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An Overview on Nutritional Composition and Therapeutic Benefits of Sesame Seeds (*Sesamum indicum*)

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Abstract: ***Sesame seeds commonly known as gingelly seeds or til is one of the oldest oilseed cultivated all over the world with India and China being the largest producers. Both black and white sesame seeds are abundant in not only macro or micronutrients but also contain plethora of bioactive components such as lignans and phytosterols contributing to it being a good source of antioxidants. Presence of sesamin, sesaminol, myristic acid and lecithin in sesame seeds attributes to its anti-inflammatory, anti-hypertensive, anti-hyperglycemic, anti-hyperlipidemic and anti-cancer properties. Sesame oil is also known for its anti-microbial activity. Sesame is also an important crop mentioned in Ayurveda and is used in shirodhara, a body relaxing technique. Its oil is also used as skin softener and is utilized in the treatment of cracked heels. Seasame oil can also be substituted with regular oil and its seeds are used as garnishes in breads, biscuits and crackers. Til chikki and laddo's are also prepared in Indian households. Though it is widely used, consumption of even two sesame seeds might trigger allergic reactions in few people. In this review article topics like nutritional composition, therapeutic benefits, uses, products developed and safety and dosage of sesame is discussed.***

Keywords: sesame, sesamin, sesaminol, lignans, phytosterols

I. INTRODUCTION

Sesamum Indicum, also known sesame seeds as gingelly seeds, til or benni seed is one of the oldest seeds known to humankind. Sesame plant is an annual crop belonging to Pedaliaceae family [1]. It is an oilseed crop cultivated all the world. Since it can withstand dry conditions, it is usually grown in tropical and subtropical regions. India,China and Myanmar are largest producers of sesame in the world (Namiki 1995)[2]. According to De Candole, India might have received sesame around 1500 BC during the pre-Aryan period from Malayan and Indonesia. Archaeological evidence has shown that around 3000 BC sesame was cultivated in Palestine and Syria and in Babylonia around 1750 BC. Sesame has also been recovered from Harappa, a part of Indus Valley civilization around 3600-1500 BC [3]

Sesame seeds are not only good source of carbohydrates, protein and fats (oil) but also rich in micronutrients and bioactive components [4]. It is known as 'Queen of Oilseeds' as it is highly resistance to oxidation and rancidity. Sesame seeds are a reservoir of nutrients. Bioactive components like phytosterols, tocopherols and lignans such as sesamin and sesamolin provide numerous health benefits to humans.

Sesamin and sesamolin exhibit antioxidant, anti-inflammatory, antihypertensive and anticarcinogenic properties [5].The seeds were primarily used for preparation of oil and wine. Sesame seeds are used in preparations of biscuits, crackers, sweets and desserts. They are also used to garnish bread loaves. [1,4] Sesame seeds are usually used in the form of sesame oil. Sesame oil is used to make soaps, insecticides and medicines [5]. After the extraction of oil, defatted sesame seed meal (DSSM) can be used as cattle feed as its rich in protein [6]. The oil quality is influenced by variety and quality of sesame seeds used for oil production and also on processes used for oil production [7].

Sesame seeds colour varies from cream-white to charcoal-black whereas white and black are typical skin colours. According to food for health in traditional beliefs of Asian countries, it is believed that black sesame seeds are more superior to white sesame seeds and is included in Pharmacopoeia of the People's Republic of China (PPRC, 2015) as liver and kidney benefiting traditional Chinese medicine (TCM). It has been reported that the phytochemical content and biological activity of sesame seeds is affected by its colour. [4]

With this brief description, an attempt is made to write a review on nutritional composition and therapeutic benefits of sesame seeds.

II. NUTRITIONAL COMPOSITION

Sesame seeds play an important role in human nutrition. It constitutes an inexpensive source of protein, fat, vitamins and minerals in the diet [8]. Sesame seeds are composed of 10-15% carbohydrates, 15-20% protein, 43-45% lipid, 5-6 % moisture, 15-20% fiber and 5-6% ash [9]. Sesame seeds are rich source of oil and contain high amounts of unsaturated fatty acids (83-90%), mainly 37-40% linoleic acid, 35-43% oleic acid, 9-11% palmitic acid and 5-10% stearic acid with trace amounts of linolenic acid. Sesame seeds are a good source of antioxidants and bioactive compounds like phenolics, phytosterols and phytates. They are also rich in polyunsaturated fatty acids (PUFA) and short chain peptides. Sesame seeds also have special significance due to its high content of Sulphur amino acids and phytosterols [10]

A comparison between white and black sesame seeds is made for various nutrients in the following tables. The macronutrient composition of white and black sesame seeds is listed below in Table 1.

Table 1: Macronutrients present in 100g of sesame seeds [11], [12], [13], [1]

Nutrient	Composition (white sesame)				Composition (black sesame)		Composition (brown sesame)
Country	INDIA	CHINA	SUDAN	NIGERIA	CHINA	NIGERIA	SUDAN
Moisture (%)	4.7	4.71	5.24	4.18	4.20	5.41	5.17
Fat (%)	51.9	52.6	47.09	46.09	48.40	45.63	47.3
Carbohydrate (%)	18.4	15.4	-	16.95	17.80	10.83	-
Protein (%)	19.8	22.2	-	21.94	20.28	23.64	18.95
Fiber (%)	10.8	-	5.61	4.70	-	7.15	4.92
Ash (%)	5.2	4.32	4.81	6.16	6.10	7.34	4.01

The vitamin content of white and black sesame seeds is listed below in Table 2.

Table 2: Vitamins per 100g of sesame seeds [12], [13]

Vitamin	Composition (white sesame)	Composition (black sesame)
Vitamin A(mg)	8.92	9.54
Thiamine(mg)	0.83	0.71
Riboflavin(mg)	0.36	0.38
Vitamin D(mg)	11.57	12.63
Vitamin C(mg)	6.21	4.25
Vitamin E(mg)	28.46	17.45
Vitamin K(mg)	19.57	13.61

Table 3. Depicts the mineral content of white and black sesame seeds.

