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RESEARCH PAPER

Development and Process Standardization of Functional Spread Using Sesame Seeds (*Sesamum indicum* L.), Pumpkin Seeds (*Cucurbita maxima*) and Sunflower Seeds (*Helianthus annuus*) and Storage Stability

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ABSTRACT

The present investigation entitled "Development and process standardization of functional spread from multi-seeds" was carried out in the Department of Food Technology, Parul University of Applied Sciences, Parul University, Vadodara, India. The functional spread was developed from multi-seeds like sesame seeds, pumpkin seeds and sunflower seeds and evaluated for their quality and storage stability. The developed product was analyzed for various physico-chemical attributes including, FT-IR technique used for ascertaining functional groups and morphology of spread. FT-IR spectra showed 3621.87 cm^{-1} which represent OH group, 3585.98 cm^{-1} are observed which showed NH2 groups present in product. 2934.21 cm^{-1} in which indicates the presence of aromatic carbon group present and 1639.29 cm^{-1} shows the presence of CO group present in the product. The developed functional spread was stored for 30 days at refrigeration (4°C) and ambient condition (18-38°C) in air-tight containers. The moisture content, ash, fat and protein was found to be 40.8 per cent, 1.5 percent, 23.46 per cent and 18.36 per cent respectively. At ambient temperature, the functional spread showed significant rise in its moisture content to 41.0 per cent. The ash content, fat and protein showed decreasing trend to 1.43 per cent, 23.40 per cent and 18.30 per cent respectively. The increase in moisture was less at refrigeration temperature i.e., 40.93 per cent. Also the fat, protein and ash content were decreased to 23.42 per cent, 18.33 and 1.45 per cent respectively. Thus refrigeration temperature could be regarded as better storage temperature as it could retain maximum amount of nutrients. The spread was best for consumption up to 30 and 15 days at refrigeration and ambient condition, respectively. The cost of production of spread was found to be cheaper than the spreads available in the market. The particular spread contains healthier ingredients without any animal fats in it. Therefore, it is recommended that the spread definitely have enhanced nutraceutical and anti-oxidant properties and the consumption of these food items could tackle the issues related to CVD, obesity and Vitamin-E deficiency.

HIGHLIGHTS

- Development of healthy and functional spreads.
- Rich in Anti-oxidants as prepared from multi-seeds.

Keywords: FT-IR, Antioxidant, Functional spread, Pumpkin seeds, Sesame seeds, Sunflower seeds

The phrase "functional food," describes processed meals that contain components which support certain bodily functions in addition to being nutrient-dense, was originally used in Japan in the 1980s (Bailey, 2009 and Berry, 2002). Functional food

