

# Oilseeds for better health

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## Abstract

Malnutrition and under-nutrition are serious problems in the developing countries of the world. As majority of population is vegetarian, the availability of good quality nutrition is reduced. Oilseeds are next to cereals in importance and are more energetic providing superior quality protein, essential fatty acids, vitamins and minerals. Oilseed protein is successful in combating protein energy malnutrition. Oilseeds like Soybean, Groundnut, Flaxseed, Sesame seeds and Niger seeds are utilized as food and in the preparation of value added and nutritious food products. They even have nutraceutical value. Various deadly diseases such as cardiovascular diseases, hypertension, diabetes and cancers can be prevented by the supplementation of oilseeds in regular diet. This article reviews the potential health effects of oilseeds. Oilseeds will gain greater attention in future as they are renewable and biodegradable in nature.

**Keywords:** Malnutrition; Oilseeds; Soybean; Groundnut; Flaxseed; Sesame seed; Niger seed.

## Introduction

Malnutrition and Undernutrition are serious problems in the developing countries of the world. The United Nations Food and Agriculture Organization estimated that one in eight people were suffering from chronic undernourishment in 2010-2012. According to FAO 2012, there are 16 million people undernourished in developed countries. Majority of the people in India are vegetarian, the availability of good quality nutrition especially protein is reduced. Among foods from plant origin, oilseeds are a concentrated source of energy. The defatted oilseeds meals contain more protein than most other plant and animal foods. Contrary to animal fats, vegetable oils contain higher proportion of unsaturated fatty acids and meet the dietary requirements of essential fatty acids.

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Oilseeds have been under cultivation since antiquity. The production of oilseeds is spread all over the world due to advances in the production and processing technologies. Oilseeds are those crops in which energy is stored in the form of oil. Oilseeds are leading suppliers of superior quality protein, specially vegetable oils and fat soluble vitamins like Vitamin A to nutritional products, natural foods and premium snack foods worldwide e.g. corn, oat, cotton, soybean, mustard, safflower, sunflower, peanut, rapeseed, coconut, oil palm and olives. Most of the oilseeds produced are used for oil extraction. In India, nine major oilseeds i.e. Groundnut, Rapeseed-mustard, Soybean, Sunflower, Sesame, Safflower, Niger, Castor and Linseed are produced. Out of these, five edible oilseeds i.e. Soybean, Groundnut, Flaxseed, Sesame seeds and Niger seeds are being discussed in this article.

As given by Indian Oilseeds and Produce Export Promotion Council (IOPEPC), the production of Indian Oilseeds (Million Tons):-

Table 1: Year-wise production of Indian Oilseeds (Million Tons)

Oil Seed	2013	2012	2011	2010	2009	2008	2007
Soy bean	-14	-13	-12	-11	-10	-09	-08
Soy bean	10.2	10.7	10.6	9.5	8.5	8.9	9.46
Ground nut	6.48	4.33	6.02	5.84	5.12	5.92	6.09
Sesame seed	0.65	0.60	0.76	0.75	0.76	0.58	0.66
Flax seed	0.12	0.11	0.13	0.16	0.16	0.13	0.10
Niger seed	0.07	0.08	0.09	0.1	0.08	0.08	0.07

## Soybean

Soybean (*Glycine max*) is an important oilseed belonging to the family *Leguminosae*, is grown as a food crop. Soybean is mainly cultivated for its seeds, used commercially as human food and livestock feed, and for the extraction of oil. Soybean the miracle bean is the base of healthy life. Soybean provides 446kcal and 20g fat per 100 g seeds. It provides 36g protein, 15.7mg iron and 277mg calcium. The average crude protein (CP) content of soybean is 38% with a rich and balanced amino acid profile most

of which tend to be deficient in cereal grains (Nahashon and Nthenge 2011). Recent reports also demonstrated that among the oilseed feed ingredients; soybean meal is the most digestible with its amino acid digestibility values ranging from 83 to 93% for Cysteine and Phenylalanine, respectively.

#### Food product development

Nine supplementary foods incorporating Defatted Soy Flour (DSF) at 20%, 30% and 40% levels were developed. Products with 20% DSF were more acceptable even after 15 days and 1 month storage. Crude protein, crude fibre and ash content increased from 14.91% to 15.78%, 0.42% to 1.41% and 1.15 to 1.57% respectively (Shah and Chawla 2005).