Table 3: Minerals present in sesame seeds [12, 13]

Mineral	Composition (white sesame)		Composition (black sesame)	
Unit	(µg/g)	mg/100g	(µg/g)	mg/100g
Calcium	1167	473	22854	521
Phosphorous	134	466	158	482
Potassium	10250	465	9722	468
Sodium	1544	-	769	-
Magnesium	35	412	78	380
Iron	111	6.21	121	5.54
Selenium	-	0.03	-	0.07
Zinc	170	8.78	161	7.90
Manganese	35	5.90	78	6.22

Table 4. Depicts the amino acid content of white and black sesame seeds.

Table 4: Amino acids per 100g of sesame seeds [13], [14]

Amino acid	Composition (white sesame) (g)		Composition (black sesame) (g)
Essential amino acids			
Histidine	2.25	3.09	3.22
Threonine	4.78	4.29	3.84
Valine	5.44	5.18	4.06
Lysine	4.78	3.30	2.43
Leucine	7.57	7.50	6.67
Isoleucine	4.85	4.29	3.08
Tryptophan	1.25	2.53	2.12
Methionine	1.87	3.46	2.83
Non-essential Amino acids			
Tyrosine	-	3.84	3.38
Phenylalanine	-	4.58	4.52
Alanine	3.13	3.37	1.93
Arginine	7.45	4.39	3.88
Serine	6.62	3.14	1.38
Glycine	-	3.33	2.81
Proline	4.08	1.31	3.19
Aspartic acid	9.88	8.95	8.10
Glutamic acid	16.54	17.68	15.15

The fatty acid content of white and black sesame seeds is listed below in table 5.

Table 5: fatty acids per 100g of sesame seeds [13], [15]

Fatty acid	Composition (white sesame)		Composition (black sesame)	
Palmitic acid (%)	9.39	14.02	9.23	12.03
Stearic acid (%)	7.86	5.72	5.88	4.93
Oleic acid (%)	45.85	47.03	46.27	45.46
Linolic acid (%)	37.89	-	38.79	-
Linoleic acid (%)	0.29	35.01	0.34	33.79
Arachidic acid (%)	0.89	1.00	0.70	1.00
Lauric acid (%)	0.08	-	0.20	-

Bioactive components of sesame is listed below in Table 6.

Table 6: Bioactive components per gram of sesame seed [16], [5]

Bioactive component		Composition (mg/g)
Lignans	Sesamin	8.80
	Sesamolin	4.50
	Sesamol	1.20
	Sesaminol	1.40
Phytosterols	β-sitosterol	3.35
	Campesterol	1.00
	Stigmasterol	0.37

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III. THERAPEUTIC BENEFITS

Sesame seeds add up to fiber and are a nutritious source of plant protein [17]. Sesame seeds help in digestion stimulate blood circulation and benefits the nervous system. Sesame seeds are one of the richest source of iron and zinc, including sesame seeds in diet would be an ideal. Sesame seeds are the best source of calcium that contains far more calcium than dairy products. Sesame seeds help relieve constipation. Sesame oil effectively treats cracked heels. Sesamin present in these seeds protects the liver from oxidative damage [11].Therapeutic benefits are exhibited by sesame seeds due to presence of .bioactive components like lignans and phytosterols. Sesame seeds help to lower blood cholesterol and hypertension, act as anti-oxidant, help to prevent alzihmer and provides immunity. [18] Few of therapeutic benefits of sesame seeds are discussed below.

A. Antioxidant Property

Many degenerative diseases are caused by production of free radicals which can be scavenged by antioxidants.[19]. Recently much attention has been given to natural antioxidants not only as safe food additives but also for medicinal purposes [20]. Isolation of antioxidants from natural sources is desirable as synthetic antioxidants may exhibit toxicity [21] Sesame seeds possess significant antioxidant activity hence they can be incorporated into normal diet, which might benefit as a natural antioxidant. [22,10]. One study have also indicated that presence of high content of phenols and flavonoids in sesame is responsible for antioxidant and antiproliferative properties and stated that white sesame seeds are potential sources of functional foods to prevent chronic diseases. [23]. Sesamin, sesamolin and myristic acid found in sesame seeds possess antioxidant properties [24]. When subjected to high temperatures sesamin and sesaminol are converted to sesamol, a more powerful antioxidant. [25] Roasting sesame seeds not only add up brown colour but also increases antioxidant activity [10].

B. Antihyperlipidemic Effect

Sesame seeds alleviates disesases related to lipid metabolism due to presence of high amounts of polyunsaturated fatty acids [26]. Monounsaturated fatty acids and polyunsaturated fatty acids present in sesame are the good kind of fats that helps to lower cholesterol. They are low in saturated fats [27]. Lecithin and lignans also inhibit production of cholesterol [5]. Sesamin, a bioactive component also attributes in lowering atherogenesis- triggering LDL, VLDL and TG levels and increasing atheroprotective HDL levels [28]. Furthermore, vitamin E and flavonoids naturally occuring in sesame are known to possess lipid-lowering properties [29]. Ingestion of sesame increases the time for erythrocyte hemolysis, lag phase of LDL oxidation, and slightly reduces the levels of thiobarbituric acid reactive substances in LDL [30]. A study conducted on albino rats showed a reduction in total cholesterol levels, when the group was treated with 3 ml of sesame oil for 8 weeks [31] Another study conducted on atherosclerotic mice showed that administration of sesame oil reduced blood lipids by 50% and also helped to prevent atherosclerosis by 85% [32]. It can be concluded that sesame reduces LDL, decreases plasma and erythrocyte membrane lipid peroxidation and increases HDL [33].

