	0.2	0.2	–	22.2	5.6		
Others	6.6	2.8	11.8	2.5	19.0	4.8		
	238.6	100.0	477.7	100.0	397.5	100.0		

Table 2.15

Sunflower Seed – Major Importers

'000 net tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Tot
Japan	3.9	2.0	45.4	8.8	1.3	0.3		
Australia	5.0	2.5	6.3	1.2	6.2	1.5		
Belgium	2.6	1.3	1.5	0.3	1.9	0.5		
Czechoslovakia	16.6	8.4	65.0	12.6	68.9	16.6		
France	0.4	0.2	1.9	0.4	46.9	11.3		
German D	65.0	33.0	92.5	17.9	74.0	17.9		
German	32.6	16.5	79.0	15.3	120.2	29.0		
Italy	63.0	32.0	179.7	34.7	30.6	7.4		
Netherlands	1.0	0.5	17.2	3.3	15.1	3.6		
Portugal	-		4.1	0.8	28.3	6.8		
Others	6.9	3.5	25.3	4.9	20.6	5.0		
World Total	197.0	100.0	517.9	100.0	414.0	100.0		

Sesame seed

Only a very limited proportion of sesame seed production enters international trade. Table 2.16 shows the major exporters. There has been a general tendency for exports to increase, except for 1971 which was a relatively bad year. 1974 had the highest level of exports totalling 262,000 tons, or 13% of total production, compared to 1965 with 178,000 tons or 10% of total production.

The developing countries comprise the major exporters of sesame seed, normally accounting for well over 90% of all supplies. Sudan is the largest exporter with 35 per cent of the present market; a proportion that has declined only slightly since 1965. Ethiopia and Nigeria accounted for a further 23% in 1965, divided equally, but while Ethiopia increased exports to 84,600 tons, or 32% of the total trade in 1974, and maintained its position as second largest exporter, Nigerian exports have declined to zero. In contrast Thailand and Mexico have increased their shares of total world exports from less than 3% of the market in 1965 to over 10% in 1974. Mexico in particular seems to have established a long-term interest in the crop. However, it must be reiterated that trade in sesame seed makes a very small contribution to world oilseed supplies and, unlike the other oilseeds sesame is seldom exported for subsequent processing into oil. Most exported sesame seed is used in the confectionary industry.

World imports of sesame seed have progressively increased since 1965. From 158,857 tons in 1965, imports increased to 187,001 tons in 1970 and to 200,093 tons in 1974.

Japan with 33,357 tons, or 21% of the world total, was the largest importer in 1965 with Italy and USA claiming second and third places with 19.7% and 7.9% respectively. The USSR, China, Portugal, Lebanon, Israel and Egypt also imported significant quantities. A large number of small importers collectively claimed 48,372 tons or 30.5% of the total imports.

By 1970, Japan, Italy and USA had substantially increased their imports and maintained their former positions as leading importers but Egypt had [illegible] a leading importer. Together the four countries accounted for 70% of total imports. Imports into Israel, Lebanon, USSR and Greece also increased substantially.

Table 2.1

Sesame – ajor Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Sudan	70.6	39.6	81.9	36.9	92.5	35.3		
Ethiopia	21.5	12.1	39.7	17.9	84.6	32.2		
Nigeria	20.5	11.5	12.1	5.5	-	-		
Tanzania	9.8	5.5	5.3	2.4	3.5	1.3		
Hong Kong	7.5	4.2	5.4	2.4	2.2	0.8		
Khmer Rep	8.9	5.0	9.3	4.2	4.0	1.5		
Nicaragua	5.5	3.1	5.9	2.7	4.8	1.8		
Thailand	3.7	2.1	3.7	1.7	13.4	5.1		
Mexico	0.4	0.2	3.6	1.6	15.0	5.7		
Others	30.0	16.8	55.1	24.8	42.4	16.2		
World	178.4	100.0	222.0	100.0	262.4	100.0		

Table 2.1

Sesame Se i - Major Importers

000 met tons

Countries	1965	% of total	1970	% of total	1974	% of total	1975	% of total
Egypt	5.0	3.2	19.0	10.2	15.0	7.5		
USA	12.6	8.1	19.4	10.4	25.7	12.9		
China	7.4	4.8	5.4	2.9	13.4	6.7		
Israel	2.0	1.3	3.3	1.8	6.0	3.0		
Japan	33.4	21.5	52.7	28.2	49.7	24.9		
Lebanon	4.4	2.8	5.4	2.9	6.0	3.0		
USSR	4.0	2.6	8.77	4.7	5.1	2.6		
Greece	0.2	0.1	4.5	2.4	6.4	3.2		
Italy	31.2	20.1	40.3	21.6	19.0	9.5		
Portugal	6.5	4.2	1.9	1.0	3.7	1.9		
Others	48.4	31.2	26.3	14.1	50.0	25.0		
World total	155.1	100.0	186.9	100.0	200.0	100.0		

In 1974, despite a slight decline in volume, Japan maintained its role as leading importer with the USA in second place. Italian imports of sesame declined by 50 per cent between 1970-75 but Italy remains the third major importer. Israel, Lebanon and Greece all continued to import steadily increasing quantities and in 1974 accounted for just under 10 per cent of all imports. However, a quarter of all sesame imports in 1974 were still dispersed amongst a large number of small outlets and it seems the nature of the trade in sesame seed that this pattern will continue to be a dominant feature.

Safflower seed

The USA has been the only consistent major exporter of safflower seed. Mexico has been exporting for a number of years but recently exports have been banned to increase domestic stocks. India, one of the three largest producers, does not export. For many of the minor exporters, the export of safflower seed is not categorised in their trade statistics but is included in other oilseeds. Table 2.18 gives data on the exports of safflower seed, which fully illustrate the overwhelmingly dominant position of the USA.

The main importers of safflower seed have been Japan, Spain and Australia. The total quantity imported in 1965 was 120,000 tons but this figure fell to 46,000 tons in 1970, before recovering to 92,500 tons in 1972. Owing to the fact that importers now record safflower seed under "other oilseeds" in their trade reports more recent data on the import trade is difficult to obtain.

To summarise, it is evident that trade in oilseeds since 1965 has undergone a number of developments. Of outstanding importance is the growth exports of soyabeans, which has largely accounted for the overall growth in the oilseed trade. Apart from soyabeans there seems to be a marked tendency for the trade in oilseeds to either decline or at least stagnate. Trade in groundnuts, copra, cottonseed, palm kernels and safflower seed has actually fallen whilst trade in sunflower seed and sesame seed, never very substantial, has grown very slowly. Only the trade in rapeseed provides an exception. Compared to the trade in soyabeans the trade in rapeseed is still very small but it is nevertheless currently the second most important oilseed traded in seed form.

The relatively stagnant nature of the export trade in most of the major oilseeds in recent years contrasts with the production pattern of an overall upward trend. It should however be viewed against developments in the trade in oilseed products. This is reviewed below.

B. Oils

The volume of vegetable oils traded has expanded steadily with only minor interruption, since 1965 at an average annual rate of about 9% which implies a doubling of supplies in approximately ten years.

In 1965 it was possible to distinguish six principal traded oils each of which had at least 10% of the market but equally none had more than a quarter of the market. Soyabean oil and palm oil had the largest shares, with 22% and 20% respectively, but groundnut, coconut, cottonseed and sunflower seed oils were all traded in broadly similar amounts. Thus the vegetable oil trade had a comparatively broad product base. In addition, smaller amounts of palm kernel oil, rapeseed oil and sesame seed oil were also available.

The virtual doubling of supplies since 1965 has been accompanied by a marked concentration of the trade in vegetable oils. In 1965, soyabean and palm oils, the two leading products, had an aggregate 42% of the market but this has now grown to 53%. Faced with a major expansion of supplies in these two oils, producers of the other vegetable oils have had difficulty in retaining their market shares, even though quite often their own supplies have been increased. For example, both coconut and cottonseed oils have increased in absolute terms but not enough to prevent a marked decrease in their market shares. However, the worst performance has been that of groundnut oil. Even less groundnut oil is traded now than in 1965, which inevitably means a quite significant loss of markets.

The remaining oils, notably sunflower seed and rapeseed, have both managed to improve their own market shares since 1965 but at a rather more modest level of supply than that achieved by the leading oils. Nevertheless, they remain significant factors and help to counter the tendency to greater concentration of the vegetable oils trade.

Soyabean oil

Trade in soyabean oil increased from 0.7 million tons in 1965 to 1.5 million tons in 1974. To a major extent the level of trade is dictated by the USA as the world's major producer. In 1965 the USA exported 78%

Table 2.12

Trade in Vegetable Oils

'000 m.t.

	1965	% of Total	1970	% of Total	1974	% of Total
Soyabean	691.4	22.5	1125.9	25.6	1549.3	25.6
Groundnut	415.4	13.5	429.7	9.7	370.5	6.1
Coconut	474.8	15.4	615.6	14.0	664.7	11.0
Cottonseed	352.8	11.5	245.1	5.6	363.4	6.0
Palm Oil	618.0	20.1	906.2	20.6	1688.7	27.9
Palm Kernel	108.8	3.5	170.1	3.9	286.2	4.7
Sunflower	315.7	10.3	731.2	16.6	748.7	12.4
Rape/Mustard	94.7	3.1	178.9	4.1	371.4	6.1
Sesame	NA	NA	NA	NA	NA	
Safflower	NA	NA	NA	NA	NA	
Total	3071.6	100.0	4402.7	100.0	6042.9	100.0

Table 2.20

Soyabean Oil – Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Canada	15.8	2.3	21.4	1.9	8.1	0.5		
USA	545.1	78.8	674.5	59.9	758.2	48.9		
Japan	5.6	0.8	13.2	1.2	2.9	0.2		
Belgium	6.0	0.9	27.4	2.4	77.9	5.0		
Denmark	41.3	6.0	56.4	5.0	31.7	2.0		
France	4.0	0.6	29.3	2.6	80.9	5.2		
German Fed. Rep.	15.5	2.2	69.0	6.1	241.1	15.6		
Netherlands	17.5	2.5	86.5	7.7	196.4	12.7		
Romania	–	–	5.3	0.5	12.0	0.8		
Spain	0.1	–	85.6	7.6	59.1	3.8		
Others	40.5	5.9	57.3	5.1	81.0	5.2		
WORLD TOTAL	691.4	100.0	1125.9	100.0	1549.3	100.0		

Table 2.21

Soyabean Oil – Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Morocco	44.5	6.7	38.5	3.9	63.9	4.3	35.0	4.9
Tunisia	22.2	3.3	28.2	2.9	54.0	3.6	21.3	3.0
Peru	14.0	2.1	21.3	2.2	70.3	4.7	22.1	3.1
India	40.5	6.1	78.5	7.9	60.0	4.0	2.0	0.3
Iran	27.6	4.1	96.8	9.8	155.0	10.4	67.9	9.5
Pakistan	50.5	7.6	88.5	8.9	128.5	8.6	10.1	1.4
France	1.2	0.2	37.2	3.8	85.4	5.7	90.0	12.6
Italy	1.8	0.3	37.1	3.7	130.6	8.8	107.1	15.0
Netherlands	22.9	3.4	35.9	3.6	78.7	5.3	73.5	10.3
Sweden	8.1	1.2	37.6	3.8	52.8	3.6	42.4	5.9
Others	434.1	65.0	489.8	49.5	607.8	40.9	242.4	34.0
World Total	667.4	100.0	989.4	100.0	1487.0	100.0	713.8	100.0

of world supplies but Table 2.20 shows a decline to less than half in 1974. However, the other notable soyabean oil exporters are not, for the most part, soyabean producers. The tendency has been for other developed countries, especially West European countries, to import USA soyabeans, process them and export the oil surplus to their own needs. In particular, West Germany and the Netherlands have built up a considerable trade in this manner and now account for over a quarter of soyabean oil exports.

