

Review on Traditional Extraction of Sesame Oil

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Background: Cold-pressed Sesame Oil is used as a cooking oil, especially used for sautéing and deep-frying. It has a high smoke point which is suitable for Indian cooking. Cold pressing technique retains all its natural flavor, aroma, nutritive value making this oil excellent for cooking and adds more taste to food dishes. Sesame oil contains sesamol and sesaminol, that have strong health effects. Sesame is a significant source of bioactive constituents, such bioactive ingredients include lignans, tocopherol, and phytosterols. These lignans have many pharmacological properties such as antioxidant activity, antiproliferative activity, enhanced antioxidant action of vitamin E in lipid peroxidation systems, decreased cholesterol, neuroprotective effects, reduced breast and prostate cancer incidences, etc.

Method: The oil analysis was done using SOP-CHM-29-00, SOP-CHM-28-00, FSSAI manual 5 (14.9): 2016, FSSAI Manual 4 (A8): 2016, FSSAI manual 5 (10.1): 2016, SOP-CHM-27-00, AOAC 996.06 20th Ed, AOAC 994.10 20th Ed., AOAC 985.29 20th Ed methods. The microbiological, chemical and organoleptic test was done to examine the shelf life of the product.

Results and Conclusion: Sesame Oil was analyzed in the laboratory and results showed that it contains Total Fat (99.88g/100g), of which PUFA (47.26g), MUFA (35.88g), SAFA (16.72g) and cholesterol (< 1.0 N. D.). The results of the analysis of the food sample conform to the recommended limits for the tested parameters only and the sample has a shelf life of 9 months from the date of manufacturing.

Keywords: Cold-Pressed Oil; Sesame Seeds; PUFA; MUFA; Omega 3 Fatty Acids

Introduction

Sesame seeds contain several compounds of antioxidant lignan that include lipid-soluble lignans and water-soluble lignan glucosides. Most of them are fat-soluble lignans, and thus elute on extraction into the crude. Sixteen lignan varieties have been isolated from sesame so far, rests are glycosylated and thus excluded from the oil-free meal. Sesamin and sesamol are the primary aglycon lignans. Sesamol, sesaminol, sesamolol, pinoresinol, matairesinol, lariciresinol and episesamine are the subsidiary aglycon. The

lignan glycosides also made up of sesaminol, sesamolol and pinoresinol mono- di- and triglucosides. Sesaminol triglucoside, sesaminol diglucoside and sesaminol monoglucoside are the most abundant lignan glycosides in sesame [1].

Sesamin and sesamol have been reported to have many pharmacological properties like, anti-proliferative, antioxidant activity, antihypertensive effects, neuroprotective effects against hypoxia or brain damage and reducing the incidence of breast and prostate

cancer [1]. The presence of lignans such as sesamol and sesamin, sesamol has been closely linked to the marvellous high oxidative stability in sesame oil [2].

Tocopherols are lipophilic, phenolic compounds of plant origin and are the major constituents of vitamin E. According to Jiang, *et al.* the most abundant component in sesame seeds is tocopherol. α , β tocopherol which is also found in sesame seed. According to Yamashita *et al.* Vitamin E activity was recorded in sesame seeds, not solely due to the reduced tocopherol content of the seed, but due to the synergistic effect of both sesame lignans and tocopherol [3].

Sesame seeds also constitute a rich source of phytosterols. Phytosterols have better ability to suppress HMG-CoA reductase activity compared with cholesterol. Phytosterols have anti-cancer properties, anti-atherosclerotic, anti-inflammatory and antioxidant effects [4]. β -sitosterol is the predominant phytosterol in sesame oil, followed by campesterol and stigmasterol, with a level of between 231.7 to 305.2 mg 100 g⁻¹ sesame seed. Sesame seeds were reportable to have the highest phytosterol content (400 - 413 mg 100 g⁻¹) [5].

Review of Literature

Improves blood pressure

In his research, D. Sankar indicated that replacement of sesame oil, as the sole edible oil, lowered blood pressure in patients with hypertension who were taking diuretics and β blockers. Sesame oil also has positive effects on the levels of triglyceride, electrolytes, lipid peroxidation, and antioxidants [6]. The antihypertensive study suggests that a 4-week daily administration of 2.52g black sesame seeds triggered a significant reduction in systolic blood pressure, by an average of 8.2 mmHg. This antihypertensive effect is due to decreased oxidative stress. Taken into consideration the absence of side effects and inexpensive preparation, the regular ingestion of dietary black sesame seeds can help prevent cardiovascular disease in people with prehypertension, or even those with hypertension [7].