C. Anti-hyperglycemic Effect

Since primitive times sesame has been known as an imminent crop used for its medicinal properties. Recent studies have also proven that sesame is also beneficial to diabetic hypertensive patients [34]. Phytochemicals present in sesame help to reduce postprandial hyperglycemia by inhibiting carbohydrates metabolizing enzymes [35]. Bioactive components like fat-soluble lignans, sesamin, sesamolin and γ-tocopherol may have antidiabetic activity [36]. Sesame seeds are also a good source of fiber. Fiber hinders assimilation of sugar thereby maintaining glucose levels in the body. Low amount of starch present in sesame also adds up in controlling sugar levels [35]. Sesame is also beneficial for patients with diabetic nephropathy, as it has proved to improve serum parameters [37]. A study found out that diet supplemented with sesame seeds and Nigella sativa improved kidney function in diabetic patients by decreasing elevated levels of blood urea nitrogen (BUN) and Creatinine levels [38]. Another study conducted on rats revealed that liver glycogen level was significantly decreased in diabetic rats and indicated that ethanolic extract of sesame has potential effect to control hyperglycemia [39]. Sesame oil along with glibenclamide can be exceptionally valuable in clinical practice for improvement of hyperglycemia. [35].

D. Anti-hypertensive Effect

Hypertension is an independent risk factor for cardiovascular diseases (CVD) which is one of a major cause of mortality and morbidity. Vitamin E, gamma tocopherols and lignans like sesamin, sesamolin and sesamol in sesasme are known to provide anti-hypertensive effects [40]. Sesamin exhibits not only anti-hypertensive properties but also anti-atherogenic, anti- thrombotic, anti-obesity and lipolytic effect. Sesamin is also known for its radical scavenging ability, which induces endothelium dependent vasorelaxation [41].

Studies have shown that decreasing oxidative stress and improving antioxidant status is beneficial for hypertension. Therefore, antioxidant property of sesamin contributes to its anti-hypertensive effect (Nakano et al, 2002) [40, 41, 42]. A study conducted on humans concluded that consuming 60 mg of sesamin for 4 weeks decreased 3.5 mmHg of systolic blood pressure and 1.9 mmHg of diastolic blood pressure [43]. Another study on humans indicated that using sesame oil as their regular oil instead of palm oil or groundnut oil for about 45 days resulted in remarkable reduction of blood pressure [44]. Sesame oil also has a positive effect on cardiac hypertrophy in hypertensive rats [45].

E. Anti-cancer Property

Though not many studies have been conducted on anti-cancer property of sesame, lignans present in *S. indicum* have shown anti-cancer effects both in vitro and in vivo [27]. The anti- cancer effect of sesamin has been attributed to its anti-proliferative effect, pro- apoptotic effect, anti-metastatic and pro-autophagocytic activities. Sesamin ameliorated tumor development and progression and can be used in prevention of cancer [46]. Sesamol, another lignin present in sesame acts a metabolic regulator that possess anti-proliferative, anti-mutagenic, anti-hepatotoxic, anti-inflammatory and chemo preventive properties [47, 8]. Sesamolin also induces apoptosis in human lymphoid leukemia cells by DNA fragmentation [27]. Studies have indicated that presence of alkaloids, flavonoids, glycosides and saponins might have antioxidant and anti-cancer activity (Sheela et al, 2015) [48]. A study in humans has shown that sesamin lignan can be converted by intestinal microflora to mammalian lignin, enterolactone and enterodiol, which may benefit against hormone related diseases such as breast cancer [49]. Another possible mechanism for anti-cancer activity of sesame is that sesamin arrested cell growth in early phase of cell cycle known as G1, by regulating a protein known as D1, which promotes cancer cell growth [50].

IV. SESAME IN AYURVEDA

Ayurveda is a holistic health approach, which originated in India thousands of years ago [51]. Sesame is known as Tila taila and its oil is known for its therapeutic benefits in Ayurvedic texts [52]. Ayurvedic knowledge says that sesame provides special strength to those who use it as a medicine and it acts as a strengthener and immunity booster [53]. Sesame oil is one of the best oils mentioned in Ayurveda [54]. Ayurveda mentions the use of mediated oils to treat various disorders. Sesame oil along with herbs and water is cooked for a prolonged period and utilized as mediated oil [55]. Sesame oil is also used in Shirodhara, a calming and soothing technique of the body and mind. Sesame oil is preferred as it is a neutral oil and blends well with other essential oils [52]. A study demonstrated that sesame oil shirodhara improves sleep quality in people having sleep disorders [56]. According to Ayurvedic texts, gargling with milk boiled with sesame and liquorice helps to strengthen teeth [57]. A study conducted among people with plaque-induced gingivitis concluded that there was a decline in total colony count of aerobic microorganisms [58].

V. USES OF SESAME

Sesame seeds and oils are known not only for its's traditional use but also for its neutraceutical, pharmaceutical and industrial role [5]. Uses of sesame are discussed below in Table 7.

Table 7: Uses of Sesame [5], [59], [60], [61], [62], [63], [64], [65]

Use	Bioactive component of sesame
Nutraceutical use	
Hepatoprotection	Lecithin
Cardio protective	Fiber anf Flavanoids
Skin softener	Sesame oil
Systemic pain reliever	Alkaloids
Pharmaceutical uses	
Drug vehicle and laxative	Sesame oil
Hypoglycemia	Flavonoids
Inhibition of malignant melanoma	Linoleate in triglyceride form
Solvent for intramuscular injections	Sesame oil
Antimicrobial mouthwash	Sesame oil
Industrial uses	
Antifungal	Chlorosesamone, anthraquinone

Bactericidal and insecticidal	Sesamin and sesamolin
Cosmetics	Myristic acid
Biodiesel	Sesame oil
Traditional uses	
Intestine lubrication	Sesame oil
Constipation	Sesamin
Intestinal worms	Sesamin, sesamolin
Food preservation	Lignans