Significant absentees from the list of soyabean oil exporters are the developing countries growing soyabeans, notably Brazil, Mexico and Indonesia. Most, if not all, of their trade is still in the form of soyabeans.

Soyabean oil is imported and utilised by more countries than any other vegetable oil. Table 2.21 illustrates the fact that no country has a dominant share of the import trade; on the contrary a large number of countries import relatively small amounts.

The distribution of countries importing soyabean oil range from Latin America to Africa, Western Europe and Asia. Western Europe, namely Italy, France and the Netherlands, accounts for a little over one third of total imports but Asia, mainly Iran, and Africa, Morocco and Tunisia, also take significant quantities. This diverse geographical distribution of soyabean oil supplies is one illustration of its highly competitive nature.

Coconut oil

The expansion in coconut oil trade over the past ten years has been modest in comparison with some other oils, increasing from 458,000 tons in 1965 to 605,000 tons in 1974. However, it is estimated that there was a substantial increase of perhaps 80,000 tons in 1975 which may well be continued in the next few years with the maturation of extensive plantings in the Philippines and elsewhere.

It is apparent from Table 2.22 that the expansion of the Philippines' output has already begun. In 1965 that country exported 241,000 tons or 30 per cent of total supplies but by 1974 this had grown to 415,000 tons or 62 per cent of supplies. It is estimated that the 1974 figure has been substantially increased in 1975. It is also significant that a major proportion of the increased production of coconuts in the Philippines has been in the form of the oil rather than copra. Minor exporters who have maintained small shares of the market include Papua New Guinea, Fiji and Mozambique; in aggregate they retain about 7 per cent of the market but their trade in copra suggests the possibility of an expansion of processing though the small amounts involved could be a limiting factor.

A significant expansion of Malaysian supplies is noticeable but at present they remain a minor contribution: 48,000 tons in 1974.

One further feature of coconut oil trade over the past decade has been the decline of Sri Lanka whose declining production was referred to in Chapter 1. Sri Lanka held 18 per cent of the market with exports of 88,000 tons but by 1974 the amount involved had fallen to 20,000 tons and the market share to 3 per cent. Without a substantial improvement at the production level a reversal of this trend seems unlikely.

As illustrated in Table 2.23, over 40 per cent of coconut oil supplies go to the USA, mostly from the Philippines. The USA's share of world imports has remained much the same since 1965 but recently showed signs of increasing. It is estimated that the USA may have accounted for almost 60 per cent of 1975 coconut oil imports.

Other major importers are principally European, including West Germany, UK, Italy, France and Poland. Together they currently account for about a quarter of total supplies but West Germany takes by far the greater share.

Minor importers are Canada, South Africa and China but the amounts involved are comparatively small.

Table 2.28

Coconut Oil – Major Importers

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Mozambique	6.5	1.4	7.3	1.2	8.5	1.3		
West Malaysia	18.5	3.9	42.5	6.9	43.8	6.6		
Philippines	241.4	50.8	338.0	54.9	415.7	62.5		
Singapore	17.1	3.6	38.1	6.2	23.7	3.6		
Sri Lanka	88.3	18.6	57.9	9.4	20.5	3.1		
German Fed.Rep.	1.3	0.3	12.4	2.0	12.7	1.9		
Netherlands	35.9	7.6	31.9	5.2	50.9	7.7		
Fiji	15.0	3.2	19.0	3.1	13.0	2.0		
Fr. Polynesia	0.3	0.1	10.8	1.8	7.2	1.1		
Papua N. Guinea	25.9	5.5	21.7	3.5	26.6	4.0		
Others	24.8	5.2	36.2	5.9	42.1	6.3		
World Total	474.8	100.0	615.6	100.0	664.7	100.0		

Table 2.23

Coconut Oil - Major Importers

'000 metric tons.

Countries	1965	% of total	1970	% of total	1974	% of total
South Africa	6.8	1.5	10.1	1.7	11.0	1.8
Canada	18.0	3.9	21.5	3.6	22.0	3.6
USA	174.7	38.1	260.5	43.7	249.4	41.2
China	10.8	2.4	20.9	3.5	18.1	3.0
Singapore	10.0	2.2	14.1	2.4	19.5	3.2
France	3.9	0.9	18.7	3.1	16.8	2.8
German Fed. Rep.	55.3	12.1	31.6	5.3	74.5	12.3
Italy	15.8	3.4	19.8	3.3	20.0	3.3
Poland	6.0	1.3	6.3	1.1	11.1	1.8
U. K	42.7	9.3	48.1	8.1	33.5	5.5
Others	114.1	24.9	144.8	24.3	129.5	21.4
World Total	458.1	100.0	596.4	100.0	605.4	100.0

Groundnut Oil

In line with the setbacks in groundnut production in recent years, trade in groundnut oil has also suffered reversals. Somewhat less groundnut oil, 390,000 tons, was traded in 1974 than in 1965 when 415,000 tons were exported. Bearing in mind the overall expansion of the oilseed economy and trade in oilseed products, this represents a significant decline by groundnuts relative to other oilseeds.

Table 2.24 shows that in 1965 the trade in groundnut oil was dominated by West Africa, Senegal, Nigeria and The Gambia having 34 per cent, 22 per cent and 4 per cent of the market respectively. Apart from these countries only Argentina with 19 per cent of the market, and the USA with 7 per cent, were significant exporters.

Much the same picture was true in 1970 except that Argentinian trade suffered a setback and was replaced by Brazilian sources. Since 1970, the significant change has been the decline of Nigeria, whose groundnut oil exports are now little more than a fifth of their level in 1965. The other West African countries, Senegal and The Gambia, were more successful in sustaining their exports despite production problems. Exports from The Gambia now exceed those of 1965 but Senegalese exports are still only some two-thirds of their former level.

The gap created by the fall in West African supplies has been partly filled by Brazil, which seems to have established a firm hold on the market, and currently accounting for about 8 per cent of total supplies. Likewise, Argentinian supplies appear to have recovered but, at 59,000 tons or 16 per cent of the market in 1974, are still below their 1965 level.

As shown by Table 2.25, very little traded groundnut oil has a destination outside Western Europe. France is by far the major importer, with an estimated 53 per cent of total imports in 1975. This is a marked increase over previous years. French imports have historically accounted for about one third of total supplies. The other major importers are West Germany and the UK, but UK imports are very much on the decline. The 29,000 tons imported in 1975 is less than half the 1965 level. West German imports have held up rather better but are again well below the 1965 levels. It seems that groundnut oil exports are becoming concentrated even within the traditional European markets, with France and Belgium taking most of the available supplies.

Table 2.24

Groundnut Oil - Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Gambia	16.3	3.9	16.0	3.7	17.6	4.8		
Nigeria	92.2	22.2	90.3	21.0	23.7	6.4		
Senegal	142.5	34.3	146.1	34.0	100.1	27.0		
USA	27.7	6.7	14.5	3.4	20.8	5.6		
Argentina	79.2	19.1	42.6	9.9	59.0	15.9		
Brazil			31.9	7.4	30.1	8.1		
China	5.0	1.2	7.0	1.6	15.0	4.0		
France	11.5	2.8	20.4	4.7	14.8	4.0		
German Fed. Rep.	3.8	0.9	3.4	0.8	10.9	3.0		
Netherlands	4.2	1.0	3.0	0.7	12.2	3.3		
Others	33.0	7.9	54.5	12.7	66.3	17.9		
World Total	415.4	100.0	429.7	100.0	370.5	100.0		

Table 2.25

Groundnut Oil - Major Importers 1965-75

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Dominican Rep	15.1	3.6	5.5	1.3	6.3	1.6	-	-
Hong Kong	10.4	2.5	12.3	2.9	12.1	3.1	13.5	4.0
Singapore	5.0	1.2	6.0	1.4	6.2	1.6	1.5	0.4
Belgium	9.0	2.1	21.4	5.0	22.6	5.7	20.9	6.1
France	155.6	36.7	142.6	33.1	142.6	36.2	180.4	52.9
German Fed Rep	49.1	11.6	52.3	12.1	51.2	13.0	38.1	11.2
Italy	0.2	-	8.2	1.9	35.1	8.9	25.0	7.3
Netherlands	10.1	2.4	9.4	2.2	15.5	3.9	9.0	2.6
U K	69.5	16.4	95.8	22.2	36.3	9.2	28.8	8.4
Switzerland	5.3	1.3	3.8	0.9	8.0	2.0	-	-
Others	94.4	22.3	73.4	17.0	57.8	14.7	23.8	7.0
World Total	425.7	100.0	430.7	100.0	393.7	100.0	341.0	100.0

Cottonseed Oil

Trade in cottonseed oil over the past decade has shown comparatively little change in terms of the amount involved but the pattern of trade has undergone a number of changes.

As illustrated in Table 2.26, the USA remains the dominant influence, having retained in the region of 60-75 per cent of the export market over the past ten years. If anything the USA is tending to consolidate its position as the principal source of cottonseed oil exports.

All other producers appear relatively insignificant by comparison. The second major exporter, the USSR, exports little more than one tenth of the USA's exports. Other very minor exporters are Nicaragua, Guatemala, Argentina, Israel and The Sudan. The export of cottonseed by Nicaragua suggests that some expansion of processing may be possible there, but on the whole, there appear to be few developing countries where cottonseed oil could be substituted for cottonseed exports in view of the small-scale of the latter.

