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Oil Technologists' Association of India (North Zone)

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Editor's desk..............

Dietary fats and oils provide most concentrated energy (9Kcal/g) of any food stuff. They supply essential fatty acids which are precursors of important hormones (prost anoids).

The shorter polyunsaturated fatty acids (PUFAs) are synthesized on land by many plants and therefore, dietarily obtained from vegetable oils. However, the longer chain members of each family are either biosynthesized in inside the body after dietary ingestion of the shorter 18-carbon precursors or they are obtained directly from either animal or marine sources. For example, the longer chain ω-3 PUFAs, ecosapentaenoic acid (EPA, 20:5 ω-3) and docosahexaenoic acid (DHA, 22:6 ω-3). The latter is found in fish and marine oils and therefore, can be ingested directly from these sources.

Now-a-days, the use of algal oil in food and supplements is growing due to the consumer's interest towards EPA and DHA rich products along with pharmaceuticals as it is also an alternative source for vegans.

Studies have shown that EPA and DHA are important for proper fetal development during pregnancy, including neuronal, retinal, immune function, and also to reduce many cardiovascular issues.

As such, EPA/DHA can be obtained from Algal oil for Vegans and from Fish for Non -Vegetarians.

Yours truly
C.S. Joshi
Editor

Editor's desk..............

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Edible green algae, a rich source of Omega-3 (PUFA): An Overview

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Omega-3 Fatty Acids and its Importance

Omega-3 fatty acids (ω-3 FAs) known for its association with healthy aging, are type of polyunsaturated fatty acid (PUFA). Since, human body cannot efficiently produce ω-3 FAs by itself; it needs to be gained through the diet. There are different kinds of ω-3 FAs namely eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) which are obtained through fish and alpha-linolenic acid (ALA) as a plant source of ω-3 FA. The consumption of ω-3 FAs have several health benefits mainly for improving cardiovascular health, along with anti-inflammatory, anticancer, supplementation for pregnant women, reducing blood pressure level and also helps in the development of brain, heart and eye retina of infants.

Food Sources of Omega-3 Fatty Acids

ω-3 FAs are innately found in various foods and yet are incorporated into some food supplements. Fish and other seafood's particularly cold-water fatty fish, for instance, mackerel, sardines, salmon, tuna, whitefish and herring are good sources of EPA and DHA whereas ALA obtained through plant food sources like nuts and seeds (walnuts, almonds, flaxseed, chia seed and linseed) Plant oils (such as canola, flaxseed, hemp and olive), other (Brussels sprouts, avocado, winter and summer squash). Existing sources have certain troubles like resource depletion, overexploitation, and the hazardous heavy metals presence like mercury, undesirable fishy flavor, and oil stability problems. Considering, these complications, feasible substitute sources of LC-PUFAs needs to be introduced. Novel ω-3 FAs sources can be generated from microalgae which could get rid of these dilemmas.

Microalgae Characteristics and their Varieties

Microalgae, living in colonies are basically microscopic algae with a single cell and chlorophyll. They are photosynthetic, unicellular microorganisms with sizes in the range of 0.0002 mm to 0.002 mm and in filamentous forms with sizes of 0.1 mm or greater. They lack a stem, leaves, and roots; nevertheless through photosynthesis process they convert sunlight, CO_2 and water into O_2, carbohydrate, lipid and protein. These organisms, which include both eukaryotic and prokaryotic organisms, can cultivate in waste water, fresh water, and marine aquatic environments. Algae are the major suppliers of ocean life, serving as the core of the oceanic food chain. Algae, in particular, produce ω-3 FAs, which are later on consumed by many other sea species. Microalgae can be classified as green, brown, red, as well as blue-green algae; they belong to the protista kingdom rather than the plant kingdom. Few microalgae species can synthesize various bioactive compounds like pigments, PUFAs, antioxidants, enzymes, polysaccharides as well as other essential compounds. Temperature, pH, light, and nutrients influence algal growth, biomass yield, and metabolite compounds. Microalgae have the complex, rigid and robust structure of cell walls along with various polysaccharides such as xylan, uronic acid, cellulose, minerals, etc. Amongst diverse microalgae species, few species namely scenedesmus and chlorella can survive in severe environments of higher temperature and CO_2. There are numerous algal species, and each exhibits variations in the EPA and DHA production.

Harvesting

Microalgae can be harvested using a variety of methods; the method chosen is largely decided by the final product's value and characteristics. Furthermore to improve harvesting efficiencies with costs, fusion of techniques are usually applied. Thickening (flotation, coagulation/flocculation, filtration and centrifugation) and dewatering steps come in two stage of microalgae separation. The harvesting method must not be poisonous or contaminate algal biomass. Techniques presently in use for algae harvesting are chemical, mechanical, and biological along with electrical methods also. Among these, mechanical methods are the most efficient and so far widely used. However to minimize operation and maintenance costs along with better effectiveness mechanical methods are frequently preceded by a chemical or biological method.

Extraction of Algal Oil

Microalgae have a robust and rigid cell wall structure which limits the release of bioactive compounds; hence for obtaining appropriate lipid quantity, suitable pretreatment for cell rupture is required. Algal oil extraction for EPA and DHA production is complicated because, as the algal cell walls get disrupted, these LC-PUFAs are subjected to possible oxidation. Whenever these PUFAs reacted with oxidized ions, an unbreakable chain reaction occurs resulting in rancid oil that is unfit for human consumption. Therefore, the oxidation enhancing materials should be eliminated from oil extraction and storage space. Long overdue, several conventional extraction methods such as Soxhlet, Bligh-Dyer and Folch etc. have been used for algal oil extraction but though they are easy to operate, economical, have few drawbacks as well. Presently many novel extraction techniques for algal oil extraction have been explored like microwave assisted extraction (MAE), enzyme assisted extraction (EAE), ultrasound-assisted extraction (UAE), pulsed electric field (PEF) and so forth. These methods tackle the issues of conventional extraction such as longer extraction time, contamination, the use of hazardous solvents, and the negative impact on the environment. Concurrently, they are useful for enhancing lipid extraction rate and keep up bioactive activity.

Conventional Extraction Methods

Under conventional methods, mainly Solvent based extraction method (Soxhlet, extraction using organic solvent) are used for cell wall rupture. For getting appropriate lipid, selection of solvent is very important. Properties of solvent like low toxicity, polarity, water miscibility and lipid solubility decide the yield. The conventional extraction methods give quantity oil yield but quality is effected as it needs further processing as well.

Green Extraction Methods

Several green extraction techniques i.e. microwave assisted extraction (MAE), enzyme assisted extraction (EAE), ultrasound-assisted extraction (UAE), pulsed electric field (PEF) and so forth are being employed to overcome the drwa backs of conventional methods.. In green extraction methods, cell disruption is carried out by implodes and acoustic cavitation, enzymatic digestion, chemical hydrolysis and supercritical fluid extraction. In microwave-assisted extraction using microwave power heat is generated which is further used for cell rupture and subsequently release of sub cellular compounds. For MAE important parameters to be considered are extraction time, power, solvent type and concentration, and solid/liquid ratio.

Whereas, in ultrasound-assisted extraction, algal oil from microalgae cells, obtained by acoustic cavitation. Here also ultrasonic power, solvent type, extraction time and temperature are essential to enhance the lipid extraction rate.

For enzymatic extraction either a single enzyme or a combination of enzymes to disrupt the algal cell wall are used. Chosen enzyme is based on polysaccharides (such as cellulose, cellulose and hemicellulose) present in the algal cell membrane and lipid content as well. This method is the substitute to mechanical method.

In pulsed electric field extraction, swelling of algae cell membranes takes place by pulses of a strong electric field and releases intracellular compounds. PEF extraction is based on the principle of electrophoration.

Supercritical fluid extraction employs the solvating properties of a supercritical fluid. The parameters to consider for SFE are pressure, solvent, temperature, extraction time, and the flow rate of solvent, particle size and sample size. The use of CO_2 for SFE is the substitute for use of toxic solvents with certain advantages including low critical point and safe for use (as per FDA), economic and eco-friendly.

Conclusion

Algal oils, an important natural and sustainable source of omega-3 LC-PUFAs, posses multiple health benefits to avoid the risk of widespread diseases, when compared to other omega-3 sources (such as fish oil and vegetable oil), and it is also an alternative source for vegans. Nowadays the use of algal oil in food and supplements is growing due to the consumer's interest towards EPA and DHA rich products along with pharmaceuticals. Hence, studies on green extraction techniques, optimization of extraction parameters with respect to quality and yield of algae oil need to be exlored. Further this extracted oil could be used for development of neutraceutical food products.

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TRADE NEWS

SEA urges govt. to focus on mustard to make country self- reliant in oilseed production

The Solvent Extractors Association SEA of India has demanded the central government give more focus on mustard crops in order to make the country self-reliant in oilseed production. India has emerged as the largest importer of edible oils in the world and the domestic consumption of edible oil has touched the level of about 240 lakh tons which is likely to increase further with the growing population and per capita income. India currently produces around 100 lakh tons of edible oil. The gap between the demand and supply of edible oils is about 140 lakh tons and is met through imports. ‘’The dependency on imported edible oil is a matter of concern and to address this challenge, India needs to critically look into the ways and means to increase the productivity of oilseeds crops including important crops of mustard,

The government should also make efforts to ensure that the farmers get the proper price for the crops so that they are not demoralized towards cultivation.

Source :- SEA

USDA: World oil seed production in 2022/2023 will increase by 12.9%

The American Department of Agriculture (USDA) has released, in its report for the month of May, a first estimate of world production of oilseeds for the 2022/23 campaign. In total, the harvest of the three main oilseeds (sunflower, rapeseed and soybean) will amount to 525.73 million tons, 10% more than in the 2021/22 campaign (477.93 million tons).

According to the first forecasts of the USDA, world soybean production will increase, in the 2022/23 campaign, to 394.69 million tons, 12.9% more than in the 2021/22 campaign (45.32 million tons more), in which the drought had a significant impact on the harvests of South America. The increase is mainly due to the increase registered in Brazil, with 149 million tons, 24 million tons more than in the 2021/22 campaign (19.2% more). Rapeseed production will increase by 12.8% Regarding rapeseed production, the USDA forecasts, in the 2022/23 campaign, an increase of 9.1 million tons compared to the 2021/2022 campaign.

Source: USDA

India: Oilseeds and Products Update

India's soybean, peanut, and sunflower seed production for marketing year (MY) 2022/23 (October-September) is estimated at 11.1 million metric tons (MMT), 6.65 MMT, and 200,000 metric tons, respectively, reflecting heavy late season rainfall in September and October that impacted yields and crop quality. Cumulative edible oil imports in MY 2021/22 have increased four percent to 14.5 MMT, and crude palm oil remained th primary consumed oil despite Indonesia's palm oil export restrictions. Favourable domestic oilseed availability, and the Indian government's November order removing stock limits on oil and oilseeds will support higher crush in the out year. Despite reduced oil the meal export demand the previous MY, availability of oil meals and stabilised pricing are expected to result in higher use for Domestic animal field and exports. Price volatility of oil seeds and derivatives (oil and meal), continued rupee devaluation , and greater erratic weather patterns cause significant uncertainty in the new market year.

Source: USDA :Dec. 2022.