VI. PRODUCTS DEVELOPED USING SESAME

Sesame is widely used around the world either in the form of seeds, flour or oil. Sesame oil has been incorporated into the diets from past 6000 years [60]. Sesame oil is highly oxidative stable vegetable oil used as regular oil in many houses [26, 66]. Sesame seeds are constituted as condiments in various recipes around the world. It is used to add flavour and texture to bread, biscuits, crackers and salad dressings [67]. Dehulled seeds can be used directly in foods like halva, laddu and chikki. Sesame flour is used in preparation of ready to eat instant foods and its flour is used as methionine supplement. Sesame protein can be used in preparation of nutritious beverages [68]. Sesame seeds are also used in preparation of tahini and bread dips. It is also used in rice and noodle dishes to add flavour and aroma into the food [25]. Sesame seeds are also used in the preparation of sweet meat known as rewari and gajak [69].

VII. SAFETY CONSUMPTION AND DOSAGE

Sesame is safe to consume and is widely used all over the world. 1-2 tablespoon of sesame seeds and 1-2 sesame seed capsule can be consumed twice a day. ¼- ½ teaspoon of sesame seeds powder can be consumed once or twice daily [70]. Consuming 60 mg of sesamin helps to lower blood pressure. [44]. Sesame oil can be given orally for a week to reduce bloating problem [71]. Around 18.39 mg/person/day of lignans from sesame can be given to males while 13.26 mg/person/day is recommended for females [72]

VIII. SESAME AS AN ALLERGEN

Sesame allergy which can be life threatening has been growing worldwide over past two decades [73, 74]. Sesame seed allergy can be associated with severe reactions [75]. Anaphylaxis to sesame could be a complication of vegetarian diet [76]. Sesame allergy is more common among children and anaphylaxis reaction tends to be less severe among adults [77, 78]. Consumption of just two sesame seeds or lowest dose of sesame protein can trigger severe reactions in sesame allergic populations [78, 80]. Studies indicate that protein and oil components of sesame can trigger immediate hypersensitivity through IgE antibody and delayed hypersensitivity via cell mediated immune responses [81]. Symptoms like Hives, Itching, rashes, wheezing, cramps, diarrhea and vomiting can be seen in allergic reactions caused by sesame [82].

IX. CONCLUSION

Sesame seeds are highly nutritious seeds and can be easily incorporated into our diets. They are not only rich in macro and micronutrients but also rich in bioactive components, which contribute to it being utilized for its therapeutic role. Sesame seeds are also known for its traditional use and it is an important crop mentioned in Ayurveda. Many products are developed using sesame and it may trigger allergic reactions in few people. Consumption of sesame on daily basis would be ideal and it may lead to improvement of health of individuals.