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is any healthy meal that resembles conventional food in appearance, is consumed as part of a regular diet, and is said to offer physiological benefits like a health-promoting or disease-preventing quality in addition to serving as a source of nutrients. Functional foods can be processed foods fortified with a variety of components that do have a good impact on diseases and health, as well as raw foods created by genetic alteration, feeding trials, or other methods. Newer functional foods are being developed with global efforts (Kaur and Das, 2011). Butter, also known as spread and made from animal sources, is a common food consumed all over the world. Additionally, it has gained a strong position in the Indian market (Chawla, 2013). Due to its mouth-watering texture and creamy aroma, butter also regarded as spread is frequently consumed in a range of foods, including cakes, chocolates, ice cream, cookies, and more(Djekic and Miocinovic, 2014). Dairy substitutes are becoming more popular in the modern period due to social movements like veganism and brutality against animals, as well as considerations like excessive fat consumption and environmental implications. With special preparations and flavourings to mimic the buttery scent, feel, and texture, other oilseeds can also be utilised as a source of butter substitutes. Functional foods, nutraceuticals, dietary supplements, and other naturally occurring substances have been related to improving health and preventing disease (Labdeli *et al*., 2019 and Petrović *et al*., 2010). With 68% of the global production, India, Myanmar, China, and Sudan are the top sesame producers (Banerjee and Kole, 2009). It has been utilised in religious rites for ages in India, Egypt, and the Persian region (Joshi, 1961 and Weiss, 1971). Due to the high quality of its oil, sesame is known as the "queen of oilseeds" (Bedigian and Harlan,1986 and Bedigian *et al*.,1985). Sesame seeds include lignans such sesamin, sesamolin, sesaminol, sesangolin, 2-episalatin, and isomers of tocopherol, which are responsible for the sesame seeds' antioxidant capabilities as well as a number of other health benefits(Kamal-Eldin *et al*., 1994). Additionally, sunflower seeds are a great source of nutrients like calcium, copper, iron, magnesium, manganese, selenium, phosphorus, zinc, potassium, and sodium (Anjum *et al*., 2012). Oleic (C18:1) and linoleic (C18:1) acids are abundant in sunflower oil. As a result of these fatty acids' ability to lower LDL cholesterol and total cholesterol, the risk of coronary artery disease is reduced (Chowdhury *et al*., 2007). As a large source of lipids, proteins, carbs, and other elements necessary for maintaining good health, the *Cucurbita maxima* seed (pumpkin seed) is an important part of the human diet (Alfawaz, 2004). Honey is made from nectar, a sweet and viscous liquid that is gathered from plants. (White, 1975). It has been used as a sweetener on a global scale since antiquity. [Anonymous.1996- Food and Agriculture Organization] The antimicrobial, anti-inflammatory, and antioxidant properties of honey help to strengthen the immune system (Meda *et al*. 2004). Along with Sesame seeds, Pumpkin seeds, sunflower seeds and Natural sweetener-Honey, Cocoa powder have been used to impart a chocolaty Flavour to the spread. The primary ingredients of natural honey are sugar and water, but it also contains sizable quantities of enzymes, vitamins, minerals, and amino acids. Honey contains a small amount of enzymes. The main enzymes discovered in honey are diastase, invertase, and glucose oxidase because catalase and acid phosphatase are only sparingly present (White,1975). The two major sugars in honey are fructose (32.56-38.2%) and glucose (28.54-31.3%) (Ezz El-Arab, 2006). As its carbohydrates, honey has a ratio of 2.1:1.0 between fructose and glucose. Only minute quantities of other sugars, such as sucrose, reducing disaccharides, and higher oligosaccharides, are present (White, 1975). The amount of water in honey, how long it takes to separate it, and how it ripens all affect how long it will keep (Andrew, 2004). Honey's water activity ranges from 16 to 18.3% at temps between 40 and 100 degrees Fahrenheit (4 and 37 degrees Celsius). Numerous minerals and minor elements can be found in honey. Biomedical functions depend heavily on trace amounts of substances like (Al, Ba, Sr, Bi, Sn, Te, Tl, W, Sb, Cr, Ni, Ti, V, Co, Mo) and essential minerals like (P, S, Ca, Mg, K, Na, Zn, Fe, Cu, Mn) (Stocker, 2005). Fourier Transform Infrared (FTIR) Spectroscopy was employed to identify the functional groups present in the spread for the present research work.

MATERIALS AND METHODS

The present study entitled "Development and process standardization of functional spread using multi-seeds" was conducted under different

experiments in the Department of Food Technology, Parul Instituteof Applied Sciences, Parul University, Vadodara, Gujarat, India.

Procurement of Raw materials

Sesame seeds (*Sesamum indicum L.*), Pumpkin seeds (*Cucurbita maxima*) , Sunflower seeds (*Helianthus annuus*), Sesame oil, Honey and cocoa powder were procured from the local markets of Vadodara District of Gujarat and brought to Product Development Laboratory of Department of Food Technology, Parul Institute of Applied Sciences, Parul university, Vadodara. The ingredients were used to make the product (Functional spread) and for various physicochemical and nutritional analysis.