Action on fatty acid metabolism

A study carried on rats showed that Sesamine has also been shown to decrease lipogenesis by reducing lipogenic liver enzymes. Sesamine has been shown to decrease the expression of lipogenic genes of the sterol regulatory element-binding protein-1

(SREBP-1), acetyl-CoA carboxylase and fatty acid synthase, which means less fat is esterified in the liver and therefore less fat synthesis [8].

Improves cardiac health

Male low-density lipoprotein receptor (LDLR) mice were fed an atherogenic diet in the 3 months study or reformulated atherogenic diet with the same amount of diet from sesame oil. We quantified plasma lipids and atherosclerotic lesions after 3 months of feeding. Diet containing sesame oil significantly reduced atherosclerotic lesion formation and triglyceride, plasma cholesterol, and LDL cholesterol levels in low-density lipoprotein receptor mice. These results suggest that sesame oil could inhibit atherosclerosis lesion formation effectively [9].

Sesame lignans are also capable of hindering the esterification of fatty acids and help in promoting ketogenesis [10].

Sesame oil can decrease hepatic 3-hydroxyl-3-methyl-glutaryl coenzyme A reductase (HMG-CoA reductase) enzyme activity along with its intestinal absorption. HMG-CoA reductase is rate-limiting enzyme in cholesterol synthesis therefore reduction in serum and liver cholesterol in rats [11]. A study done by Hirata, *et al.* examined cholesterol, LDL-c and apoprotein B levels in 12 hypercholesterolemic men by giving 32 mg of sesamin capsules for 4 weeks followed by 65 mg for 4 weeks. It was observed that there was a reduction in total cholesterol by 9%, LDL-C by 16.5% and apoprotein B by 10.5% [12].

Anti-inflammatory effect

Sesame oil and its lignan "Sesamol" have been substantiated to be potent anti-inflammatory agents. They have an excellent protective effect against endotoxin-associated inflammatory damage as they inhibit the release of inflammatory mediators. Sesamol also prevents endotoxins from binding to its receptor, which reduces the activation of the inflammatory transcription factor NF- κ B. Thus, sesame oil or sesamol may help reduce the inflammatory response in inflammation associated diseases [13]. Research has proven that the topical use of sesame oil may lessen oxidative stress by inhibiting the production of xanthine oxidase and nitric oxide in rats [14]. Sesame oil has been used in traditional Taiwanese medicine to alleviate the inflammatory pain of joints and wounds. Massage with topical sesame oil has shown to be effective in significantly reduc-

ing pain severity of patients with limb trauma [15].

Oral administration of sesame oil has a therapeutic effect in rats against the acute inflammatory response caused by MSU crystals. Another clinical study showed that patients with upper or lower extremities have trauma which reduces the frequency of non-steroidal anti-inflammatory drugs through topical use of sesame oil [16]. Sesame seeds include lignans and gamma tocopherols that act synergistically in rats to produce vitamin E production. It increases the recycling of vitamin E which improves liver function and provide protection against alcohol-induced oxidative stress. Sesamin decreases cholesterol levels and improves HDL levels [17].

Anti-obesity effect

One study published in the "Yale Journal of Biology and Medicine" in 2006 showed that participants who ate about 2.6 table-spoons of sesame oil in line with a day lost a mean weight of 2.6 pounds in forty-five days. When subjects stopped ingesting 45 days of sesame oil, they started to regain the weight that they had lost. This study suggests that the polyunsaturated fatty acids in sesame oil may play a role in weight loss because they increase leptin plasma levels, a hormone that maintains the energy balance and suppresses food intake [6].

Role in cancer prevention

Topical use of Sesame oil shows antineoplastic properties It has been found to inhibit the proliferation of human colon cancer cells [18]. 2005 *in vitro* take a look at the study carried out by the University of Toronto's Department of Nutritional Sciences studied the outcomes of giving 25 grams of unground whole flaxseeds and sesame seeds over a 4-week duration to wholesome postmenopausal ladies. Urine test results showed an increase in female mammalian lignans obtaining both whole flaxseeds and sesame seeds, indicating that both are effectively converted by the bacterial flora in the colon, possibly helping to prevent the growth and spread of colon cancer cells [19].

