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Nutraceutical Profile Of Selected Oils, Distillates And Butters

RIPAL R. KHAMAR & Y. T. JASRAI
Department of Botany, University School of Sciences, Gujarat University,
Ahmedabad - 380009, Gujarat, India
E-mail: ripalkhamar@gmail.com

Abstract : The mixed tocopherol , phytosterol and sqalene were estimated in the oils and their deodorized distillate (remove of flavor) available in the India market and to know about the nutraceuticals value in respect with tocopherol (vitamin E), Phytosterol and squalene.The oils taken in the investigation were Amaranth oil, Avocado oil, Cashew nut shell oil, Castor oil, Coconut oil, Corn/Maize oil, Cottonseed oil, Cumin oil, Fish oil, Groundnut oil, Linseed oil, Mustard oil, Neem oil, Olive oil, Palm oil, Pomegranate seed oil, Psyllium seed oil, Rice bran oil, Safflower oil, Sesame oil, Soybean oil, Sunflower oil and Wheat germ oil. Avacado oil contains highest quantity of mixed tocopherol while the lowest % is found in coconut, cumin, flaxed seed , neem and pomegranate oils. Phytosterol was highest in Pumpkin seed oil and lowest in Sesame seed oil. Sqalene (precursor to cholesterol) was highest in Amaranth seed oil and Mango butter oils and lowest in Shea butter. In deodorised distillate, phytosterol was highest in Soya bean oil but lowest in Olive oil. However, Sqalene was highest in distillate of Olive oil and lowest in distillate of Groundnut oil.Punicic acid (polysaturated fatty acid) and sesamin (a lignin) were present in Palm oil, Pomegranate seed oil and Sesame oil raw and in distillates.

KEYWORDS: Edible oil, Distillate, Butter, Nutraceutical profile, Tocopherol, Vitamin E

INTRODUCTION: The present study has been undertaken to know the nutritional value of fatty acids in the oils used as food in 20 oils. The oils are Amaranth oil, Avocado oil, Cashew nut shell oil, Castor oil, Coconut oil, Corn/Maize oil, Cottonseed oil, Cumin oil, Fish oil, Groundnut oil, Linseed oil, Mustard oil, Neem oil, Olive oil, Palm oil, Pomegranate seed oil, Psyllium seed oil, Rice bran oil, Safflower oil, Sesame oil, Soybean oil, Sunflower oil, Wheat germ oil as well as distillate of Coconut oil, Cottonseed oil, Groundnut oil, Maize oil, Olive oil, Palm oil, Rice bran oil, Safflower oil, Soy oil, Sunflower oil, Garcinia butter/oil, Mango butter/oil, Peanut butter/oil, Shea butter/oil. The excessive use of consumption of fatty acids is harmful for patients suffering from cardiac diseases. Vitamin E is essential for the proper functioning of our cells; it also prevents the abdominal blood clot and helps in oxygenation in the body. Vitamin E helps to strengthens the nerves and muscles. It is also helps blood to flow freely.

It is suggesting that Punicic acid, a fatty acid from pomegranate seed oil, inhibits breast cancer cell proliferation. Since squalene which belongs to family of steroids is a precursor to cholesterol, and it is now accepted that statins cut off cholesterol synthesis prior to the formation of squalene.

Plant oils mainly includes edible refined oils along with other medicinal plant oils whereas, other part includes the distillates from the edible oils. The vegetable oil processing involves refining (to remove the free fatty acids), bleaching (to remove the colour bodies and deodorization (to remove off flavors), often abbreviated as RBD. During deodorization - the distilled fraction from the crude oil containing free fatty acids is taken out at 210-230^{0}C temperature as a part of refining activity of the oil. This process of distillation is essential for refining of edible oils as it removes the unwanted fatty acid and odour from the oil, as per the law of Food authorities - Indian government the edible grade oils should be having FFA (free fatty acid) content less than 0.5 %. By deodorization all the odours and unwanted flavor is removed by distillation during refining along with the other unsaponifiable materials. These fractions are part of refining process of oils, wherein various nutritional unsaponifiables are distilled along with fatty acid which includes nutritional compounds like tocopherol, phytosterol, squalene, sesamin, linoleic acid, alpha-lipoic acid etc. Similar type of work was carried by Berab *et al*., (2006). They have used Psyllium as a medicinal plant which has high nutritive values. The lipidic properties, higher content of essential fatty acids -linoleic acid and presence of considerable amount of tocopherol 2007 had suggested the medicinal properties of *Plantago* and role of it in the treatment of various heart diseases. Kwasi, 2002 and Matthäus, 2007 had worked on Palm oil and its constituents. They suggested that phytosterols makes Psyllium seed oil a potential product for food, dietary supplement for pharmaceutical industries. Blumenthal *et al*., (2000), Krauss *et al*., (2000) and Shrestha *et al*., (2007) studies various raw materials in oils and fixed oil. They were of the opinion that the lipid components are the nutritional compounds of tocopherols. Keeping in view the

aforesaid facts an extensive study was taken up with the objectives to analyze the nutritional profile of oils and distillate.