Economic Survey 2022: Oils and fats contributed to around 60% of 'food and beverages'

The inflationin the foods and beverages category in the fiscal FY22 (till December), said **The rising price of oil and fats was the major driver of inflation** the **Economic Survey 2021-22**. According to the survey, which was released by the Ministry of Finance on **January** 31, oil and fats contributed to around 60 percent offood and beverages inflation in the country, despite having a weight of only 7.8 percent in the group.

"Inflation of the sub-group has risen sharply since mid-2019; remained in double digits since April 2020 and witnessed a further uptrend in 2021-22. In 2021-22 (April - December), its inflation has been 30.9 percent, and stood at 24.3 percent in December 2021," it added.

Edible oils such as palm oil are a key raw material for FMCG and HoReCa (hotels, restaurants and caterers) industries and a rise in the prices of these commodities impacts consumer goods beyond food products such as soaps, shampoos, etc. FMCG companies for several quarters have been battling inflation due to the spike in the prices of palm oil and other commodities

India imports around 60 percent of its consumption of edible oils, and palm oils (crude and refined) constitute around 60 percent of the imports of edible oils. As a result, fluctuation in imports and international prices transmit to domestic prices of edible oil.

The current spike in prices of edible oils is mainly on account of high and increasing international prices of edible oils.

The rise in oils component of Food and Agriculture Organisation's (FAO) food price index from May 2020 onwards has been steep, and reached a 10-year high due to robust global import demand amidst the shortages over migrant labour impacting production in Malaysia," said the Economic Survey 2021-2022 document.

According to the Survey, the rise in international prices was accompanied by a decline in imports of edible oils. During the oil year 2020-21 (November 2020-October 2021), India's imports of edible oils have been the lowest in the last six years, the survey said. However, in terms of value, it has increased by 63.5 percent in 2020-21 as compared to 2019-20, reflecting the rise in international prices of edible oils.

Unlike last financial year, the food and beverages group was not the major driver of inflation, indicated the survey.

As per the survey, while food and beverages' contribution to retail inflation stood at 59 percent in FY21, in the current financial year it has dropped to 31.9 percent. The sub-groups of 'fuel and light' and miscellaneous, which includes 'transport and communication' and health, were the largest contributors to the inflation in April-December 2021 period, said the survey.

The contribution of the miscellaneous group, showed the survey has increased from 26.8 percent in 2020-21 (April-December) to 35 percent in 2021-22 (April-December) and the contribution of 'fuel and light' increased from 2.3 percent to 14.9 percent.

The government has taken several measures to stem the rise in edible oil prices. The duty on edibles oil has been reduced with effect from October 2021 and the basic duty on refined palm oil/ palmolein, refined soyabean oil and refined sunflower oil has been reduced to 17.5 percent from 32.5 percent with effect from October 2021. Steps are also being taken to improve the production of secondary edible oils, especially rice bran oil to reduce the import dependence

Source: Money Control News –Jan-2022

Brazil Soybeans:

MY 2022/23 Bumper Crop Pushes Upwards Brazil soybean production for marketing year (MY) 2022/23 is estimated at 155.0 million metric tons (mmt), higher by 1.0 mmt (1 percent) from last month, and higher by 24.5 mmt (19 percent) from last year. Harvested area is estimated at 43.7 million hectares (mha), unchanged from last month and up 2.1 mha (5 percent) from last season. Yield is estimated at 3.55 tons per hectare (t/ha), about 1 percent above last month and up 13 percent from last year. USDA forecasts the MY 2023/24 soybean production at a record 163.0 mmt; planting for this crop will begin in October 2023. Nationally, over 94 percent of the soybean crop has been harvested as of early May. The majority of the remaining crop is in the southern state of Rio Grande do Sul, where 80 percent of the crop Foreign Agricultural Service/USDA 27 May 2023 Global Market Analysis has been harvested compared to the five-year average of 90 percent

Source : Tech Assistance & Rural Agency (EMATTER-RS)

IMPORTANT FIGURES

Table 01: Major Oilseeds: World Supply and Distribution (Commodity View)
Million Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
Oilseed, Copra	5.92	5.78	6.07	6.03
Oilseed, Cottonseed	43.48	40.90	41.68	42.45
Oilseed, Palm Kernel	19.36	19.09	19.13	20.02
Oilseed, Peanut	47.74	50.42	51.85	49.54
Oilseed, Rapeseed	70.23	74.55	74.89	88.13
Oilseed, Soybean	340.90	368.60	359.91	369.57
Oilseed, Sunflowerseed	54.27	49.13	56.95	51.66
Total	581.90	608.45	610.48	627.40
Imports				
Oilseed, Copra	0.15	0.08	0.09	0.08
Oilseed, Cottonseed	0.81	0.84	1.03	1.14
Oilseed, Palm Kernel	0.14	0.14	0.15	0.15
Oilseed, Peanut	4.37	4.32	4.06	4.26
Oilseed, Rapeseed	15.82	16.66	13.89	19.31
Oilseed, Soybean	165.24	165.49	156.59	165.32
Oilseed, Sunflowerseed	3.34	2.74	3.79	4.78
Total	189.88	190.27	179.60	195.05
Exports				
Oilseed, Copra	0.28	0.10	0.12	0.14
Oilseed, Cottonseed	0.88	0.96	1.29	1.32
Oilseed, Palm Kernel	0.08	0.06	0.11	0.05
Oilseed, Peanut	5.02	5.06	4.44	4.62
Oilseed, Rapeseed	15.98	18.11	15.09	20.57
Oilseed, Soybean	165.56	164.86	154.02	168.49
Oilseed, Sunflowerseed	3.69	2.90	3.91	5.12
Total	191.48	192.05	178.97	200.29
Crush				
Oilseed, Copra	5.76	5.71	5.94	5.89
Oilseed, Cottonseed	33.55	31.96	32.71	32.81
Oilseed, Palm Kernel	19.40	19.07	18.94	20.05
Oilseed, Peanut	19.10	19.68	19.91	19.82
Oilseed, Rapeseed	68.96	71.80	71.91	80.81
Oilseed, Soybean	312.39	315.82	314.23	312.20
Oilseed, Sunflowerseed	49.36	45.08	46.87	49.74
Total	508.52	509.12	510.50	521.33
Ending Stocks				
Oilseed, Copra	0.05	0.05	0.05	0.05
Oilseed, Cottonseed	1.68	1.52	1.21	1.36
Oilseed, Palm Kernel	0.18	0.18	0.29	0.26
Oilseed, Peanut	4.71	4.98	5.05	4.44
Oilseed, Rapeseed	7.67	6.40	4.25	6.26
Oilseed, Soybean	94.97	100.06	98.73	101.32
Oilseed, Sunflowerseed	3.08	2.62	8.01	4.73
Total	112.34	115.81	117.60	118.40

Totals may not add due to rounding

Table 02: Major Vegetable Oils: World Supply and Distribution (Commodity View)
Million Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
Oil, Coconut	3.61	3.58	3.73	3.70
Oil, Cottonseed	5.06	4.78	4.93	4.95
Oil, Olive	3.15	2.93	3.27	2.61
Oil, Palm	73.04	73.21	72.95	77.74
Oil Palm Kernel	8.52	8.43	8.38	8.86
Oil, Peanut	6.18	6.37	6.47	6.44
Oil, Rapeseed	28.30	29.32	29.12	32.73
Oil, Soybean	58.50	59.27	59.22	58.70
Oil, Sunflowerseed	21.13	19.02	19.71	20.93
Total	207.50	206.92	207.78	216.67
Imports				
Oil, Coconut	1.84	1.94	2.18	1.98
Oil, Cottonseed	0.12	0.10	0.11	0.10
Oil, Olive	1.31	1.21	1.29	1.12
Oil, Palm	47.03	46.84	41.65	48.60
Oil, Palm Kernel	3.03	2.94	2.65	2.92
Oil, Peanut	0.31	0.44	0.29	0.47
Oil, Rapeseed	5.80	6.32	5.11	6.36
Oil, Soybean	11.54	11.78	11.54	9.75
Oil, Sunflowerseed	11.72	9.68	9.68	11.15
Total	82.68	81.26	74.51	82.44
Exports				
Oil, Coconut	1.88	1.71	2.27	2.01
Oil, Cottonseed	0.12	0.10	0.13	0.12
Oil, Olive	1.47	1.36	1.41	1.19
Oil, Palm	48.36	48.09	43.89	50.57
Oil, Palm Kernel	3.29	3.21	2.78	3.04
Oil, Peanut	0.32	0.48	0.35	0.45
Oil, Rapeseed	5.87	6.41	5.25	6.46
Oil, Soybean	12.38	12.62	12.24	10.62
Oil, Sunflowerseed	13.47	11.33	11.08	12.66
Total	87.14	85.30	79.40	87.11

	2019/20	2020/21	2021/22	2022/23
Domestic Consumption				
Oil, Coconut	3.63	3.66	3.59	3.84
Oil, Cottonseed	5.05	4.85	4.93	4.90
Oil, Olive	3.03	3.07	3.13	2.78
Oil, Palm	70.91	72.53	69.58	75.32
Oil, Palm Kernel	8.17	8.30	8.30	8.73
Oil, Peanut	6.19	6.44	6.37	6.48
Oil, Rapeseed	28.35	28.61	29.78	31.96
Oil, Soybean	57.05	58.44	59.21	57.98
Oil, Sunflowerseed	18.94	18.31	17.58	18.92
Total	201.31	204.21	202.47	210.91
Ending Stocks				
Oil, Coconut	0.64	0.80	0.84	0.67
Oil, Cottonseed	0.22	0.15	0.14	0.17
Oil, Olive	0.85	0.56	0.58	0.35
Oil ,Palm	15.76	15.19	16.32	16.78
Oil, PalmKernel	1.13	1.00	0.96	0.97
Oil, Peanut	0.40	0.30	0.34	0.33
Oil, Rapeseed	2.86	3.48	2.68	3.35
Oil, Soybean	5.38	5.37	4.69	4.53
Oil, Sunflowerseed	2.79	1.84	2.58	3.07
Total	30.02	28.70	29.12	30.21

Totals may not add due to rounding

Table 03: Major Oilseeds: World Supply and Distribution (Country View)
Million Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
Brazil	133.92	143.91	135.48	161.49
United States	106.98	124.52	131.35	125.93
China	62.52	65.81	62.07	68.51
Argentina	53.64	51.21	49.67	31.11
India	36.19	39.23	43.21	41.69
Other	188.65	183.76	188.70	198.67
Total	581.90	608.45	610.48	627.40
Imports				
China	102.71	104.12	94.46	103.70
European Union	22.95	22.19	22.82	23.75
Mexico	7.36	7.86	7.23	8.12
Japan	5.78	5.70	5.78	6.15
Argentina	4.88	4.82	3.84	8.70
Turkey	4.38	3.73	3.68	4.37
Thailand	3.95	4.26	3.34	4.16
Egypt	5.03	3.76	4.68	2.55
Pakistan	3.09	3.35	2.30	2.07
Bangladesh	3.04	2.70	2.99	2.24
Other	26.70	27.80	28.49	29.25
Total	189.88	190.27	179.60	195.05
Exports				
Brazil	92.51	82.02	79.45	93.42
United States	47.07	62.78	59.71	55.29
Canada	13.99	15.20	9.58	13.10
Ukraine	5.68	4.05	5.71	9.03
Paraguay	6.63	6.35	2.28	5.71
Argentina	11.24	6.36	3.99	4.83
Australia	1.67	4.03	6.48	7.36
Other	12.70	11.26	11.78	11.55
Total	191.48	192.05	178.97	200.29

