

REVIEW ARTICLE

Cost effectiveness of palm oil in comparison to other oils and fats in the country with special emphasis on lower income group

R P Singh

Former Director, Harcourt Butler Technological Institute, Kanpur -208002, India

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Corresponding Author

Address for Correspondence: R P Singh, Former Director, Harcourt Butler Technological Institute, Kanpur-208002, India

E Mail ID: rpshtbi@rediffmail.com

Citation

Singh RP. Cost effectiveness of palm oil in comparison to other oils and fats in the country with special emphasis on lower income group. Indian J Comm Health. 2014;26, Suppl S1:37-44

Source of Funding : Nil **Conflict of Interest:** None declared

Abstract

Fats and oils in the form of vegetable oils are integral part of diet and comprise of an important source of calorie density and micronutrients in human diet. The per capita edible oil consumption in India (14.5 kg in 2012-2013) has been steadily rising over the decades but is still short of the average worldwide consumption in the developed countries. Especially the below poverty line population lags far behind in terms of per capita edible oil consumption and therefore is a major reason for widespread malnutrition. Inadequate consumption of edible oils, which acts as vehicle (mainly promotes absorption in intestine) for important micronutrients like vitamin A, D, E and K, is the root cause behind this. Palm oil is an important source of carotenoids (pro-vitamin A), tocopherols (Vitamin E), sterols, essential fatty acid and is cost effective in comparison to other edible oils. Crude palm oil which is orange red in color is refined, bleached and deodorized to produce the universally known bright golden oil. Palm oil is a natural semi-solid oil and on fractionation it yields soft fraction and hard fraction. Olein (liquid fraction) is mostly used as a cooking and frying oil. Stearin finds many applications in solid fat formulations and is extensively used in food processing.

Key Words

Dietary fats; per-capita consumption; malnutrition; micronutrients; palm oil; hard and soft palm fractions.

Introduction

Fats and oils are richest source of energy. Besides this, they have nutritional value and health benefits due to the presence of essential fatty acids and many micronutrients. The unsaponifiable matter of vegetable oils includes micronutrients such as tocopherols, tocotrienols, β -carotene, oryzanol, squalene etc., which have been reported for health benefits [1]. The fat soluble vitamins viz, vitamin A, E, D, and K are carried in the human body through oil/fat as a vehicle. The lower income group is consuming very meagre quantity of oil and thus they are not able to get vital nutritional vitamins. Global edible oil consumption has increased by about 18% over the last 5 years and edible oil production mix is largely dominated by palm oil, which is now the

single largest consumed vegetable oil on the globe [2]. Total national demand of vegetable oils is 18 MMT but we are producing approximately 8.5 MMT and to meet our domestic demand, the rest is imported. Vegetable oil is the second largest imported commodity after petroleum. India imports more than 50% of total oil demand with a dominating palm oil proportion of 74% (as of 2012) [3]. Palm oil has dominated Indian imports since the last two decades, for its logistical advantages, contractual flexibility, and consumer acceptance [2]. Palm oil, a well-balanced healthy edible oil is now an important energy source for mankind. Today it is widely acknowledged as a versatile and nutritious vegetable oil, Trans fat free with a rich content of vitamins and antioxidants [4]. The oil palm fruit is unique in producing two oils. Palm oil is obtained

from the fleshy mesocarp and palm kernel oil from the seed, usually in a ratio of ten to one [5]. Crude palm oil is orange red in color due to the presence of carotenoids compounds and after refining it turns to a golden colour oil globally known as RBD Palm oil. This oil is consist of hard and soft fractions and can be fractionated into a liquid olein and solid stearin to increase its versatility in food applications. Olein is mostly used as a cooking and frying oil. Stearin finds many applications in solid fat formulations and is extensively used in food processing [5].