MATERIALS: The Study materials were divided in two category , as oils and deodorized distillate of the oils.

CATEGORY – 1: List of selected oils

Amaranth oil, Avocado oil, Coconut oil, Corn/Maize oil, Cottonseed oil, Cumin oil, Fish oil, Groundnut oil, Linseed oil, Mustard oil, Neem oil, Olive oil, Palm oil, Pomegranate seed oil, Psyllium seed oil, Rice bran oil, Safflower oil, Sesame oil, Soybean oil, Sunflower oil and Wheat germ oil

CATEGORY – 2: List of selected deodorized distillate (DOD) & fixed oils / butters

distillate of Coconut oil, distillate of Cottonseed oil, distillate of Groundnut oil, distillate of Maize oil, distillate of Mustard oil, distillate of Olive oil, distillate of Palm oil, distillate of Safflower oil, distillate of Soy oil, distillate of Sunflower oil, Garcinia butter, Mango butter, Peanut butter and Shea butter

METHODOLOGY: The following nutritional were analyzed using Gas Chromatography method (AOCS: Ce-7-87, 1997);

1. Tocopherol content
2. Phytosterols
3. Squalene
4. Other nutraceutical

Internal Standard Solution: Weigh accurately 750 mg Hexadecyl hexadecanoate in 250 ml volumetric flask, dissolve it in a mixture of 2 parts of pyridine and 1 part of propionic anhydride and make the volume up to the mark with the same, having concentration 3.0 mg/ml internal standard.

Standard Preparation: Weigh accurately 100-120 mg of mixed tocopherol standard in 100 ml Erlenmeyer flask having 19/38 standard ground glass neck. Pipette 15 ml internal standard solution and reflux it for 15 minutes under cooled water condenser.

Assay Preparation: Weigh accurately about 300-400 mg of test sample in 100 mL Erlenmeyer flask having 19/38 standard ground glass neck. Pipette 15 mL internal standard solution and reflux it for 15 minutes under cooled water condenser.

Chromatographic Conditions:

Column : CP Sil 5 CB make Varian, 30 m x 0.25 mm, 0.25µ
Column type : Capillary Column
Column flow Rate: 1.2 ml/min
Initial Column Temp : 285 °C
Hold time (1) : 35 minutes
Temperature Raise : 3.0 °C
Final column Temp. : 295 °C
Hold time (2) : 1 minute
Total Time : 39.33 min.
Detector : Flame Ionization detector
Detector Temperature : 300 °C
Injector Temperature : 290 °C
Split Ratio : 100

System Suitability: Inject blank and record the chromatogram, inject internal standard and record the retention time of internal standard, inject standard preparation and record the retention time of d-alpha tocopherol and internal standard. Disregard any peak obtained due to blank. The test is valid if and only if the resolution between internal standard and d-alpha-Tocopherol is more than 2.0.

Procedure: Inject standard preparation twice and record the chromatogram, inject sample preparation in duplicate and record the chromatogram. Calculate ratio of each alpha, beta plus gamma and delta tocopherol against internal standard in the same way calculate ratio of each individual sterol viz. campesterol, stigmasterol and sitosterol in both standard and sample preparation and calculate percentage of each tocopherol and sterol derivative using formula:

Calculation: $$\text{Assay} = \frac{Ws \times \text{Purity } Ps \times Ru}{Wu \times 100 \times Rs}$$

Where,

Ws = Weight of standard taken

Wu = Weight of sample taken

Ps = Purity of individual alpha, beta plus gamma and delta tocopherol, campesterol, stigmasterol and sitosterol

Ru = Ratio of the peak response of individual alpha, beta plus gamma and delta tocopherol and individual sterols to the peak response of IS in sample preparation

Rs = Ratio of the peak response of individual alpha, beta plus gamma and delta tocopherol and the individual sterols to the peak response of IS in standard preparation