	2019/20	2020/21	2021/22	2022/23
Crush				
China	127.49	130.00	125.05	130.63
United States	63.04	62.66	63.87	64.73
Brazil	51.48	50.52	55.04	58.31
European Union	45.72	46.66	47.91	49.27
Argentina	41.88	43.68	42.79	34.26
India	30.01	32.39	32.51	34.14
Russia	20.05	18.75	21.20	23.90
Indonesia	12.67	13.02	12.79	13.36
Ukraine	18.73	15.40	12.50	12.97
Canada	11.88	12.07	10.40	12.05
Mexico	7.37	7.67	7.46	8.03
Turkey	5.42	5.25	5.31	6.39
Pakistan	6.23	5.48	5.66	4.16
Malaysia	5.47	4.99	4.83	5.33
Japan	4.68	4.68	4.79	5.07
Other	56.42	55.94	58.41	58.76
Total	508.52	509.12	510.50	521.33
Ending Stocks				
Brazil	20.63	29.68	27.72	33.66
China	26.33	33.07	31.52	37.80
Argentina	28.09	26.28	25.18	18.97
United States	15.96	8.64	9.14	7.97
European Union	3.64	2.79	3.28	3.83
Other	17.70	15.35	20.76	16.17
Total	112.34	115.81	117.60	118.40

Major Oilseeds includes Copra, Cottonseed, Palm Kernel, Peanut, Rapeseed, Soybeans and Sunflowerseeds.

Table 04: Major Protein Meals: World Supply and Distribution (Country View)
Million Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
China	90.64	92.35	88.47	92.26
United States	48.77	48.26	49.27	50.16
Brazil	38.48	37.94	41.33	43.71
European Union	29.59	30.19	30.75	31.39
Argentina	31.57	32.82	31.98	25.22
Other	107.60	107.54	107.70	112.28
Total	346.65	349.09	349.51	355.03
Imports				
European Union	21.52	21.23	21.62	21.05
China	6.36	7.12	7.18	8.29
Indonesia	5.17	5.50	5.73	5.92
Vietnam	6.20	6.10	6.41	6.15
United States	4.12	4.39	3.57	4.18
Thailand	3.57	3.36	3.55	3.51
Korea, South	3.45	3.45	3.42	3.44
Other	40.62	41.45	42.30	39.18
Total	91.02	92.59	93.77	91.71
Exports				
Argentina	28.09	29.33	27.60	22.10
Brazil	17.50	16.58	20.21	21.65
United States	12.83	12.62	12.44	12.93
Indonesia	5.20	5.33	5.85	5.82
Canada	5.24	5.63	4.81	5.50
Ukraine	6.10	5.02	3.92	4.38
Russia	2.94	2.74	3.10	3.60
Other	18.13	20.18	18.25	19.11
Total	96.03	97.43	96.17	95.08

	2019/20	2020/21	2021/22	2022/23
Domestic Consumption				
China	95.97	98.40	95.15	100.33
European Union	49.48	49.27	49.54	49.79
United States	40.10	40.01	40.43	41.36
Brazil	20.75	21.09	21.57	22.25
India	15.94	16.53	17.38	18.05
Russia	8.00	8.20	8.49	8.85
Mexico	7.55	7.61	7.62	7.87
Vietnam	7.42	7.54	7.63	7.77
Indonesia	6.06	6.44	6.58	6.86
Thailand	6.09	6.04	6.06	6.25
Other	84.17	84.71	86.14	85.59
Total	341.52	345.85	346.60	354.96
SME				
China	90.30	92.61	89.31	93.65
European Union	42.61	42.58	42.64	42.52
United States	38.72	38.60	39.28	39.92
Brazil	20.31	20.72	21.20	21.83
India	13.61	14.00	14.71	15.18
Mexico	7.26	7.32	7.39	7.58
Russia	6.60	6.72	6.89	7.20
Other	93.47	94.68	96.46	96.04
Total	312.88	317.23	317.89	323.91
Ending Stocks				
Brazil	3.78	4.07	3.63	3.46
Argentina	2.87	2.42	2.93	1.95
European Union	1.45	0.99	1.13	1.04
India	0.61	0.41	0.88	0.49
Indonesia	0.67	0.94	0.66	0.63
Other	11.02	9.97	10.09	8.46
Total	20.40	18.80	19.32	16.02

Major Protein Meals include Copra, Cottonseed, Fish, Palm Kernel, Peanut, Rapeseed, Soybean, and Sunflower Meal.

Table 05: Palm Oil: World Supply and Distribution (Country View)
Thousand Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
Indonesia	42,500	43,500	42,000	46,000
Malaysia	19,255	17,854	18,152	18,600
Thailand	2,652	2,963	3,376	3,415
Colombia	1,529	1,558	1,747	1,768
Nigeria	1,140	1,275	1,400	1,400
Other	5,966	6,057	6,274	6,561
Total	73,042	73,207	72,949	77,744
Imports				
India	7,398	8,411	8,004	9,450
China	6,719	6,818	4,387	7,200
European Union	7,112	5,970	4,979	5,000
Pakistan	3,416	3,500	2,824	3,600
United States	1,503	1,576	1,593	1,900
Bangladesh	1,510	1,285	1,339	1,600
Malaysia	790	1,300	1,237	950
Philippines	1,107	1,188	1,177	1,150
Egypt	1,173	1,127	1,196	1,150
Kenya	1,143	839	789	1,000
Other	15,158	14,828	14,124	15,603
Total	47,029	46,842	41,649	48,603
Exports				
Indonesia	26,249	26,874	22,321	28,450
Malaysia	17,212	15,878	15,527	16,000
Guatemala	758	776	792	860
Papua New Guinea	698	745	834	780
Colombia	611	454	449	700
Other	2,827	3,362	3,969	3,779
Total	48,355	48,089	43,892	50,569
Domestic Consumption				
Indonesia	14,595	15,700	17,430	18,690
India	8,459	9,214	8,146	9,050
China	6,200	6,550	5,100	6,650
European Union	6,575	6,360	4,850	4,700
Malaysia	3,559	3,242	3,303	3,550
Pakistan	3,445	3,470	3,145	3,545
Thailand	2,485	2,510	2,374	2,635
United States	1,483	1,598	1,566	1,889
Nigeria	1,590	1,650	1,715	1,790
Bangladesh	1,480	1,430	1,483	1,580
Colombia	1,096	1,149	1,255	1,310
Philippines	1,235	1,255	1,280	1,255
Egypt	1,200	1,215	1,200	1,145
Vietnam	942	950	977	982
Brazil	758	870	840	915
Other	15,810	15,363	14,911	15,636
Total	70,912	72,526	69,575	75,322
Ending Stocks				
Indonesia	4,576	5,502	7,751	6,611
Malaysia	1,722	1,756	2,315	2,315
India	1,376	844	977	1,682
China	895	1,149	421	951
EuropeanUnion	1,137	588	540	690
Other	6,049	5,350	4,316	4,527
Total	15,755	15,189	16,320	16,776

Table 06: Rapeseed and Products: World Supply and Distribution
Thousand Metric Tons

	Marketing Year	Oilseed, Rapeseed 2021/22	Oilseed, Rapeseed 2022/23	Meal, Rapeseed 2021/22	Meal, Rapeseed 2022/23	Oil, Rapeseed 2021/22	Oil, Rapeseed 2022/23
Production							
China	(Oct-Sep)	9,737	10,622	6,435	7,020	14,714	15,530
India	(Oct-Sep)	5,808	6,136	3,705	3,914	11,100	11,500
Canada	(Aug-Jul)	5,092	5,858	3,573	4,192	13,752	19,000
Japan	(Oct-Sep)	1,221	1,335	904	1,040	4	4
European Union	(Jul-Jun)	12,426	13,794	9,156	10,164	17,389	19,536
Other		7,676	9,181	5,347	6,402	17,931	22,555
World Total		41,960	46,926	29,120	32,732	74,890	88,125
Imports							
China	(Oct-Sep)	2,225	2,200	973	1,800	1,657	3,800
India	(Oct-Sep)	1	0	34	25	0	0
Canada	(Aug-Jul)	11	8	19	20	105	140
Japan	(Oct-Sep)	7	20	33	20	2,116	2,450
European Union	(Jul-Jun)	576	760	593	400	5,570	6,900
Other		4,872	5,997	3,456	4,090	4,440	6,015
World Total		7,692	8,985	5,108	6,355	13,888	19,305
Exports							
China	(Oct-Sep)	11	20	3	3	0	0
India	(Oct-Sep)	1,207	1,400	7	7	0	0
Canada	(Aug-Jul)	4,395	5,150	2,573	3,250	5,253	8,600
Japan	(Oct-Sep)	10	0	7	5	0	0
European Union	(Jul-Jun)	703	740	337	700	447	550
Other		1,326	1,469	2,322	2,495	9,390	11,416
World Total		7,652	8,779	5,249	6,460	15,090	20,566
Domestic Consumption							
China	(Oct-Sep)	11,951	12,802	8,300	8,300	17,010	18,510
India	(Oct-Sep)	4,375	4,900	3,660	3,970	10,950	11,600
Canada	(Aug-Jul)	650	700	1,030	1,055	9,515	10,650
Japan	(Oct-Sep)	1,220	1,353	916	1,060	2,124	2,447
European Union	(Jul-Jun)	12,300	13,750	9,225	9,800	22,400	25,000
Other		11,281	13,568	6,653	7,770	13,845	16,644
World Total		41,777	47,073	29,784	31,955	75,844	84,851
Ending Stocks							
China	(Oct-Sep)	0	0	841	1,358	953	1,773
India	(Oct-Sep)	450	286	407	369	519	419
Canada	(Aug-Jul)	183	199	525	432	865	755
Japan	(Oct-Sep)	18	20	46	41	207	214
European Union	(Jul-Jun)	312	376	398	462	830	1,716
Other		504	645	458	685	872	1,382
World Total		1,467	1,526	2,675	3,347	4,246	6,259

Table 07: Sunflowerseed and Products: World Supply and Distribution
Thousand Metric Tons