Prevent diabetes

Magnesium and other nutrients present in sesame seeds, and especially sesame oil, has been shown to combat diabetes. Sankar, *et al.* (2010) found that sesame oil improves the effectiveness of

the oral antidiabetic drug glibenclamide in type 2 diabetic patients [20].

At Yaounde, Noumi and Bouopda 2014 reviewed phototherapy recommending sesame to prevent and treat prostatic ailments. For 2 - 3 months, 1 spoonful of oil is given twice a day to treat prostatitis [21].

Studies have emonstrated that sesamol could be used as an important agent in treating Huntington's disease (HD) [22].

Boosts bone health

Sesame seeds are rich source of zinc thus, they contribute towards the bone mineral density which substantiate its role in strengthening bones and used in Bhagna chikitsa Study by Hyun, *et al.* 2004 has revealed a clear correlation between low dietary intake of zinc, low blood levels of the trace minerals and osteoporosis at the hip and spine [23].

Oral health

Sesame seeds and sesame oil are some of the most significant benefits of clearing dental plaque and improving oral health. They are involved in an activity known as oil pulling, which involves swishing oil around in your mouth hereby you can boost oral health and even whiten up your teeth. One of the studies showed that oil pulling with sesame oil reduced the number of streptococcus mutants in both plaque and saliva in the teeth and mouth and improved overall health [24].

Dermatological use

Ultraviolet light produces various reactive oxygen species inside the skin. This reasons skin damage such as sunburns, wrinkles and pores and skin cancers. Sesame seeds are full of packed with antioxidants that act as a defence against reactive oxygen species. Chen, *et al.* in his study reported that the mutation caused by UV irradiation on the p53 gene can be prevented by the topical application of alpha-tocopherol. Dietary intake of α -tocopherol reduces photocarcinogenesis induced by UVB light [25].

Some studies found that mouth wash with sesame oil shows an 85% reduction in the bacteria which causes gingivitis. Sesame oil also cures chronic sinusitis. When it used for throat gargling, it kills Streptococcus and other common cold bacteria. It helps sufferers

of psoriasis and dry skin ailments. It is a useful natural UV protector [26].

Methodology

The mortar is fixed to the floor and is usually made from wood. The pestle is made from “Vagai Wood”. Firstly, the freshly formed high-quality oil seeds are cleaned and weighed. It loads a batch of oilseed into the mortar. As the churner moves around the mor-

tar, the pestle grinds the oilseed inside. A certain amount of water is added after the seed has grounded. The water mixes with the ground oilseeds releasing oil which is expelled by the kneading action of the pestle through a hole in the bottom of the mortar; the oil is filtered and collected in a container and stored in stainless tanks.

Results and Discussion

Figure 1: The primary stages of cold-pressing oil.

In table 1, Sesame Oil was analyzed in the laboratory and results showed that it contains Total Fat (99.88 g/100g), of which PUFA (47.26g), MUFA (35.88g), SAFA (16.72g) and cholesterol (< 1.0 N. D.).

A food shelf life is a period within which the food can be consumed safely and/or has an acceptable quality for consumers. By performing shelf life analysis, accurate dates for products can be defined, ensuring that the quality remains acceptable to consum-

Sr. No.	Parameters	Units	Method	Result of Analysis
	Energy	Kcal/100g	SOP-CHM-29-00	898.92
	Total Carbohydrates	g/100g	SOP-CHM-28-00	0.00
	Protein	g/100g	By FSSAI manual 5 (14.9): 2016	0.00
	Total Fat	g/100g	By FSSAI Manual 4 (A8): 2016	99.88
	Sugar	g/100g	By FSSAI manual 5 (10.1): 2016	0.00
	Saturated Fat	g/100g	AOAC 996.06 20 TH Ed.	16.720
	Trans Fat	g/100g	AOAC 996.06 20 th Ed.	0.00
	MUFA	g/100g	AOAC 996.06 20 th Ed.	35.889
	PUFA	g/100g	AOAC 996.06 20 th Ed.	47.269
	Cholesterol	mg/100g	AOAC 994.10 20 th Ed.	< 1.0 N.D.
	Sodium	mg/100g	SOP -CHM-27-00	0.77
	Dietary Fibre	g/100g	AOAC 985.29 20 th Ed.	0.00

Table 1: Nutrition facts of sesame oil.

