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## Nutritional quality of beetroot and multi seeds for chips

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### Abstract

An investigation was undertaken with fifty mustard genotypes to study the correlation and path coefficient analysis of twelve yield contributing characters. Correlation analysis revealed that seed yield per plant is positively and significantly correlated with harvest index followed by number of secondary branches per plant and number of siliquae per plant at genotypic level. Path coefficient analysis revealed that days to maturity, number of secondary branches per plant, number of siliquae per plant, siliqua length, 1000 seed weight, harvest index and oil content had direct positive effect on seed yield per plant. Whereas, days to 50% flowering, plant height, number of primary branches per plant and number of seed per siliqua had direct negative effects on seed yield per plant both at genotypic and phenotypic levels. Based on the results it has been concluded that harvest index, number of secondary branches per plant and number of siliquae per plant exerted high correlation and direct influence on seed yield per plant. These traits may be considered for selection and to improve the yield of mustard genotypes.

**Keywords:** Beetroot, sesame seeds, pumpkin seed and flaxseed etc.

### Introduction

Functional foods are defined as food or dietary components which are added to food products to increase the nutritional value and health benefits. The food is modified by increasing the concentration, addition or removal of a particular component as well as increasing the bioavailability of food<sup>[56]</sup>. Beetroot was originated in Asia and Europe. Eating beetroot chips, drinking beetroot juice and beetroot powder can provide an alternative and healthier option of replacing consumption of whole vegetables<sup>[41]</sup>. Functional chips are recently gaining popularity in the market as people want a healthier option for snacking which can provide the nutrition and as well as it is tasty. Women nowadays are suffering from many problems like menstruation cramps, pcos, pregnancy related problems, etc. Menstruation problems is one of the common problems suffered by women from the 19th century till now<sup>[80]</sup>. Craving of food is the desire to eat a specific food, which is mostly seen in women during their menstruation cycles. Cravings are majorly of unhealthy foods like sweet foods or salty snacks. It is mainly carbohydrate-based food because brain serotonin level gets depleted at the stage of ovulation cycle which can have adverse consequences on mood<sup>[49]</sup>. Modifying the simple chips with healthier options and incorporating it with different seeds to enhance the chips nutritive value.

### Beetroot

Beetroot is scientifically called *Beta vulgaris*L. and it belongs to *Chenopodiaceae* family. *Chenopodiaceae* family includes 1400 species divided into 105 genera. Species of genus beta are *B. vulgaris ssp. Maritima*, *B. vulgaris ssp. vulgaris*, *B. vulgaris ssp. adanensis*, *B. macrocarpa*, *B. macrocarpa Guss*, *B. Patula Ait*, *B. intermedia*, *B. intermedia Bunge*, etc<sup>[62]</sup>. The other commonly known names of beetroot are spinach beet, beet, garden beet, chard, white beet, and sea beet. Beetroot is most commonly used as salads, pickles, soups, boiled etc.<sup>[16]</sup>. Beetroot contains essential components like vitamins, minerals, phenolics, nitrates, Betalains, ascorbic acid and carotenoids, which have health promoting effects on the body<sup>[62]</sup>. Cultivation of beetroot is done for the production of food grade colour, sugar, functional agent and as snacks. Betaine plays an important role in conversion of homocysteine to methionine as the important amino acids can, therefore help in reducing the excess homocysteine levels from intestinal tracts. Betalains are nitrogen-containing, water soluble, yellow and red betalanic acid derived pigments which are of two classes; betacyanin (red violet) and betaxanthin (yellow orange). The colour that is extracted from the beetroot is used in food industries and is known as red beet root.