Table 2.27 illustrated that over the decade quite substantial changes have taken place in the destination of cottonseed oil exports. Egypt has emerged as the major importer. Egypt took one third of world supplies in 1974 and is estimated to have taken at least two-thirds of world supplies in 1975. It is only in the past ten years that Egypt has developed this interest in cottonseed oil imports.

Of the other importers, Europe takes about one quarter of world supplies, East Germany, West Germany, UK and Sweden predominating. However, the general tendency seems to be for European importers, especially West Germany, to take a declining share of the trade.

The only other major importers are Venezuela and Japan. The former country has doubled its cottonseed oil imports since 1965 and in 1974 accounted for 11 per cent of all imports. Similarly Japanese imports have increased dramatically, and it may well be that the next few years will see a complete reorientation of cottonseed oil trade away from the historical USA/European route.

Table 2.26

Cottonseed Oil - Major Importers

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Sudan	9.8	2.8	9.1	3.7	9.0	2.5		
Uganda	8.7	2.5	9.0	3.7	0.5	0.1		
Guatemala	1.9	0.5	1.4	0.6	7.1	2.0		
Nicaragua	1.3	0.4	9.3	3.8	15.4	4.2		
USA	255.6	72.4	159.8	65.2	275.0	75.7		
Argentina	1.1	0.3	1.0	0.4	8.0	2.2		
China	22.2	6.3	7.7	3.1	5.0	1.4		
Israel	2.0	0.6	5.0	2.0	8.9	2.4		
Syrian A Rep	15.8	4.5	8.4	3.4	-	-		
USSR	20.8	5.9	26.2	10.7	29.6	8.1		
Others	13.6	3.9	13.2	5.4	4.9	1.3		
World Total	352.8	100.0	245.1	100.0	363.4	100.0		

Table 2.27

Cottonseed Oil - Major Importers

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Egypt	28.8	7.7	56.2	20.6	115.0	33.3		
Canada	21.6	5.7	14.0	5.1	11.3	3.3		
El Salvador	1.4	0.4	1.6	0.6	1.5	0.4		
Venezuela	15.4	4.1	15.8	5.8	39.5	11.4		
Iran	26.7	7.1	1.3	0.5	11.0	3.2		
Japan	2.1	0.6	3.8	1.4	16.9	4.9		
German DR	20.8	5.5	26.2	9.6	25.0	7.2		
German Fed.Rep.	79.1	21.0	31.6	11.6	25.5	7.4		
Sweden	7.0	1.9	4.7	1.7	16.3	4.7		
U.K.	33.1	8.8	41.1	15.1	20.9	6.1		
Others	139.9	37.2	76.6	28.1	62.4	18.1		
World Total	375.9	100.0	272.9	100.1	345.3	100.0		

Palm Oil

World exports of palm oil have expanded dramatically since 1965, having almost trebled to reach 1.6 million tons in 1974. Table 2.28 gives the broad picture. Almost the entire increase has come from the Far East, notably Malaysia but also Indonesia. The region increased its share of world exports from 51% in 1965 to 83% in 1974. The only other region producing and exporting significant quantities of palm oil is Africa, whose exports have fluctuated considerably, and which has experienced a reduction in its share of total world trade. In 1974 African exports of palm oil were only about 200,000 tons. It should be noted, however, that palm oil is also re-exported from the developed countries, especially the Netherlands.

By far the major exporter is Malaysia with exports at 900,000 tons in 1974. This figure compares with 143,000 tons in 1965 and follows a period of almost continuous growth which is expected to continue for some years. The other major exporter is Indonesia which exported 281,000 tons in 1974. This is a less spectacular rate of increase than Malaysia's, but is expected to increase further. It should be noted that a proportion of the Far East trade passes through Singapore which recorded exports of palm oil of 217,000 tons in 1974, mostly of Malaysian origin.

In the rest of the world only two countries are exporters of significant amounts namely the Ivory Coast and Zaire. The former has experienced a dramatic increase since 1968 and in 1974 exported 101,000 tons, whereas Zaire exports have tended to decline from a 1968 peak. Other African exporters are Cameroon, Dahomey, and Angola, all of which export under 20,000 tons annually. A notably change in the world trade in palm oil is evident in the case of Nigeria, which in 1965 was the leading exporter with 152,414 tons but by 1974 this figure had fallen to a negligible amount. The reason for this lies only partly in a fall in production, since Nigeria is still Africa's largest producer at 450,000 tons but is also due to increased domestic consumption.

Table 2.29 presents a broad picture of palm oil in parts. Regionally, Western Europe is the largest importing area, though as a proportion of world imports its share has fallen from 75% in 1964-6 to 47% in 1974.

Table 2.20

Palm Oil - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Nigeria	152.4	24.7	7.6	0.8	0.2	-		
Malaysia	143.2	23.2	402.0	44.4	900.7	53.3		
Indonesia	125.9	20.4	159.1	17.6	281.2	16.7		
Singapore	47.7	7.7	133.3	14.7	217.6	12.9		
Ivory Coast	1.2	0.2	12.5	1.4	101.6	6.0		
Zaire	79.0	12.8	118.9	13.1	62.4	3.7		
Netherlands	5.7	0.9	19.3	2.1	49.9	3.0		
Cameroon	12.9	2.1	8.4	0.9	18.0	1.1		
Dahomey	13.3	2.2	15.0	1.7	11.5	0.7		
Papua N. Guinea	-	-	-	-	13.0	0.8		
Others	36.7	5.9	30.1	3.3	32.6	1.9		
World	618.0	100.0	906.2	100.0	1688.7	100.0		

Table 2.29

Palm Oil - Major Importers

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Netherlands	64.5	11.0	89.3	10.0	147.1	9.0	165.0	10.3
USA	3.0	0.5	65.9	7.2	200.4	12.3	400.0	25.1
Iraq	50.1	8.6	66.0	7.4	125.0	7.7	110.0	6.9
Japan	16.4	2.8	40.3	4.5	115.3	7.1	105.0	6.6
Singapore	48.8	8.3	140.8	15.8	265.6	16.3	120.5	7.6
Belgium	27.7	4.7	25.5	2.9	26.0	1.6	29.7	1.9
German Fed. Rep.	102.6	17.6	115.9	13.0	133.0	8.1	289.8	18.2
Italy	32.0	5.5	42.9	4.8	53.6	3.3	50.0	3.1
France	36.7	6.3	41.1	4.6	56.4	3.5	49.9	3.1
U.K.	117.2	20.1	162.7	18.2	223.3	13.7	205.8	12.9
Others	85.4	14.6	103.4	11.6	284.6	17.4	68.1	4.3
World Total	584.4	100.0	891.8	100.0	1630.3	100.0	1593.8	100.0

Within Europe, the UK is the largest importer, followed by the Netherlands and West Germany. The pattern of usage differs however, since the Netherlands re-exports a large part of its inputs, in contrast to the UK and West Germany which utilize practically all imports in domestic manufacturing. In fact, the Netherlands is the largest single supplier of palm oil to Belgium. Of interest is the wide diversity of main sources of supply for the different countries. Thus, although Malaysia is the world's largest exporter, it is the major source of supply for only three of the EEC countries namely Denmark, Netherlands, and the UK. For West Germany the main supplier is Indonesia, for Italy it is Zaire, and for France it is the Ivory Coast.

In North America, the main importer is the USA with 200,000 tons in 1974. Although this makes the USA world's second largest importer of palm oil the amount is insignificant in relation to the total US market for edible fats and oils, amounting to only 2.0% of this market. Nevertheless, more palm oil is imported into the USA than any other oil.

In the rest of the world Pakistan and Iraq with 120,000 tons each, Japan with 115,000 tons and India with 53,000 tons are the remaining major importers. Iraq is almost entirely dependant on imports for its vegetable oil requirements and most y imports palm oil, for use as ghee. Palm oil constitutes some 30% of India's current imports of edible oils and fats.

Palm Kernel Oil

World trade in palm kernel oil between 1965-74 increased quite substantially from 108,000 tons in 1965 to 170,000 tons in 1970 and by 1974 had reached 286,000 tons. This represents an increase of over 56% between 1965-70 and of 68% between 1970-74. Table 2.30 provides the basic information.

In 1965, the largest exporter was Zaire with 32,000 tons or 30 per cent of the world market, with Netherlands, Dahomey and Brazil taking second, third and fourth places with 18.1%, 15.6% and 11% of the market respectively. West Germany, UK and Paraguay accounted for most of the remainder. It is readily apparent that in the case of the West European countries palm kernel oil was being re-exported.

Table 2.30

Palm Kernel Oil - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Dahomey	17.0	15.6	18.6	10.9	16.6	5.8		
Nigeria	1.0	0.9	32.8	19.3	38.5	13.5		
Zaire	32.9	30.2	50.3	29.6	34.0	11.9		
Brazil	12.0	11.0	14.4	8.5	2.0	0.7		
Paraguay	3.1	2.8	6.6	3.9	6.9	2.4		
West Malaysia	-	-	2.3	1.4	92.3	32.3		
German Fed. Rep.	7.2	6.6	3.2	1.9	8.2	2.9		
Netherlands	19.7	18.1	31.5	18.5	40.2	14.0		
Switzerland	0.8	0.7	0.6	0.4	1.2	0.4		
U.K.	4.6	4.2	0.2	0.1	1.5	0.5		
Others	10.5	9.7	9.6	5.6	44.8	15.7		
World Total	108.8	100.0	170.1	100.0	286.2	100.0		

Table 2.31

Palm Kernel Oil - Major Importers,

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
South Africa	2.9	3.1	2.0	1.3	3.8	1.5		
Canada	4.5	4.8	5.2	3.3	4.4	1.8		
U.S.A.	37.9	40.6	37.4	23.5	69.8	28.3		
Argentina	1.6	1.7	1.9	1.2	3.5	1.4		
Belgium	1.5	1.6	9.0	5.7	6.5	2.6		
France	6.1	6.5	9.9	6.2	18.1	7.3		
German Fed Rep	14.5	15.5	22.6	14.2	33.6	13.6		
Italy	10.1	10.8	9.9	6.2	12.4	5.0		
Netherlands	1.6	1.7	19.5	12.2	23.6	9.6		
U K	0.9	1.0	33.4	21.0	56.5	22.9		
Others	11.8	12.6	8.4	5.3	14.7	6.0		
World Total	93.4	100.0	159.2	100.0	246.7	100.0		

By 1970 both Zaire and Netherlands had increased their exports and maintained their positions among the world's leading exporters with a collective 48 per cent of the market. However, Nigerian exports increased dramatically to claim almost 20 per cent of the world market. Dahomey, despite an increase in its exports, was forced into fourth position with 10.9% of the world total. Brazil and Paraguay also marginally increased their exports and Malaysia emerged for the first time as an exporter.