	Marketing Year	Oilseed, Sunflowerseed		Meal, Sunflowerseed		Oil, Sunflowerseed	
		2021/22	2022/23	2021/22	2022/23	2021/22	2022/23
Production							
Argentina	(Mar-Feb)	4,0504,500	1,514	1,642	1,503	1,631	
Russia	(Sep-Aug)	15,572	16,254	5,795	6,268	5,823	6,298
Turkey	(Sep-Aug)	1,750	1,900	1,156	1,470	923	1,176
Ukraine	(Sep-Aug)	17,500	11,200	4,460	4,791	4,644	4,988
European Union	(Oct-Sep)	10,285	9,287	5,621	5,459	4,394	4,267
Other		7,796	8,522	2,698	2,867	2,424	2,566
World Total		56,953	51,663	21,244	22,497	19,711	20,926
Imports							
Argentina	(Mar-Feb)	0	1	0	0	0	0
Russia	(Sep-Aug)	75	75	3	5	1	1
Turkey	(Sep-Aug)	669	1,200	820	750	1,308	1,500
Ukraine	(Sep-Aug)	21	30	3	2	1	0
European Union	(Oct-Sep)	1,794	2,100	2,589	2,575	2,181	1,900
Other		1,231	1,377	3,877	4,748	6,192	7,747
World Total		3,790	4,783	7,292	8,080	9,683	11,148
Exports							
Argentina	(Mar-Feb)	156	150	976	975	873	1,000
Russia	(Sep-Aug)	235	550	2,025	2,250	3,150	3,950
Turkey	(Sep-Aug)	118	125	36	90	889	1,225
Ukraine	(Sep-Aug)	1,622	2,350	3,275	3,750	4,465	4,500
European Union	(Oct-Sep)	396	500	990	1,000	852	1,100
Other		1,383	1,442	465	561	848	888
World Total		3,910	5,117	7,767	8,626	11,077	12,663
Domestic Consumption							
Argentina	(Mar-Feb)	3,850	4,165	540	600	582	612
Russia	(Sep-Aug)	14,550	15,730	3,800	3,900	2,300	2,340
Turkey	(Sep-Aug)	2,302	2,922	2,050	2,135	1,260	1,310
Ukraine	(Sep-Aug)	11,350	12,200	1,200	1,000	415	390
European Union	(Oct-Sep)	11,425	11,125	7,160	7,045	5,338	5,403
Other		7,968	8,469	6,099	7,023	7,681	8,867
World Total		51,445	54,611	20,849	21,703	17,576	18,922
Ending Stocks							
Argentina	(Mar-Feb)	848	1,034	126	193	282	301
Russia	(Sep-Aug)	958	1,007	55	178	427	436
Turkey	(Sep-Aug)	101	154	113	108	222	363
Ukraine	(Sep-Aug)	4,690	1,370	225	268	44	142
European Union	(Oct-Sep)	659	421	185	174	535	199
Other		753	741	351	382	1,071	1,629
World Total		8,009	4,727	1,055	1,303	2,581	3,070

Table 08: India Oilseeds and Products Supply and Distribution
Thousand Metric Tons

	2019/20	2020/21	2021/22	2022/23
Production				
Oilseed, Cottonseed	12,100	11,718	10,359	10,614
Oilseed, Peanut	6,255	7,300	8,700	6,300
Oilseed, Rapeseed	7,400	8,600	11,100	11,500
Oilseed, Soybean	9,300	10,456	11,889	12,038
Oilseed, Sunflowerseed	140	150	140	215
Other	998	1,003	1,021	1,022
Total	36,193	39,227	43,209	41,689
Domestic Consumption				
Meal, Cottonseed	4,523	4,584	4,381	4,210
Meal, Peanut	1,525	1,597	1,604	1,515
Meal, Rapeseed	3,100	3,650	4,375	4,900
Meal ,Soybean	5,780	5,850	6,273	6,580
Meal, Sunflowerseed	398	166	240	265
Other	618	682	504	577
Total	15,944	16,529	17,377	18,047
SME				
Meal, Cottonseed	3,665	3,714	3,550	3,411
Meal, Peanut	1,708	1,789	1,797	1,697
Meal, Rapeseed	2,206	2,597	3,113	3,486
Meal, Soybean	5,500	5,500	5,873	6,155
Meal, Sunflowerseed	265	111	160	177
Other	265	291	220	251
Total	13,610	14,003	14,713	15,178
Food Use Dom. Cons.				
Oil, Cottonseed	1,350	1,360	1,305	1,240
Oil, Palm	8,050	8,839	7,800	8,650
Oil, Peanut	1,150	1,160	1,185	1,110
Oil, Rapeseed	2,690	2,680	3,590	3,900
Oil, Soybean	5,125	4,950	5,825	4,940
Oil, Sunflowerseed	2,560	2,300	1,850	2,050
Other	380	400	375	444
Total	21,305	21,689	21,930	22,334
Domestic Consumption				
Oil, Cottonseed	1,395	1,408	1,350	1,286
Oil, Palm	8,459	9,214	8,146	9,050
Oil, Peanut	1,160	1,170	1,195	1,120
Oil, Rapeseed	2,770	2,750	3,660	3,970
Oil Soybean	5,125	4,950	5,825	4,940
Oil, Sunflowerseed	2,560	2,300	1,850	2,050
Other	704	747	674	763
Total	22,173	22,539	22,700	23,179
Imports				
Oil, Cottonseed	3	8	4	1
Oil, Palm	7,398	8,411	8,004	9,450
Oil, Peanut	0	0	0	0
Oil, Rapeseed	78	25	34	25
Oil, Soybean	3,626	3,251	4,231	3,150
Oil, Sunflowerseed	2,514	1,958	1,956	2,300
Other	113	157	80	131
Total	13,732	13,810	14,309	15,057

SME - 44 Percent Protein Soybean Meal Equivalent

Table 09: Oilseed Prices
U.S. Dollars per Metric Ton

Year Beg Oct 1	Soybean U.S. 1/	Soybean U.S. 2/	Soybean Brz 3/	Soybean Arg 4/	Soybean Rott 5/	Peanut U.S. 6/	Peanut Rott 7/	Sunseed U.S. 8/	Sunseed Rott 9/	Rapeseed Hamb 10/	Copra Rott 11/
Oct - Sep Average											
1/12-20/21	398	405	441	436	462	491	1482	466	481	483	785
2011/12	488	505	549	533	562	502	2,480	562	593	616	829
2012/13	530	537	538	543	592	653	1,391	557	580	579	570
2013/14	482	487	514	517	542	531	1,300	484	466	505	854
2014/15	362	356	388	401	407	484	1,294	496	432	417	749
2015/16	339	346	382	375	396	421	1,260	446	440	409	907
2016/17	347	351	385	376	404	430	1,554	387	408	432	1076
2017/18	343	337	396	386	403	509	1,317	383	403	425	784
2018/19	309	307	360	347	370	467	1,302	385	380	420	483
2019/20	316	325	367	354	380	447	1,444	450	420	433	602
2020/21	461	495	531	525	563	463	1,473	513	685	594	993
2021/22											
Oct	437	452	520	541	549	529	1,560	672	748	782	1,269
Nov	448	455	506	543	553	560	1,560	666	741	793	1,281
Dec	459	473	516	560	565	529	1,548	699	716	822	1,188
Jan	474	515	546	602	608	575	1,525	683	721	852	1,319
Feb	544	576	633	649	669	540	1,500	708	757	803	1,423
Mar	566	607	677	688	720	551	1,500	747	970	1019	1,496
Apr	581	615	667	652	723	545	1,450	818	895	1101	1,353
May	592	616	665	649	720	558	1,450	886	878	996	1,168
Jun	603	628	661	648	675	556	1,460	886	769	785	1,122
Jul	570	565	604	591	618	558	1,500	798	654	678	998
Aug	562	570	620	607	633	551	1,550	833	686	644	923
Sep	518	535	608	582	643	567	1,550	725	616	590	829
Average	529	551	602	609	640	552	1,513	760	763	822	1,197
2022/23											
Oct	496	494	600	585	623	586	1,560	646	619	622	738
Nov	514	519	614	601	646	659	1,585	626	626	633	775
Dec	529	535	589	617	646	531	1,605	650	591	601	777
Jan	533	541	590	616	648	615	1,605	628	606	600	724
Feb	555	554	566	622	651	600	1,650	679	601	588	743
Mar	547	541	530	605	575	593	1,670	593	522	519	737
Apr	547	540	493	566	558	602	1,725	593	504	501	720
*May	N/A	507	475	527	518	N/A	1,800	N/A	508	452	693
Jun											
Jul											
Aug											
Sep											
Average	532	529	557	592	608	598	1,650	631	572	565	738

1/ U.S. Farm Price; USDA. 2/ U.S. NO.1 Yellow Cash Central Illinois; AMS.
3/ Brazil Paranagua, FOB; IGC 4/ Argentina Up River, FOB; IGC
5/ Rotterdam CIF; US origin; Oil World. 6/ US Farm Price, Inshell, USDA.
7/ US Runners 40/50%, Shelled Basis, Oilworld. 8/ US Farm Price; USDA
9/ Amsterdam CIF; EU; Oil World 10/Hamburg CIF; Europe “00”; Oil World.
11/ Phil/Indo CIF NW Europe; Oil World
* Preliminary

Table 10: Vegetable Oil Prices
U.S. Dollars per Metric Ton

Year Beg Oct 1	Soybean U.S. 1/	Soybean Brz 2/	Soybean Arg 3/	Soybean Rott 4/	Cottonseed U.S. 5/	Sunseed U.S. 6/	Sunseed Rott 7/	Peanut U.S. 8/	Peanut Rott 9/	Palm Malay 10/	Canola Rott 11/	Coconut Rott 12	Corn U.S. 13
Oct - Sep Average													
11/12-20/21	828	846	843	931	1,065	1,397	952	1,635	1,635	739	966	1,177	898
2011/12	1,144	1,162	1,164	1,241	1,173	1,834	1,254	2,247	2,455	1,032	1,258	1,244	1,236
2012/13	1,039	1,012	1,014	1,098	1,071	1,452	1,189	1,934	1,963	791	1,127	858	1,029
2013/14	843	871	870	950	1,337	1,304	929	1,430	1,355	803	954	1,278	869
2014/15	697	706	705	778	1,009	1,471	850	1,265	1,354	626	782	1,128	827
2015/16	658	704	698	774	1,011	1,275	849	1,294	1,443	628	798	1,362	865
2016/17	718	765	763	848	902	1,181	807	1,496	1,524	699	871	1,621	825
2017/18	662	722	722	822	703	1,203	776	1,470	1,326	626	844	1,175	669
2018/19	606	651	649	745	775	1,174	719	1,422	1,269	521	840	724	594
2019/20	654	705	698	785	886	1,434	795	1,532	1,571	645	879	899	870
2020/21	1,261	1,163	1,147	1,266	1,787	1,639	1,350	2,261	2,091	1,021	1,306	1,483	1,193
2021/22													
Oct	1,552	1,383	1,397	1,491	2,172	2,844	1,446	2,238	2,000	1,318	1,778	1,884	1,258
Nov	1,465	1,392	1,392	1,456	2,133	2756	1,441	2,205	1,975	1,338	1,800	1,905	1,277
Dec	1,404	1,351	1,351	1,457	2,057	2756	1,396	2,205	1,944	1,259	1,743	1,795	1,237
Jan	1,448	1,389	1,372	1,508	2,159	2714	1,413	2,274	1,925	1,358	1,814	2,016	1,192
Feb	1,563	1,533	1,532	1,622	2,235	2543	1,500	2,315	1,878	1,540	1,739	2,146	1,307
Mar	1,684	1,752	1,759	1,963	2,533	2844	2,570	2,370	2,200	1,778	2,128	2,271	1,481
Apr	1,848	1,826	1,835	1,969	2,647	2,654	2,126	2,535	2,200	1,702	2,223	2,054	1,577
May	1,927	1,803	1,810	1,961	2,636	2,502	2,055	2,563	2,050	1,703	2,204	1,752	1,715
Jun	1,770	1,621	1,596	1,772	2,552	2155	1,777	2,563	2,099	1,473	2,055	1,686	1,684
Jul	1,494	1,331	1,318	1,548	2,222	1724	1,557	2,275	2,000	1,017	1,713	1,497	1,372
Aug	1,595	1,361	1,370	1,657	2,508	2028	1,522	2,364	2,025	1,016	1,611	1,361	1,443
Sep	1,557	1,220	1,201	1,604	2,496	1949	1,306	2,460	2,021	901	1,377	1,228	1,461
Average	1,609	1,497	1,495	1,667	2,362	2,456	1,676	2,364	2,026	1,367	1,849	1,800	1,417
2022/23													
Oct	1,602	1,279	1,292	1,568	2,429	2,067	1,353	2,375	1,995	901	1,370	1,105	1,442
Nov	1,746	1,366	1,381	1,648	2,573	2,337	1,337	2,447	2,034	940	1,351	1,179	1,536
Dec	1,502	1,251	1,234	1,414	2,317	2,035	1,244	2,227	2,051	953	1,229	1,160	1,323
Jan	1,455	1,183	1,184	1,359	2,253	1,890	1,220	2,103	2,100	943	1,194	1,085	1,345
Feb	1,394	1,145	1,170	1,246	2,205	1,791	1,168	1,940	2,100	959	1,162	1,119	N/A
Mar	1,297	1,058	1,060	1,122	2,129	1,689	1,056	1,861	2,094	971	1,021	1,105	N/A
Apr	1,223	953	967	1,064	2,041	1,609	1,045	1,802	2,063	975	1,000	1,068	N/A
*May	1,157	913	920	964	2,023	1,513	930	1,885	2,023	877	906	1,036	1,146
Jun													
Jul													
Aug													
Sep													
Average	1,422	1,144	1,151	1,298	2,246	1,866	1,169	2,080	2,058	940	1,154	1,107	1,358