Treatment details

The present research was focused on the development of functional spread. The wholeresearch was divided into various experiments and sub-experiments. The experiments details are given below:

Table 1: Standardization of treatment blends

Treatment	Composition of Ingredients					
Treatments	Sesame seeds (%)	Pumpkin seeds (%)	Sunflower seeds (%)	Sesame oil (%)	Honey (%)	(Cocoa Powder) (%)
T_0	100 (Peanut)	—	—	—	20	—
T_1	50	25	25	15	20	5
T_2	33.3	33.3	33.3	15	20	5
T_3	25	50	25	15	20	5
T_4	25	25	50	15	20	5
T_5	40	30	30	15	20	5
T_6	30	40	30	15	20	5
T_7	30	30	40	15	20	5
T_8	60	20	20	15	20	5
T_9	20	60	20	15	20	5
T_{10}	20	20	60	15	20	5
T_{11}	70	15	15	15	20	5
T_{12}	15	70	15	15	20	5
T_{13}	15	15	70	15	20	5
T_{14}	80	10	10	15	20	5
T_{15}	10	80	10	15	20	5
T_{16}	65	15.	20	15	20	5
T_{17}	20	65	15	15	20	5
T_{18}	65	20	15	15	20	5
T_{19}	10	75	15	15	20	5
T_{20}	75	10	15	15	20	5
T_{21}	15	10	75	15	20	5

In order to standardize the recipe of developed functional spread a total of 21 treatments were carried out. The standardization was done with the help of 9 point Hedonic scale by trained panel comprising of Institutional faculties of Parul Institute of Applied Sciences, Parul University of Vadodara.

Preparation of product

Sunflower seeds and pumpkin seeds were soaked overnight (7-8 h) for enhancing its nutrient content and for development of creamy and soft texture. Sesame seeds, Soaked- sunflower and pumpkin seeds were taken in equal proportions respectively and roasted for 2 minutes individually after spreading on the tray in an oven at 160 °C. After that they were transferred to the mixer-Jar and grinded until a smooth consistency was achieved along with the addition of sesame oil, cocoa powder for chocolate flavor and honey as a sweetener. The prepared spread was collected and stored in an air-tight container.

Chemical analysis

To characterize food product in terms of chemical composition, traceability, safety, quality, sensory perception and nutritional value various parameters were analyzed. Moisture content, ash, crude fibre and carbohydrate were calculated by (Ranganna, 2009). Energy value was measured by bomb calorimeter. Crude fat and crude protein were estimated by AOAC (2012). Fourier Transform - Infrared Spectroscopy (FT-IR) was carried out as per the guidelines given by Stuart (2005) to identify the functional group present in the spread.

Sensory evaluation

Nine-point Hedonic scale method as given by Amerine *et al*. (1965) was followed for conducting the sensory evaluation of sample.

Cost of production of functional spread

Cost incurred for the purchase of raw materials like seeds, sesame oil, honey cocoa powder, polyethylene pouches and other materials was considered. An over-head charge on expenditure, manufacturing cost on machinery and equipment, building etc was included for the calculation of unit