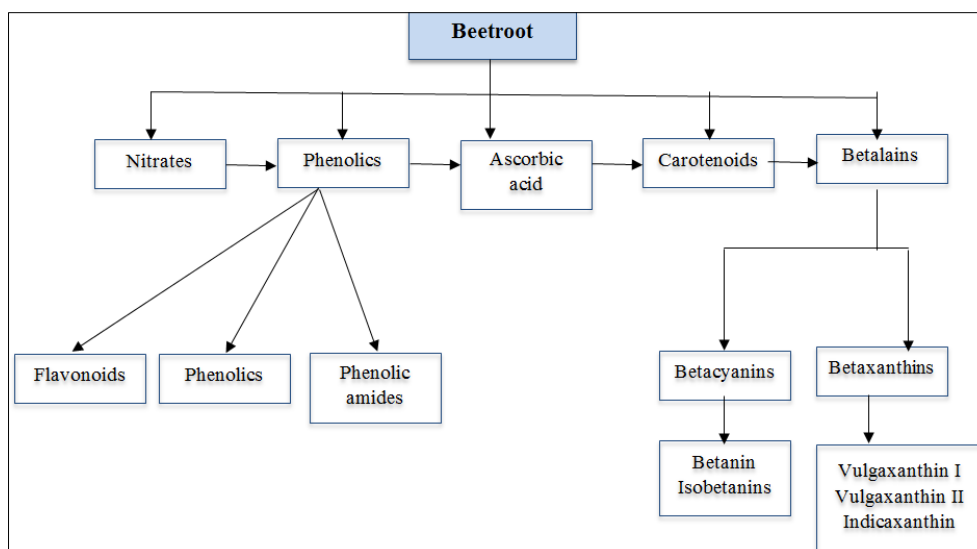
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These colours are then used to enhance the colour of soups, jam, jelly, breakfast cereals etc. [15]. Beetroot is also a good source of dietary fibre, manganese, potassium, amino acid and folic acid. The most popular human choice of beet is the red coloured beetroots [18]. Beetroot contains pigment called betalains which is composed of vulgaxanthin I, vulgaxanthin

II, Indica xanthin, betanin, prebetanin, neo betanin and Iso betanin and phenolic compounds [41]. Betalians present in the beetroot have high antioxidant and anti-inflammatory effects. Beetroot also benefits in blood pressure, cancer removal and also detoxification in the human body for relaxation.



**Fig 1:** Overview of potentially bioactive compounds in beetroot [82].

### Nutritional composition

Beet roots are said to be rich in carbohydrates, starch, proteins, soluble fibre and moderate caloric value, but it is low in fats. Vitamins that are found in beetroot are vitamin K, A, E, C, B complex vitamins are also present, like thiamine (B1). Riboflavin (B2), pantothenic acid (B5), niacin (B3), pyridoxine (B6), folate (B9) and cyanocobalamin (B12). Antioxidants present are betalains, carotenoids, coumarin, flavonoids, phenolic compounds, triterpenes and

sesquiterpenoids. Other bioactive compounds that are found in beets are saponin, alkaloids, amino acid (like leucine, isoleucine, lysine, valine, cystine, methionine, threonine, phenylalanine, arginine, glutamic, proline, alanine, and tyrosine) and tannins. Beetroot is a good source of minerals, like manganese, potassium, sodium, iron, zinc, copper, boron, silica, magnesium and selenium [48]. Even the leaves of the beetroot contain mainly excellent sources of vitamins and minerals like A, K, C and D [44].

**Table 1:** Nutritional composition of beetroot

Composition	Value Fresh beetroot tubes
Water (g)	91.3 ± 4.29
Protein (g)	1.89 ± 0.3
Carbohydrates (g)	7.23 ± 2.33
Fibre (g)	3.25 ± 0.55
Sugar (g)	6.76 ± 1.23
Total lipids (fat) (g)	0.15 ± 0.05
Ash (g)	1.08 ± 0.72
Alpha carotene (ug)	22.0 ± 2.0
Beta carotene (ug)	0
Betaine (ug)	128.7 ± 22.0
Folate (ug)	109
Niacin (ug)	0.334
Vitamin A	0
Vitamin B6	0.067
Vitamin C (mg)	7.2 ± 2.5
Sodium (mg)	78.0 ± 5.0
Potassium (mg)	325 ± 4.5
Phosphorus (mg)	40.00
Magnesium (mg)	23.0 ± 2.0
Calcium (mg)	16 ± 3.5
Manganese (mg)	0.359 ± 0.04
Zinc (mg)	0.365 ± 0.015
Copper (mg)	0.075
Iron (mg)	0.80

Source - [48]