1/ Decatur; Average Wholesale Tank Crude; USDA. 2/ Brazil Paranagua, FOB Crude; IGC.
3/ Argentina Up River, FOB Crude; IGC 4/ Dutch FOB; Ex-Mill; Oil World. 5/ PBSY Greenwood MS; USDA.
6/ Minneapolis FOB; USDA. 7/ EU FOB NW Euro; Oil World. 8/ South East Mills FOB; Tank Cars Crude; USDA.
9/ Rotterdam CIF; Any Origin; Oil World. 10/ Malaysia FOB; RBD; Oil World. 11/ Dutch FOB EX-Mill, Oilworld
12/ Rotterdam CIF; Phil/Indo; Oil World. 13/ Chicago; Crude; AMS

Physico-Chemical Characterization of Moringa oleifera Oil

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ABSTRACT

Moringa oleifera is indigenous to India and plently available in Odisha. This study deals with physico-chemical characterization of oil of *Moringa oleifera* seed collected from different domains of India. The oil content of the seed was extracted by Soxhlet apparatus. Different physico-chemical properties like acid value, iodine value, saponification value, un-saponification value, peroxide value was estimated following standard procedure. Fatty acid composition of the oil was analyzed by GC. The fatty acid composition of oil of the seed collected from different domains of India was calculated and compared. The fatty acid composition study shows that the 75% oleic acid is present in *Moringa oleifera* oil. The *Moringa oleifera* oil used in different areas such as culinary, cosmetic & medicinal purpose. It is comparable with olive oil but it has high cost than all other oil.

KEYWORDS: *Soxhlet extraction, Moringa oleifera, Physic-chemical characterization, Fatty acid composition*

INTRODUCTION

Moringa oleifera is found in India, Pakistan, South Africa and it is mostly found in different areas of India, like Odisha, Andhra Pradesh, Kolkata, Tamil Nadu, Himachal Pradesh, Jammu & Kashmir, Bihar, Jharkhand, Delhi, Madhy Pradesh. Odisha is the native place of *Moringa oleifera* seeds[1]. The seed contains approximately 28-39% oil depending on their plant variety and area climate. The seed is white in color and oil is yellow in color.

It has been used for culinary, cosmetic and medicinal purpose. It is used for skin protectants like ,

- To soft dry skin & protect skin in moisture.
- It is good to dry & protect lips.
- It is beneficial to treatment dry skin, protect rough skin infection, outside virus, skin burns, insect bites, minor cuts. It has one of the antiseptic and anti-inflammatory properties.
- It is clear to dark spot in our skin and minimizes dark spot.
- It is used to make soaps and liquid body wash and make hair care products.
- It is used to make perfumes, deoderant and face creams etc.

The *Moringa* oleifera is of different varity types like **PKM-1, PKM-2, KM-1, JAFFNA, ODYSEE, ROHIT-1, KADIKAL, DHANRAJ etc.** The oil has high oleic acid content. It is extremely resembles to olive oil because due to its fatty acid composition. The vegetable oil normally contains less than 40% oleic acid while *Moringa* oil concentration range from 70% to 75%. The variation in oleic acid content depends upon area climate and genetic variation. The *Moringa* oil chemical properties depend on their oil extraction times, because the oil preparation is

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fresh (1, 2 weak) then the oxidation process is low otherwise the oil preparation date is more (1, 2 year) then the oxidation process is more. The *Moringa* seed is soft and silk in nature[2]. The seed is collected from SVM Exports, Indian herbal raw materials (No.2F/1049, P&T Colony, 6th Street West, Tuticorin-628008, Tamilnadu, India).

Extraction of oil is generally carried out by different processes like Soxhlet extraction, Supercritical fluid extraction and boiling process. The boiling process is not environmental friendly. Another process is supercritical fluid extraction this is a non-organic oil extraction process. The oil obtained by this process is more high quality than chemical process. This process uses CO_2 for extraction of oil, it is most popular, non toxic, readily available and chip. The boiling process is very simple and it is non organic. The oil is **excellent quality but it is more time taking process[3]**. The present study deals with extraction, physico-chemical characterization of moringa oil and fatty acid composition of the seed oil of *Moringa oleifera* collected from different domains of India.

2. METHODOLOGY

2.1 Materials

Moringa oleifera seed is of different types but in this study eight verities of seed like **PKM-1, PKM-2, KM-1, JAFFNA, ODYSEE, ROHIT-1, KADIKAL and DHANRAJ** was collected from different domains of India**.** The seed is yellow in color. Then it was decorticated to get the kernel which is white in color. The seeds were dried and stored properly.

2.2 Analysis of *Moringa* oleifera seed powder

The moisture content of the seed powder was determined by AOAC method. The total oil content was found out by soxhlet extraction in n-hexane for 6-8 hrs.

2.3 Extraction of *Moringa* oleifera seed

The oil content in the Moringa seed was determined by solvent extraction. For oil content determination[4] the powdered samples of whole seed were extracted separately in Soxhlet apparatus using hexane (60-80°C) as solvent. About 50g of the sample was packed in a thimble and that thimble was placed inside 500ml capacity soxhlet. The soxhlet was fitted to 500ml round bottomed flask (RB) and the RB was placed in the heating mantle adjusting the heating rate to give a condensation rate of 2-3 drops. Above the soxhlet cold water circulation was given through condenser. About 300ml of solvent was used for the extraction. The extraction was continued for 6-8hrs. After eight hours the material in the RB was cooled and filtered. The extract was concentrated in Rotary evaporator (Laborata 4000-Efficient, Heidolph Instruments, Germany). Then the oil was treated with few amount of sodium sulphite (Na_2SO_3) to remove moisture and the residual oil was separated and weighed.

Chemical properties of Extracted oil

The Physico-chemical properties such as acid value, iodine value, saponification value, un-saponification value, peroxide value, fatty acid composition were determined by AOAC method[5].

2.4 Acid value

The acid value was determined by directly titrating the oil in an alcoholic medium with aqueous potassium hydroxide solution. The oil was melted, cooled and then weighed in a conical flask. The weight of the oil taken for the test and the strength of the alkali prepared was such that the volume of alkali required for the titration did not exceed 20 - 25 ml. 50 -100 ml of freshly prepared neutralized hot ethyl alcohol and 1 ml of phenolphthalein was added in the oil. The mixture was boiled for five minutes and titration was carried out as hot as possible until permanent faint pink color appears[6]**.**

TABLE 1 Physico-chemical Properties of Moringa oil

Properties	PKM-1	PKM-2	KM-1	ROHIT-1	DHANRAJ	JAFFNA	KODIKAL	ODYSEE
Oil Yield (%)	34.63	34.01	36.15	28.25	34.89	37.78	33.22	38.43
ACID VALUES	0.617	0.615	0.618	6.788	5.553	1.234	2.468	0.617
IODINE VALUES(g of I/100g of oil)	62.606	67.823	64.345	62.604	62.606	60.867	60.867	69.562
SAPONIFIABLE VALUES (mg of KOH/gm of oil)	170.63	108.40	156.58	122.46	114.43	176.66	126.47	124.47
UNSAPONIFIABLE VALUES (%)	0.56	0.58	0.84	0.87	0.57	0.56	0.59	0.84
PEROXIDE VALUES	0.86	0.84	0.84	0.84	0.84	0.84	0.84	0.84

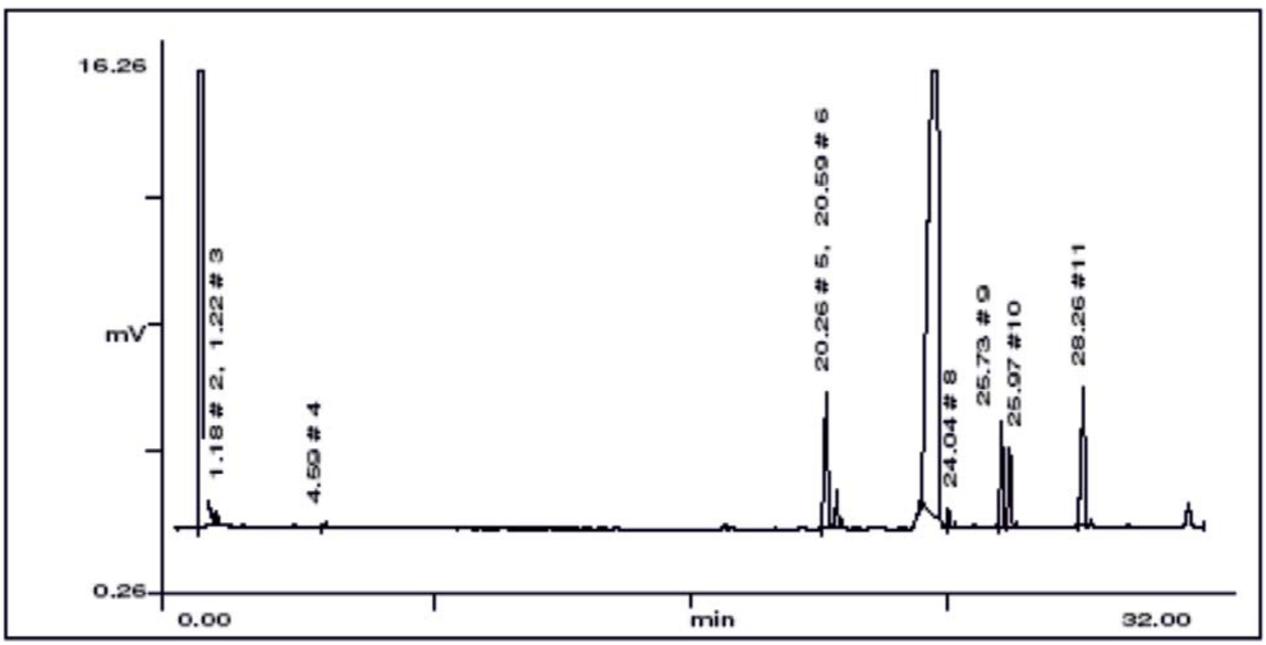

Fig.1 Gas Chromatograph of *M. Oleferia* oil

2.5 Iodine value composition

Iodine value was measured by AOAC method. About 5g of oil was taken into 250ml Erlenmeyer flask. 2ml of Wijs solution was added and then stored in the dark for 30 min at 20 æ%C to 30 æ%C. About 20ml of KI solution was added then 100ml of recently boiled water was added and cooled. The solution is titrated with 0.1N thiosulphate solution with constant stirring. The titration is continued until the yellow color has almost disappeared. 1-2ml starch indicator solution is then added and the titration continued until the blue color has just disappeared[7]. (AOAC , 1993,1996). The iodine values is defined as the grams of iodine absorbed by 100 g sample, it defines the degree of unsaturation which implies the number of C-C double bonds in fats & oils[8].