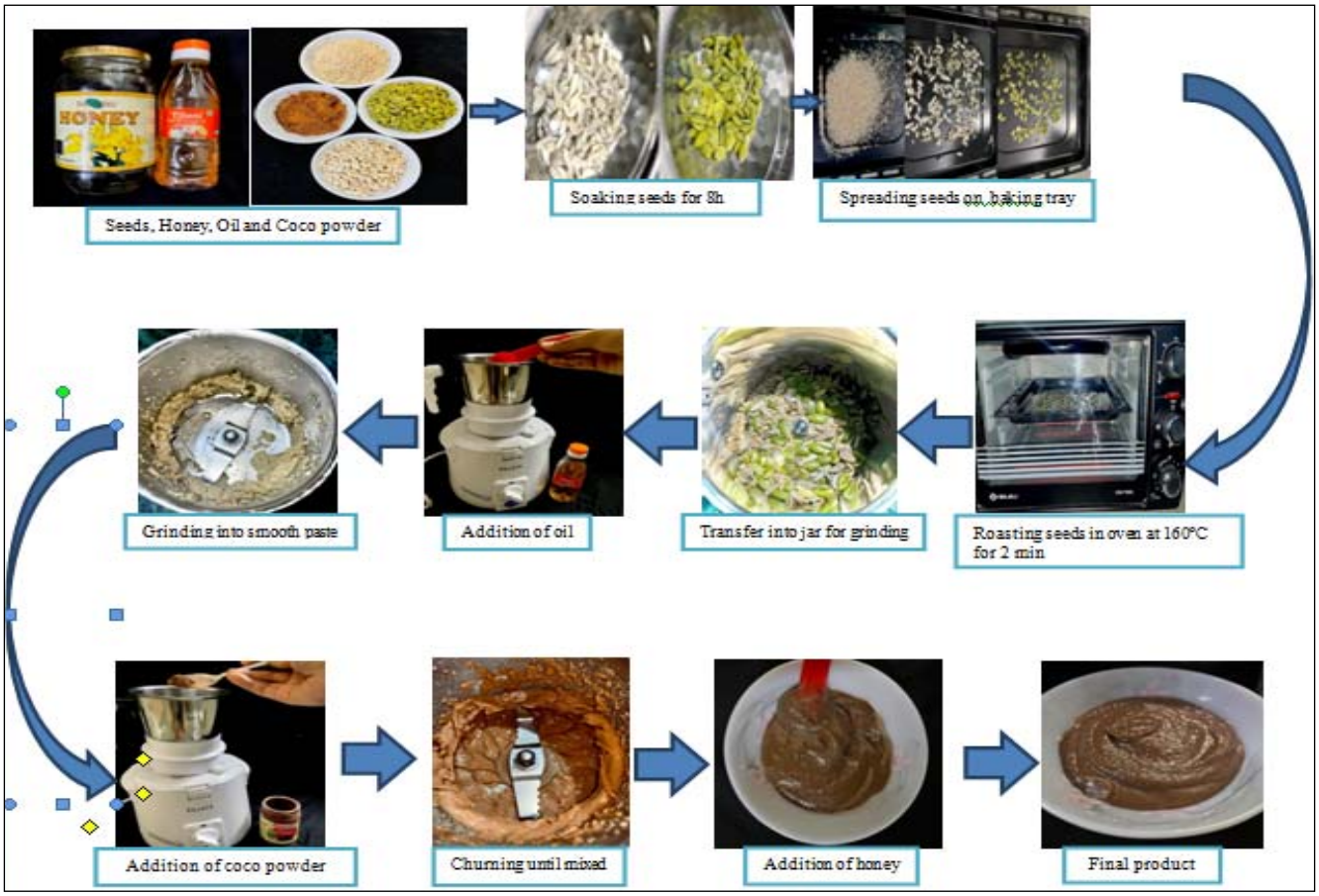

Fig. 1: Unit Operation of Development of Functional Spread

cost on product sale price of functional spread was calculated.

RESULTS AND DISCUSSION

The present research entitled "Development and process standardization of functional spread using multiseeds" was conducted under different experiments in the Department of Food Technology, Parul Instiute of Applied Sciences, Parul University, Vadodara, Gujarat, India during the years 2022-2023. The results of the study have been presented and discussed under different heads and sub-heads:

Table 2: Standardized blend for preparation of functional spread

Sl. No.	Ingredients	Quantity (g)
1	Sesame seeds	33.3
2	Pumpkin seeds	33.3
3	Sunflower seeds	33.3
4	Sesame oil	15
5	Honey	20 ml
6	Cocoa powder	5

Chemical analysis

Various parameters such as ash content, Moisture, crude protein, crude fat, crude fibre, carbohydrates and energy value were determined in order to understand the chemical composition of developed spread.