By 1974 Malaysia had become the world's largest exporter, selling nearly a million tons or 32.3% of total exports. The traditional exporters, namely, Netherlands, Nigeria and Zaire, accounted for almost another 40 per cent. Exports from Dahomey and Brazil declined, Brazil in particular recording a marked drop to insignificant levels.

As shown by Table 2.31 in 1965, the USA was the largest importer of palm kernel oil with nearly 38,000 tons or 40% of the world total. West Germany, Italy and France took a further 15%, 10% and 6% respectively. Significant quantities were also imported by Canada, South Africa, Argentina, Belgium, Netherlands and the UK.

By 1974 the USA had increased its imports in absolut terms but its share had fallen to claim 28.3% of the total world market. The United Kingdom had also increased its imports by 69% to retain its 1970 position as second largest importer with 22. % of the market. West Germany, Netherlands and France accounted for a further 30% of total imports. Italy, Canada and Argentina also increased their imports buth the quantities remained comparatively small.

Sunflower Oil

Sunflower oil exports have more than doubled over the past decade, but most of this expansion took place during the first five years, 1965-1970. Since 1970, exports have tended to fluctuate annually but the 1974 exports showed little change from these of 1970.

Throughout the decade, the USSR as shown in Table 2.32, has been the dominant exporter with as much as 70 per cent of the market, but currently its share is about 64 per cent. Eastern Europe specifically Romania, Bulgaria and Hungary, account for a further 22 per cent of the market but Romania is by

Table 2.32

Sunflower Oil - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Argentina	35.5	11.2	101.2	13.8	2.5	0.3		
Bulgaria	1.0	0.3	46.9	6.4	25.8	3.4		
Belgium	-	-	20.2	2.8	13.9	1.9		
France	-	-	7.3	1.0	8.8	1.2		
German Fed.Rep.	6.1	1.9	11.2	1.5	36.4	4.9		
Hungary	15.0	4.8	18.9	2.6	29.0	3.9		
Netherlands	0.2	0.1	38.6	5.3	19.9	2.7		
Romania	33.0	10.5	119.1	16.3	120.0	16.0		
Yugoslavia	-	-	3.4	0.5	2.4	0.3		
USSR	221.2	70.1	351.0	48.0	481.2	64.3		
Others	3.8	1.2	13.3	1.8	8.8	1.2		
WORLD TOTAL	315.7	100.0	731.2	100.0	748.7	100.0		

Table 2:33

Sunflower Oil - Major Importers

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Algeria	16.0	4.7	23.1	3.3	39.0	5.3		
Cuba	49.9	14.6	54.7	7.8	65.0	8.9		
Iran	20.0	5.8	15.5	2.2	37.0	5.0		
Czechoslovakia	25.2	7.4	45.2	6.5	31.0	4.2		
France	1.3	0.4	58.1	8.3	108.8	14.8		
German DR	42.8	12.5	50.8	7.3	57.0	7.8		
German Fed. Rep.	69.1	20.2	130.4	18.7	137.3	18.7		
Belgium	9.2	2.7	36.3	5.2	30.4	4.1		
Netherlands	8.3	2.4	51.8	7.4	25.2	3.4		
Switzerland	10.7	3.1	28.3	4.0	28.0	3.8		
Spain	-	-	-	-	-	-		
Austria	-	-	-	-	-	-		
Others	89.6	26.2	204.7	29.3	174.4	23.8		
World Total	342.1	100.0	698.9	100.0	733.1	100.0		

far the leading exporter from that region. Apart from the countries mentioned above, only the Netherlands and West Germany contribute significantly to sunflower oil trade at present. Argentina, a major exporter in 1965 traded very little sunflower oil in 1974. The marginal interest of developing countries in sunflower production and trade seems likely to preclude any major change in the broad picture in the near future. Total dominance by the USSR and Eastern Europe seems likely to continue.

Trade in sunflower oil Table 2.33, is characterised by a large number of importers who, individually handle comparatively small quantities. Almost one third of such imports go to countries which in themselves handle no more than 3-4 per cent of total imports, and often much less.

Broadly, however, trade in sunflower oil is dominated by Europe. Over 75% of imports go to European countries and the trade is often between countries in the same region. Outside Europe only Cuba, Iran and Algeria are major importers, accounting collectively for almost 20 per cent of total imports in 1974.

Within Europe, West Germany and France are the leading importers, with 19% and 15% respectively of total imports. Of secondary importance are East Germany, Belgium, Czechoslavakia, the Netherlands and Switzerland.

It seems very unlikely that the European dominance of the sunflowerseed oil trade will change dramatically, but the emergence of new producers, especially the USA, could bring a measure of diversification.

Table 2.34

Rapeseed Oil - Major Exporters

'000 met. tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Canada	-	-	-	-	27.7	7.5		
China	3.8	4.0	16.7	9.3	14.0	3.8		
Hong Kong	-	-	1.2	0.7	1.3	0.4		
Japan	3.6	3.8	6.9	3.9	2.6	0.7		
France	32.3	34.1	39.4	22.0	121.8	32.8		
German Fed.Rep.	24.5	25.9	33.0	18.4	96.8	26.1		
Hungary	-	-	8.0	4.5	3.4	0.9		
Netherlands	1.2	1.3	7.4	4.1	23.4	6.3		
Poland	7.8	8.2	37.6	21.0	40.7	11.0		
Sweden	16.4	17.3	20.0	11.2	30.9	8.3		
Others	5.1	5.4	8.7	4.9	8.8	2.4		
World Total	94.7	100.0	178.9	100.0	371.4	100.0		

Table 2.33

Rapeseed Oil – Major Importers

'000 met tons

Countries	1965	% of Total	1970	% of Total	1974	% of Total	1975	% of Total
Algeria	12.7	18.0	16.3	9.9	40.0	12.5		
Morocco			1.3	0.8	50.5	15.8		
Chile			2.5	1.5	15.5	4.8		
Hong Kong	3.7	5.2	21.6	13.1	26.1	8.1		
India	0.3	0.4	0.1	0.1	24.6	7.7		
Czechoslovakia	3.0	4.2	20.0	12.2	15.2	4.7		
German Fed. Rep.	7.7	10.9	15.0	9.1	23.9	7.5		
Italy	0.6	0.8	22.1	13.5	9.7	3.0		
Netherlands	11.2	15.9	6.1	3.7	18.8	5.9		
U.K.	0.3	0.4	14.7	8.9	10.8	3.4		
Others	31.1	44.1	44.6	27.1	85.2	26.6		
World Total	70.6	100.0	164.3	100.0	320.3	100.0		

Rapeseed Oil

For the past decade France has been the world's leading exporter of rapeseed oil, and at the present time accounts for one third of the market. (Table 2.34). Throughout the period 1965-75 West Germany has been a close rival. In spite of the fact that rapeseed oil exports over the decade have increased from 94,000 tons to 370,000 tons the two countries have managed to retain virtually 60% of the market. However, the emergence of Canada and the Netherlands, over the past few years as significant exporters could affect the dominant position of these two principal exporters in the near future. Sweden also continues to expand its exports but has not been able to keep up with the rapid overall expansion of the market and is consequently tending to account for a declining share. The only other major exporter is Poland whose record is somewhat erratic; the underlying trend has been for Polish exporters to decline but in 1974 it still retained 11 per cent of the market. The leading rapeseed producers amongst the developing countries, namely India and Bangladesh have little if any trade in rapeseed products.

Rapeseed oil exports are dispersed amongst a large number of importers. Over one quarter of the market is shared by countries who individually account for no more than 3.0 per cent of total imports.

The general tendency appears to be for a number of importers, not historically associated with the rapeseed oil trade, to be consolidating their positions. Chile, Hong Kong, India, Czechoslavakia, Italy and the UK are among present importers who while still importing on a comparatively modest scale, showed in 1965 only a marginal, if any, interest in rapeseed oil. It is possible that entirely new channels of rapeseed trade are in the process of being established.

Sesame and Safflower Oils

There are no recorded statistics of trade in these two oils. Sesame oil is used overwhelmingly in the producing countries, largely at the rural level. To a degree the same comment applies to safflower oil, but in addition it also has industrial uses which are mainly confined to the USA. In the case of both oils, the amounts involved are very small.

To summarise, it is evident that there has been a tendency, which still exists, for a higher proportion of the vegetable oil trade to be dominated by a smaller number of oils as the total amount traded has expanded. With the exception of palm oil, most of the expansion has been in those oilseeds which are not widely grown in developing countries, for example, sunflower, rapeseed and soyabean. Even in the case of palm oil, the degree of expansion has been largely due to one country. It is to be hoped that trade in coconut oil will continue to grow and that groundnut oil will recover some of its lost ground. In addition, there are signs that some of the traditionally temperate oilseeds are becoming more widely established and diversifying their overseas markets.

CHAPTER 3

SUBSTITUTABILITY OF OILS

Fats and oils are interchangeable when their chemical and physical characteristics, either natural or acquired by processing, make them suitable for the same end use. The principal users of vegetable oils are increasingly able to utilise modern technology to modify oils so that they can substitute one oil for another in both food and non-food end products. The extent to which substitutability is possible is basically a technical problem but even when the technical constraint is overcome the absolute availability and relative prices of oils and fats very much influence the decision regarding the choice of raw material. Thus the decision becomes essentially a technico-economic one, but can in some countries also be subject to political and social constraints.

Physical and Chemical Characteristics of Vegetable Oils and Fats

Vegetable oils and fats are composed mainly of fatty acids and triglycerides. One molecule of glycerol is combined with three molecules of fatty acids consisting of various chain lengths, with usually between 4 and 24 carbon atoms contained in the chain. Mono and diglycerides are also constituents of natural oils and fats to a smaller extent, where one or two fatty acids are combined with one molecule of glycerol. When all the carbon atoms in the fatty acid chain are linked to two hydrogen atoms (except for the terminal carbon atom which is linked to 3 hydrogen atoms) the acid is "unsaturated", but when one or more adjacent pairs of carbon atoms in the chain are each linked to only one hydrogen atom or to none at all, double or triple bonds are formed and the acid is "unsaturated". All naturally occuring vegetable oils consist of saturated and unsaturated fatty acids in varying proportions and impart to the oil certain chemical and physical properties. Generally, the higher the saturated fatty acid content of an oil, the more solid it will be at 15°-20°C, while vegetable oils containing a major proportion of unsaturated fatty acids will be completely liquid in this temperature range.