RESULTS AND DISCUSSION:

Seed oil worked as one of the alternate source of natural vitamin 'E' - tocopherol along with its fatty acid evaluation. The deodorizer distillate of the oil has much quantity of tocopherol and sterol which can be suggested as the feed stock for the extraction of mixed tocopherols (natural vitamin E) on commercial basis. Results of oils showed that 0.3-0.4 % mixed tocopherols, 0.3-0.4 % phytosterols, 4-6 % squalene in Amaranth oil, 0.5-1.5 % mixed tocopherols, 0.2-0.5 % phytosterols, 0.5-1.5 % squalene in Avocado oil, 0 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Cashew nut shell oil, 0 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Castor seed oil, 0.1-0.2 % mixed tocopherols, 0 % phytosterols, 0.1-0.2 % squalene in Coconut oil, 0.2-0.4 % mixed tocopherols, 0.3-0.5 % phytosterols, 0.4-0.8 % squalene in Corn oil, 0.4-0.6 % mixed tocopherols, 0.3-0.5 % phytosterols, 0 % squalene

OBSERVATION :

The Nutraceutical profile and the percentage for mixed Tocopherols, Phyto sterols and Squalene present in the 21 oils present in the Indian market are as follows -

Table 1: Nutraceutical profile from selected oils

Sr. No.	Raw material	Mixed Tocopherols (%)	Phyto sterols (%)	Squalene (%)
1	Amaranth oil	0.3-0.4	0.3-0.4	4-6
2	Avacado oil	0.5-1.5	0.2-0.5	0.5-1.5
3	Coconut oil	0.1-0.2	-	0.1-0.2
4	Corn (Maize) oil	0.2-0.4	0.3-0.5	0.4-0.8
5	Cottonseed oil	0.4-0.6	0.3-0.5	-
6	Cumin oil	0.1-0.2	-	-
7	Fish oil	0.2-0.5	-	-
8	Flaxseed oil	0.1-0.2	0.3-0.6	0.5-0.7
9	Groundnut oil	0.2-0.45	0.3-0.6	-
10	Mustard oil	0.10.15	-	-
11	Neem oil	0.1-0.2	0.2-0.3	-
12	Olive oil (Raw)	0.2-0.3	0.3-0.6	0.5-1
13	Palm oil	0.1-0.2	0.2-0.5	0.2-0.5
14	Pomegranate seed oil	0.1-0.2	0.3-0.6	-
15	Psyllium oil	0.2-0.3	-	-
16	Rice bran oil	0.4-0.6	0.3-0.5	0.1-0.4
17	Safflower oil	0.2-0.4	0.3-0.5	0.2-0.4
18	Sesame oil (Raw)	0.1-0.3	0.1-0.4	-
19	Soybean oil	0.3-0.5	0.3-0.6	0.2-0.4
20	Sunflower oil	0.2-0.4	0.3-0.5	-
21	Wheat germ oil	0.3-0.6	0.2-0.4	0.1-0.4

Table 2: Nutraceutical profile from selected distillate of oils

Sr. No.	Raw material	Mixed Tocopherols (%)	Phyto sterols (%)	Squalene (%)
1	Distillate of Coconut oil	2-4	3-5	-
2	Distillate of Cotton seed oil	4-6	5-7	0.2-0.3
3	Distillate of Groundnut oil	3-6	4-7	0.1-0.3
4	Distillate of Maize oil	2-5	2-5	-
5	Distillate of Mustard oil	0.2-0.7	2-4	-
6	Distillate of Olive oil	0.5-2	0.5- 1.0	8-12
7	Distillate of Palm oil	0.5-1	1-2	-
8	Distillate of Safflower oil	2-5	3-6	1.2
9	Distillate of Soybean oil	5-8	5-9	1-2
10	Distillate of Sunflower oil	5-7	4-6	0.2-0.5
11	Garcinia butter	0.2-0.3	1-2	1-3
12	Mango oil/butter	0.1-0.2	1-3	2-4
13	Peanut butter	0.5-2	1-3	1-2
14	Shea butter	0.2-0.3	0.2-1	0.5-1