2.6 Determination of Saponification value

The oil was saponified by refluxing with a known excess of alcoholic potassium hydroxide solution[9]. The alkali consumed for saponification was determined by titrating the excess alkali with standard hydrochloric acid. About 1.5 – 2 g of oil was weighed and taken in a conical flask. 25 ml of alcoholic potassium hydroxide solution was added into it and was refluxed for one hour. It was boiled gently until the sample was completely saponified. The flask and condenser was cooled and then washed with about 10 ml of hot neutral ethyl alcohol. Hereafter, 1 ml of phenolphthalein was added and titrated with standard HCl solution.

2.7 Determination of Un-Saponification value

About 5 g of oil was weighed in the 250ml Erlenmeyer flask. Then 50 ml of alcoholic Potassium hydroxide solution was added in the flask. It was boiled gently under reflux condenser for one hour or until the saponification was complete. The condenser was washed with 10 ml of ethyl alcohol. The mixture was cooled and transferred to a separating funnel. The transfer was completed by washing the flask first with ethyl ether and then with cold water. Altogether 50 ml of water was added. This was followed by an addition of 50 ml of petroleum ether. It was shaken vigorously for two minutes and then allowed to settle. The lower layer containing the soap solution was transferred to another separating funnel and the ether extraction was repeated for five more times.

All the ether extract was collected in a separating funnel. This was washed three times with 25 ml portions of alcohol shaking it vigorously and drawing off alcohol water layer after each washing. It was then washed with 20 ml portions of water until the wash-water no longer turns pink on addition of few drops of phenolphthalein indicator solution. The ether layer was evaporated to dryness. It was cooled and weighed.

After weighing residue was taken in 50 ml of warm neutral ethyl alcohol containing few drops of phenolphthalein indicator solution and titrated with standard sodium hydroxide solution and unsaponifiable matter was determined as per standard method[10].

2.8 Peroxide value composition

Peroxide value was measured by AOAC method[11]. About 0.1g of oil was taken into 250ml Erlenmeyer flask. KI solution was added then mixture of CH_3COOH and $CHCl_3$ was added. About 2-3 drop starch indicator was added and titration was carried out using 0.1M $Na_2S_2O_3$ solution.

2.9 Fatty acid composition

About 0.5g of oil was taken into 250ml round bottom flask. 25ml of petroleum ether & 5ml of methanol was added in the flask. About 2ml of sodium methoxide was added. The flask was fitted with air condenser & boiled until fat is saponified in 30min. The alcoholic soap solution was transferred into 250ml separating funnel. 2-3ml of methanol was added and washed with water (4-8) time. Shake vigorously till the layers separate and clear. The lower water layer was drained and upper petroleum ether layer was collected. The upper layer was transferred to test tube and sodium sulphate was added to remove moisture. Then it was dissolved in 0.3 ml of petroleum ether and injected into gas chromatograph using split injection at 250 æ%C and flame ionization detector at 250 æ%C. The separation was performed using capillary column (DB-Wax, 30m × 0.32mm × 0.25 µm) at column oven isothermal at 210 æ%C. The standard fatty acid methyl esters, purchased from Sigma-Aldrich (USA) were injected to gas chromatograph and identification of individual fatty acids were done by comparing the retention times of fatty acid methyl ester of the samples with that of reference methyl esters. The percentage fatty acid compositions were calculated from their peak areas.

3. RESULT & DISCUSSION

The oil content of different varieties of seed collected different locations was given in Table-1. The oil content of the seed varied as these are of different geographical locations. It is observed that the oil content of the seed varies from 28.25-38.43%. The oil content of the moringa seed in present analysis exceeds the oil content of two conventional oilseed crops: cotton (15.0–24.0%) and soybean (17.0–21.0%) [12]. It is found that Odysee variety seed contains higher percentage oil (38.43%) in comparison to other varities of seed. The oil yield is varied may be due to differences in variety of plant, cultivation climate and ripening stage.

Acid value of oil extracted from different varieties of seed was determined by same procedure for all varieties of seed and given in Table-1. Acid value tells about the amount of free fatty acid present in the oil. The seed oil of PKM-1, PKM-2, KM-1 and Odysee variety seed has nearly comparable low acid value but ROHIT-1 and DHANARAJ seed has high acid value. The low acidity of the oil is comparable to those of *M. oleferia* oil reported from Malawi[13] and Kenya[14]. The iodine value is defined as the grams of iodine absorbed by 100 g sample. The iodine value of different varieties of seed oil was given in Table-1. It gives information about degree of unsaturation[8]. The iodine values of the oil varies from 60.867- 69.562. It is found that more unsaturation is present in Odysee variety seed oil followed by PKM-1. The iodine values of the oil obtained from different varieties of seed is in close agreement with other researchers[5]. The Saponification is the process of breaking down or degrading a neutral fat into glycerol & fatty acid by treating the fat with alkali. Saponification value is mgs of KOH required to saponify 1g of fat[8]. Saponification value of oil is a measure of triglyceride content of the oil. Jaffna variety seed oil has high saponification value followed by PKM-1 and KM-1 varieties. The unsaponifiable matter content of the oil is within the range of Ground nut oil, Soyabean oil and Palm oil[15]. The high unsaponifiable matter of the oil suggests that the oil has tocopherol, stigmasterol, camphesterol, stigmastanol, camphestanol, sitosterol and other different components which are responsible for the medicinal properties of the oil. The peroxide values of the oil of different varieties of seed are close to each other. Peroxide value measures the content of hydroperoxides in the oil. Low peroxide value indicates that the oil has high resistance to oxidation. The peroxide value of oil is in agreement with the result obtained by other researchers[13, 16, 17].

Fatty acid composition was given in Table.2. The *Maringa olefera seed* oil contains different type of fatty acids such as palmitic acid, palmitoleic acid , heptadecanoic acid, heptadecanoic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid and behenic acid[18]. Oleic acid is the predominant fatty acid present in all varieties of seed oil followed by palmitic acid, behenic acid, steric acid and linolenic acid. The oil has high nutritional value and superior stability due to high oleic acid content. The oil has high ratio of monounsaturated to saturated fatty acid. The fatty acid content of oil of different varieties seed is comparable with the data obtained by other researchers [13, 17].

4. CONCLUSION

Maringa oleifera seed oil is good for health and compared with mustard oil, sunflower oil, sesamne, flax, cotton etc. The oil yield is more in Soxhlet extraction process. The oil is yellow in color. The

Maringa oleifera seed contains 28%-39% of oil. It is a medicinal oil and it is beneficial for treatment of dry skin, protect rough skin infection, outside virus, skin burns, insect bites, minor cuts. It has antiseptic & anti-inflammatory properties. The fatty acid present in different type of acid is palmitic Acid, palmitoleic acid, heptadecanoic acid, heptadecenoic acid , stearic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid, behenic acid. Oleic acid is the predominant fatty acid followed by other acids. The percentage of unsaturated fatty acid is more than the percentage of saturated fatty acid. The physico-chemical properties study reveals that it is good quality oil and can be stored for long time without being rancid. The oil can be used for fuel.

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ROLE OF SATURATED FATS IN HUMAN DIET

According to the World Health Organization (WHO), "existing evidence suggests that the intake of fatty acids is a major determinant of the serum lipid and lipoprotein profile." When measured through blood tests their values can determine a person's risk for cardiovascular disease (CVD). Numerous epidemiological studies associate high amounts of total cholesterol and triglycerides with the disease. There are aspects if saturated fats really contribute to chronic disease. When researchers dig into the data to determine the effect of individual SFA on serum profiles they find that there are differences. Cholesterol and triglyceride levels can go up or down for fatty acids like, Lauric (C12:0), Myristic (C14:0) or Palmitic acid (16:0) while studies show Stearic acid (18:0) has no effect. This SFA specific variation of serum lipid profiles.

Further analyses of research findings has also confirmed the health benefits of unsaturated fatty acids. The fate of saturated fats, however, still awaits consensus. When there is increased PUFA and MUFA in a diet that still contained SFA instead of replacing it with a mixture of carbohydrates. It is specified that partially replacing SFA with PUFA had a greater effect on lowering LDL cholesterol and triglycerides. When SFA intake remained below 10% of a subject's total energy intake, the individual maintained a desirable serum profile.

Courtesy:- AOCS-APRIL-2022

ON THE CUTTING EDGE OF PLANT PROTEIN INNOVATION - VARIOUS KINDS OF MUSHROOMS

KANSAS CITY – Legumes like soybeans and peas have stood out in advancing plant protein product development in recent years. Other protein sources and new technologies are starting to make inroads as well. For example, fermentation plays a role in producing upcycled ingredients. Another instance involves growing seaweed in the desert.

The innovations come as plant protein product sales remain on an upward trajectory. US retail sales of plant-based food grew 6.2% in 2021 to reach $7.4 billion, according to data released in March by the Plant Based Foods Association, The Good Food Institute and SPINS.

Myco Technology, Inc., Aurora, Colo., and the Oman Investment Authority (OIA) have partnered on developing upcycled ingredients. Myco Technology uses a fermentation platform to harness mushroom mycelia to create ingredients, including plant protein. The OIA grows about 400,000 tonnes of dates per year, but more than half goes to waste or animal feed.

The two companies have formed a joint venture that will upcycle the excess dates by using the sugar in the fruit as a source of carbon to fuel the production of mushroom-based protein. Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment, according to the Upcycled Food Association.

Construction of a production facility in Oman will begin in 2023 on a 10-hectare (25-acre) site. Commercial production should begin by the second quarter of 2025, according to the OIA. A total of 16,000 tonnes of dates are expected to be processed each year.

Seaweed in the desert

IFF, New York, is expanding in the plant protein category through seaweed, sourcing both at sea and on land.