### Dried beetroot powder

The fresh beetroot is washed, peeled, cut into pieces and dried. The drying of beetroot is done in a tray drier for approx. 60 – 65 °C for 7- 8 hours. Then the dried beetroot pieces are grinded in a grinder. The material is passed through a mesh and fine powder is obtained <sup>[57]</sup> as shown in figure 2. The dried beetroot powder has low moisture content present

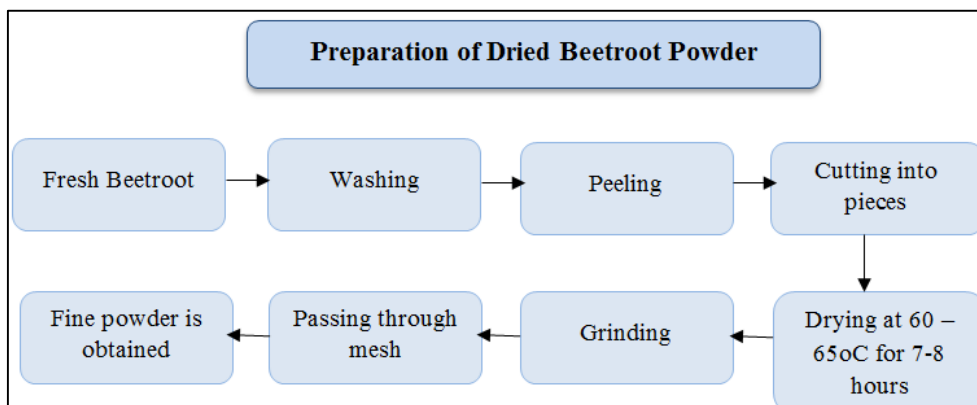


Fig 2: Preparation of dried beetroot powder.

### Health promoting properties of beetroot

Beetroot (red) is considered as a good source of natural antioxidants and is the most potent vegetable which comes in top 10 categories <sup>[75]</sup>. To get all the beneficial health properties, red beetroot must be consumed as raw, juice, boiled, baked as chips, salad or dried in any combination in various dishes <sup>[44]</sup>. Development of obesity is due to the oxidative stress and inflammation. Beetroot contains betalain pigment which has antioxidant activity <sup>[89]</sup>. Betaine inhibits lipid peroxidation in membranes or linoleate emulsions when it is catalysed by the "free iron" redox cycle (cytochrome c), H<sub>2</sub>O<sub>2</sub>-activated met myoglobin, or lipoxygenase, respectively <sup>[44]</sup>. Consuming red beets has the added benefit of preventing macular degeneration, which is linked to the presence of carotenoids, which are known to lower the risk of cataract formation. The nutrients and vitamins aid in the detoxification of the blood and liver and have the power to treat digestive, liver, and kidney diseases, especially the accumulation of fatty deposits in the liver brought on by alcohol abuse, protein deficiency, or diabetes. Natural minerals found in beetroot give bones strength <sup>[43, 67, 68, 4]</sup>.

### Wheat flour

Wheat is the staple food for the majority of the population in the world and is a good source of vegetable protein for the majority of vegetarians. Although wheat is frequently only seen as a source of calories, it also provides the human diet with important amino acids, minerals, and vitamins, beneficial phytochemicals, and dietary fibre <sup>[81]</sup>. According to their species, commercial types, and development habits, wheat is categorised. Based on them, there are sixteen species, three growth patterns, and two commercial varieties of bread (*Triticum aestivum*) and macaroni or Durum wheat (*Triticum durum*) (winter habit wheat, spring wheat and facultative wheat). Winter freezes cause winter wheat to go dormant <sup>[22]</sup>. Wheat has a viscoelastic property which is unique and a variety of food products are prepared using wheat. Although wheat may be quickly transformed into chips, it hasn't been the primary ingredient because it has a distinct flavour and

which helps to increase the bioactive compound present in it. High amount of powder can be incorporated in the product which will indirectly increase the nutritional properties of the product. The shelf life of the product also increases as growth of microorganism is restricted because of low moisture present in the food.

texture than traditional potato chips <sup>[31]</sup>.

