Palm Oil in the Indian Industry†

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Oils and Fats – The Domestic Situation

The per capita annual availability of edible oils in India is around 5.5 kg as against the minimum nutritional requirement of 10 kg recommended by I.C.M.R., and the WHO recommendation of 20 kg. Compared with the per capita consumption of 11 kg for the world as a whole and of more than 25 kg in advanced countries, the average intake of edible oil in India is very low.

Domestic edible oil production is not sufficient even to maintain the current low level of per capita availability. The gap between demand and supply of edible oils goes on widening and is expected to increase from the current level of 1.5 million tonnes to 3.6 million tonnes by the year 2000 *(Table 1)*.

Even though India is the second largest producer of soap in the world, its per capita consumption per annum is one of the lowest – 2.4 kg as against 14 kg in the USA and 12 kg in West Germany. In 1984-85, the organized sector is expected to produce 370 000 tonnes of soap including 160 000 tonnes of laundry soap, while the small-scale sector is expected to produce 685 000 tonnes of laundry soap and a negligible quantity of toilet soap. The demand for washing soaps by the year 1990 is expected to be around 910 000 tonnes. The demand for oil for the soap industry is estimated at 522 000 tonnes in 1984 and 729 000 tonnes in 1990.

In the absence of any major breakthrough in domestic production, India is becoming increasingly dependent on imports to narrow the gap between supply and demand *(Table 2)*. The country is now one of the largest importers of fats and oils in the world, and these account for over 6% of its total imports. The imports of fats and oils are expected to reach 1.5 million tonnes, worth RS 10 billion, in 1984–85.

TABLE 1. EDIBLE OILS: SUPPLY, DEMAND AND DEFICIT (millions of tonnes)

	1970–71	1976–77	1980–81	1985–86	1990–91	1995–96	2000–01
Supply	2.504	2.544	3.030	3.588	4.626	4.555	5.154
Demand	3.103	3.454	4.480	4.433	5.569	6.980	8.747
Deficit	0.599	0.910	1.450	0.885	1.543	2.425	3.593

Note: Demand projections for 1985, 1990, 1995, 2000 are based on 3.5% growth in national income.

The problem of shortages is not confined to edible oils; it extends to the inedible oils used in the manufacture of soaps, cosmetics, paints and varnishes. The manufacture of soaps is the most important use of oils other than as food.

The contribution of palm oils and also to world trade to India's imports has increased in the recent past in a spectacular way. (The

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slump in imports of palm oil in the current year may be only temporary). This is clear from *Table 3* which gives details of India's oil imports.

For these reasons, they have good frying performance. Frying experiments and tolerance studies have demonstrated the complete suitability of these oils for cooking.

TABLE 2. IMPORT OF EDIBLE OILS BY INDIA

	1981	1982	1983	1984–85 Estimated
Quantity (in millions of tonnes)	1.154	0.894	1.256	1.5
Value (in billions of Rupees)	5.492	3.909	6.281	10.000

TABLE 3. INDIA'S OIL IMPORTS: PALM OIL AND TOTAL
(Quantity in '000 tonnes; value in millions of Rupees)

	1981		1982		1983	
	Quantity	Value	Quantity	Value	Quantity	Value
Neutralised Palm Oil	95	442.4	109	476.4	87	388.3
RBD Palm Oil	267	1 238.0	261	1 172.6	350	1 731.7
RBD Palm Olein	67	317.2	88	359.0	188	903.9
	429	1 997.6	558	2 008.0	625	3 023.9
Total oils	1 154	5 491.8	894	3 908.7	1 256	6 281.0

Thus the picture is one of shortages and a widening gap between the supply of and the demand for oils. In the absence of a concerted effort to boost domestic production, continuing dependence on imports appears inevitable. The role of palm oil in India has to be examined in the light of this.