The company partnered with Israeli startup SimpliiGood by Algaecore Technologies Ltd. to develop a smoked salmon analog made from spirulina. Spirulina is a type of seaweed, but this spirulina is grown in the desert under controlled conditions. SimpliiGood produces 50 tons of spirulina per year with a harvest every 24 hours.

"The spirulina SimpliiGood cultivates is one of the most efficient converters of sun energy into protein," said Lior Shalev, chief executive officer and founder of Algaecore. "Spirulina requires salt, minerals, heat, CO2 and water to thrive. The process of growing spirulina actually captures carbon and uses it to grow."

To advance the initiative, an agreement for strategic development was signed by the Israeli Innovation Authority, SimpliiGood and FoodNxt (an innovation lab established by IFF). SimpliiGood provides the raw material and texture and color qualities while IFF contributes the flavor and aroma attributes. The salmon alternative is expected to enter the market by the end of 2023.

IFF in May launched Seaflour, a hydrocolloid sourced from red seaweed, in the United States, calling it ideal for plant-based beverage applications like nut-based and soy-based milk alternatives. The ingredient contains protein, fiber and minerals. It offers benefits in stability, high-suspension ability and mouthfeel.

"Seaflour has a unique synergy with plant proteins, keeping plant-based beverages stable and appealing, and providing smooth, creamy texture and mouthfeel throughout their shelf lives," said Michael Cammarata, senior beverage technologist, IFF, Nourish division. "This eliminates the need for additional stabilizers. With this single ingredient, manufacturers have the potential to reduce fat and sugar levels in their products without compromising texture or mouthfeel."

Microalgae is part of ADM's protein mapping as the company seeks to understand not only new protein technologies but also consumer perceptions and demands, said Wendy van Buren, ADM's global commercial growth leader, alternative proteins. ADM's Outside Voice research showed 30% of global plant consumers, which are defined as flexitarians, vegetarians or vegans, are aware algae is a protein source.

"However, awareness of this emerging protein source does not necessarily translate to consumption," she said. "In fact, only 7% of global plant consumers state they consume algae. This presents a fantastic opportunity for brands to bridge this gap with innovative alternative meat, dairy and more offerings with algae and microalgae.

"Algae, including microalgae, also hold an interesting consumer associated nutrition and sustainability story, with 21% and 18% of global plant consumers perceiving algae as nutritious and eco-friendly, respectively. However, from a sensory and functionality, and even a nutritional quality perspective, algae and microalgae still have a way to go until they reach similar characteristics to other alternative and plant proteins."

Legumes' many attributes

Legumes, including soybeans, black beans, peas and chickpeas, have unique attributes, said Dina Fernandez, global director, protein nutrition solutions for Chicago-based ADM.

"For instance, legumes tend to have a higher nutritional quality than other cereal-based proteins, including corn, wheat and rice," she said. "This is critical to the plant-based space, as many consumers dabbling in the flexitarian diet are motivated by nutritional goals when considering purchasing plant-based alternatives. This characteristic is particularly important to consumers seeking products like protein shakes and dairy beverages since they tend to be more focused on nutritional attributes."

She added legumes provide emulsification and gelling properties that are essential for meat and dairy alternatives.

Ingredion, Inc., Westchester, Ill., remains invested in legume-based ingredients. The company at the Institute of Food Technologists annual meeting and food expo July 11-13 in Chicago will feature its Vitessence TEX Crumbles textured protein and Vitessence Pulse pea proteins in such plant-based meat alternatives as Italian sausage crumbles, burgers, seafood patties, shredded chick 'n and vegetarian frankfurters.

Courtesy: Food Business News

FORGET OLIVE OIL. THIS NEW COOKING OIL IS MADE USING FERMENTATION AND REQUIRES 99% LESS WATER TO PRODUCE

Conventional vegetable oils lead to devastating deforestation. Zero Acre's first cooking oil is made by fermentation instead. Forget olive oil. This new cooking oil is made using fermentation and requires 99% less water to produce.

The world runs on vegetable oil. It's the third-most-consumed food globally after rice and wheat. It's in your morning croissant and your oat milk, your salad dressing, your afternoon snack bar, and your midnight cookie.

Our obsession with vegetable oil is so big that we use more land—around 20% to 30% of all the world's agricultural space—for vegetable oil crops than for fruits, vegetables, legumes, and nuts combined. All of this leads to devastating deforestation, biodiversity loss, and climate change. But what if we could grow cooking oil in a lab?

Launching today, Zero Acre's first product is a cooking oil made by fermentation: High in healthy fats and low in bad fats, its Cultured Oil is produced using 85% less land than canola oil, emits 86% less CO2 than soybean oil, and requires 99% less water than olive oil. At $29.99, it's significantly more expensive than its vegetable counterpart, but replacing just 5% of vegetable oils used in the U.S. with so-called cultured oil, the company claims, would free up 3.1 million acres of land every year.

Vegetable oils are bad for the environment, but they've also been linked with obesity, heart disease, cancer, and other diseases. That's why Jeff Nobbs, cofounder and CEO of Zero Acre, has been trying to take them out of the food system for years—first with a keto-friendly restaurant called Kitava in San Francisco, then with nutrition-tracking software. Now his company is looking to make cooking oil by fermenting microbes rather than harvesting crops.

Conventionally, vegetable oil is made by crushing parts of a vegetable or seed (like sunflower seeds or olives) and extracting the oil. "Cultured oil," on the other hand, is made by fermentation.

So, let's back up a little. Fermentation involves a naturally occurring chemical reaction between two main groups of ingredients: microorganisms and natural sugars. Microorganisms include bacteria, microalgae, yeast, and other fungi; natural sugars can be found in a variety of products, from wheat to milk to grapes.

To make wine, for example, winemakers add yeast to grape juice. The yeast then converts, or ferments, the natural sugars of the grapes into ethanol, and you have yourself a crisp glass of chardonnay. But you can thank fermentation for an abundance of other foods like bread, cheese, yogurt, pickles, and even chocolate.

When it comes to cooking oil, the process is similar. Nobbs won't disclose the exact kind of microorganism being used to produce Zero Acre's Cultured Oil, but he says the company works with both non-GMO yeast and microalgae. "We focus on cultures that naturally produce healthy fats, and yeast and microalgae do that efficiently," he says.

The process starts with a proprietary culture made up of food-producing microorganisms (yeast or microalgae) that is fed natural plants like sugar beet and sugarcane. (The company doesn't grow these directly, but both are part of its supply chain.)

Over the course of a few days, the microorganisms convert, or ferment, the natural plant sugars into oils or fats. The resulting mixture is then pressed and the oil is released, separated, filtered, and cultured oil is born. (Nobbs describes the taste as "lightly buttery," though you can taste it only if you have it straight up with a spoon.)

Nobbs says the entire process takes less than a week, compared to soybean oil (the most widely consumed oil in the U.S.), which requires a six-month period just for the seeds to mature. His company's Cultured Oil also requires 90% less land to produce than soybean oil. (The only reason the company needs land is to grow sugarcane, though Nobbs aspires to eventually use sugars in existing food waste like corncobs and orange peels, bringing the amount of land needed closer to zero, hence "Zero Acre.")

That's if the company manages to scale up. According to Kyria Boundy-Mills, a microbiologist at the University of California, Davis, who has studied yeast oils for the past 10 years, "microbial oils" like the one Zero Acre is producing have been studied for at least 80 years, "mostly for fuel," she says via email.

Boundy-Mills recalls a biotechnology company called TerraVia (formerly Solazyme), which developed a technology to make biodiesel from microalgae. TerraVia then switched gears and used it to make the first culinary algae oil on the market, which made it to Walmart but was discontinued a few years later.

It's a cautionary tale for Zero Acre, but "fermentation is a mature technology," Boundy-Mills says, noting that yeasts and microalgae have been grown in large-scale commercial fermentations for decades. The challenge remains the price.

"Fermentation is faster than growing crops, but the capital and operating costs of fermentation facilities is much, much more per acre than farmland," she says. (Zero Acre runs a research facility in San Mateo and has raised $37 million to date.)

A bottle of Zero Acre's Cultured Oil isn't cheap, but as demand grows, Nobbs hopes that economies of scale will help the company lower the cost. "We want to kick off the flywheel, but it's going to take a while to replace 200 million metric tons [of vegetable oil]," he says.

Nobbs is also eyeing solid fats that could replace palm shortening, and foods that come with cultured oil as an ingredient, noting, "We want an ecosystem to develop around cultured oil the same way it has developed around olive oil."

Courtesy: Fast Company

SPERM QUALITY AND DIETARY FAT

The type and amount of fat men eat may affect their semen quality, according to researcher. A study found an association between a high total fat intake and lower total sperm count and concentration. It also found that men who ate more omega-3 polyunsaturated fats had better-formed sperm than men who ate less.

The study found that the relationship between dietary fats and semen quality was largely driven by the consumption of saturated fats. Men consuming the most saturated fats had a 35% lower total sperm count than men eating the least, and a 38% lower sperm concentration. “The magnitude of the association is quite dramatic and provides further support for the health efforts to limit consumption of saturated fat given their relation with other health outcomes such as cardiovascular disease etc. All the men in the study were overweight or obese, and the health effects of this could also affect semen quality.

Source: Health and Nutrition News, AOCS

OMEGA-3 FATTY ACID SUPPLEMENTATION HELP YOU BUILD MUSCLE

Omega-3 fatty acids are polyunsaturated fats that perform key functions in the body, including supporting cardiovascular, immune, brain, and neuromuscular function. We humans aren't able to produce the amount of omega-3 fatty acids our bodies need. Omega-3 fatty acids therefore are considered essential nutrients, meaning we need to get them from the foods we eat. In some cases, healthcare providers may recommend omega-3 fatty acid supplementation. Studies have investigated the effect of omega-3 fatty acid supplementation on muscle mass, strength, and function; however, the results have been inconclusive. Some studies found omega-3 fatty acid supplementation enhanced muscle mass, strength and function, while others found no effect.

A previous review that found a stronger relationship between omega-3 fatty acid supplementation and increased muscle mass and function among the elderly may have a more pronounced effect on older adults with chronic illness: "previous literature suggests that omega-3 fatty acid supplementation may be more likely to provide an anabolic stimulus in situations whereby muscle protein synthesis is compromised within older adults who have higher degrees of anabolic resistance and in conditions of increased systemic inflammation, such as chronic diseases."

LEMONGRASS ESSENTIAL OIL

ABOUT

Lemongrass essential oil comes from the lemongrass plant (*Cymbopogon citratus*), which grows mainly in tropical and subtropical parts of the world. The prefix 'lemon' indicates its typical lemon-like odor, which is caused mainly by the presence of citral. Citral is a combination of two stereo isomeric monoterpene aldehydes; the trans isomer geranial is in predominance to the cis isomer neral. Lemongrass essential oil has been used since ancient times in folk medicine as a remedy to improve circulation, stabilise menstrual cycles, promote digestion or increase immunity. It is also used to produce perfumes, flavors, detergents, and pharmaceuticals. The method found to be the most suitable for the extraction of lemongrass essential oil is steam distillation, since it allows obtaining the oil without altering product quality. The chemical composition of the essential oil of C. citratus varies according to the geographical origin, farming practices, plant age, photoperiod, harvest period, genetic differences, and extraction methods. The chemical constituents of the essential oil which have constantly been detected and determine its biological activity are aldehydes, hydrocarbon terpenes, alcohols, ketones, and esters. The lemongrass essential oil shows a wide spectrum of biological activities. High antibacterial and remarkable antifungal activities make the longrass oil a potential food preservative.