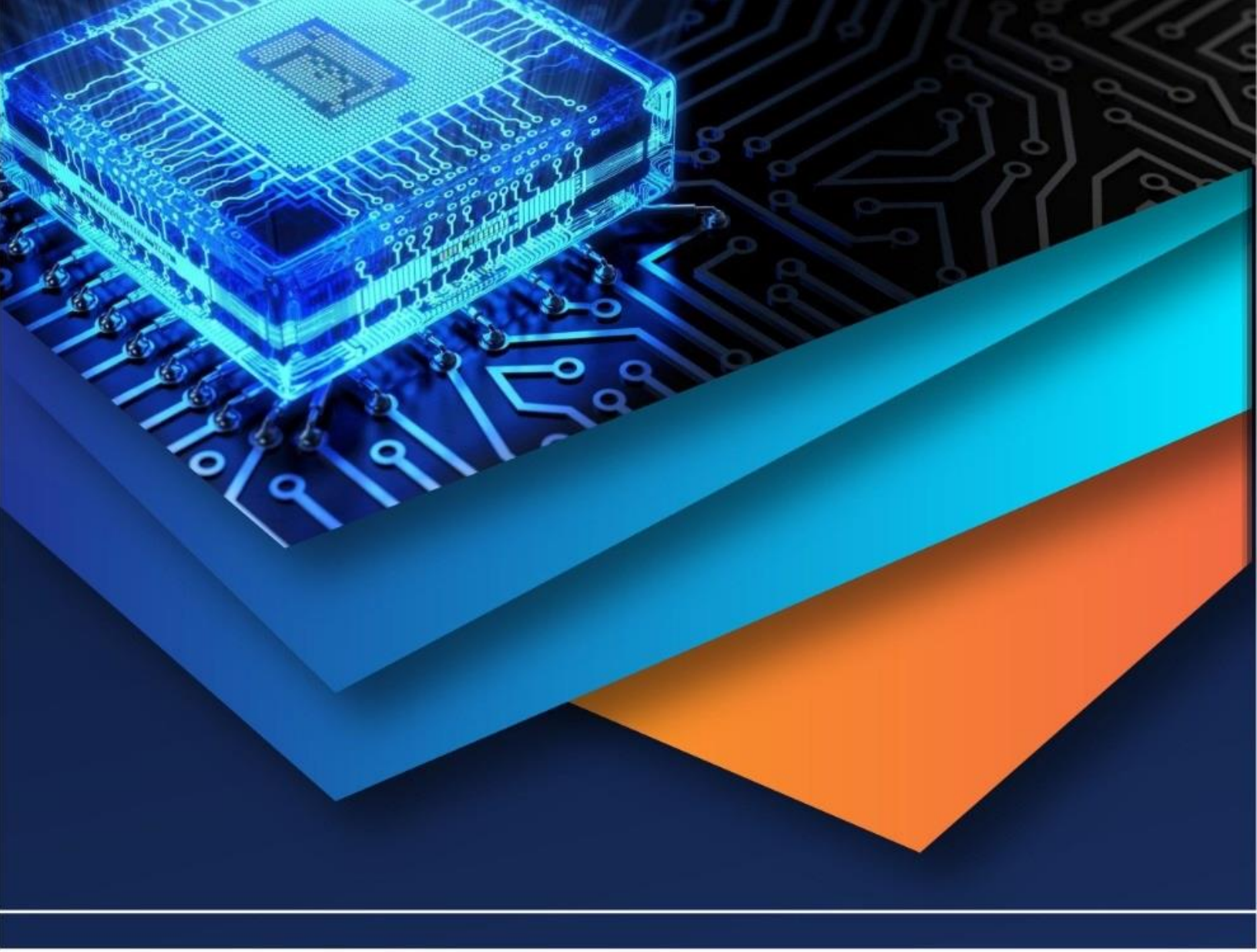
REFERENCES

[1] Mahdi Abdelmageed, Mohammed Ali, Husham Abdelmonum Mahmoud, Masaged Aldoma and Hatim M.Y Hamadnalla. Proximate Composition of Sudanese Sesamum indicum L. (white and brown) Sesame Seeds. An Archieve of organic and inorganic sciences, Volume 4- issue 4. Aug 25, 2020.
[2] O Idowu Atinuke, M Alashi Adeola, D Nwachukwu Ifeanyi, N Tayo Fagbemi and E Aluko Rotimi. Functional Properties of Sesame (Sesamum indicum Linn) seed protein fractions. Food Production, Processing and Nutrition volume 3. 2021.
[3] N M Nayar and K. L. Mehra. Sesame: Its Uses, Botany, Cytogenetics and Origin. Economic botany vol24, 20-31. Jan 1970.
[4] Lin Zhou, Xiaohui Lin, Arshad Mehmood Abbasi and Bisheng Zheng. Phytochemical Contents and Antioxidant and Antiproliferative Activities of Selected Black and White Sesame Seeds. BioMed Research International, vol. 2016. Aug 14, 2016.
[5] Niti Pathak, A.K Rai, Ratna Kumari and K.V bhat. Value addition in sesame: A perspective on bioactive components for enhancing utility and profitability. Pharmacogn Rev. 8(16): 147-155. Dec 2014
[6] Manal A.M. Hassan. Studies on Egyptian Sesame Seeds (Sesamum indicum L.) and its products. 3. Effect of Roasting Process on Gross Chemical Composition, Functional Properties, Antioxidative Components and Some Minerals of Defatted Sesame Seeds Meal (Sesamum indicum L.). World Journal of Dairy & Food Sciences 8 (1): 51-57. 2013