Unsaturated fatty acids are classified into mono-unsaturated acids having only one double bond in the carbon chain, di- and tri-unsaturated (polyunsaturated) acids having two or three bonds in the carbon chain. The commonest occurring mono-unsaturated fatty acid is oleic; olive oil contains about 82% oleic acid. Linoleic acid is the most frequently found di-unsaturated fatty acid in vegetable oils, ranging from about 1 per cent in palm kernel oil, to 58 per cent in sunflower oil. Linolenic acid, which has three double bonds in the carbon chain, occurs to a much smaller extent in vegetable oils, with none or only a trace in edible oils such as sesame, sunflower, coconut, and palm kernel, between 2-9 per cent in soyabean, but about 45 per cent in linseed oil, which although it is possible to use as an edible oil, is generally used in the manufacture of non-food products such as paints, linoleum and varnishes.

Technical Consideration Affecting Substitutability

The degree of saturation of an oil or fat can be determined chemically and is expressed as an iodine number of value. This characteristic of an oil or fat is important when considering the substitutability of oils. Table 3.1 gives details of the fatty acid composition and iodine value of the vegetable oils under review. The oils and fats which are composed mainly of saturated fatty acids are more stable and resistent to chemical deterioration than those containing a large proportion of unsaturated fatty acids. The most widely used method of modifying oils so that they can be readily used as substitutes, is hydrogenation, whereby the addition of hydrogen to unsaturated oils renders them more saturated and thus more stable. Theoretically it is possible to hydrogenate most unsaturated oils and by so doing make them into substitute oils for the natural saturated oils. However, there are limits to the degree of substitutability since the end product may be required to have certain properties such as plasticity at low temperatures for suitable storage in a refrigerator, or to have a completely bland flavour. In this situation the manufacturer, in order to obtain these characteristics, may be restricted in his choice of oils and fats as raw materials for modifying.

Although the main criterion for the substitutability of oils and fats is probably based on the degree of saturation/unsaturation and iodine value, nevertheless, other factors need to be considered. Characteristics such as viscosity at different temperatures, solidification point, and the odour, taste and colour required in the final product, need to be considered when deciding on which oils and fats to use for raw materials.

Table 3.1

FATTY ACID COMPOSITION*, SOLIDIFICATION POINT AND IODINE VALUE OF SOME VEGETABLE OILS

	Palm Oil	Palm Kernel	Coconut	Groundnut	Cottonseed	Sesame	Soya	Sunflower	Safflower	Rapeseed
Saturated Acids										
Caproic	-	-	0-0.8	-	-	-	-	-	-	-
Caprylic	-	2.4-4.3	5.4-9.5	-	-	-	-	-	-	-
Capric	Trace	3.0-6.3	4.5-9.7	-	-	-	-	-	-	-
Lauric	0.05-0.12	44.5-52.0	44.1-51.3	-	-	-	-	-	-	-
Myristic	0.5-5.9	14.1-18.6	13.1-18.5	-	Trace	0-0.3	-	-	-	-
Palmitic	30.0-47.0	6.5-10.4	7.5-10.5	7.5-12.5	20.0-25.0	7.8-9.4	7.0-14.0	3.5-6.5	6.0-7.0	2.0-7.0
Stearic	2.0-8.0	1.3-3.5	1.0-3.7	2.8-4.9	2.0-7.0	3.6-5.7	2.0-6.0	8.7-14.2	2.0-3.0	-
Arachidic	-	0-1.9	0-1.5	1.3-1.9	-	0.4-1.2	-	Trace	-	-
Unsaturated Acids										
Oleic	40.0-52.0	10.5-18.5	5.0-8.2	41.4-67.4	18.0-30.0	35.0-49.4	23.0-34.0	14.1-43.1	12.1-17.3	6.0-55.0
Linoleic	5.0-11.0	0.7-2.5	1.0-2.6	13.9-35.1	40.0-55.0	37.7-48.4	52.0-60.0	44.2-75.4	76.6-79.0	11.0-31.0
Linolenic	-	-	-	Trace	-	-	2.3-3.0	-	-	5.0-15.0
Erucic	-	-	-	-	-	-	-	-	-	41.0-49.0
Iodine Value	46-60	14-20	7-10	84-102	99-113	104-116	120-141	113-143	130-150	97-101
Solidification Point °C	24-30	24-27	14-25	-2to+3	2-4	-6to-3	-18to-8	-18to-16	-20to-13	-10 to -12

* per cent by weight of total fatty acids.

Another important factor affecting substitutability is the availability of an oil or fat in the highly competitive world market. Thus an oil or fat which becomes in excess supply in its traditional markets is likely to be used as a raw material by manufacturers in both the food and non-food processing industries. An example would be the widespread use of soyabean oil by manufacturers because it has tended to be readily available and supplies have been generally predictable on a short-term basis. Palm oil is being increasingly used as end - users are able to assess that future supplies are fairly assured due to the already substantial planting of oil palms in Malaysia and with the prospect of an increase in supplies from new plantings in Indonesia. The result of intensive competition between soyabean and palm oil will probably be that each oil will find uses in an increasing number of new end-use products.

Methods used to modify the natural characteristics of oils and fats

The majority of vegetable oils which are utilised as raw materials for processing into other end products have already been modified to some extent by refining techniques such as washing with aqueous alkali, decolourising by heating with bleaching earth, and deodourising with steam. These treatments do not generally alter the natural characteristics of the oil or fat but are employed to remove colour pigments, aldehydes, ketones and phospholipids.

Hydrogenation

The modified process which is most frequently used to render oils and fats interchangeable is hydrogenation. In the presence of a catalyst it is possible to add hydrogen to fatty acids which have one or more double bonds, and convert them from being unsaturated to saturated. The process reduces the iodine value, and increases melting point of the oil.

A reduction of one whole number of the iodine value of one ton of oil or fat, with a corresponding increase of the melting point by $1^{o}C$ needs about $1m^3$ of hydrogen. The hydrogen is usually prepared by an electrolytic process and to produce $1m^3$ of hydrogen requires about 4.5 K wh. of electricity. It is therefore possible to calculate in terms of hydrogen and electricity the cost of hydrogenation for oils and fats in relation to their degree of unsaturation and iodine value. However, the major cost of hydrogenation is in the specialised equipment necessary to carry out the operation and its efficient utilisation.

Hydrogenation procedures vary according to the raw materials and the requirements of the end product. The reaction can be controlled, for instance to ensure that the two double bonds of linoleic acid becomes saturated before the single double bond of the oleic acid is saturated. Selective hydrogenation is thus the relative efficiency with which the hydrogenation reaction is controlled so that hydrogen is added to the greatest amount of the most highly unsaturated acids before it is added to the less unsaturated acids. In practice this is an important technique since for example if cottonseed oil were to be used as a raw material for addition to margarine it would be selectively hydrogenated until a fat with a melting point of about 83°C was produced. However, if cottonseed oil were to be used as a constituent of a cooking fat then the oil would need to be virtually fully hydrogenated to a fat with a melting point of 21 - 23°C.

Other purposes for which hydrogenation is utilised is to increase the stability of an oil and to increase or decrease the plasticity so as to render the oil more suitable for blending with other oils and fats. Soyabean oil, which is prone to flavour reversion, is hydrogenated until its iodine value is reduced by about 20 units to produce a non-reversing oil.

During hydrogenation a number of side reactions occur to form both positioned and geometrical isomers of oleic acid. Iso-oleic acids have the same iodine value and molecular weight as oleic acid, but the melting points of almost all of them are appreciably higher. Thus oleic acid (-9-octadecenoic) which has the double bond in the 9:10 position has a melting point of about 13°C, while de laidio acid, the trans isomer of oleic acid has a melting point of around 44°C. Another isomer with the double bond in the 12:13 position is trans -12-octadecenoic with a melting point of 52°-53°C. About twenty three different isomers of oleic acid have been reported, most of them not naturally occurring, but several are certainly present in hydrogenated fats. In the manufacture of "hard butters" such as cocoa butter substitute fromliquid oils a product is required which combines relative hardness with non-greasiness, and a short plastic range. A high proportion of iso-oleic acids in this type of product is a distinct advantage and some hard butters produced from groundnut oil have an iso-oleic acid content of 53-54 per cent. The operating conditions that favour the formation of iso-oleic acids are achieved by modifying the hydrogenation, usually by increasing the concentration of catalyst, lowering the pressure of hydrogen, and by a higher reaction temperature.

While discussing methods of hydrogenation, it is worth mentioning that it is possible to desaturate or dehydrogenate saturated fatty acids in the laboratory, but on an industrial scale it presents many technical difficulties which are costly to overcome. Nevertheless, the possibility remains that an economic process could be evolved should the demand for unsaturated fatty acids not be met by the production of naturally occuring unsaturated oils and fats.

Esterification and Interesterification

These two processes are being increasingly used by both the edible and industrial oils and fats manufacturers, to modify oils in order to use them as substitute materials. When oils and fats are reacted with monohydric aliphatic alcohols, mono-alkyl-esters are formed. The alkyl-esters can be used as chemical intermediates for introducing fatty acids into a reaction. A practical application is, for example, the removal of lower fatty acids from coconut oil by reacting it with methyl esters of fatty acids with twelve or more carbon atoms.

Mono-glycerides and related compounds are used as emulsifiers in the manufacture of margarine, cooking fats, shortenings, ice cream and other fat containing foods. They are prepared from refined, deodourised oils and fats by reacting them with glycerol in the presence of an alkaline catalyst[2] at a temperature of about 245°C. A mixture consisting of 50-60 per cent mono-glycerides and 30-45 per cent of diglycerides, together with some tri-glycerides and glycerol is produced. Separation of the mono-glycerides is carried out by molecular distillation. Other polyhydric alcohols can be used in place of glycerol such as sorbitol, mannitol, and polyglycerols, and the use of propylene glycol monoesters of edible fatty acids for addition to shortenings for bread making was one of the earliest patents for this type of fat modification.

The reaction of a triglyceride with a monoglyceride ester, in the presence of a suitable catalyst, and with removal of one of the product esters by distillation during the reaction so that the reaction proceeds to completion, is a method known as random interesterification. Oils and fats consist of mixtures of triglycerides and as an example of this type of interesterification it is possible to modify coconut oil by reacting it with ethyl stearate to replace some of the fatty acids in the oil by stearic acid and removing the ethyl formed in the reaction by distillation. The change in properties produced by interesterification of natural oils and fats depends upon their fatty acid composition and the natural arrangement of the fatty acids in the glycerides. Generally, interesterification will result in the oil or fat undergoing a change in consistency and having a considerably raised melting point.