Biscuits produced with soy flour substitution, upto 25%, were nutritionally superior to that of the whole wheat flour biscuits. To obtain biscuits of high nutritional and organoleptic qualities, wheat flour could be substituted with 10% of soy flour. The soy flour added product biscuit has good shelf life (Awasthi et al. 2012)

#### Nutritional interventions and health benefits

A study was conducted on thirty five males (45-60 years) suffering from one of the risk factors- hypercholesterolemia, hypertension or obesity. Supplementation of the wheat flour chapattis with defatted soy flour in the ratio of 7:3 for 90 days showed significant reduction in the weight, Body Mass Index (BMI), Waist to hip ratio, Mid upper arm circumference (MUAC), Systolic and Diastolic blood pressure, Total cholesterol (TC), Low density lipoprotein- cholesterol (LDL-C), Very low density lipoprotein- cholesterol (VLDL-C) and Triglycerides (TGs) (Choudhary and Singh 2004).

In another research the effect of supplementation of Soybean on blood glucose and lipid profile in thirty Non Insulin Dependent female diabetics (40-60 years) was studied. They were given 125 g of instant wheat meal (100 parts whole wheat and 25 parts defatted soybean) daily for a month, as 45 g in breakfast, 40 g in mid morning and 40 g in evening tea. Results showed increased intake of protein (52 to 64g), fibre (28 to 31g) and zinc (7.5 to 9mg). Mean fasting and post prandial blood glucose levels reduced from 161 to 122mg/dl and 245 to 180mg/dl respectively. TC, LDL-C and VLDL-C also decreased significantly (Gulati and Kochhar 2004).

#### Groundnut (Peanut)

Groundnut or Peanut (*Arachis hypogaea*) belongs to *Leguminosae* family. It is known as The King of Oilseeds. India is the second largest producer of groundnuts after China. These are often referred as poor man's protein, when taken in adequate amounts in any form, will supplement rich nutrients to the body that can provide growth and energy, and play a vital role in the prevention of diseases.

#### Nutritional profile

Groundnut provides 567 kcal per 100 g. It also contains 44 to 56% oil and 22 to 30% protein on a dry seed basis and is a rich source of minerals. Groundnuts are reported to be a good source of resveratrol (200-250 ug/100 g), a phenolic compound which is known to possess significant anti- ageing effects and to reduce cardiovascular disease and risks of cancer (Asibuo et al. 2008).

They also provide an inexpensive source of high quality dietary protein and oil.

#### Food product development

Partially de-oiled peanut meal flour (DPMF) was blended with wheat flour for making biscuits at 5, 10, 15 and 20% levels. Chemical analysis of DPMF showed 30.26% crude protein, 10.1% crude fat and 43.65% carbohydrates. On a 9-point hedonic scale, the highest overall acceptability score of 8.6 was obtained with 5% fortification (Yadav et al. 2012).

Fifteen value added products for nutritional and health benefits were prepared by incorporating partially defatted peanut flour at different levels and the developed products were evaluated organoleptically for sensory attributes by using nine point hedonic rating scale. In all the products the acceptable percentage of peanut flour used was 5-50%. The acceptable percentage of peanut flour was 5% for soup, 10% for *mathi*, *tikki*, *vada*, *pancake*, *biscuits* and *kheer*, 15% for *halwa* and *dhokla*, 20% for *seviyan*, *idli* and *burfi*, 30% for *vadiya* and *papad* and 50% for *panjeeri* and overall acceptability score was 7.2 for soup, 7.56 for *mathi*, 8.47 for *tikki*, 8 for *vada*, 8.14 for *pancake*, 7.86 for *biscuits* and 8.51 for *kheer*, 8.3 for *halwa* and 8.04 for *dhokla*, 8.18 for *seviyan*, 8.13 for *idli* and 8.08 for *burfi*, 8.12 for *vadiya* and 8.4 for *papad* and 8.04 for *panjeeri*. The developed products were found to be highly nutritious in terms of protein, fiber, energy, iron, calcium, beta-carotene and ascorbic acid. Products were found safe even after 3 months of storage (Bansal and Kochhar 2013).

#### Nutritional interventions and health benefits

Inclusion of daily one oz (30g) handfuls of peanuts within a moderate fat diet can be recommended as a useful means not only to improve diet quality but also to assist with weight management, due to their satiating effects (Higgs 2005).

A study was conducted on fifty-four hypercholesterolaemic men with TC concentrations between 200 and 350 mg/dl by asking them to consume peanut supplements (about 77 g) with their habitual diet for 4 weeks. Compared with the habitual diet, peanut supplementation of the habitual diet significantly reduced TC/HDL cholesterol (HDL-C) ratio and LDL cholesterol (LDL-C)/HDL-C ratio. Peanut consumption increased HDL-C and total antioxidant capacity (TAC) (Ghadimi et al. 2010).