### Nutritional composition of wheat flour

The three main components of wheat flour are starch (about 70–75%), water (14%), and proteins (10–12%). In starch, the normal concentrations of amylose and amylopectin are 25–28% and 75–75%, respectively <sup>[31]</sup>. Compared to wheat flour, potato flour has a lower amylose ratio and approximately 77% more starch, which results in distinct processing properties <sup>[38]</sup>. After hydration and mixing, the wheat proteins transform into three-dimensional viscoelastic wheat flour dough. These proteins can be divided into two categories: those that create gluten (including gliadins and glutenin's) <sup>[25]</sup>. Cereals are a good source of thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), and folates, among other B vitamins (B9). There has been much discussion on whether to fortify flour with folates (B9) on a voluntary or mandatory basis, but there is no consensus on this issue at the global level <sup>[48]</sup>.

Table 2: Nutritional composition of wheat flour

Nutrients	Amount per 100g of edible wheat flour
Protein (g)	12.6
Fat (g)	2.0
Carbohydrates (g)	68.5
Starch (g)	66.8
Total sugar (g)	1.7

Source - <sup>[71]</sup>

### Hormonal issues in women

There are many women in India who are suffering from many hormones related problems like PCOD, PCOS and irregular periods. If those issues are left untreated or ignored it will affect in future during pregnancy. Polycystic ovarian syndrome (PCOS) is prevalent in females of reproductive age. Women with PCOS may experience irregular or prolonged menstrual cycles or have elevated amounts of androgens, or male hormones. The ovaries could produce a lot of tiny fluid-filled sacs (follicles) but not consistently release eggs. Majority of study has been undertaken on the relationship

between lesser or highly consumed dietary nutrients and the common indicators of menstruation. This is because diet is important during the adolescent period and can have long-term impacts that can influence menstruation signs in young women [58]. However, dietary issues, particularly in adolescent girls, are a major public health concern and a risk factor for conditions including osteoporosis, anxiety and depression, as well as menstruation irregularities like amenorrhoea [72].

### Seed cycles

Seed cycling is a practice of eating a specific seed to support the key hormone of each phase in the menstrual cycle [12]. Seed cycling is one of the most effective ways in handling the hormonal balance in women. Seed cycle helps to increase the level of nutrients which are required for hormonal imbalance. Nowadays women are facing many issues related to the hormonal imbalance which are difficult to handle, problems like irregular periods, post menopause disbalance, acne, pcos, etc. Seeds also have different disease controlling properties, from cardiovascular problems to protecting against cancer. Adding them in products or making an easy way to incorporate them in daily life can decrease the level of women suffering from this issue. Products that can be made with seeds are laddoo, bars, chips, wafers, breads, etc. It can be added to our daily food like salads, smoothies, oatmeal, etc.

1. Follicular phase (Ovulation day 1-14) - Eating 1-2 tablespoons each raw and fresh grounded flax seeds and pumpkin seeds [12].
2. Ovulation - luteal phase (day 15 - 28) - Eating 1-2 tablespoons of each raw and fresh grounded sunflower and sesame seed [12].

### Working of seed cycle

Seed cycling can boost follicular phase levels of estrogen and luteal phase progesterone levels. The follicular phase, which lasts from days 1 to 14 (around the time of ovulation) in a typical 28-day cycle, is when your body produces oestrogen. We advise eating pumpkin seeds and flaxseed (1 tablespoon daily), which are high in phytoestrogens, a mild, naturally occurring form of oestrogen, during this phase. The luteal phase lasts from day 15 to day 28 and is characterised by a steady rise in progesterone levels (until your flow starts). During this period, it is advantageous to consume 1 tablespoon each of sunflower and sesame seeds since the high levels of zinc and vitamin E in these foods encourage the production of progesterone [12].

### Flaxseed

Flax is a blue flowering herb that produces flat seeds which vary from golden yellow to reddish brown colour. It belongs to a *Lineaceae* family [59]. Flax seed is also called linseed. These seeds contain oil which can be extracted and used for edible purposes [82]. It contains a high amount of dietary fibre and it is a significant source of omega 3 fatty acid. Omega 3 fatty acids are essential fatty acids which are very important for the body. Plant and animal sources including fish oil and flaxseed are rich in omega 3 fatty acid. Flax seeds contain short chain polyunsaturated fatty acids i.e., alpha linolenic acid (ALA). Alpha linolenic acid (ALA), lignans and fibre are the main bioactive compounds present in flax seed. There are four commonly found flaxseeds forms: - grounded flaxseed, whole flaxseed, partially defatted flaxseed and flaxseed oil [69].