National scenario of edible oils:

In the late 1980s and early 1990s, India pursued self-sufficiency in vegetable oils production but trade reforms in mid-1990s, followed by meager growth in domestic oilseed production, fuelled the resurgence of imports. Domestic price support policies have favored crops that compete with oilseeds resulting into waning oil crop production and stagnant yields. Before April, 1994, import of edible oils was channelized through STC (A Govt. Organization). STC was importing palm oil, soybean oil and rapeseed oil for PDS (Public Distribution Scheme) and for distribution to Vanaspati industry but in 1994 - 95 import of all edible oils were placed under open general license (OGL). Then onwards India's import of edible oils went on increasing rapidly [6]. India's import increased to 4.42 MMT in 2001-02, to 8.18 MMT in 2008-09 and to 11.10 MMT (Projected) in 2013-14. The quantity of import of palm oil increased much more in comparison with other oils. The per capita consumption of edible oils in India was only 4 kg in 1973. It increased to 9.40 kg in 2001-02, 10.50 kg in 2007-08 and 14.50 kg (Projected) in 2013-14 [6].

Change in consumption patterns, availability, pricing, policy changes towards imports and domestic production of other oilseeds have all influenced usage of edible oils. Given the underlying growth drivers of these segments, the mix of oil application is not expected to change significantly over the next five years. Palm oil has dominated Indian imports for the last two decades, for its logistical advantages, contractual flexibility, and consumer acceptance. India is the largest importer of palm oil which is also the lowest priced oil [2]. Apart from human consumption, as RBD palmolein it also supports many other industries in India like refining, vanaspati

and other industrial sectors. The significant growth in production, consumption and market share of palm oil is to a large extent due to: Palm oil yield of 4.2 MT per hectare per year is around nine times that of soybean, seven and a half times that of rape seed and six times that of sunflower oil. Therefore palm oil is cost competitive vis-à-vis other vegetable oils and animal fats. Palm oil, the cheapest oil among soybean oil, rapeseed oil and sunflower seed oil, has been able to capture new markets and make inroads into markets that have traditionally preferred other oils [7]. Compared to other oil crops, the oil palm produces high yields, is easy to cultivate and bears fruit all around the year.

Consumption Pattern:

Almost 90% of the palm oil imported and produced domestically is used for edible/ food purposes, while the remaining is used for industrial/non-edible purposes (like soap, detergent and cosmetics manufacturing). Palm oil is now the single largest consumed vegetable oil in India. Over the last 25 years, factors such as change in consumption patterns, availability, pricing, policy changes towards imports and domestic production of other oilseeds have all influenced its usage [7].

Given the underlying growth drivers of these segments, the mix of oil application is not expected to change significantly over the next five years. The largest consumers of oil are the refiners who sell loose/packaged oil for edible purposes. Consumption trends in India are marked, not just rising overall consumption, but by changing the patterns of consumption as well. In the early 1970's almost all vegetable oils consumed in India comprised groundnut, rapeseed & cottonseed oil palm, soybean & sunflower oil accounted for only 4% [6]. However over the years, palm oil, soybean oil have become the leading edible oil consumed because domestic production has not been able to keep pace with the demand.

Consumption & Characteristics of Indian Consumer [8]

- Palm is the main oil in, Out-of-Home consumption like HORECA, chips - savoury manufacturers etc.
- The lower and middle class Indian consumers are very price sensitive and switch to cheaper oils.

- Share of food budget is 47% v/s Total expenditure budget of an average middle class consumer, which justifies their sensitivity towards oil price.
- Palm being the most economical edible oil lower by Rs 50-100 per 10 kgs from other edible oils is used in blending with other oils.
- A big portion of Palm oil imported in India is due to a cheaper substitution to other oils and to fill the gap of other oils.
- Overall oil and palm oil consumption in India seems very promising.

Demand Drivers [7, 8]

- Consistent GDP growth rate approximate 5 – 7 % in last 5 years (current year it may be around 4.9%).
- The big emerging Indian middle class.
- The double digit growth of out of home consumption of edible oils.
- Per capita consumption of edible oils in India at 14.40 kg projected for 2013-14 is still a lot below threshold level of consumption.
- Even with a moderate population growth the absolute increase in number of people is quiet High.
- Although all India per capita consumption was 14.5 kg in 2012-13, but in many States consumption is only about 10/11 Kg. Consumption growth in these States will increase at faster space.
- A point to note is that the Indian Edible Oils demand is both switchable and elastic: Switchable to other oils to quiet an extent & is elastic to an extent.