Table 3: Chemical composition of functional spread

Parameters	Amount (%)
Ash	1.5
Moisture	40.8
Crude protein	18.36
Crude fat	23.46
Crude fibre	4.59
Carbohydrates	52.09
Energy value	354.50 Kcal/100g

Table 2 depict moisture and ash content as 40.8 per cent and 1.5 per cent respectively. The obtained value of protein, fat, carbohydrates and fibre were 18.36, 23.46, 52.09 and 4.59 per cent respectively. The energy value obtained was 354.40 Kcal/100g.

Similar observations were recorded by (Mohammed *et al*. 2018).

Table 4: Minerals content in developed Functional spread

Minerals	Amount mg/100 g
Calcium	8.06
Magnesium	15.37
Iron	3.54
Zinc	1.3

Table 3 depicts the calcium, magnesium, iron and zinc content as 8.06, 15.37, 3.54 and 1.3 mg/100g respectively. Similar findings were recorded by (Mohammed *et al*. 2018).

1. FT-IR analysis

A well-known method for the identification and structural study of chemical compounds is fourier transformed infrared (IR) spectroscopy. The peaks in the FTIR spectrum of a sample correspond to the molecules' different chemical bonds and functional groups because they are caused by the molecules' vibrational modes being excited by the sample. Consequently, a compound's IR band is one of its most distinctive physical characteristics and can be thought of as its "fingerprint." Because a compound absorbs infrared energy proportionally to its concentration, infrared spectroscopy is a potent instrument for quantitative analysis. FTIR analysis was carried out for identification of functional groups and chemical compounds present in developed spread and its results are discussed here under.

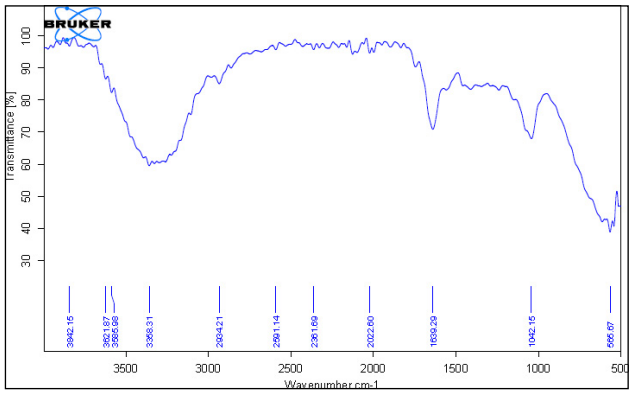

Fig. 2: FT-IR Analysis of functional spread

The results obtained in Fig. 2 shows FT-IR spectra 3621.87 cm^{-1} which represent OH group, 3585.98 cm^{-1} are observed which showed NH_2 groups present in product. 2934.21 cm^{-1} in which indicates the presence of aromatic carbon group present and 1639.29 cm^{-1} shows the presence of CO group present in the product. Similar observations have been recorded by (Donald *et al.*).

Storage studies

Table 5: Storage studies of functional spread at ambient temperature (25-27°C)

Parameters (%)	0th Day	10th Day	20th Day	30th day
Moisture	40.8	40.92	40.98	41.0
Ash	1.5	1.46	1.45	1.43
Fat	23.46	23.43	23.41	23.40
Protein	18.36	18.35	18.31	18.30

The functional spread showed significant rise in its moisture content from 40.8 per cent to 41.0 per cent. The rise in moisture content may be due to permeability of air and water. The ash content, fat and protein showed decreasing trend from 1.5 per cent to 1.43 per cent 23.46 per cent to 23.40 per cent and 18.36 per cent to 18.30 per cent respectively. Protein content might be decreased due to denaturation of protein.

Table 6: Storage studies of functional spread at refrigeration temperature (4°C)

Parameters (%)	0th Day	10th Day	20th Day	30th day
Moisture	40.8	40.83	40.88	40.93
Ash	1.5	1.49	1.48	1.45
Fat	23.46	23.45	23.43	23.42
Protein	18.36	18.36	18.35	18.33

The increase in moisture was less at refrigeration temperature from 40.8 per cent to 40.93 per cent. Also the fat, protein and ash content were decreased from 23.46 per cent to 23.42 per cent, 18.3 per cent to 18.33 and 1.5 per cent to 1.45 per cent respectively. Thus refrigeration temperature could be regarded as better storage temperature as it could retain maximum amount of nutrients.