Directed interesterification occurs when a mixture of triglycerides react with a highly active catalyst such as sodium methoxide, so rapidly that the temperature of the reaction is lowered to such an extent that crystallisation commences. The low temperature causes the higher melting - point glycerides to crystallise out from the reaction mixture. Interesterification of palm oil when carried to equilibrium at higher temperatures produces a fat which contains about twelve per cent of fully saturated triglycerides. However, when the interesterification is carried out at about 38°C the high melting point saturated triglycerides crystallise out, and the continuous removal of the least soluble fraction from the reaction by crystallisation unbalances the equilibrium and palm oil with a fully saturated triglyceride content of around 28 per cent can be obtained. This method has been used to increase the fully saturated triglyceride content of other vegetable oils including soyabean, groundnut, and cottonseed oil[4] [5].

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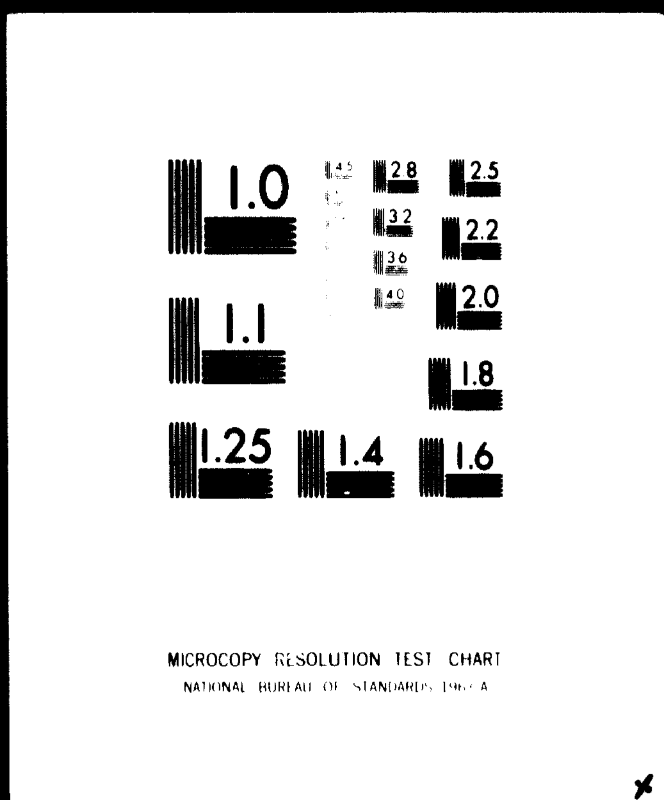

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Fractionation

Two processes are invloved in the process of fractionation (a) holding the oil at a controlled temperature to allow crystallisation and (b) separation of the crystals (2,3). This process was formerly applied to coconut and palm kernel oils by packing the solidified oils, after slowly cooling to about 23°C, into small cloth bags and subjecting them to hydraulic pressure to expel the liquid 'olein', leaving solid 'stearin' in the bags. However this process is costly and has been virtually superseded by hydrogenation, where the harder (higher melting point) fractions are required. However, fractions suitable for use as cocoa butter substitutes are obtained by fractionally crystallising these oils[1].

The winterisation of liquid oils such as cottonseed, sunflower and groundnut oils is a long established application of fractionation. This involves the removal of a small amount of natural waxes and high melting triglycerides which would otherwise cause these oils to be cloudy or semi-solid in cold weather. Their substitutability is thus increased as salad or table oils.

The fractionation of palm oil is of particular current interest since the process is operating in producing countries. More than 45 per cent of the triglycerides in palm oil have a melting point of 34°C or higher and these are the main constituent of the stearin fraction. The majority of the glycerides comprising the olein fraction have a melting point of 19°C and therefore an olein fraction which remains liquid at ambient temperatures below about 19°C cannot be obtained from palm oil in significant quantities no matter how efficient the fractionation process used. In practice perfect separation of the glyceride groups cannot be obtained by crystallisation because of (a) mutual solubility (b) mechanical entrainment and (c) the presence of minor constituents with intermediate properties. Fractionation is improved by using a two stage process. The highest melting glycerides are removed in a first stage. The liquid fraction is then cooled to a lower temperature and a second crop of stearin crystallises. In this way three products are obtained - an olein of improved low temperature stability, a stearin of high melting point and a stearin of intermediate melting point. Although fractionation can be carried out on the crude oil, crystallisation is usually improved with degummed neutralised oil. If fractionation is combined with directed interesterification an olein with very good low temperature stability, at least equivalent to olive oil, can be obtained but the yield is inevitably limited by the natural content of unsaturated acids. A very high melting point stearin is also produced. The main fractionation processes used comprise (a) simple filtration, (b) centrifugal separation with the aid of detergents and (c) solvent fractionation.

(a) Simple filtration

The oil is held at a controlled temperature in large tanks fitted with slow stirrers. Crystals form and build into aggregates several millimetres in diameter and are filtered off.

(b) Centrifugal separation

After controlled crystallisation, the crystals are broken up and intimately mixed with an aqueous solution of detergent and magnesium sulphate. As a result the crystal surfaces are wetted by the detergent, displacing the liquid oil. The slurry is separated in a centrifuge to yield an olein fraction and a (stearin + detergent solution) fraction. The latter is heated and separated in a second centrifugation.

(c) Solvent fractionation

The oil is dissolved in a controlled quantity of hexane solvent. Crystallisation is effected at a reduced temperature and the solids filtered off. The solvent is distilled off separately from the olein and stearin fractions. A patented process uses isopropanol as the solvent in which the crystallisation results in a two phase system, the olein as the lower phase and solvent with stearin crystals suspended in it as the upper phase. Separation is by decantation[4].

In general palm oil olein competes with other liquid oils and palm oil stearin can be substituted for hydrogenated fats.

Polymerisation

Polymerisation as a method for modifying oils and fats is mainly applied to vegetable oils destined for industrial usage. The reaotion of fatty acids and esters involves the formation of new chemical bonds between moleoules. The bonds are formed at unsaturated groups in the fatty acid chain or at a position activated by those groups and the result is an oil or fat with an increased molecular weight. The principal practical advantage of polymerisation is that the viscosity of oils can be increased and the method is used in the heat - bodying of unsaturated oils for use in the paints and varnishes industries.

Safflower oil is of considerable value as a polymerised oil to the paints industry sinoe it produoes good gloss retention properties, and the formation of uniform polymers imparts good film flexibility. Alkyd resins are produoed when polybasic acids are introduced into the moleoules of high moleoular weight oils and safflower oil so modified is considered to have unequalled rapid and even drying, non-yellowing, and oolour retaining properties, oompared with dehydrated castor oil whioh is also widely used in alkyd resins.

Substitutability of Individual Oils

The following sections outline the oharacteristics of individual oils and review the type of processing needed to make each oil suitable, if possible, for specific end uses. Table 3.2 provides a summary of the main form of utilisation and the processes assooiated with each for the individual oils.

Palm Oil

Palm oil is composed of approximately 50% saturated fatty acids, primarily palmitic acid, and 50% unsaturated fatty acids, mainly oleio and linoleic acids. It is very different, therefore, from other oommeroial vegetable oils suoh as sunflower seed, safflower, and soyabean oils, which are oomposed principally of unsaturated fatty acids, and from palm kernel and coconut oils which contain predominantly short-chain saturated fatty acids. In addition, palm oil is a highly coloured oil due to the presence of fat soluble carotenoids, mainly alpha and beta carotenes.

The major end use of palm oil in the main importing countries is in the manufacture of margarine, compound cooking fats and shortenings. For use in these products, palm oil competes with partially hydrogenated soyabean, cottonseed, and marine oils and it is very much a question of relative prices as to which is used. Palm oil has no specific end uses and although it can and is used as a substitute oil, it is also vulnerable to being substituted by other vegetable oils. On the basis of present knowledge, it is highly likely that, with assured supplies of palm oil of good quality, it will be used as a substitute oil in increasing quantity. When utilised for the manufacture of margarine and some biscuit fats, palm oil can be used in the form of bleached deodourised oil without previous hydrogenation. For use in compound cooking fats and shortenings palm oil is generally hydrogenated or partially hydrogenated depending on the melting point and plasticity required for the end product.

The technique of fractional crystallisation applied to palm oil has widened the range of end uses for the oil. The liquid fraction can be used as palm olein cooking oil and would thus become a substitute for groundnut, maize, soyabean and sunflower oils, which are more often used as domestic cooking oils. The solid or stearin fraction can be used for the manufacture of margarine and shortening without hydrogenation. Stearin prepared from fully hydrogenated palm oil has been used extensively as a substitute for cottonseed oil[10] stearin in shortenings and frying fats in the United States.

Vanaspati, a ghee fat substitute, is manufactured in several countries from fractionated palm oil and it has been suggested[11] that a blend consisting of about one third palm olein, one third groundnut oil and the remainder natural palm oil, is suitable for this product. The palm olein in the blend would substitute for cottonseed oil.

Palm oil can be substituted also for tallow which is used primarily in the soap and animal feed industries, but generally tallow is lower priced and therefore has the competitive advantage in these markets. Low grade palm oil, that is with a free fatty acid content in excess of 5%, is used in low quality soap and candles, while palm oil with even higher free fatty acid content can be used in tin plating. In addition palm oil could be used for the manufacture of bio-degradable detergents for which lauric oils are preferred at present.

Coconut and Palm Kernel Oils

The similarity between the fatty acid composition of coconut oil and palm kernel oil enables these oils to be considered together from the point of view of substitutability. They are composed mainly of the glycerides of short-chain fatty acids, between 6 and 14 carbon atoms in the chain, and which are fully saturated. Lauric acid, containing 12 carbon atoms, is present to the extent of 45-48%, and these oils are generally referred to as lauric oils.

The lauric oils are used extensively in the manufacture of margarine and compound cooking fat and shortenings. They have been displaced in table margarine to some extent by the introduction of polyunsaturated fatty acids, but when the lauric oils are competitively priced they are used as a substitute for other vegetable oils in the production of cooking margarines. In recent years there has been a decrease in many developed countries in the use of compound cooking fats for frying and baking, preference being given to other forms of vegetable oils and consequently a major outlet for lauric oils has declined. However, lauric oils are being increasingly used as a substitute for butter fat and natural liquid cream in imitation dairy products.