in Cotton seed oil, 0.1-0.2 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Cumin oil, 0.2-0.5 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Fish oil, 0.1-0.2 % mixed tocopherols, 0.3-0.6 % phytosterols, 0.5-0.7 % squalene, ALA>50 % in Flaxseed oil, 0.2-0.45 % mixed tocopherols, 0.3-0.6 % phytosterols, 0 % squalene in Groundnut oil, 0.1-0.15 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Mustard oil, 0.1-0.2 % mixed tocopherols, 0.2-0.3 % phytosterols, 0 % squalene in Neem oil, 0.2-0.3 % mixed tocopherols, 0.3-0.6 % phytosterols, 0.5-1 % squalene in Olive oil, 0.1-0.2 % mixed tocopherols, 0.2-0.5 % phytosterols, 0.5-0.5 % squalene in Palm oil, 0.1-0.2 % mixed tocopherols, 0.3-0.6 % phytosterols, 0 % squalene, punicic acid >75 % in Pomegranate seed oil, 0.2-0.3 % mixed tocopherols, 0 % phytosterols, 0 % squalene in Psyllium oil, 0.4-0.6 % mixed tocopherols, 0.3-0.5 % phytosterols, 0.1-0.4 % squalene in Rice bran oil, 0.2-0.4 % mixed tocopherols, 0.3-0.5 % phytosterols, 0.2-0.4 % squalene in Safflower oil, 0.1-0.3 % mixed tocopherols, 0.1-0.4 % phytosterols, 0 % squalene, 0.5-1 % sesamin in Sesame oil, 0.3-0.5 % mixed tocopherols, 0.3-0.6 % phytosterols, 0.2-0.4 % squalene in Soyabean oil, 0.2-0.4 % mixed tocopherols, 0.3-0.6 % phytosterols, 0 % squalene in Sunflower oil and 0.3-0.6 % mixed tocopherols, 0.2-0.4 % phytosterols, 0.1-0.4 % squalene in Wheat germ oil as nutraceuticals profile **(Table 1)**. Results of DOD and butters showed that 2-4 % mixed tocopherols, 3-5 % phytosterols, 0 % squalene in DOD of Coconut oil, 4-6 % mixed tocopherols, 5-7 % phytosterols, 0.2-0.3 % squalene in DOD of Cotton seed oil, 3-6 % mixed tocopherols, 4-7 % phytosterols, 0.1-0.3 % squalene in DOD of Groundnut oil, 2-5 % mixed tocopherols, 2-5 % phytosterols, 0 % squalene in DOD of Maize oil, 0.2-0.7 % mixed tocopherols, 2-4 % phytosterols, 0 % squalene in DOD of Mustard oil, 0.5-2 % mixed tocopherols, 0.5-1 % phytosterols, 8-12 % squalene in DOD of Olive oil, 0.5-1 % mixed tocopherols, 1-2 % phytosterols, 0 % squalene, 2-3 % tocotrienol in DOD of Palm oil, 2-5 % mixed tocopherols, 3-6 % phytosterols, 1-2 % squalene in DOD of Safflower oil, 5-8 % mixed tocopherols, 5-9 % phytosterols, 1-2 % squalene in DOD of Soyabean oil, 5-7 % mixed tocopherols, 4-6 % phytosterols, 0.2-0.5 % squalene in DOD of Sunflower oil, 0.2-0.3 % mixed tocopherols, 1-2 % phytosterols, 1-3 % squalene in Garcinia butter, 0.1-0.2 % mixed tocopherols, 1-3 % phytosterols, 2-4 % squalene in Mango butter, 0.5-2 % mixed tocopherols, 1-3 % phytosterols, 1-2 % squalene in Peanut butter and 0.2-0.3 % mixed tocopherols, 0.2-1 % phytosterols, 0.5-1 % squalene in Shea butter as nutraceuticals profile

(Table 2). The present results are in confirmation to the observations of earlier investigators (Naveh *et a*l., 2002 ; Bruce (2005); Jones., 2005; USDA., 2007, Berger, 2003; Thompson and Cunnane., 2003 and Martirosyan., 2007.) had worked on Amaranth oil. Jones and King, 1996 had worked on Cotton seed oil. Jones(2005). Thompson and Cunnane, (2003) had worked on Linseed oil and found the presence of Tocopherols as a lipidic component in various vegetative oils and in the deodorized distillate of oils. Bettaieb*, et al*., 2010 have investigated the roots, stem, leaves and flowers of *Cuminum cyminum* L for their essential oils, total phenolics, flavonoids and tannins contents and reported phenolic compounds with antioxidant activities. They found polyphenolic compounds in the essential oil. Their observations were based on gas chromatography mass spectrometry (GC- MS). Khamar & Jasrai (2014 a and 2014) confirmed the observations of above referred authors regarding the presence of phenolic compounds in oils and distillate of oils

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