Price Structure [9]

Palm oil import

The major importing and trading centres for palm in India are Chennai, Kakinada, Mumbai, Mundra, Kolkata, Mangalore and Kandla. Indonesia accounts for ~82%, while Malaysia accounts for ~17% of the total palm oil imports to India. Domestic vegetable oil industry had demanded to raise custom duty on RBD palmolein to create duty difference of 7.5% (as per Commission Report) plus duty difference on Indonesia i.e. 7% total 14.5%. From the June month, Government of India partially accepted and announced to raise Import Duty on Refined Oils to 10% from 7.5% creating duty difference of 7.5%

between Crude & Refined to protect the domestic refining industry and domestic farmer [10].

Policies related to production and distribution of palm oil

The Ministry of Food has been subsidizing imported edible oil distribution under the public distribution system (PDS). Particularly for below poverty line households, from the rising prices of edible oils, the Central Government introduced a scheme for distribution of upto 10 lakh tons of imported edible oils in 2008-09 at a subsidy of Rs. 15/- per kg through State Governments/UTs at the rate of one litre per ration card per month. Four Central Public Sector undertakings, PEC, MMTC, STC and NAFED have been entrusted the job of importing, refining, packing and distribution of subsidized edible oils to the States/UTs.

The scheme for import of 10 lakh tons of edible oils with a subsidy of Rs 15/- per kg was extended during 2009-10, 2010-2011 and in 2011-12 upto 30.9.2012. After the implementation of the scheme, edible oil prices have substantially declined and poorer sections were provided edible oils at subsidized rates [10, 11].

Role of fat soluble vitamins: Fats serve as a vehicle for fat-soluble vitamins like vitamins A, D, E and K and carotenes and promote their absorption. They are also sources of essential polyunsaturated fatty acids. It is necessary to have adequate fat in the diet along with essential fatty acids [12]. Vitamin A is required for new cell growth, healthy skin, hair, and tissues, and vision in dim light. Vitamin D promotes absorption and use of calcium and phosphate for healthy bones and teeth. Vitamin E protects red blood cells and helps prevent destruction of vitamin A and C [13].

Deficiency of vitamins and major consequences

Vitamin-D

It has been estimated that 1 billion people worldwide have Vitamin D deficiency or insufficiency. Vitamin D deficiency and low calcium intake are important risk factors for osteoporosis. Vitamin D deficiency causes low bone mass, muscle weakness and therefore increased risk of fracture. This is responsible for physiological production of Vitamin D endogenously in the skin from 7-dehydrocholesterol present in the subcutaneous fat [14].

Vitamin-A

Pro-vitamin like beta-carotene is converted to vitamin A in the body. Fat-soluble vitamins can be stored in the body while water-soluble vitamins are not and get easily excreted in urine. The earliest ocular manifestation of vitamin A deficiency (VAD) is night blindness, and Bitot spots on the white of the eye. Severe vitamin A deficiency leads to keratomalacia (ulceration and sloughing of the cornea) and total blindness. In addition to the ocular manifestations, vitamin A deficiency has been shown to cause growth retardation, decreased resistance to infections, and even death [14].

Vitamin-K

Without sufficient amounts of vitamin K, hemorrhaging can occur. Newborn babies lack the intestinal bacteria to produce vitamin K and need a supplement for the first week. Those on anticoagulant drugs (blood thinners) may become vitamin K deficient. People taking antibiotics may lack vitamin K temporarily because intestinal bacteria are sometimes killed as a result of long-term use of antibiotics. Also, people with chronic diarrhea may have problems absorbing sufficient amounts of vitamin K through the intestine [14].

Vitamin-E

Vitamin E deficiency is rare. Cases of vitamin E deficiency usually only occur in premature infants and in those unable to absorb fats. Since vegetable oils are good sources of vitamin E, people who excessively reduce their total dietary fat may not get enough vitamin E [14].

What makes palm better among all?