Table 2: Nutritional profile of the oilseeds

Oilseeds	Energy (kcal)	Protein (g)	Fat (g)	Iron (g)	Calcium (mg)
Soybean	446	36	20	15.7	277
Groundnut	567	25.3	40.1	2.5	90
Sesame seed	573	17.7	49.6	14.5	975
Flaxseed	534	18.3	42.2	5.73	255
Niger seed	515	24	39	56.7	300

#### Sesame seeds

Sesame, (*Sesamum indicum* L.), belonging to the family *Pedaliaceae* is an ancient oilseed crop. It is an annual crop cultivated in tropics to temperate zones. India is a major producer of sesame, followed by China, Myanmar and Sudan. There are 3 varieties of sesame seeds known: white, black and red. It is also known as gingelly, til, benne seed and popularly as "Queen of Oilseeds" due to its high degree of resistance to oxidation and rancidity. Sesame seed has a high food value because of its higher contents of good quality edible oil and nutritious protein.

### Nutritional profile

Sesame seeds provide 573 kcal and 18g protein, vitamin B1, dietary fiber as well as an excellent source of phosphorus, iron, magnesium, calcium, manganese, copper and zinc. Sesame seed is rich in polyunsaturated fatty acids (PUFA) e.g. palmitic and stearic and natural antioxidants. The seeds contain two unique substances, sesamin and sesamol which belong to a group of special beneficial fibers called lignans and have a cholesterol lowering effect in humans and prevent high blood pressure and increase vitamin E supplies in animals (Pathak et al. 2014). Sesame is very important as a protein source for human consumption due to presence of balanced amino acid composition, especially methionine. Thus, a diet enriched with this protein was found beneficial to patients suffering from kwashiorkor.

### Food product development

Defatted sesame seed flour was used to replace millet flour at 30, 40, and 50% for the preparation of biscuits. Protein content of the biscuits was significantly increased by replacement with sesame seed flour. Sensory evaluation results showed that the biscuits were highly rated for flavour (Alobo 2001).

Cookies were prepared from blends of wheat flour with 10, 20, 30 and 40% dehulled sesame seed meal. The protein content increased from 12.52% with wheat flour to 16.86% with 40% substitution (Inyang and Wayo 2005).

### Nutritional interventions and health benefits

The effects of sesame on lowering serum lipids and enhancing antioxidant capacity was studied in 21 hyperlipidemic patients by instructing them to consume their regular diet for 2 weeks before starting the experimental diet. The experimental diet with 40 g roasted sesame was consumed for 4 weeks and the regular diet followed for another 4 weeks. The results showed that the diet with sesame significantly decreased the levels of serum total cholesterol and low-density lipoprotein (LDL) cholesterol (Chen et al 2005).

A study was conducted to evaluate the effect of sesame (*Sesamum indicum* L.) in fifty Osteoarthritis (OA) patients; divided into two groups, namely control and sesame groups. Twenty-five patients in the control group received standard treatment while 25 patients in the sesame group received 40 g/day sesame by oral administration during 2 months of the study along with standard drug therapy. There was significant difference in pain intensity between the two groups after treatment. The present study showed a positive effect of sesame in improving clinical signs and symptoms in patients with knee OA and indicated the fact that sesame might be a viable adjunctive therapy in treating OA (Eftekhar et al. 2013).

### Flax seeds

Flax (also known as common flax or linseed), with the binomial name *Linum usitatissimum*, is a member of the genus *Linum* in the family *Linaceae*. It is a food and fiber crop that is grown in cooler regions of the world. This small brown or golden hard-coated flax seed provides all the essential nutrients. The health benefits of flax are often attributed to its omega-3 and fiber profiles.

### Nutritional profile

Flaxseed is known for its unique nutrient profile which provides 534 kcal and contains fat 42%, protein 18%, total dietary fibre 28%. Flaxseed contains 27% of fiber of which two-thirds is insoluble and one-third soluble. Insoluble fiber consists of cellulose, hemicellulose and lignin. Soluble fiber is in the form of mucilaginous material composed of polysaccharides and has proved to reduce cholesterol and regulate blood glucose (Tarpila et al. 2005). It also contains good amount of  $\alpha$ -Linolenic Acid (ALA), omega-3 fatty acid, protein, dietary fiber, lignan. Flaxseed proteins are relatively high in arginine, aspartic acid and glutamic acid whereas lysine, methionine and cysteine are limiting amino acid.

### Food product development

Cakes containing four different concentrations of flaxseed flour (5, 15, 30 and 45%) as partial replacement for wheat flour were prepared. Cakes made with 5, 15, and 30% of flaxseed flour, the most accepted by consumers, had dietary fiber levels ranging from 3.5 to 6.2 g and linolenic acid ranging from 445 to 2,500 mg per 100 g of the product (Moraes et al. 2010).