Palm Oil and Palm Olein for Direct Consumption

Currently palm oil and palm olein constitute a substantial portion of the oils allocated to the public distribution system. These are in the fully refined form and are sold at a comparatively low price. Both are used as cooking oils but palm olein, being liquid, is preferred for the purpose. These oils are inherently stable against oxidation due to the low content of PUFA (polyunsaturated fatty acids) and are non-foaming.

A look at the physiological and nutritional aspects shows that these oils compare favourably with most indigenous oils. The calorific value is the same as for all other oils and fats, 9 Kcals/g. Palm oil and its olein do not contain any fatty acids which are not present in other edible oils. Palm oil is characterized by a relatively simple fatty acid profile consisting of about equal amounts of saturated and unsaturated fatty acids. The most important fatty acid in palm oil and palm olein is palmitic (35 – 50%), followed by oleic (40 – 45%) and linoleic (6 – 12%). Palm olein, the liquid fraction-produced from the semi-solid palm oil is richer in unsaturated fatty acids than the unfractionated starting material. The fatty acid profile of these oils shows a fair amount of linoleic acid and is not grossly unbalanced. Many of our edible oils do not have an ideally balanced fatty acid profile from the metabolic point of view. (The linoleic acid content is 22% in groundnut oil, 15% in mustard oil and only 2% in ghee and vanaspati). Palm oil and its olein have good digestibility compared to vanaspati and groundnut oil. Feeding studies lead to the conclusion that in the context of a normal mixed diet, palm oil is a wholesome source of energy. The unbalanced fatty acid profile of palm oil and its fractions in relation to serum lipid levels can be counteracted (as with any other edible oil) by supplementing the diet with vegetable oils rich in essential fatty acids. According to one popular view in India, the invisible fats present in rice, wheat, pulses and vegetables are all rich in linoleic acid and their consumption assures a satisfactory intake of the essential fatty acids.

Palm Oils for the Vanaspati Industry

The vanaspati industry with an annual output of around 875 000 tonnes (licensed capacity 1 480 000 tonnes) contributes about 25% of the edible oil requirements of the country. Over the years, the input oils for vanaspati production have undergone remarkable changes -- from groundnut oil in the early years to newer types of indigenous oils like cottonseed, sunflower and rice bran oils, *etc*., and in the last few years including an increasing proportion of imported oils. Currently 85% of the oil required for the vanaspati industry is met by imported oils, mainly soya, palm and rape. In all cases 5% of sesame oil is used as a marker.

The incorporation of palm oil in vanaspati in India has been rather limited – not more than 20 to 25%; some reasons for this are considered below. (The 20 to 25% excludes palm olein).

With the conventional bleaching processes used in India, decolorization of crude palm oil is very difficult. The standard process, therefore, adopts a limited degree of 'brush' hydrogenation for the saturation of carotenoids (I.V. drop around 5 units). The inevitable rise in melting point further limits the proportion of palm oil (which itself has a high m.p.) in the end product. Till May 1983, the Vegetable Oil Products Order specified a m.p. range of 31 – 37°C for vanaspati. After persistent representations from the industry and after considering the digestibility aspects of a higher m.p. vanaspati, the specifications were amended to permit a m.p. range of 31 – 41°C. This measure has definitely made it possible to incorporate a higher proportion on palm oil into the vanaspati oil blend. For the same m.p., it is possible to incorporate a higher proportion of RBD palm oil produced by the physical refining process as compared to the oil produced by the 'hydro' bleaching-method.

The fractionation of palm oil into high melting stearins and low melting oleins during transport and storage also leads to difficulties in controlling the m.p. of the vanaspati. This can be overcome to a great extent by better oil-handling facilities.

Blends containing a higher proportion of palm oil do not give the same granular texture as some hydrogenated oils, *e.g.* hydrogenated soya or cottonseed oils. Marketing opinion in India is said to regard granular texture (resembling ghee) as very important. Proper chilling treatment to get slow crystallization may overcome this problem to some extent. However, a product with a smooth buttery texture can be attained by quick chilling as in the votator and experience in this field has been that the market will not be averse to a non-granular product consisting entirely of palm oil.