### Nutritional composition

As flaxseed is the important source of omega 3 fatty acid in the vegetarian diet, therefore it is the alternative supplier for fatty acid [28]. The adequate intake of (ALA) is 1.6g/day for males and 1.1g/day for women. 30g of flaxseed provides 6g of ALA which is 2 - 3 times the amount adequate [9]. Flaxseed contains about 55% ALA, 20 - 30% of protein which is composed of mainly 80% globulins and 20% glutelin's and the fibre content is 35% [20, 74, 76]. The amino acid composition of flax seed is similar to soybean protein [59]. Flaxseed protein is rich in aspartic acid, glutamic acid and arginine, but limited in lysine [82]. Flaxseed is a rich source of lignans (phytoestrogens). Secoisolariciresinol diglycoside (SDG) is the major lignan present in flax seed. The major storage tissue of oil in flaxseed is the cotyledons, containing 75% of seed oil [76]. Flaxseed oil constitutes 98% triacylglycerol, phospholipids and 0.1% free fatty acids [61]. Flax seed is also a good source of minerals like calcium, iron, magnesium, phosphorus, zinc and very little sodium [82].

**Table 3:** Nutritional composition of flax seed

Nutrients	Amount per 100 g of edible flaxseed
Moisture (g)	6.5
Protein (g)	20.3
fat(g)	37.1
Minerals (g)	2.4
Crude fibre(g)	4.8
Total dietary fibre (g)	24.5
Carbohydrates (g)	28.9
Energy (kcal)	530.0
Potassium	750.0
Calcium (mg)	170.0
Phosphorus (mg)	370.0
Iron (mg)	2.7
Vitamin A (ug)	30.0
Vitamin E(mg)	0.6
Thiamine (B1) (mg)	0.23
Riboflavin (B2) (mg)	0.07
Niacin (mg)	1.0
Pyridoxine (mg)	0.61
Pantothenic acid	0.57
Biotin (ug)	0.6
Folic acid (ug)	112

Source - [69, 32]

### Health benefits of flaxseed

Flaxseed is considered most benefited in terms of medical uses. Supplementation of flax seed in foods is gaining popularity. Flaxseed contains bioactive compounds and functional ingredients which have beneficial effects on health like cardiovascular diseases, cancer, and diabetes, obesity, and bone disorder, renal and hormonal issues. Flaxseed has cholesterol lowering properties as it possesses antioxidant and hepato protective properties [18]. Flaxseed contains insoluble fibre which helps in cases like constipation, diverticular disease and irritable bowel syndrome as it has water binding capacity. It also increases the nutrient absorption by delaying gastric emptying [73]. Dietary flaxseed has exhibit protective effect against menopause problems. In a study it was reported that eating high dose of flaxseeds over longer duration decreased the menopausal symptoms [26]. Other studies reported that caution must be taken for flaxseed consumption during pregnancy and lactation as the SDG contained in flaxseed can reduce serum and milk triglycerides and

cholesterol level [86]. There is increased risk of osteoporosis in postmenopausal women. Most studies showed no effect of flaxseed consumption on bone density or bone turnover in postmenopausal women. In animal study it was seen that flaxseed results in an additional benefit when combined with estrogen therapy. ALA may improve the osteoporotic bone condition than lignan content in flaxseed [47].

### Flaxseed used in Bakery products

Flaxseed can be also incorporated into bakery products as whole, milled, grounded, roasted and also in the form of oil. Addition of flaxseed powder or whole flaxseed into snacks like chips, bread, cake etc. can enhance the texture and also give it superior taste with a nutty flavour [53]. It also gave a positive result and enhanced overall nutritive quality [54]. A study showed that incorporation of dietary flax seed in bakery goods like breads and muffins increased the ALA levels in blood. Other studies showed that milling flaxseed powder and storing them for 4 months did not cause any deterioration of quality [82].