Microbial evaluation

Initially microbial growth was absent. But as storage period time increased, slow microbial growth was recorded and total plate count (TPC) of functional obtained was 11,300 cfu/g.

Cost of production

Table 7: Cost of production of Developed functional spread

Ingredients	Rate /100g or 100 ml	Quantity required (g)	Amount (₹)
Sesame seeds	22	33	7.26
Pumpkin seeds	75	33	24.75
Sunflower seeds	40	33	13.2
Sesame oil	35	15	5.25
Honey	76	20	15.20
Cocoa powder	120	5	6
Miscellaneous	—	—	10
Processing charge	@ 10 % of total cost		8.66
Total Cost = ₹ 90.32			

The cost incurred in the preparation of functional spread was calculated by taking into consideration the cost of all inputs. The processing cost and other expenses including depreciation are added to the total expenditure. The sale price per 100 g of the product was calculated after adding 10 per cent processing cost. The total cost of the production was found out to be ₹ 90.32 /100 g for developed functional spread. The spreads available in market are costlier and as they are mainly composed of nuts such as peanuts and hazelnuts but people having nut allergies can't consume it. So, prepared spread from multi-seed is a cheaper and healthier option.

CONCLUSION

The functional Spread prepared with the use of oilseeds such as sesame seed and sunflower seed has a creamy odour and acceptable texture. It is regarded as healthy due to presence of beneficial ingredients in it. The oilseeds; sesame, pumpkin seeds and sunflower seeds are densely packed with antioxidants, Vitamin-E content and Tocopherol which is confirmed by FTIR analysis. The obtained values of moisture content, ash, fat, protein, carbohydrate and energy value of developed functional spread was observed to be 40.8 per cent, 1.5 per cent, 23.46 per cent, 18.36 per cent, 52.09 per cent and 354.50 Kcal respectively. This functional spread has calcium, magnesium, iron and zinc content as 8.06, 15.37, 3.54 and 1.3 mg/100 g respectively. On comparing the changes during storage at ambient and refrigeration temperature, it was found out that minimum changes in the parameters were observed at refrigeration condition. So, the refrigeration condition was considered the best for the storage of developed spread. In a nutshell, the ingredients involved offer a nutritious contribution to the habitual diet, with potentially beneficial effects over spreads available in market made out of animal sources; this plant based spread makes it a desirable food choice.

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REFERENCES

Alfawaz, M.A. 2004. Chemical composition and oil characteristics of pumpkin (*Cucurbita maxima*) seed kernels, *J. Food Sci. and Agric. Res.*, **4**: 5-18.

Amerine, M.A., Roessler, E.B. and Ough, C.S. 1965. The effect of pH and titratableacidity, *Am. J. Enology and Viticulture,* **16**: 29-37.

Andrew Renwick, 2004. ADA. *Use of nutritive and non-nutritive sweeteners,* **104**: 255-75.

Anjum, F.A., Nadeem, M., Khan, M.I. and Hussain, S. 2012. Nutritional and therapeutic potential of sunflower seeds, *British Food J.*, **114**: 544-52.

Anonymous, 1996. Food and Agriculture Organization-Value-added products form beekeeping.

AOAC, 2012. *Official Methods of analysis of AOAC International* 19th ed. Gaitherburg.

Bailey, R. 2009. Foods for Specified Health Use (FOSHU) as functional foods in Japan: Japan has a regulatory framework for the growing area of "functional foods". DOI: 10.1002/9780470277676.ch15.

Banerjee, P.P. and Kole, P.C. 2009. Analysis of genetic architecture for some physiological characters in sesame (*Sesamum indicum* L.) Euphytica, *J. Nutri. and Food Sci.*, **168**: 11-22.