[7] Wenting Yin, Maradza Washington, Xeuting Ma, Xi Yang, Aliu Lu, Rui Shi, Renyong Zhao, Xuede Wang. Consumer acceptability and sensory profiling of sesame oils obtained from different processes. Grain & Oil Science and Technology.Volume 3, Issue 2, Pages 39-48. June 2020
[8] M.M. I Aladji abatchoua, S. Dolinassou, M.A Nassourou, T.B.B Noubissie and Y.N Njintang. Variability and diallel analysis of seed protein content in sesame (Sesamum indicum L.). International Journal of Research Studies in Agricultural Sciences (IJRSAS) Volume 6, Issue 10. 2020.
[9] Manal A.M. Hassan. Studies on Egyptian Sesame Seeds (Sesamum indicum L) and its Products. 2. Effect of Roasting Conditions on Peroxide Value, Free Acidity, Iodine Value and Antioxidant Activity of Sesame Seeds (Sesamum indicum L.). World Journal of Dairy & Food Sciences 8 (1): 11-17. 2013
[10] Niti Pathak, Ashwani Kumar Rai, Ratna Kumari, Adarshana Thapa, Kangila Venkataraman Bhat. Sesame Crop: An Underexploited Oilseed Holds Tremendous Potential for Enhanced Food Value. Agricultural Sciences, vol. 5 No.6. 2014.
[11] Jaya Singh, Neelma Kunwar and Smita Tripathi. Benefits and nutritive value of sesame seeds. International Journal of Recent Scientific Research Vol. 7, Issue, 9, pp. sepr 2016.
[12] P. Kanu .Biochemical Analysis of Black And White sesame seeds from China. American journal of Biochemistry and Molecular Biology 1 (2): 145-157, 2011.
[13] F.M. Makinde. R.Akinso. Nutrient composition and effect of processing treatments on anti-nutritional factors of Nigerian sesame (Sesamum indicum Linn) cultivars. International food research journal. 20(5):2293-2300, Jan 2013
[14] O Temitope Fasuan,O Saka Gbadamosi, and O. Taiwo Omobuwajo. Characterization of protein isolate from Sesamum indicum seed: In vitro protein digestibility, amino acid profile, and some functional properties. Food Science and Nutrition 6(6): 1715–1723. 27 Jul 2018
[15] A.H Bahkali, M.A Hussain and A.Y. Basahy. Protein and oil composition of sesame seeds (Sesamum indicum, L.) grown in the Gizan area of Saudi Arabia. International journal of Food And Nutrition volume 49,1998
[16] Muthulakshmi Chellamuthu, Selvi Subramanian and Manonmani Swaminathan. Genetic Potential and Possible Improvement of Sesamum indicum L). DOI: 10.5772/intechopen.94885. November 30th 2020
[17] Marsha McCulloch, Health and Nutrition Benefits of Sesame Seeds. Healthline, February 13 2019.
[18] Sonia Kapoor, S. Sanjay Parmar, Manju Yadav, Darshna Chaudhary, Manish Sainger, Ranjana Jaiwal and K. Pawan Jaiwal. Sesame (Sesame indicum L.). Methods in molecular biology 1224:37-45. Sept 2015
[19] Komar Ruslan, Shelvy Happyniar, Irda Fidrianny. Antioxidant potential of two varieties of Sesamum indicum L. collected from Indonesia. Journal of Taibah University Medical Sciences.Volume 13. 3, June 2018.
[20] Toshihiko Osawa, Masayasu Nagata, Mitsuo Namiki, Yasuko Fukuda. Sesamolinol, a Novel Antioxidant Isolated from Sesame Seeds. Agricultural and Biological Chemistry, Volume 49. 1 November 1985
[21] Mohamed Elleuch, Dorothea Bedigian, Souhail Besbes,B Christophe Blecker &Hamadi Attia. Dietary Fibre Characteristics and Antioxidant Activity of Sesame Seed Coats (Testae). International Journal of Food properties. 22 Dec 2011
[22] Emmanuel Elikem Dravie, Nii Korley Kortei, Edward Ken Essuman, Clement Okraku Tettey, Adjoa Agyemang Boakye, Gaston Hunkpe. Antioxidant, phytochemical and physicochemical properties of sesame seed (Sesamum indicum L). Scientific African Volume 8, July 2020.
[23] Xiaohui Lin, Lin Zhou, Tong Li, Charles Brennan, Xiong Fu and Rui Hai Liu. Phenolic content, antioxidant and antiproliferative activities of six varieties of white sesame seeds (Sesamum indicum L.). RSC Advances (IF 3.361). Jan 2017
[24] H.S Vishwanath, K.R Anilkumar, S.N Harsha, Farhath Khanum and A.S Bawa. In Vitro antioxidant activity of Sesamum indicum seeds. Asian Journal of Pharmaceutical and Clinical Research Vol 5. 2012.
[25] D Bopitiya and T. Madhujith. Antioxidant Activity and Total Phenolic Content of Sesame (Sesamum indicum L.) Seed Oil.Tropical Agricultural Research vol.24 (3):296-302. 2013
[26] F. Amin Majdalawieh, F. Jenna Farraj, I Ronald Carr. Sesamum indicum (sesame) enhances NK anti-cancer activity, modulates Th1/Th2 balance, and suppresses macrophage inflammatory response. Asian Pacific Journal of tropical biomedicine. 2020.
[27] J. Daniel DeNoon. Sesame Oil Benefits Blood Pressure Cooking Oil Switch May Be High Blood Pressure Treatment, Inter-American Society of Hypertension. April 2003.
[28] F Amin Majdalawieh, Sarah Dalibalta M. Sarah Yousef. Effects of sesamin on fatty acid and cholesterol metabolism, macrophage cholesterol homeostasis and serum lipid profile: A comprehensive review. European Journal of Pharmacology Volume 885. 15 October 2020
[29] Sedigheh Asgary, Mahmoud Rafieian-Kopaei, Somayeh Najafi, Esfandiar Heidarian and Amirhossein Sahebkar, Antihyperlipidemic Effects of Sesamum indicum L. in Rabbits Fed a High- Fat Diet. The Scientific research journal. Volume 2013. 04 sept 2013.
[30] Pey Rong Chen, Kuo Liong Chein, Ta Chen Su, Chee Jen Chang, Tsuei- Ling Liu, Hsiuching Cheng, Chingmin Tsai. Dietary sesame reduces serum cholesterol and enhances antioxidant capacity in hypercholesterolemia. Nutrition Research Volume 25, Issue 6, Pages 559-567. June 2005.
[31] A. Ebtisam.Marzook, E Ahmed Abd El Moneim, A Abdelmonsef Elhadary. Protective role of sesame oil against mobile base station-induced oxidative stress. Journal of Radiation Reseach and Applied Sciences Volume 7, Issue 1. January 2014.
[32] Krithika Selvarajan, Chandrakala Aluganti Narasimhulu, Reena Bapputty, and Sampath Parthasarath. Anti-Inflammatory and Antioxidant Activities of the Nonlipid (Aqueous) Components of Sesame Oil: Potential Use in Atherosclerosis. Journal of Medicinal Food. 18(4): 393–402. 1 April 2015.
[33] Arundhati Biswas, Pubali Dhar, Santinath Ghosh. Antihyperlipidemic effect of sesame (Sesamum indicum L.) protein isolate in rats fed a normal and high cholesterol diet. Food science Journal. Dec 2010
[34] Hina Saleem, Hafeez Ahmad Sadaqat, Humera Razzaq. Diabetes and sesame: an insight about the benefits of sesame (Sesamum indicum L.) in curing diabetes. Journal of Diabetes, Metabolic Disorders & Control. Volume 8 Issue 1. 2021.
[35] K. Amutha Godavari. In-vitro-antidiabetic activity of n-butanol extract of Sesamum indicum. Asian Journal of Pharmaceutical and Clinical Research 9(4):60-62. July 2016.
[36] Farhan Aslam, Sanaullah Iqbal, Muhammad Nasir, Aftab Ahmad Anjum, Pamela Swan and Karen Sweazea. Evaluation of White Sesame Seed Oil on Glucose Control and Biomarkers of Hepatic, Cardiac, and Renal Functions in Male Sprague-Dawley Rats with Chemically Induced Diabetes. Journal of Medicinal Food. 20(5): 448–457. 1 May 2017
[37] Palanisamy Bhuvaneswari, Shanmugasundaram Krishnakumari. Nephroprotective effects of ethanolic extract of Sesamum indicum seeds (Linn.) in streptozotocin induced diabetic male albino rats. International Journal of Green Pharmacy 6(4):330-335. October 2012