Palm oil presents definite advantages by comparison with liquid oils like those of soyabean, sunflower, rapeseed, rice bran, *etc*., in the manufacture of vanaspati. The hydrogenation process required for these oils is expensive in terms of energy (steam, electricity required for the process as well as for producing hydrogen) specialized plant and plant time, the need for a catalyst and the need for hydrogen. Energy conservation is something which can never be overemphasized. Cost savings can be made through reduction of the chemical cost of processing the oil, the cost of hydrogenation, and the cost due to process losses. Cost savings also result from the long life of palm oil, *e.g.* in various frying applications. *Tables 4* to *6* give an idea of some of the savings in the process adopted. If palm oil is made available more cheaply than soyabean oil, the total savings would be really substantial.

especially when it costs money just to create them. In the USA and Europe, technological efforts are directed towards producing solid fats without hydrogenation using trans-esterification, inter-esterification, *etc.*, which will solidify oils physically without reducing the content of the valuable PUFA by chemical means. In this context palm oil acts as a source of naturally hard fat. This would also help to conserve indigenous oils like cottonseed for direct use. However, the law, as it stands, does not permit the manufacture of solid fats by trans- and inter-esterification in India.

TABLE 4. COST OF HYDROGEN PER TONNE OF OIL

Oil	I.V. Change		Slip M.P.	kWh	Power Cost
	Initial	Final	°C		Rs.
Soyabean	130	70	36	348	278
Rapeseed	102	69	36	191	153
Sunflowerseed	136	75	36	354	283
Groundnut	110	72	36	220	176
RBD Palm oil	0			–	–
Palm oil (Hydro-bleaching)	53	48	39	29	23

Notes: (1) Power Rate Rs. 0.80.
(2) To reduce the I.V. of one tonne of oil through one unit, 1 m^3 hydrogen at 60°F and 14.7 psig is required; to produce this, the electricity required is 5.8 kWh to the cell.

Partial hydrogenation of an oil, as is done in vanaspati manufacture, introduces a number of unnatural fatty acid isomers. Compositional studies show varying amounts of saturated acids (normally within 33%), a large proportion of *trans*-monoenes (11 – 60%, 40% being an average figure) and minor amounts of conjugated dienes (less than 1%). In the body, the *trans* fatty acids get deposited in various tissues and differ from the naturally occurring *cis* acids in the manner in which they are incorporated into triglycerides, phospholipid's and cholesterol esters. They may not have any harmful effect (judging from the evidence so far available), but are certainly not desirable,

Palm oil also offers distinct possibilities for making speciality fats for margarines, bread spreads, cocoa butter substitutes, *etc.*, at least in the future.

Palm Oil for Technical Uses

The major application of oils in India, after those for edible purposes, is in the manufacture of soaps. Traditionally, the main source of long-chain fatty acids in soaps used to be animal tallows. Researches by Indian scientists into the chemistry of a series of non-conventional oils has resulted in the modifying and upgrading of several minor oils (like rice bran,

TABLE 5. COMPARATIVE ANALYSIS OF OILS

Oil qualities	Soyabean oil or Sunflower oil (Crude & Degummed)	RBD Palm oil
FFA	1%	0.1–0.15%
Moisture and impurities	0.5%	0.1% max.
Gum Residue	0.6%	–
Colour	Y = 22, R = 1.2 (¼" Cell)	Y = 30, R = 3 (in 5¼" Cell)

TABLE 6. COMPARATIVE PROCESSING COSTS PER TONNE OF OIL

Chemical	Soyabean/Sunflower		RBD Palm Oil	
	Quantity (kg)	Cost (Rs)	Quantity (kg)	Cost (Rs)
Phosphoric acid	2	24	–	–
Caustic soda (solid)	2.5	13	–	–
Bleaching earth	30	300	10	150
Nickel catalyst	1	77	–	–
		414		150
Savings with RBD Palm oil		–	–	264

castor, linseed, sal, neem, karanja and kusum) for soap-making.