Lauric oils have been used in a range of imitation dairy products including filled milk, cream fillings and coffee whiteners. Filled milk is natural milk from which most of the butterfat has been extracted and replaced by vegetable oil, usually coconut oil because it provides the preferred flavour. The keeping property of the filled milk is better than natural milk, while being similar in taste. Similarly, dried coffee whiteners made from lauric oils have a longer shelf life than the corresponding dried product made from natural milk and this is due to the fact that lauric oils are less prone to oxidation than natural milk fat. Hydrogenated lauric oils are used in the preparation of biscuit creams in preference to other vegetable oils because their melting point gives the desired effect of the cream melting in the mouth.

The major non-food use for lauric oils is in the soaps and detergent industries. Soap manufacturers, particularly of high quality toilet soaps, prefer to use lauric oils because they produce, when blended with other fats, soaps with good lathering properties. When the price of lauric oils are relatively low the soap manufacturers tend to increase the amount of these oils at the expense of other oils and tallow.

The lauric oils have many industrial uses based on the high percentage of lauric acid they contain and are therefore unlikely to be substituted in these uses by other vegetable oils, although in the United States, for some end uses, synthetically produced lauryl alcohol from petroleum sources is used. Specific products such as sodium lauryl sulphate and sodium lauryl sarcosinate used in the cosmetics industry, and diethanolamine condensates of coconut oil acids, or lauric acid diethanolamine condensates are used in appreciable quantities as foam boosters by detergent manufacturers, and are unlikely to be substituted for by other vegetable oils containing only a small precentage of lauric acid. Other lauric oil derivatives include di- and polyethylene mono- and dilaurate, which are used as emulsifiers in the food industry by the bakery trade, and in the manufacture of specialised detergents. The potassium and sodium salts of mixed coconut fatty acids, which comprise the major constituent of liquid hand-washing soaps, and a mixture of crude coconut oil and coconut oil sulphate is prefered as a leather lubricant after tanning and dyeing pale coloured leather as it does not discolour the final product.

Groundnut Oil

Groundnut oil contains between 40-67% oleic acid, and 13-35% linoleic acid, but only trace amounts of linolenic acid, so although it is a very unsaturated oil, it remains comparatively resistent to oxidative rancidity. Refined groundnut oil is mostly used by various food industries, while poor quality and crude oil may be used for the manufacture of soaps and detergents.

Groundnut oil is an excellent deep frying and pan frying oil, with a smoke point of 226.5°C, which may be clarified and re-used many times for frying foods of a different flavour. It has been reported[12] that for this use it is superior to cottonseed, maize, and soyabean oils. The oil is also used in the manufacture of shortenings, when it is hydrogenated and blended with other vegetable oils.

Groundnut oil is also preferred for making salad dressings[13] to be stored below -12°C, since groundnut oil solidifies in an amorphous form that does not break the emulsifying layer on freezing.

The most specific food product made from groundnuts is peanut butter and although at present it is of major importance only in the United States, there is some desire to manufacture this product in groundnut producing developing countries. Peanut butter has a high nutritional value due to its high protein and fat content. It is generally used as a spread on bread, biscuits, and crackers and would most likely be a substitute for butter and margarine.

The major non-food uses for groundnut oil are in the manufacture of cosmetics, soaps and detergents. Poor quality groundnut oil may be used by the soaps and detergent industries, which is the general end use of most low-grade vegetable oils. The cosmetics industry uses groundnut oil to form the base of many face creams, shaving creams and hair lotions. It is specific for some of these products since the oil is believed to have an energising effect on the skin when applied by massaging, and it is extensively used in this respect on polio patients.

From the point of view of substitutability, the use of groundnut oil in both food and non-food uses is more likely to be affected by economic than technical considerations, since the oil has very few specific end-uses which cannot be substituted for by other vegetable oils.

Cottonseed oil

Cottonseed is a valuable by-product of the cotton fibre industry. The oil contains a high proportion of unsaturated fatty acids; oleic acid, 18-30% and linoleic acid 40-55%, with the remainder being saturated acids, predominantly palmitic acid 20-25% and stearic acid 2-7%.

Crude cottonseed oil is a very dark coloured oil with a pronounced odour and flavour, but after refining to remove gossypol and related pigments along with free fatty acid, and chilling for removal of its higher-melting glycerides, a light yellow coloured oil is produced which can be used as a salad oil.

Fully refined and deodourised cottonseed oil is virtually all used for the manufacture of salad and cooking oil, and, when hydrogenated, for the production of margarine and shortening. Technically the oil has no specific natural characteristics which make its use desirable for particular end use products, and the use of cottonseed oil by food industries is therefore largely decided by availability, quality, and price. In the United States, where considerable quantities of cottonseed oil are always available, research and development work on new and improved products based on the oil has been proposed. Some suggested products are: edible coating materials prepared by combining the fatty acids with starch, cellulose and other polyhydric compounds of high molecular weight: edible high viscosity oils and hard waxes prepared by incorporating the fatty acids with polyols of intermediate molecular weight, and food grade emulsifiers made by combining fatty acids with sucrose, other saccharides and glycosides. However, from the technical point of view other vegetable oils could also be used for these end use products, and the use of cottonseed oil would probably depend upon economic considerations.

Poor quality cottonseed oil and the soap stock obtained from the refining process can be used for soapmaking. Research work carried out in the United States has shown that some of the amides of modified cottonseed fatty acids are excellent low temperature plasticisers for polyvinyl chloride resins and other plastic materials. These amides can be substituted for plasticizers such as di-2-ethylhexyl phthalate, an ester of phthalic acid, which has caused some concern with regard to environmental contamination. Current research on cottonseed oil fatty acids is also being carried out to formulate substitute extreme pressure and anti-wear additives, which were formerly based on sperm whale oil, and which can no longer be imported into the United States.

Sesame oil

The major fatty acids of sesame oil are oleic and linoleic acids, 35-49% and 37-48% respectively. However it is not the fatty acid characteristics which impart special properties to the oil, but the unsaponifiable matter containing sesamin, sesamolin and sesamol. Sesamol is a phenolic compound formed by the hydrolysis of sesamolin and sesamin and its presence in sesame oil helps to make the oil highly resistant to oxidation. Only small quantities of free sesamol are found in the crude oil, but it is liberated from the other compounds when the oil is bleached with acid activated bleaching earths, by dilute mineral acids and also during hydrogenation.

Refined sesame oil is an exceptionally good edible oil, and is used directly as a bland salad oil and for cooking purposes. It compares very favourably in these uses with olive oil and this often leads to sesame oil being used as an adulterant of olive oil, rather than straight forward substitution. Due to its relative high price, sesame oil is also frequently adulterated with cheaper vegetable oils, usually groundnut or cottonseed. Sesame oil can be used in the manufacture of margarine and shortening but for these products it is not very competitive with the cheaper vegetable oils such as soyabean, cottonseed amd groundnut.

At one time the unsaponifiable fraction of sesame oil containing sesamin and sesamolin was extracted and widely used as synergists for pyrethrin insecticides. This end use largely disappeared with the introduction of the more effective synergists, such as pipronyl butoxide.

Because of its high stability compared with other vegetable oils, sesame oil has some specific end uses in the pharmaceutical industry which employs the oil as a vehicle for medicaments which are required to be administered subcutaneously or intramuscularly. It may also be used in the preparation of liniments, plasters, ointments and special soaps. Small quantities of sesame oil have been used in the perfumery industry as a fixative, but cheap synthetic products have tended to replace this use.

The relatively high price and uncertainty of supply of sesame oil restricts its use to food, rather than non-food uses, and even in the edible oil market its use is principally confined to substituting for olive oil, as an adulterant for olive oil, or top quality salad and cooking oils.

Safflower Oil

Safflower oil is unusual in having a very high percentage of unsaturated fatty acids, but virtually no linolenic acid. It has the highest linoleic acid content (76–79%) of any commercial vegetable oil and this characteristic has been exploited for both food and non-food uses. The crude oil is golden yellow in colour due to the presence of beta-carotene, but this is removed during normal refining and bleaching processes.

The high linoleic acid content has made safflower oil popular on the edible oil market owing to the demand for oils containing high proportions of poly-unsaturated acids. These acids tend to reduce a high serum cholesterol level in the blood. As a result, specialised food products containing safflower oil and other very unsaturated vegetable oils have been produced, particularly in North America, for persons suffering from Hypercholesterolemia. Products such as imitation dried eggs, filled milk, salad dressing, margarine, and imitation cream are also made using safflower oil and the oil is very suitable for use as a cooking oil. For use in compounded products such as margarine, all-purpose shortening, and emulsified cake and bread shortening, safflower oil is equal or superior to other vegetable oils in ensuring that these products remain plastic over a wide temperature range.

Industrially, safflower oil is used in the manufacture of alkyd resins and protective coatings. For the production of alkyd resins the oil is valued for its unequalled rapid and even drying, non-yellowing and colour retaining properties. Dehydrated castor has been widely used for the manufacture of alkyd resins, but safflower oil is prefered since it produces resins of superior quality. In particular, safflower oil based alkyd resins do not develop synaresis, or "after tack" some days subsequent to application or exhibit wrinkle or "gas check" in a foul atmosphere. However, the substitution of safflower oil for dehydrated castor oil in these uses would probably depend on the availability of each oil and their relative prices.

Protective coatings prepared with safflower oil have good gloss and gloss-retention properties, exhibit little wrinkling, and have good climatic resistance, combined with good film flexibility. Exterior housepaints based on safflower oil remain essentially white, compared to colour changes in linseed oil paints, which show a marked increase in yellowing when in shadow.

Varnishes prepared with modified safflower oil have been found to be superior to those formulated with linseed oil. Substitution of linseed oil by safflower oil in paints and varnishes is technically desirable, but manufacturers of these products would probably not change their formulations based on either oil unless there was a substantial price difference between the oils.

Sunflower oil

The fatty acid composition of sunflower oil makes it very suitable for edible purposes. It is relatively low in saturated fatty acids with 3.5 - 6.5% of palmitic acid, and 8.7 - 14.2% stearic acid, but has a high percentage of linoleic acid, 44-75%, and a varying amount of oleic acid between 14-43%. The oleic and linoleic acid composition vary widely and inversely, with each other, and generally oil extracted from seed grown in cooler climates contains higher levels of linoleic acid and a higher ratio of poly-unsaturated to saturated fatty acids.

The demand for vegetable oils containing high proportions of polyunsaturated acids has also popularized the use of sunflower oil as a cooking and salad oil. Sunflower oil has a high smoke point (232°C) which makes it particularly well suited for frying chips, doughnuts, nuts, meat products and other foods. The oil is also used in the manufacture of margarine and compound cooking fat. With a fatty acid composition similar to safflower oil but with a lower and more variable ratio of linoleic to oleic acid sunflower oil can be used as a substitute for safflower oil in edible products, and has the competitive advantage of being more readily available on the world market.