Lemongrass is native aromatic tall sedge which grows in many parts of tropical and sub-tropical South East Asia and Africa. In India, it is cultivated along Maharashtra, Kerala, Karnataka and Tamil Nadu states besides foothills of Arunachal Pradesh and Sikkim. It was introduced in India about a century back and is now commercially cultivated in these mentioned states.

HARVESTING

Lemongrass can be harvested 6-9 months after the slips are planted and can be harvested as frequently as once every month through the growing season. Cutting stimulates growth and allowing the plant to develop to large will lead to a reduced oil yield. The lemon grass is harvested in the morning on a dry day to allow the evaporation of dew and to avoid loss of the plant's color due to heat. When harvested mechanically, sharp tools and machinery are used in order to make sure a clean cut and to avoid splitting the edges of the leaves. If the plant is cut too low, the lemongrass leaves will retain less oil, thus the optimal oil quality is in the higher parts of the leaves.

Post –Harvesting Management

Drying: The lemongrass has been allowed to wilt for 24 hours before the distillation as it reduces the moisture content by 30% and improves oil yield. The lemon crop is chopped into small pieces before lling in the stills. It can be distilled in similar distilleries as used for Japanese mint in India.

Distillation : Lemongrass oil is obtained through steam Distillation. Lemongrass oil has a strong lemon-like odor. The oil is yellowish in color having 75 to 85% citral and a small amount of other minor aroma compounds. The recovery of oil from the grass ranges from 0.5 to 0.8 percent. It takes about four hours for the complete recovery of the oil.

There are two types of distillation:-

Hydro-distillation: In this process, the herb is packed in a vessel and partly filled with water. The unit vessel is heated by direct fire without an external boiler. This method of distillation is less efficient, but the unit is simple and cheaper.

Steam Distillation : Fresh lemongrass small pieces was placed into one suitable container containing distilled water. The container was fitted with a condenser and heated. Water at 0°C flowed counter-currently during the condenser to condense the ensuring steam. When the water level reached 100°C, it started boiling ripping off the essential oil from the lemongrass. When the lemongrass got heated up, the lemongrass essential oil that was extracted from the leaf mixed with the water vapor.

Both passed during the condenser and the vapor was condensed into a liquid. With the use of cold water, cooling was prepared possible and volatilization of the essential oil was avoided. The condensate was openly collected in a suitable container for separation. This produced two layers of oil and water. The tap of the separating vessel was opened to let out the water. The oil was immediately collected into a suitable container and was closed strongly to prevent vaporization of the essential oil. The lemongrass oil was collected and the volume of oil obtained was weighed.

The Advantages of Steam Distillation method are as follows;

(a) The amount of steam & the quality of the steam can be controlled.

(b) Lower risk of thermal degradation as temperature normally not above 100°C.

(c) Most generally used process for the extraction of essential oils on a large scale.

SOLVENT EXTRACTION METOD:

Dry sample of lemongrass pieces were placed in a suitable containerone. After that, N-hexane solvent was poured into the container. The content was allowed to stand for 36 hrs; this was made to extract all the oil content in the lemongrass and for complete extraction. After which the extract was decanted into another container. Ethanol was added to extract the essential oil since lemongrass essential oil is soluble in Ethanol. The mixture was then transferred to a separating vessel and separated by a procedure called liquid separation process. The content of the separating vessel was allowed to approach to equilibrium, which separated into 2 layers (depending on their different density). The lower Ethanol extract and the upper Hexane layer were collected into 2 separate containers and were placed in a water bath at 78oC. This was done to remove the Ethanol leaving the natural essential oil.

List of machinery used in the extraction of lemongrass oil is;

1. Evaporator vessel (SS)
2. Condenser (SS)
3. Florentine flask (SS)
4. Steam boiler
5. Pump (condensate)
6. Pump (cooling water)
7. Cooling tower

Purification of Oil: The insoluble particles present in the lemongrass oil are removed by a simple filtration process after mixing it with anhydrous sodium sulfate and keeping it overnight or for 4 to 5 hours.

CHEMICAL COMPOS ITION:

The Major Components in most Lemongrass species include:-

Neral, Isoneral, Geranial, Iso Geranial, Geraniol, Geranyl acetate Citronellal, citronellol, Germacrene-D, and Elemol.

Storage and Packing of Oil: The lemongrass oil can be stored in containors made up of steel or Aluminium or galvanized iron, depending upon the quantity of oil to be stored. The oil must be filled upto the brim and the container should be kept away from direct heat and sunlight in cool or shaded places**.**

Lemon Grass Essential Oil Benefits: Some of the benefits of Lemongrass essential Oil are mentioned below:-

1. Aromatic Use: lemongrass oil used as part of your aromatherapy session, it will induce a feeling of positivity and motivation. However, you should know that you can use its scent to repel insects.

2. Topical Use: Dilute the lemongrass oil and rub it on your skin before you go outside this may protect you from free radicals. What is more, you can apply topically after a hard workout to muscle relaxation and quicker recovery.

3. Lemongrass or lemongrass oil is used as a natural remedy to heal wounds and help prevent infection.

4. Muscles and tendons that tighten up can be eased with lemongrass oil. The oil will help develop blood circulation and provide immediate pain relief by soothing muscle spasms. Backaches, muscle knots, pulled muscles, and sprains can be alleviated after rubbing the problem areas with diluted lemongrass oil because of the active anti-in ammatory agents it contains.

5. Lemongrass oil helps reduce pain in muscles and joints, pain resulting from viral infections, and soreness caused by exercise.

6. Lemongrass oil is a natural antiseptic and astringent. It acts as a skin tone and can help keep hair and nails healthy and glowing. For overall hair and skin care, add a few drops to shampoo and lotion. To relieve an itchy scalp and help decrease hair loss, massage a few diluted drops onto your scalp for a few minutes, leave it on for half an hour, and rinse off. It will leave hair looking shiny and smelling fresh.

Reference : Pol.J.Food Nutr. Sci. 2019, 69 (4) : 324- 341, and Internet Sources.

LAUGH AND LOUD

*A little girl to her mother, "Mommy, today in school I was punished for me for thing that I didn't do."

The mother said in anger, "But that's right! I'm going to have a talk with your teacher about this … by the way, what was it that you didn't do?"

The little girl replied, "My homework.

****

Q. Where did the Chemist have his Lunch ?

A. On a periodic Table

****

Q. Why did the Scientist take out his Door Bell?

A. He wants to win No-Bell Prize.

****

Q. How do you know that Saturn has been married multiple times ?

A. Because she has multiple Rings.

****

*After death, one scientist was sent to heaven. Hetried to call the Lab but it was "very costly". He saw one of his colleagues keep calling from the hell.

He inquired from the gate keeper…why it is so…Gate keeper replied "Hell to Lab calls are alwaysconsidered "local".

****

Q. Why it is so easy to stay awake until 6 am but so hard to wake up at 6am ?

A. Things in motion tend to stay in motion while things at rest need more Force

****

"2 GET and 2 GIVE" CREATS MANY PROBLEMS So just double it

"4 GET and 4 GIVE" SOLVES MANY PROBLEMS

****

"A teacher asked her students to use the word "beans" in a sentence.

"My father grows beans," said one girl.

"My mother cooks beans," said a boy.

A third student spoke up, "We are all human beans."

****

MEMBER PAGE

Fortification of Edible Oils

by R.C.ARORA

For the past few years Researchers have shown a wide spread shortage of Vitamin A & D deficiencies along with Iodine, Iron and Folic Acid in Indian population especially children in the age group of 1 to 5 years, leading to Night Blindness, Goitre, Anaemia and various birth defects. The required intake of vitamins from the regular diet is emerging as big health problem and as such it becomes imperative to enrich the diet with additional doses of vitamins and minerals in Food items including vegetable Oils. These vitamins and minerals are essential for the proper growth of physical fitness and working of the immune system. Micronutrients also help in formation of Hormones and Enzymes.

Dietary diversification, micronutrients supplementation and food fortification are three important strategies that can address these deficiencies or malnutrition.

Vegetable oils , besides wheat flour is a part of our food system which provide Nutritional benefits to all human beings. The average consumption of vegetable oils in India ranges from 8-10 kg per year per person and because of changing lifestyle, easily availability and affordability are the reasons for its growth in consumption.

The major veg. oils which are part of our regular diet are :-

Soyabean , Mustard, Palm, Sunflower, Ground Nut, Canola and Ricebran oil.

Oil fortification is one of the efficient and effective solutions, good cost effective and a globally accepted complementary strategy to comprehensively improve the nutrition and health of all human beings. In view of this, government has made it mandatory to add Vitamin A and D in all types of vegetable oils being produced for edible purposes.

There are Food Safety and Standards (Fortification of Foods) Regulations , which includes the standards for fortification of staple foods including edible oils ,which says ,if fortified shall be fortified with the following Micronutrients at the level given in the table below:-

S. No.	NUTRIENT	LEVAL OF NUTRIENT	SOURCE OF NUTRIET
1.	VITAMIN A	6ugRE- 9.9ugRE Per Gram of OIL	RETINYL ACCETATE RETINYL PALMITATE
2.	VITAMIN D	0.11ug – 0.16 ug Per Gm. Of OIL	CHOLECA-LCIFEROL OR EGROCAL-CIFEROL

(from Plant Source)

Similarly, Food Fortification is also important and addition of Nutrients at level higher than the found in original food is essential.

- Milk : When Fat is removed from Full-Fat Milk to produce Toned, Double Toned, it also leads to depletion of Fat Soluble vitamins, especially the vitamin A ^ D. Fortification thus helps to top up these lost vitamins.
- Level of Nutrients per liter of Toned/ Double Toned Milk /standardized milk are :-

- VITAMIN-A, 270 - 450 ug Retinyl Acetate OR Retinyl Palmitate
- VITAMIN-D, 5.0- 7,5 ug, cholecalciforal or Egrocalciferol
- **SALT**
- Salt is another important component of daily diet which is under mandatory fortification, by the addition of Iodine and is sold as IODISED SALT,
- The other fortified foods such as Biscuits, Wheat Flour, double fortified salt are also manufactured and marketed by Industry and the micronutrients normally added in foods are IRON, ZINC, IODINE CALCIUM, VITAMIN A, B group vitamins , vitamin C, D and E .

The most fortified foods and associated nutrients are:-

FOOD	NUTRIENT
- WHEAT & MAIZE FLOURS	IRON, FOLIC ACID, ZINC, VITAMIN A & B-VITAMIN
SUGAR	VITAMIN A & D, IRON
RICE	IRON, FOLIC ACID ZINC, VIT.-A, B GROUP(B-1, B-2, B-3 & B-6) -

FORTIFICATION has no effect on the shelf life of the product, however, while deciding on the appropriate quantity, only those vitamins and minerals are considered which will not change the Appearance, Taste, Texture and Flavor of the food. The concept is based on the fact that the consumer buying behavior should not be affected by the fortification process.

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