The organized soap industry is technologically well-equipped to upgrade and use these non-conventional oils and is doing so. This has eliminated dependence on tallow of the organized sector and at the same time has helped in conserving edible oils which otherwise would have been used in soap-making. It has also provided employment to many tribal people, who collect the oil seeds from the forests.

The country was importing tallow until recently, mainly for the small-scale soap industry and for fatty acid manufacture. The total ban on usage and import of tallow has led to increased pressure on indigenous soapery oils for soap manufacture. As a result, there has been an increased in their prices – by as much as 60% in the case of rice bran oil.

To tide over the difficulty of raw material supply for making soap and fatty acids, the Government has resorted to the import of palm stearin and palm fatty acids. Cost permitting, palm oil can be considered as an alternative to tallow, especially for fatty acids. Comparative characteristics of common technical fats are shown in *Table 7*. In this context it would be interesting to look at the techno-economics of palm oil and palm stearin *vis-a-vis* hardened rice bran oil (which is the major two hard oil in the organized sector of the soap industry at present). Substantial cost savings could be effected by substituting hardened rice bran oil with palm oil. These would be mainly through reduction in chemical pre-treatment costs, costs due to hydrogenation and cost of energy (steam and electricity required for the process as well as for making hydrogen). It is to be noted that due to the high FFA and other impurities, hydrogenation of rice bran oil has always been

TABLE 7. CHARACTERISTICS OF COMMON TECHNICAL FATS

Characteristics	Rice Bran	Rice Hardened Bran	Palm	Palm Stearin	Sal	Mowrah	Kusum	Beef Tallow	Mutton Tallow
Iodine Value	100	55	52	40	40	62	53	40	40
Saponification Value	186	186	200	210	190	193	227	198	194
Titre (°C)	27	45	44	50	52	40	45	40	38
Unsaponifiable Matter (%)	4.2	4.2	0.5	0.5	1.5	2.5	2.2	0.3	0.3
Fatty Acid Composition									
Lauric	–	–	–	1.0	–	–	–	–	–
Myristic	0.5	0.5	1.5	1.3	–	–	–	2.2	1.0
Palmitic	19	19	45	55.2	7.6	24	8.9	35	21
Stearic	2.5	30	4	5.3	45.8	20	1.9	15.7	30
Oleic	48	44	39	20.5	37.1	43	42.4	44.4	43
Linoleic	27.5	5.5	10.5	8	1.6	13	7.1	2.2	5
Lonolenic	1.5	–	–	0.2	0.3	–	0.3	0.4	–
Arachidic	1	1	–	0.3	7.6	–	20.9	0.7	–
Behenic	–	–	–	–	–	–	1.8	–	–
Gadoeleic	–	–	–	–	–	–	13.6	–	–
Erucic	–	–	–	–	–	–	2.1	–	–

a difficult proposition. The functional properties of soap produced from palm oil are bound to be superior compared to those of soap made from hardened rice bran oils which contains the unnatural *trans* acids. The large amount of unsaponifiable matter present in rice bran oil (4% – 6%) appears as impurities in the soap produced an affects its cleaning power. Palm oil, however, contains less than 1% unsaponifiable matter. Also, compared to the high-FFA rice bran oil, palm olein or stearin with a lower FFA yields more glycerol, which is a valuable by-product. Maximum recovery of glycerol contributes very much to the profitability of the soap making process.

Concluding Remarks

With no sign of a breakthrough in domestic production, import of oils both for edible and non-edible purposes will continue for a long time in India. An attempt has been made here to evaluate the role of palm oil in industry as a direct cooking medium, as a raw material for vanaspati and as a raw material for soap-making. Palm oil has versatility, in that it can be used as it is or in fractionated forms. The implifications of this have to be examined in relation to cost saving, energy conservation, ability to satisfy present industrial needs and adaptability to future technological requirements.

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