



# **Popular Products of Sesame (*Sesamum indicum* L.) Consumed in India and their Quality Concern**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Author PN collected the literature, written the manuscript and verified the references. Author MA suggested the topic and critically examined the manuscript. Author KA reviewed the quality concern and examined entire manuscript critically. All authors read and approved the final manuscript.*

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**Review Article**

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## **ABSTRACT**

Sesame is the most consumed oilseed available in different varieties in India. It is eaten as a whole seed, ground, roasted, powdered, oil, or defatted meal in preparation for traditional and popular ready-to-eat sweet and savory food items. It is used in household recipes, bakery items like biscuits, buns, bagel bread, weaning foods etc. Sesame seeds and its products are rich sources of energy, protein, iron, calcium, magnesium, zinc, antioxidants and essential fatty acids. The food products of sesame are available easily in rural and urban markets with a range of variety and forms. They are easily accessible and affordable for every income group. Consumers should be aware of the quality concerns of these products, which are generally sold in open packaging,

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causing health problems. They are sometimes not prepared hygienically, leading to microbial contamination of food products and causing ill effects. So this review is about the nutritional value of different ready-to-eat homestead and commercial sesame products available in the market and the quality concern, *i.e.*, nutritional and microbiological, regarding these products. Besides the quality attributes, their manufacturing under safe, hygienic conditions, packaging, and storage should be ensured to avoid health hazards. The products in which sesame is present in large quantities or one of the main ingredients are energy dense and rich in protein, fats, fiber, calcium, iron, zinc, magnesium, and manganese. Many sesame-based sweet products produced in unorganized sectors by small manufacturers were found to need improvement regarding microbial quality compared to the products with good preparation and packaging methods.

**Keywords:** Sesame; products; nutritional quality; quality concern.

## 1. INTRODUCTION

India is the second leading producer of sesame (*Sesamum indicum* L.) globally [1,2]. The crop is mainly grown in states of Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, Andhra Pradesh, West Bengal and Telangana. Different varieties of sesame seeds in India include white, brown, and black [3].

Sesame is a common ingredient in many food dishes and is widely used for nutraceutical [4-7], therapeutic [4,8], pharmaceutical [4,9,10,11], and for medicinal [12] purposes due to its antioxidative property. Its oil helps in managing the lipid levels [12,13], reduce hypertension [7,12,13], aids in atherosclerosis, arthritis, obesity, chronic renal failure [12], possess anti-cancer properties [8,10,14] and anti-degenerative properties [7]. Sesame is known for building immunity [14] and is very useful for people who have osteoporosis [15].

## 2. NUTRITIONAL QUALITY OF SESAME

Sesame seeds are the "queen of oilseeds" among oilseeds because they are an excellent source of macro and micronutrients [1-6]. Nutritionally sesame and its products are rich in energy, protein, calcium, iron, zinc, magnesium, and other micronutrients (Table 1) [3,16,17-24] and an excellent source of wholesome food. India has three common varieties of sesame seeds: white, brown, and black [3]. The energy content ranges from 507.65–519.60 kcal/100g, protein from 19.17-21.7 g/100g, fat 43.05-43.22 g/100g, iron from 13.90-15.04 mg/100g, calcium from 1174-1664 mg/100g, zinc from 7.77-8.59 mg/100g and magnesium from 328-390 mg/100g [3].

Sesame seed oil contain a good quantity of unsaturated fatty acids (such as linoleic acid,

oleic acid, palmitoleic acid, stearidonic acid, and traces of linolenic acid) and other beneficial fatty acids (such as gamma-tocopherol, sesamin, and sesamol) [24]. Folic acid is abundant in sesame seeds. It is consumed as sprouts and microgreens which is a good source of antioxidants [25,26]. Due to the presence of lignans like sesamol and sesamin, sesame is a functional food [4,27]. Sesame oil is utilized as an antioxidant and an antibacterial agent [4,28-30]. Most crops lack the amino acids valine, tryptophan, and methionine but sesame seeds are rich in these nutrients [1,30] and if used in combination, improve the nutritional quality of the food. The sesame oil cake, a by-product, is a good source of protein [31] and is used in culinary and confectionery foods [32]. Sesaminol diglucoside isolated from sesame cake found to have good scavenging of DPPH radical (diphenyl-1-picrylhydrazyl) and inhibits degradation of collagen in the body [33].