- Oil content in 1.5 times higher than the average of conventional oil seeds.
- Besides better and stable fatty acids profile, palm oil contains potent antioxidants and carotenoids. Carotene concentration in palm oil ranges from 600 – 800 ppm which is 15 times more retinol Equivalent than carrots and 300 times more equivalent than tomato [4]. The FAO/WHO recommendation fats and oils in human nutrition stated that “in countries where vitamin A deficiency is health problem, the use of red palm oil is a prime solution” [15].
- Palm oil being a vegetable oil has no cholesterol equivalent to olive oil or canola oil in its

cholesterol response properties (American Food and Drug Administration).

- Crude Palm oil contains Tocopherol and it has highest concentration of tocotrienols among all vegetable oil [4]. Concerns over the health hazards associated with trans-fatty acids (TFA) and genetically modified organisms (GMO) have also raised the demand for palm oil, as palm oil is neither derived from a GMO nor does it contains TFA.

Nutritional benefits of palm oil

- **Safe use and excellent dietary energy source:** Palm oil has been a safe and nutritious source of edible oil for healthy humans. Like other common edible fats and oils, palm oil is easily digested, absorbed and utilized in normal metabolic processes [16, 17].
- **Rich in carotenoids:** Red (unprocessed) and red or golden (specially refined) palm oils, the major cooking oils in many parts of the world, are rich sources of beta-carotene, an antioxidant and precursor of Vitamin A and tocotrienols, all of which have antioxidant properties [18, 19 and 20].
- **Vitamin E antioxidants:** Palm oil and palm oil products are naturally occurring sources of the antioxidant vitamin E constituents, tocopherols and tocotrienols. These natural antioxidants act as scavengers of damaging oxygen free radicals and are hypothesized to play a protective role in cellular aging, atherosclerosis and cancer [21, 22, 23, and 24].
- **Anti-Thrombotic:** Rats fed a palm oil-enriched diet have a reduced tendency for blood clotting [25].
- **Inhibits cancer growth:** Red palm olein is a major source of carotenoids which effectively inhibit some types of cancer. A diet containing palm oil, compared to diets based on other oils but which provide the same number of calories, exerted an inhibitory effect on the development and incidence of experimentally-induced breast cancer in rats [26, 27]. It has also been shown that the tocotrienols present in palm oil inhibit the growth of cancer cells in vivo as well as in vitro [28, 29, 30 and 31].
- **Trans fat issue:** Snakes and other RTE foods are prepared in HVO for their flavor and odor

stability but unfortunately they possess high trans content, as having excellent flavor and odor stability Palm oil can be a solution. Further handling and storage along with frying stability of palmolein can be improved by partial hydrogenation with a minimal trans acid generation i.e. below 10% where as it is as high as 40% for sunflower, soybean and other oils.

Refining and Fractionation of Palm Oil

Lesser amount of impurities like; Phospholipids, glycolipids and chlorophyll makes this oil, quite ideal for refining. It takes very less time and energy in refining and thus makes process economical in comparison to other oils. Effluent generation is quite low in palm oil refining.

Physical refining of palm oil does not differ substantially from the physical refining of other oils. However, a heat bleaching step may be integrated. Figures show the processing flow chart physical and chemical refining of palm oil. The incoming oil is dried at, and a bleaching earth/oil slurry is dosed. The slurry then passes through a vessel, which is well stirred and guarantees sufficient reaction time. This is needed to ensure complete adsorption. The bleaching earth is then filtered off and the oil is cooled. In the distillation tray, the oil is dried and concurrently heated. The oil then continuously passes through several trays of the deodorizer and is steam treated under vacuum. Then it is cooled and the vapors are condensed. Then RBD palm oil send to fractionation unit.

Fractionation is thermo-mechanical separation of palm oil in two fractions of different iodine values. Fractionation separates fats and oils into fractions with different melting points. Fractionated fats and oils have been used to prepare a variety of foods such as margarines, shortenings, salad oils, frying oils, and confectionery products. The principle of oil fractionation is based on the difference in solubility of the component TAGs. The difference in solubility is directly related to the types of TAGs in the fats and oils.