Bedigian, D. and Harlan, J.R. 1986. Evidence for cultivation of sesame in the ancient world, *The J. Econ. Bot.*, **40**: 137– 54.

Bedigian, D., Seihler, D.S. and Harlan, J.R. 1985. Sesamin, sesamolin and the origin of sesame, *Biochem. Systematics and Ecol. J.*, **13**: 133-39.

Berry, C. 2002. Biologic: Functional foods, *Int. J. Med.*, **95**: 639-640.

Chawla, A. 2013. Production, Consumption and Exports, Book of Hindustan Studies and Services Limited, pp. 1–40. https://www.hindustanstudies.com/files/dairysept09report.pdf

Chowdhury, K., Banu, L.A., Khan, S. and Latif, A. 2007. Studies on the Fatty Acid Composition of Edible Oil, *Bangladesh J. Scientific and Indus. Res.*, **42**: 311-16.

Djekic, I., Miocinovic, J., Tomasevic, I., Smigic, N. and Tomic, N. 2014. Environmental life-cycle assessment of various dairy products, *J. Cleaner Prod.*, **1**: 64–72.

Donald, P., Gary, L., George, K. and James, V. 2009. Introduction to spectroscopy. Department of Chemistry, Western Washington University, **5**: 24- 106.

Ezz El-Arab, A.M. 2006. Effect of dietary honey on intestinal microflora and toxicity of mycotoxin in mice, *Bio. Med. Central Complementary and Alternative Med. J.*, **6**: 1-13.

Joshi, A.B. 1961. Sesamum. Indian Central Oilseed Committee-Hyderabad, Book, pp. 1-109.

Kamal-Eldin, A., Appelquist, L.A. and Yousif, G. 1994. Lignan analysis in seed oils from four sesamum species: comparison of different chromatographic methods, *J. Am. Oil Chemists' Soc.*, **71**: 141–45.

Kaur, S. and Das, M. 2011. Functional foods: An overview. *Food Sci. and Biotechnol.*, **20**(4): 861–875.

Labdeli, A., Zemour, K., Simon, V., Adda, A. and Merah, O. 2019. Pistacoa Atlantica Desf, a source of healthy vegetable oil, *J. Appl. Sci.*, **9**: 2552.

Meda, A. *et al.* 2004. Therapeutic uses of honey and honeybee larvae in Central Burkina Faso, *J. Ethnopharmacology*, **95**: 103-7.

Mohammed, Amna Hassan Ahmed, Soba, Rofida Mohammed Ahmed and Salma Elgahli Mustafa, 2018. Valuation of Nutritional Composition of Yoghurt Supplemented with Sesame Paste (Tahini), Sudan university, *Journey of Sci. and Technol.*, pp. 22-27.

Petrović, M., Kezić, N. and Bolanća, V. 2010. Optimization of the GC method for routine analysis of the fatty acid profile in several food samples, *Food Chem. J.*, **122**: 285–91.

Ranganna, S. 2009. Handbook of analysis and quality control of fruits and vegetables.

Stocker, A. 2005. Trace and mineral elements in royal jelly and homeostatic effects, *J. Trace Element in Med. and Biol.*, **19**: 183-89.

Stuart, B. 2005. Infrared Spectroscopy*: Fundamentals and Applications*. John Wileyand Sons. doi: 10.1002/0470011149.

Weiss, E.A. 1971. Sesame, castor and safflower-World crop series, Barnes and Noble, Leonard Hill Books, 901.

White, J.W. 1975. Physical characteristics of Honey; In Crane E, Honey A Comprehensive Survey-Heinemann- London, pp. 207-239.

White, J.W. 1975. Composition of honey; *In* Crane E (eds). Honey, a comprehensive survey. *London: Bee research Association and Chalfont-St Peter*, 4:157-206. https://www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/reference/ReferencesPapers.aspx?ReferenceID=681687