Besides the many benefits, sesame contains a significant amount of phytochemicals such as oxalate, phytate, tannins, fibers and other binding agents that can reduce bioavailability of minerals obtained from the seeds [34]. On reduction of antinutrients through use of various processings, the bioavailability of minerals can be increased. Therefore, it is necessary to reduce the antinutritional factors from oilseeds through processing for utilizing sesame seeds as a functional food in human nutrition [35,36].

Utilization of seeds in food preparations can be increased by various processing techniques like roasting [37-43], fermentation [40,44], germination [45-48] and microwave heating [49]. These techniques decrease the level of antinutrients, increase the bioavailability of macro and micronutrients, improve digestibility and increase shelf life of the product [50].

**Table 1. Nutritional quality of sesame (white) and popular food products of sesame available in the market**

Sesame product [Ref.]	Macronutrients (per 100g)						Micronutrients (per 100g)		
	Moisture (g)	Protein (g)	Fat (g)	Ash (g)	Fibre (g)	Carbohydrate (g)	Iron (mg)	Calcium (mg)	Zinc (mg)
Seed [3]	3.3	21.7	43.05	4.13	16.99	10.83	15.04	1238	7.7
Gajak [21]	3.01	13.65	33.0	3.17	2.09	45.69	6.39	1123.49	
Revadi [21]	3.4	14.75	33.57	2.41	2.13	43.75	6.20	1050.94	
Tilpatti [21]	2.91	13.05	32.92	2.39	1.80	46.89	5.33	997.83	
Biscuits [22]	3.67	11.92	16.72	2.87	4.46	64.03	1.55	82.02	1.65
Barfi [23]	23.67	6.52	21.58	1.93	4.43	44.9		520.50	

### 3. QUALITY CONCERN FOR CONSUMERS

Sesame is used in different forms in various food products worldwide. Many regional sweet products like *gajak*, *revadi*, *chikki*, *tilpatti*, *laddoos*, *barfi* etc. and savory preparations like *khaman dhokla*, *pulao*, snacks like chilli *paneer*, honey chilli potato, *chutneys* are prepared using sesame as a main or as garnishing ingredient. Combining sesame seed meals with either cereals or pulses results in developing value-added foods that can help improve daily diets nutritionally at affordable prices. It also enhances dietary diversity and helps fight malnutrition [51,52].

Sesame products are nutritionally superior and are energy dense as sugar or jaggery is added in many preparations. *Gajak*, *tilpatti*, *revadi*, *til laddoos*, biscuits, buns, bagel breads, *barfi* etc are popular and convenient ready-to-eat products of sesame mainly eaten during the winter season in India [21]. Sesame products are offered to deities on festivals, during winters and as *prasad*. Having higher shelf-life, these products are also used as gifts and during travel.

These products can cater to every age group significantly, including young children. Weaning foods are also prepared by combining sesame seeds to fulfill the nutritional needs in economically weaker section of people [53]. These products help in linear growth during infancy and adolescent.