Conclusion

Palm oil is cheaper in comparison to any other vegetable oil therefore those deprived of nutrition through vegetable oils can be fed with Palm oil. Red palmolein is better than palm oil as it gives Vitamin A along with energy. The products obtained from

fractionation of palm oil are better in fatty acid composition as they have relatively higher iodine value and better fatty acid composition than palm oil itself. Palmolein fractionated from RBD palm oil is a very good deep frying medium and can be utilized for multiple frying. Other individual oils are also good but they become beyond the affordability of lower income groups. Blended oils are nutritionally better and also cost effective, palmolein based blend may also be cheaper than the individual counter oil with better nutritional properties. Palm stearin presently goes for soap making is also good ingredient for interesterification and it may be used for edible purposes after interesterification with liquid oils this will serve as trans free alternative of hydrogenated vegetable oil. In Indian context palm oil-based interventions are expected to have high benefit in terms of economy and its usefulness for lower income group. Thus it is concluded that palm and its fractions as well as vanaspati produce from it are stable due to lower unsaturation and its products are having less trans content and it is cost effective for its application as cooking medium.

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Tables

TABLE 1 RECOMMEND DIETARY INTAKE (RDI) AND ADEQUATE INTAKE (AI) FOR FATS SOLUBLE VITAMINS [14]

	Life stage group	Vitamin-A mcg1/RAE	Vitamin-D (mcg2)	Vitamin-E (mcg a- TE2)	Vitamin-K (mcg)
Infant	0-6m	400*	10*	4*	2*
	6m-12m	500*	10*	5*	2.5*
Child	1-3y	300	15	6	30*
	4-8y	400	15	7	55*
Males	9-13y	600	15	11	60*
	14-18y	900	15	15	75*
	19-30y	900	15	15	120*
	31-50y	900	15	15	120*
	51-70y	900	15	15	120*
	>70y	900	20	15	120*
Females	9-13y	600	15	11	60*
	14-18y	700	15	15	75*
	19-30y	700	15	15	90*
	31-50y	700	15	15	90*
	51-70y	700	15	15	90*
	>70y	700	20	15	90*
Pregnant	14-18y	750	15	15	75
	19-30y	770	15	15	90
	31-50y	770	15	15	90
Lactation	14-18y	1200	15	19	75
	19-30y	1300	15	19	90
	31-50y	1300	15	19	90

Figures

FIGURE 1 OIL WISE CONSUMPTION (IN MMT) (SOURCE: SEA INDIA)

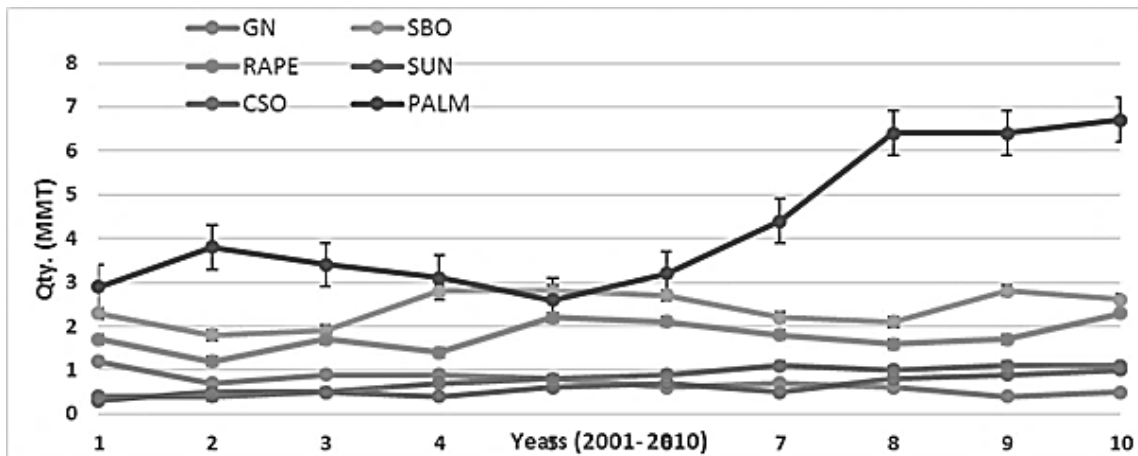


FIGURE 2 ZONE WISE CONSUMPTION OF DIFFERENT OILS (SOURCE: GGN RESEARCH)