### Pumpkin seed

Nowadays seeds are gaining interest due to their high nutraceutical and therapeutic value [23]. Pumpkin belongs to a family of *Cucurbitaceae* generally grown in tropical and subtropical regions. There are three types of pumpkin named "*Cucurbita pepo*, *Cucurbita maxima* and *Cucurbita moschata*" [48]. The pumpkin seeds contain bioactive compounds which have herbal remedial properties which help in curing different diseases [88]. Pumpkin seeds are rich in functional components like other seeds. It is high in vitamin E, carotenoids, pigment, pyrazine, provitamins, saponins, phytosterol, triterpenoids, phenolic compounds and derivatives coumarin, flavonoids, unsaturated fatty acids and protein [37, 78]. Moreover, pumpkin seeds are also good sources of magnesium, phosphorus and potassium, as well as minerals like zinc, manganese, calcium, sodium, copper, and iron. Pumpkin oil has been also used for cooking, dressing of salad and marinade. It has been used for many epicurean delight, chocolate, cereal bar, bread, pasta, pesto, muffin, soup, cake etc. It is extracted by steam distillation and cold press method. Promoting different food products primarily based on pumpkin seed, like vegetable salad, bread, quinoa bar, tortilla chips and cookies [80].

### Nutritional composition of pumpkin seed

Pumpkin seed is densely packed with all the principal functional ingredients and has a key role in disease prevention. 95% of fatty acids present in the seed are linoleic acid, oleic, stearic and palmitic and 75% are unsaturated fatty acids (UFA) [30]. The presence of unsaturated fatty acid in the pumpkin seed has a protective effect against cardiovascular disease and also has importance for growth and development of the brain and nervous system. Some research found that pumpkin seeds contain 41.59% oil, 5.34% carbohydrates, 25.4% protein, 5.2% moisture, 5.34% fibre and 2.49% ash [14]. The pumpkin seed is rich in potassium and relatively lower in sodium, high in manganese, calcium, magnesium and phosphorus. The trace metals zinc (Zn), iron (Fe), and copper are all present in pumpkin seeds (Cu). Minerals with antioxidant potential, such as Zn, Cu, Mn, and Fe, operate as cofactors in essential antioxidation. Depending on biocatalyst [60]. Researchers are paying close attention to pumpkin seed

oil since it has been shown to be a good source of phenolic chemicals, which have been linked to positive health effects in humans [52, 36, 41]. One study discovered that using pumpkin seed oil, which lowers lipid peroxidation and offers antioxidant defence against oxidative stress, helps pregnant women with MDA [70]. 100 milligrams of pumpkin seeds provide 446 calories in addition to 18.5 grams of protein, 3.2 grams of omega 3, 53.7 grams of carbs, and 19.4 grams of fat [15].

**Table 4:** Nutritive value of pumpkin seed (per 100 g)

Nutrients	Nutritional value
Moisture (mg)	56.74
Ash (mg)	3.54
Energy (kcal)	311.54
Carbohydrates (mg)	5.18
Total sugar (mg)	9.73
Protein (mg)	21.31
Fat (mg)	23.45
Total fibre (mg)	46.65
Ascorbic acid (mg)	15
Sodium (mg)	1.35
Potassium (mg)	434.71
Iron (mg)	6.02
Calcium (mg)	4.00
Zinc (mg)	18.78
Phosphorus (mg)	0.74
Copper (mg)	0.31
Manganese (mg)	1.35
Magnesium (mg)	4.35

Source - [64]

### Health benefits of pumpkin seeds

The bioactive component and minerals present in pumpkin seeds act simultaneously at different target sites and have potential health benefits, promote wellbeing and reduce the risk of diseases. Pumpkin seeds help in microbial infection, tumours, hyperglycaemia, oxidative stress, and prostate disorder and urinary bladder complications [1]. Pumpkin seed is a good source of vitamin E, the seed includes four tocopherol and tocotrienol isomers. Tocopherol and tocotrienol in pumpkin seed are antioxidants present which have an ability to deactivate highly reactive radicals [17]. Pumpkin seed also contains a valuable source of phytosterol. Number of studies have shown that the intake of phytosterol reduces the risk of cancer [84, 65] and ameliorates the treatment of prostate complications [84]. It is also a suitable alternative nutraceutical in management of some non-communicable disease in human beings [63, 87].