An energy bar sample was prepared with different levels of flaxseed (0–20%) in addition to cereals and pulses with varying levels of sweeteners (45, 50, and 55%) to deliver a nutritious food to the consumer. The energy bar with 20% flaxseed and 45% sweeteners showed the maximum energy (397.95 kcal), protein (12.41%), crude fat (11.86%), ash (1.65%), iron (3.77 mg/100 g), crude fiber (2.18%) and omega-3 as alpha-linolenic acid (22.50%, fatty acid basis) content (Mridula et al. 2013).

### Nutritional interventions and health benefits

A study was conducted to evaluate the effect of flaxseed Supplementation on blood lipid profile of sixty at risk coronary heart disease patients (40-60 yrs). The subjects were equally divided into three groups i.e. E1, E2 and C group. Flaxseed in powdered form was supplemented at the levels of 5 and 10g to E1 and E2 group respectively for 2 months while C group was not supplemented. After the study period, significant decrease in the energy intake was reported in E2 group, protein intake was significantly increased in E2 and C group and total fat intake reduced significantly in all three groups. A significant decrease in weight and BMI, reduction in BP, TC, TG in E1 and E2 was reported. An increase in HDL-C and Hb was also reported in E1 and E2 groups. No such changes were observed in C group (Gupta and Sachdeva 2008).

The effect of daily flaxseed consumption on glycemic index in obese men and women with pre-diabetes was studied. In this randomized, cross-over study overweight or obese men and postmenopausal women (n = 25) with pre-diabetes consumed 0, 13, or 26 g ground flaxseed for 12 weeks. Results showed glucose decreased on the 13 g intervention. Insulin decreased on the 13 g intervention but not the 26 g. Flaxseed intake decreased glucose and insulin and improved insulin sensitivity as part of a habitual diet in overweight or obese individuals with pre-diabetes (Hutchins et al. 2013).

### Niger Seeds

Niger (*Guizotia abyssinica*) is an oilseed crop cultivated in Ethiopia and India. The genus *guizotia* belongs to the family *compositae* (*Asteraceae*). It is a major oilseed crop of Ethiopia accounting for 50% of its total oilseed production and a minor oilseed of India accounting for 3% of its total oilseed production.

### Nutritional profile

Niger seed is a treasure trove of nutrients containing 483 calories, oil (30% - 40%), protein (10-25%), soluble sugars (12-18%), crude fibre (10-20%), moisture (10-11%) and ash (4%). Studies reported the vitamin and mineral content of Niger seed as 0.43 mg/100 g thiamine, 0.22–0.55 mg/100 g riboflavin, 3.66 mg/100 g niacin 50–587 mg/100 g calcium, and 180–800 mg/100 g phosphorus. Niger oil has a fatty acid composition typical for seed oils of the Compositae plant family (e.g. safflower and sunflower) with linoleic acid being the dominant fatty acid (up to 63%) together with palmitic acid (17%), oleic acid (11%), and stearic acid (7%). The oil from niger seed has been found to be a good source of phospholipids. The high level of vitamin K1 may be the most unique health promoting characteristic of oil.

### Food product development and interventions

A very few studies are available in relation to the food product development from niger seeds. A study conducted in Udaipur, Rajasthan aimed to assess the nutritional status and prevalence of anemia among college going girls (18-22 yrs) along with impact of dietary intervention. For dietary intervention, Niger seed ladoos were prepared and supplemented for four weeks. Results showed significant improvement ( $p < 0.05$ ) in the hemoglobin levels. Mean hemoglobin level of subjects before supplementation was  $8.42 \pm 0.37$  g/dl, which increased to  $11.16 \pm 0.37$  g/dl after completion of supplementation. The study confirmed that supplementation can rapidly improve iron status (Kumari and Bhatnagar 2011).

Traditional products such as chikki, laddoo and chutney powder were developed by substituting the major ingredients in the recipe by Niger seed. *Chikki* was best accepted at 50 per cent level of incorporation and 60 per cent level incorporation was best accepted for both *laddoo* and *chutney powder* (Byadagi and Geetha 2012).

### Conclusion

Besides cereals and pulses which form important sources of protein in the diet, oilseeds and oilseed meals represent an abundant and an important source of proteins which have not been fully utilised so far for supplementing human diet. To combat malnutrition, oilseeds can be supplemented in the food products. Incorporation of oilseeds in small amounts can be an effective measure in treating various diseases. Supplementing the routine diet with oilseeds will surely make us healthier.

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