#### 3.1 Manufacturing Practices

Sesame seeds are processed before making any food product. Many products are prepared with milk products like *khoa* or *mawa* as *laddoos*, *barfi* etc. or with jaggery or sugar. Sesame seeds are either roasted or ground and added with sugar or jaggery as the main ingredient. The products of sesame, like *gajak*, which is prepared by combining roasted sesame seeds and jaggery, and *revadi* which is roasted seeds in the shape of small drops with sugar or jaggery [21]. *Tilpatti* is a thin-cut sheet of roasted seeds prepared with sugar or jaggery syrup [21]. Sesame *barfi*, in which roasted seeds are prepared with concentrated milk, i.e., *mawa* [23]. Biscuits are prepared by combining wheat flour and sesame seeds [22]. However, it has been reported that the small-scale manufacturers generally do not follow hygienic practices during

processing and manufacturing that leads to heavy microbial load [21].

During the preparation of *gajak* with jaggery, melted jaggery is generally folded on a wooden pole, mixed with roasted sesame seeds, and beaten on the floor with a wooden hammer for mixing. Similarly, in the preparation of *revadi*, sesame seeds in small and flat drops of sugar or jaggery syrup are spread on the floor and dried. Due to hygroscopic nature of jaggery, it is highly prone to microbial contamination which may cause deterioration of the product [21,54-56]. The general condition of hygiene and cleanliness is deplorable at the site of preparation of the products.

#### 3.2 Microbial Contamination

A study on ready-to-eat spreads and dips of sesame revealed heavy microbial contamination during the processing and packaging of these food products. Consumers should know about these practices [57]. A study carried out on assessment of the microbial quality of sixty-three tahini (sesame paste) products revealed that products were poor in microbial quality when compared with local and international standards [58]. Sesame seed samples were found to have higher counts of a fungus producing mycotoxins that could provide health risks to the consumers [59]. The microbial quality of *gajak*, *revadi* and *tilpatti* locally prepared and available in the markets of Jaipur, India revealed that the products were contaminated with a total of 10 fungal species belonging to 7 genera namely *Alternaria alternate*, *Aspergillus candidus*, *A. flavus*, *A. niger*, *A. tamrii*, *Cladosporium oxysporum*, *Curvularia lunata*, *Macrophonia phaseolina* and *Rhizopus nigricans* [21]. The reason was improper handling during their preparation and production [21].

#### 3.3 Storage Conditions

The small-scale manufacturers generally stored the sesame products in polyethene bags or open trays. Road-side mobile vendors (*Thelewalas*) also store such products in open trays or glass boxes; small shopkeepers do not pack these products but keep them in covered boxes, while the big shopkeepers and departmental stores packed them in polythene bags. Many vendors sell the products of sesame available in open packaging. The unhygienic conditions may lead to microbial contamination of the products and unsafe to consume [21,60].

Therefore, to prevent biodeterioration and the development of mycotoxins, keeping good taste and acceptability of the products, storage and processing and packaging of sesame food products must be properly regulated using standard methods [56,60-62]. Good manufacturing practices (GMPs), HACCP, government regulations should be encouraged to prevent severe consequences [58].

#### 4. CONCLUSION

Sesame is a good source of vegetable oil with a healthy balance of fatty acids. It is a great functional food source to meet dietary demands because it is high in protein, calcium, iron, zinc, and magnesium and has good antioxidant activity. It is used in the food, pharmaceutical, medical, nutraceutical, and ayurvedic industries preparations. Sesame used in various homestead and commercial ready-to-eat food products which are available in the market are energy dense and rich in micronutrients. Since the poor hygienic conditions followed while preparing these food products at unorganized and small-scale manufacturing levels, the sensory and microbial quality becomes a serious concern. They are contaminated due to unhygienic practices during their preparation, manufacturing and storage.

Nevertheless, if the microbiological quality is not adequately maintained during the manufacturing process, it can cause great harm to the health of consumers. Every age group in every region of India eats various sesame seed food products, but the nutritional quality could be lowered because of faulty preparation, packaging, and storage. The physico-chemical properties of the products may also be altered. Looking at the nutritional importance of sesame as a food, correct processing methods in a hygienic unit with proper packaging and storage should be used following standard protocol to avoid health hazards. Single portion packaging may avoid the contamination of the products during handling as well as storage.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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