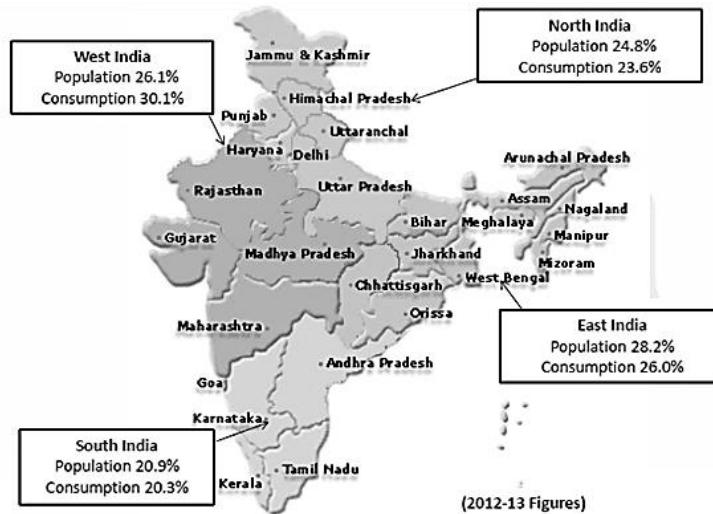


FIGURE 3 DOMESTIC AND IMPORTED OIL PRICE IN INDIAN MARKET (INR/MT) (SOURCE: SEA INDIA)

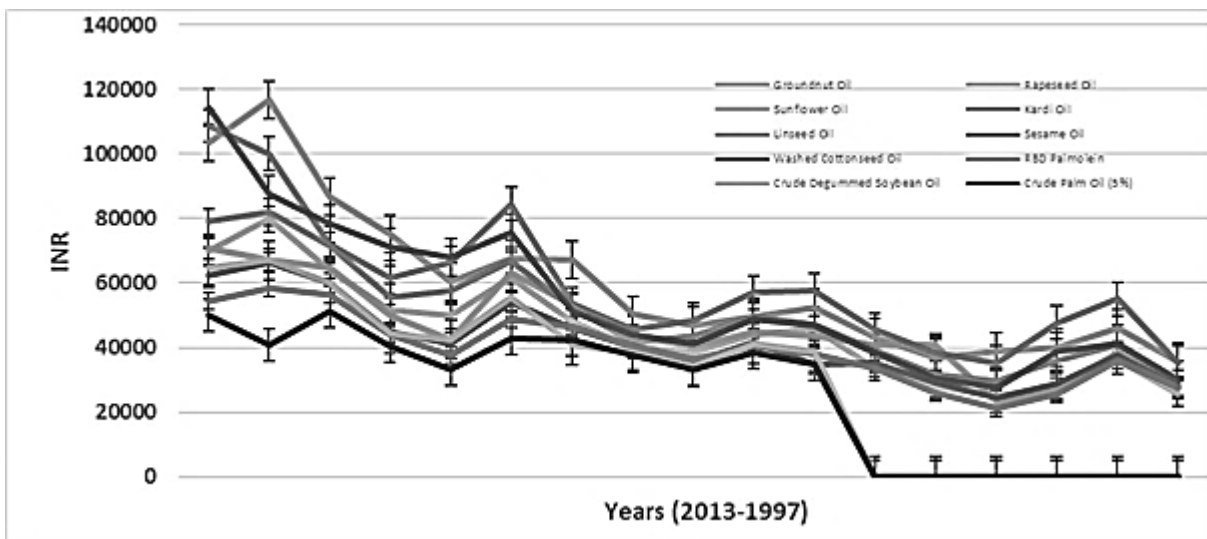


FIGURE 4 PROCESS FLOW DIAGRAM OF PALM OIL REFINING