[38] A.A Thanaa Ibrahiem. Beneficial Effects of Diet Supplementation with Nigella sativa (Black Seed) and Sesame Seeds in Alloxan-Diabetic Rats. International journal Of Current Microbiology and Applied Sciences. Volume 5 Number 1. 2016.
[39] P. Bhuvaneswari, S. Krishnakumar. Antihyperglycemic potential of Sesamum indicum (Linn) seeds in streptozotocin induced diabetic rats. International Journal of Pharmacy and Pharmaceutical Sciences 4:527-531. January 2012
[40] Jatuporn Wichitsranoi, Natthida Weerapreeyakul, Patcharee Boonsiri, Chatri Settasatian, Nongnuch, Settasatian, Nantarat Komanasin, Suchart Sirijaichingkul, Yaovalak Teerajetgul, Nuchanart Rangkadilok, and Naruemon Leelayuwat. Antihypertensive and antioxidant effects of dietary black sesame meal in pre-hypertensive humans. Nutrition journal. Aug 2011.
[41] Sarah Dalibalta, F. Amin Majdalawieh and Herak Manjikian. Health benefits of sesamin on cardiovascular disease and its associated risk factors. Saudi Pharmaceutical Journal 28(10): 1276–1289. OCT 2020.
[42] Luciana de Almeida Vittori Gouveia, Carolina Alves Cardoso, Glaucia Maria Moraes de Oliveira, Glorimar Rosa and Annie Seixas Bello Moreira. Effects of the Intake of Sesame Seeds (Sesamum indicum L.) and Derivatives on Oxidative Stress: A Systematic Review. Journal of Medicinal Food Vol. 19, No. 4 , 13 April 2016
[43] Takashi Miyawaki, Hideshi aono, yoshiko toyoda-ono, hirofumi madea, yoshinobu kiso, kenji moriyama. Antihypertensive Effects of Sesamin in Humans. Journal of Nutritional Science and vitaminology. Volume 55 Issue 1 Pages 87-91. 2009.
[44] D Sankar, MR RAO, G. Sabbandam, KV Pugalendi. A pilot study of open label sesame oil in hypertensive diabetics. Journal of Medicinal Food, 9(3):408-412. 01 Jan 2006
[45] Yen- Chang Lin, Tran Durong Thuy, Shu-Yin Wang, Pung- Ling Huang. Journal of Traditional and Complementary Medicine Volume 4, Issue 1. January–March 2014.
[46] Amin F. Majdalawieh, Mariam Massri, Gheyath Nasrallah. A comprehensive review on the anti-cancer properties and mechanisms of action of sesamin, a lignan in sesame seeds (Sesamum indicum) October 2017 European Journal of Pharmacology. October 2017
[47] F. Amin Majdalawieh, R. Zeenah Mansour. Sesamol, a major lignan in sesame seeds (Sesamum indicum): Anti-cancer properties and mechanisms of action. European Journal of Pharmacology Volume 855, 15, Pages 75-89. July 2019.
[48] Kaliyamoorthy Jayakumar, T.M. Sathees kannan, P. Thamizhiniyan and P.Vijayarengan. Evaluation of Phytochemicals Analysis, Medicinal Properties and Nutritional Value of Sesame Seeds (Sesamum indicum.L). International Journal of Modern Biology and Medicine, 6(2): 129-135. 2015
[49] D Karen Coulman, Zhen Liu, Winston Quan Hum, John Michaelides, U. Lilian Thompson. Whole sesame seed is as rich a source of mammalian lignan precursors as whole flaxseed. Nutr Cancer journal 52(2):156-65. 2005.
[50] Tomoya Yokota, Youichirou Matsuzaki, Makoto Koyama, Toshiaki Hitomi, Mayumi Kawanaka, Masako Enoki-Konishi, Yusuke Okuyama, Junko Takayasu, Hoyoku Nishino, Akiyoshi Nishikawa, Toshihiko Osawa, Toshiyuki Sakai. Sesamin, a lignan of sesame, down-regulates cyclin D1 protein expression in human tumor cells. Cancer science journal 98(9):1447-53. Sep 2007
[51] O Sahlin. Shirodhara: An Ayurvedic Approach to Stress Relief. Healthline. May 13, 2020
[52] Pravin Jawanjal. Tila Taila A Review. World journal of Pharmaceutical and Medical Research 4 (10), 76-78. Sept 2018.
[53] Meena Shamrao Deogade. An Important Drug of Ayurveda - Sesamum indicum Linn. Research gate August 2013
[54] Subhose Varanasi and Ala Narayana, Medico-Historical review of Tila. Journal Ind. Inst. Hist. Med. Vol.XXXVIII - 2008. Pp. 157 to 170. 2008.
[55] P. Lahorkar, K. Ramitha, V. Bansal and D. B. Anantha Narayana. A Comparative Evaluation of Medicated Oils Prepared Using Ayurvedic and Modified Processes. Indian J Pharm Sci.71(6): 656–662. Nov- Dec 2009.
[56] Akiko Tokinobu, Takashi Yorifuji, Toshihide Tsuda, and Hiroyuki Doi,. Effects of Ayurvedic Oil-Dripping Treatment with Sesame Oil vs. with Warm Water on Sleep: A Randomized Single-Blinded Crossover Pilot Study. Journal of Alternative and Complementary Medicine 22(1): 52–58. 1 Jan 2016
[57] Madella Gautham, D. Sai Gowtham, K. Venkat Sivudu , V. Gopala Krishnaiah, G. Pallavi. Dinacharya – A Healthy Life Style. IJARIIE-ISSN (O)-2395-4396. Vol-5 Issue-6. 2019.
[58] Sharath Asokan, Pamela Emmadi, Raghuraman Chamundeswari. Effect of oil pulling on plaque induced gingivitis: a randomized, controlled, triple-blind study. Indian J Dent Res, 20(1):47-51. Jan-Mar 2009.
[59] Tzu-Kai Lin, Lily Zhong and Juan Luis Santiago· Anti-Inflammatory and Skin Barrier Repair Effects of Topical Application of Some Plant Oils. International Journal of Molecular Sciences 19(1): 70. Jan 2018,
[60] M Magdalene Aondona, K Julius Ikya, T Moses Ukeyima, J.A Tsav-Wua Gborigo, E Rotimi Aluko, T Abraham Girgih. In vitro antioxidant and antihypertensive properties of sesame seed enzymatic protein hydrolysate and ultrafiltration peptide fractions. J Food Biochem 45(1):e13587 Jan 2021.
[61] R.N. Syed, H. Laurentin, R. Splivallo and P. Karlovsky. Antifungal Properties of Extracts of Sesame (Sesamum indicum). International Journal of Agriculture and Biology, Vol 17, No 3. 2015
[62] T. Ahmed, L.A.J Shittu, M. A Bankole, R.K Shittu, O.A Adesanya ,M.N Bankole and O.A shiru, Comparative studies of the crude extracts of sesame against some common pathogenic microorganisms. Scientific Research and Essays Vol. 4 (6), pp. 584-589, June 2009.
[63] F.A Dawodu, O.O Ayodele, T. Bolanle-Ojo .Biodiesel production from Sesamum indicum L. seed oil: An optimization study. Egyptian Journal of Petroleum Volume 23, Issue 2, Pages 191-199. June 2014.
[64] Murrium Ahmad, Kifayat Ullah, Muhammad Azim Khan. Quantitative and Qualitative Analysis of Sesame Oil Biodiesel. Energy Sources Part A Recovery Utilization and Environmental Effects Part A: Recovery (13):1239-1249. April 2011.
[65] M.Patil Neeta, Nagpurkar Mukta and Kulkarni Bilwa. Comparative Qualitative Phytochemical analysis of Sesamum indicum L. International journal of current microbiology and applied sciences. Special Issue-2 pp. 172-181. May 2015.
[66] Arya Sethuparvathy, Jollykutty Eapen. Physio-Chemical evaluation for assessing the genuinity of gingelly oil (Tila Taila) in Kerela market. International research journal of pharmacy. 7(11): 64-67 November 2016.
[67] P.E Ogbonna S.I and Ukaan. Chemical composition and oil quality of seeds of sesame accessions grown in the Nsukka plains of South Eastern Nigeria. African Journal of Agricultural Research. Vol. 8(9), pp. 797-803. 18 March 2013.
[68] Dr Anuradha. Illustrated study of drug Til Taila From different Ayurvedic and Modern Texts. World Journal of Pharmaceutical Research Volume 6, Issue 4. 2017.