Tests	Date of Analysis		11 July 19	22 July 19	12 Aug 19	3 Sep 19	Specified limits
	Phase	Units	A immediately after receiving zero time	B after 1.5 week	C after 4.5 weeks	D after 7.5 weeks	
Microbiological	Total viable count	cfu/g	4.0×10^2	5.7×10^3	5.8×10^3	6.2×10^3	$< 10^4$
	Coliforms	cfu/g	< 10	< 10	< 10	< 10	< 10
	<i>E coli</i>	org/g	Absent	Absent	Absent	Absent	Absent
	<i>Salmonella</i>	org/25g	Absent	Absent	Absent	Absent	Absent
	<i>Staphylococcus aureus</i>	org/g	Absent	Absent	Absent	Absent	Absent
	Yeast	cfu/g	< 10	9.0×10^1	9.0×10^1	9.0×10^1	$< 10^3$
	Mold	cfu/g	< 10	< 10	< 10	< 10	$< 10^3$
Chemical	pH		5.41	5.35	5.32	5.33	Not Specified
	Acid Value		3.20	3.29	3.75	3.89	Max 6
	Iodine Value		110.48	111.02	110.71	111.82	103 - 120
	Peroxide Value	meq/kg	7.16	7.36	7.51	8.34	Not Specified
	Moisture	g/100g	0.11	0.14	0.16	0.19	Not Specified
Organo Leptic	Appearance in terms of colour		5	5	5	4	3 to 5
	Odour		5	5	5	5	3 to 5
	Taste		NA	NA	NA	NA	3 to 5
	Texture/Consistency		5	5	5	4	3 to 5
Result		-	Pass	Pass	Pass	Pass	Pass/Fail
Shelf Life Obtained	Months	-	3	6	9	-	-

Table 2: Shelf life analysis of sesame oil.

ers and safe.

Shelf life depends on physical, microbiological and chemical processes taking place in the product when stored under recommended condition. Chemical changes include oxidation of food, change and loss in color, change in pH, enzymatic deterioration. Physical tests assessed are moisture content, textural changes, breakage or clumping of food. Microbial assessment for the absence of pathogenic microorganisms as per regulatory standards is carried out. Apart from the microbial and chemical shelf life of food products, sensory aspects of the food products like its flavor, texture and appearance, for example, play a vital role in consumer

acceptability.

The product, Sesame Oil was kept in a plastic container. It was stored in room conditions for 1.5 months and then accelerated for 7.5 weeks in conditions equivalent to 7.5 months in room conditions. It was tested for microbial, chemical and organoleptic parameters. In terms of organoleptic parameters, it was observed that the product was cloudy in appearance in the D phase. The results of analysis of the food sample conform to the recommended limits for the examined parameters only and the sample has shelf life of 9 months from the date of manufacture.

Conclusion

We found that fatty acid composition analysis showed that Sesame Oil is a rich source of polyunsaturated fatty acids followed by monounsaturated fatty acids and saturated fatty acids. The total extraction of oil is 40 - 44% per batch.

Cold-pressed oil is a good source of anti-oxidants, Omega-3 and Omega-6 fatty acids. Since cold pressed is naturally extracted it doesn't lose Vitamin E. It is trans-fat free and contains < 1.0 N. D. cholesterol. There is no heat processing or chemical flushing so the oil is devoid of trans-fat and harmful chemicals and it contains a natural source of nutrients. Polyunsaturated fatty acids (PUFAs) are necessary for overall health. Two families of PUFAs, n-6 and n-3, are physiologically and metabolically distinct fatty acids. In serum and erythrocyte phospholipids, the proportion of PUFAs depends on endogenous metabolism regulated by genetic polymorphisms and dietary intake. It is a major determinant of both health and illness. At the stage of cyclooxygenase and lipoxygenase, both n-3 and n-6 PUFAs are processed to active promoters of eicosanoid synthesis. Evidence from clinical and intervention research indicates that n-3 PUFAs are cardioprotective through their anti-inflammatory, anti-arrhythmic, lipid-lowering and antihypertensive effects. Both omega-3 (average-3) and omega-6 (average-6) fatty acids are important components of cell membranes and precursors to many other substances in the body, such as those involved in blood pressure control and inflammatory responses. Omega-3 fatty acids are increasingly being assisted in protecting against fatal heart disease and it is understood that they have anti-inflammatory effects which may be significant in this and other diseases. The role of omega-3 fatty acids in the prevention of diabetes and certain types of cancers is also of growing interest.

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