### Sesame seed

One of the oldest oilseed crops known to humankind is sesame (*Sesamum indicum* L), which belongs to the *Pedaliaceae* family. India, Sudan, China, and Burma are regarded as the top four producers, accounting for 60% of global production [2]. Sudan is the world's top exporter and third in terms of production. Sesame is becoming more and more significant as a source of high-quality protein and edible oil. Sesame is a crucial component of human nutrition. The majority of sesame seeds are used for extracting oil, and the remaining are consumed as food [29]. Sesame oil is recognised as an excellent vegetable oil and has a pleasant flavour [6]. The seeds can be eaten raw, dried, or combined with sugar. Some regional soups also use it as a paste. Foods' nutrient content

and bioavailability determine how nutrient-dense and nutrient-rich they are. Food ingredients that prevent the digestion, absorption, or another element of the metabolism of the nutrients included in the food are known as antinutritional factors. Oxalates and phytates, which are typically found in the seed hulls of raw sesame seeds, are antinutrients that can negatively impair the bioavailability of minerals in human nutrition [5, 3].

### Nutritional composition of Sesame seed

Sesame is a significant source of oil (50–60%), protein (18–25%), carbohydrates, and ash [6, 42, 45]. It can be processed by soaking, roasting, and germination before eating to improve their nutritional value. Sesame is abundant in antioxidant lignans and unsaturated fatty acids, such as Sesamin, Sesamol, and Sesaminol, which are also categorised as phytoestrogens [24]. Essential minerals like zinc, copper, magnesium, and calcium are abundant in sesame seeds. In addition, it has a significant amount of protein, fibre, antioxidants, and vitamin B complexes.

**Table 5:** Nutritional composition of sesame seeds (per 100g)

Nutrients	Nutritional value
Energy (kcal)	563
protein(g)	18.3
Carbohydrates (g)	25
Fat (g)	43.3
Dietary fibre (g)	16.8
Calcium (mg)	1450
Iron (mg)	9.3
Phosphorous (mg)	570
Zinc (mg)	12.20
Copper (mg)	2.29

Source - [8]

### Health benefits of sesame seed

Sesame seed is an important source of active ingredients used in antiseptics, bactericides, virucides, disinfectants, and antitubercular agents. It has been reported as a useful remedy for different treatment like oligomenorrhea, foetus abortion, increasing the sexual tendency and sperm count [35, 10, 34, 11, 58]. The findings of a study demonstrated that consuming sesame seeds can significantly improve uterine bleeding induction. The number of patients who experienced uterine haemorrhage after using sesame was 85%, which is a good response to therapy [55]. The results of another study showed that sesame seed consumption enhances testicular parameters in male rats, including fertility, sperm production, and LH levels. These parameters include the mean number and motility of sperms in the epididymis, the number and volume percentage of epithelial cells, the lumen and interstitial space, as well as the diameters of the tubules [7].

### Processing methods of chips

The methods for preparing chips include frying, baking, and microwaving. Most commercial chips are made by frying them at high temperatures (140–190 °C); as a result, they are rich in oil and can lead to overweight and other chronic illnesses. As a result, they have a detrimental impact on health-conscious consumers who favour low-calorie, nutritious foods [26]. However, consumers' attention has been drawn to baked chips as a healthier alternative to fried chips. Consumer demand for non-fried meals, especially among those who are concerned about their diet and health, is met by

baked chips made utilising dry air in the cooking line (140–190 °C, 3–10 min), which have less oil content [26, 46]. The food is internally heated by absorbing microwave energy during microwave cooking, and the chilly air around the meal tends to condense the food's evaporating water [21]. This cooking technique makes the food product less crisp and is not frequently employed in industrial production [75].

### Conclusion

Recently, numerous studies have been conducted and new food products are currently being developed that incorporate functional foods. In order to obtain all the nutrients from a single product, food products are made with various food ingredients or are multigrain. Beetroot, flaxseeds, sesame seeds, and pumpkin seeds were added to the chip to boost its nutritional content while also improving flavour and texture of the product. More work needs to be done in this field of product development to increase the variety of healthier options.

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