[69] N.C Shah, Sesamum Indicum (Sesame or Til): seeds and oil- an historical and Scientific Evaluation from Indian Perspective. Indian Journal of History of Science, 48.2 (2013) 151.28 February 2013.
[70] Diksha Gupta. Dr. Deepak Soni Sesame Seeds. Tata 1mg. 24 Sep 2019
[71] S Ganesan, M Chandhirasekaran, A Selvaraj. Ethnoveterinary healthcare practices in southern districts of Tamil Nadu. Indian journal of Traditional knowledgeVol.07. 2008.
[72] A-Young Kim, Choong-In Yun Joon-Goo Lee and Young-Jun Kim. Determination and Daily Intake Estimation of Lignans in Sesame Seeds and Sesame Oil Products in Korea. Foods 9(4): 394. 30 Mar 2020.
[73] Venugopal Gangur, G. Harini Acharya. The Global Rise and the Complexity of Sesame Allergy: Prime Time to Regulate Sesame in the United States of America. Allergies 2021, 1(1), 1-21. 21 Sept 2020.
[74] Ilan Dalal. Michael Goldberg & Yitzhak Katz. Sesame Seed Food Allergy. Current Allergy and Asthma Reports volume 12, pages339–345. 2012.
[75] A. Helen Brought, Jean-Christoph Caubet, Angel Mazon, Diab Haddad, M. Marcel Bergmann, Jacqueline Wassenberg, Valentina Panetta, Rosalynd Gourgey, Suzana Radulovic, Maria Nieto, F. Alexanfra Santos, Antonio Nieto, M.B Gideon Lack BChir, A Philippe Eigenmann. Defining challenge-proven coexistent nut and sesame seed allergy: A prospective multicenter European study. Journal of Allergy and Clinical Immunology Volume 145, Issue 4, Pages 1231-1239. April 2020
[76] Cristina Panizzolo, Maria Tura, Angelo Barbato. Anaphylaxis to sesame paste. Eur Ann Allergy Clin Immunol 37 (1):34-5. Jan 2005.
[77] Kristin Sokol, Marjohn Rasooly, Caeden Dempsey, Sheryce Lassiter, Wenjuan Gu, Keith Lumbard and A Pamela Frischmeyer-Guerrerio. Prevalence and Diagnosis of Sesame Allergy in Children with IgE-Mediated Food Allergy. Pediatr Allergy Immunol 31(2): 214–218. Feb 2020.
[78] Emmanuella Guenova, Sonya Genova, Bogomil Voykov, Silvia Novakova and Vanyo Mitev . Immunoglobulin E-Mediated Anaphylaxis to Sesame. World Allergy Organization Journal volume 1, Article number: 134. 2008.
[79] Adil Adatia, Ann Elaine Clarke, Yarden Yanishevsky and Moshe Ben-Shoshan. Sesame allergy: current perspectives. J Asthma Allergy. 10:141–151. 27 April 2017.
[80] D Dano, B.C Remington, C Astier, J.L Baumert, A.G Kruizinga, B.E Bihain, S.L Taylor, G Kanny. Sesame allergy threshold dose distribution. Food Chem Toxicol 83:48–53. 30 May 2015.
[81] Venu Gangur. Caleb Kelly and Lalitha Navuluri. Sesame allergy: A growing food allergy of global proportions? Annals of allergy, asthama and immunologym95 (1):4-11. August 2005.
[82] M. Christopher Warren, S. Avneet Chadha, H. Scott Sicherer, Jialing Jiang and S. Ruchi Gupta. Prevalence and Severity of Sesame Allergy in the United States. JAMA Netw Open.2(8): e199144. 2 Aug 2019.



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