The major non-food use of sunflower oil is in the manufacture of paints and varnishes. For the latter purpose oil originating from seeds grown in cooler climates with its higher proportion of linoleic acid is preferred. Essentially it imparts the same properties to these products as safflower oil. Sunflower oil can therefore be substituted for safflower oil, and linseed oil in paint and varnish end-uses, and since its availability in the world market is comparatively well assured, which is reflected in the price of sunflower oil compared with the other two oils, it is a highly competitive oil for these end-uses.

Rapeseed oil

The essential characteristic of rapeseed oil is the presence of erucic acid in amounts varying between 35–53%. The oil also contains the more commonly occurring unsaturated fatty acids, oleic (6–55%), linoleic (11–31%), and linolenic acid (5–16%), but with only small amounts of saturated palmitic acid (2–7%). The wide variation in the fatty acid composition of rapeseed oil is due to the introduction in recent years of cultivars of rapeseed which have produced oils with low erucic acid content and an increased content of oleic and linoleic acids. A cultivar of *Brassica napus*, winter type, is characterised by large amounts of erucic acid, typically 48–53%. The variation of *B. napus* summer type is much larger, from 10% to around 45% in Canadian and European cultivars. The summer annuals of *B.kampestris*, including the types grown in India and Pakistan, have an erucic acid content ranging from 30–55% and an oleic acid content of from 10–27%. In Canada, "zero" erucic acid rapeseed oil has already been produced and is known as "Canbra" oil. It seems very likely that in the future oils of rape and turnip rape from many countries will no longer have the characteristic erucic acid present in substantial amounts.

Although refined rapeseed oil is odourless and has a bland flavour the presence of 5–16% of linolenic acid in the glycerides renders the oil more susceptible to auto-oxidation than oils such as groundnut, making it similar to soyabean oil in its tendency to develop off-flavours. In addition, when the oil has been fed to animals under experimental conditions in quantities of 10–20% or more of the dietary fat, it has produced growth retardation, in certain cases pathological abnormalities, and in most animals it has been found to reduce food consumption. These reactions could be due to the erucic acid content, but another factor which could be responsible is the balance between saturated and monoencic fatty acids in the oil.

In Asia the major proportion of rapeseed oil is used for cooking purposes. In Europe and Canada the oil is mainly used for margarine. Because of the dietary factors discussed above, rapeseed oil is not altogether satisfactory for the production of salad oil, and its use in food dressings such as mayonnaise may give rise to breakage of the emulsion under refrigeration owing to the crystallisation of the oil.

Rapeseed oil is used in compound lubricants; as a cutting oil blended with mineral oil; as an additive in quenching oil and as a core oil for making castings. Probably the principal industrial outlet for the oil in many developed countries is the manufacture of factice. Rapeseed oil can be reacted with sulphur to prepare a rubber substitute or additive, known as factice, which is used not only as a rubber extender, but also to modify the properties of drying oil products, such as varnishes and linoleum.

Rapeseed oil is used as an industrial raw material for the preparation of chemicals employed in the textile industry for scouring, washing, and dyeing processes. The sodium salt of erucic acid is used in hot water detergents and in water-repelling agents. Certain long chain fatty amides of erucic acid either alone or in mixed rapeseed oil fatty acids have proved to be good plasticizers for vinyls chloride resins and ozonolysis of erucic acid yields pelargonic and brassylic acids, products which could have considerable industrial potential. In Canada brassylic acid esters are used in the manufacture of nylon. The oil is used in the fat liquoring or tanning process of leather and in the production of specialised inks, and varnishes.

The rapid growth of rapeseed oil utilization in Canada, where it is now second in importance to soyabean oil, combined with the expansion of production within the European Economic Community, must inevitably increase the competitiveness of the oil in the world vegetable oil market. Recent technical improvements have considerably broadened the utilisation base of rapeseed oil and hydrogenated oil is certainly competitive with other hydrogenated vegetable oils in their use for food products such as margarine, compound cooking fat and shortenings.

Soyabean oil

Soyabean oil is the major vegetable oil traded in the world market and there is no indication that this situation will change in the foreseeable future. Soyabeans are grown principally for their protein content. Refined soyabean oil consists principally of the tryglycerides of oleic (23-34%), linoleic (52-60%), and linolenic acid (2-3%), together with the saturated acids palmitic (7-14%) and stearic acid (2-6%). In the refining procedure the phospholipid fraction may be precipitated by the action of moisture, and centrifuged out of the oil. This constitutes the degumming process, and forms part of the process for the manufacture of commercial lecithin.

The majority of soyabean oil is used in the manufacture of margarine and shortenings, and for these purposes it is generally hydrogenated. Considerable quantities of the oil are used unhydrogenated as a salad oil and cooking oil, and it is also blended with olive oil for these purposes. Soyabean oil has a tendency to devolop an off-flavour or odour when stored in contact with air, or when heated to a high temperature such as its use for deep fat frying. This property is refered to as "reversion", and is due mainly to the presence of linolenic acid in the oil, but it can be overcome by partially hydrogenating soyabean oil, when the linolenic acid content is reduced to 1% or less, and the linoleic acid content to about 10%.

In the United States it is estimated that only about 10% of the total domestic production of the oil is used for industrial purposes, but it is expected that the non-food uses of the oil will increase. Soyabean oil is used in the paints, varnishes, linoleum, and printing ink industries, and fatty acids from soyabean foots and poor quality oil are being used for the manufacture of soap.

SUMMARY

With the aid of modern technology nearly all vegetable oils are substitutable to varying degrees both between each other and with other animal, marine oils, and synthetic products. The manufacturer of food and non-food materials based on vegetable oils has wide choice when deciding on a suitable substitute oil for his particular end use product. Generally, he will select the cheapest and most readily available oil, depending on the nature of his end product.

The degree of substitution between vegetable oils is a function of both economic and technical considerations. The important relationship between price and supply is demonstrated by the fact that the most competitive oils, namely palm oil and soyabean oil, have increased their share of total world vegetable oil production from 35% in 1965 to 44% in 1975, a figure which is projected to increase even further.

Within the oilseed economy the change in price differentials over the last 10 years has been considerable. In 1965 the price differential between the cheapest and most expensive of the vegetable oils was of the order of $60 per ton, but by 1973 this had risen to $150 per ton and in 1974 had reached an unprecedented $580 per ton. Differentials of this order of magnitude for what are essentially similar commodities cannot be maintained without major changes taking place in the pattern of utilisation. It is inevitable that processors should seek to take advantage of the cheaper oil by extending its uses. The development of blended food products such as salad oils, margarine, compound cooking fat and shortenings, has increased the competitiveness and substitutability of a large number of vegetable oils. In the case of salad oils, virtually all the liquid edible oils can be substituted one for another while for use in margarine and compound cooking fat it is possible to substitute most vegetable oils which have been hydrogenated, and some in the natural and unhydrogenated condition.

In addition competition from synthetic materials must not be overlooked. So far this has mainly affected the non-food products utilising lauric oils, particularly detergents. The main reason for the introduction of synthetic fatty acids and alcohols into end-use products using lauric oils was that for many years the lauric oils were relatively highly priced, and, although they are presently cheaper than most vegetable oils in the world market, substitution in the inedible sector tends to be far more irrevocable than in the food sector. Furthermore, synthetic substitutes are now available

and are well placed to take advantage of any instability or inadequacy of supply shown by the natural oils.

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Table 2

Modifications needed to Oils and [illegible] for their major [illegible]

Oil	Processing to Prepare Basic Oil	Refined Natural Oil				Modified
		Cooking Oil	Salad Oil	Margarine	Shortening	Imitation Dairy Products
Palm	Removal of FFAs, Bleached, Deodorised	Fractionation	Fractionated oil blended with other vegetable oils	Basic oil or partially or fully hydrogenated or fractionation	Partially or fully hydrogenated or fractionation	Esterification and inter-esterification
Palm Kernel	As above	Basic oil (Tropics)	NA	Basic oil	Basic oil or fully hydrogenated	Basic oil or partially or fully hydrogenated
Coconut	As above	Basic oil (Tropics)	NA	Basic oil	Basic oil or fully hydrogenated	Basic oil partially or fully hydrogenated
Cottonseed	As above	Basic oil	Basic oil	Selective hydrogenation	Fully hydrogenated	NA
Sesame Seed	As above	Basic oil	Basic oil	Partially or fully hydrogenated	Fully hydrogenated	NA
Soya bean	As above	Basic oil or blended with other oils	Basic oil or blended with other oils	Partially or fully hydrogenated	Fully hydrogenated	NA
Sunflower Seed	As above	Basic oil	Basic oil	Partially or fully hydrogenated	Fully hydrogenated	NA
Safflower Seed	As above	Basic oil	Basic oil	Basic oil	Partially or fully hydrogenated	NA
Rapeseed	As above	Basic oil mainly used in Asia	Not widely used	Hydrogenated	Hydrogenated	NA

NA = not appropriate to that oil.

SECTION 1

...ng needed to Oils and ... for their major end uses

...no	Shortening	Imitation Dairy Products	Soap and Detergents	Protective Coatings and Varnishes	Emulsifiers	Lubricants
		Modified Oil				
...r ...r ...ena- ...on	Partially or fully hydrogenated or fractionation	Esterification and inter-esterification	Distilled fatty acids	-	Esterification and inter-esterification	Distilled fatty acids
	Basic oil or fully hydrogenated	Basic oil or partially or fully hydrogenated	Blended with other oils for soap reacted with acid diethano-lamine condensates	Polymerisation to form alkyd resins	Esterification and inter-esterification	Lauric oil derivatives
	Basic oil or fully hydrogenated	Basic oil partially or fully hydrogenated	Blended with other oils as above	Polymerisation to form alkyd resins	Esterification and inter-esterification	Lauric oil derivatives
...ion	Fully hydrogenated	NA	Soap stock	NA	NA	NA
...or ...ed	Fully hydrogenated	NA	NA	NA	NA	NA
...or ...ed	Fully hydrogenated	NA	Fatty acids from "foots"	Polymerisation	NA	NA
...or ...ed	Fully hydrogenated	NA	NA	Polymerisation to form alkyd resins	NA	NA
	Partially or fully hydrogenated	NA	NA	Polymerisation to form alkyd resins	NA	NA
...ed	Hydrogenated	NA	Sodium salt of erucic acid	Reacted with sulphur	NA	Basic oil blended with mineral oil

SECTION 2

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