INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 17, No. 1, p. 63-68, 2020

RESEARCH PAPER OPEN ACCESS

Exploring the prophylactic potential of sesame seed and flaxseed as a functional food

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Key words: Flaxseed, Sesame, Cancer, Diabetes, Cardiovascular Diseases.

http://dx.doi.org/10.12692/ijb/17.1.63-68 Article published on July 17, 2020

Abstract

Flaxseed or linseed *(Linumusitatissimum L.)* comes from the flax plant, an annual herb. Sesame *(Sesamum indicumis)* belongs to family Pedaliaceae. The main importance of flaxseed and sesame is in the human nutrition sector because it is emerging as an important functional food ingredient thanks to the content of active compounds, pointed to provide health benefits. This research was conducted to analyze effect of these oilseeds crops and their compositional analysis was performed. Moisture content of samples was about 12-13%. Fat was found to be about 40% in both. Similarly, protein was found about 18-19%, fiber content about 3-4% and ash was measured about 3-8%. phytochemical analysis of flaxseed and sesame was done TPC, DPPH and ABTS were found about 190.90 mg GAE/100g, 48.37 g/100g and 6.427% respectively The obtained data was statistically analyzed to check the level of significance. Conclusively, Sesame and flaxseed can be utilized as health improving ingredients because of their miraculous nature against diseases.

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Introduction

Changing dietary patterns and variations in processing parameters have resulted in certain health disparities. Inappropriate dietary habits, as a leading cause of poor health, have resulted in high morbidity and mortality across the globe (Tarik and Ramahi, 2010). In this context, functional and nutraceutical foods have emerged as a dietary intervention against various life style related disorders.

Their nutritional aspects are primarily in several areas as cancer, cardiovascular disease (CVD), aging process, diabetes and mental health (Tewfik and Tewfik, 2008). The nutraceutical and functional foods made positive impact on health as they contain bioactive components in products of interest (Shahidi and Naczk, 2004).

The living style of people has changed with advancement in technology and they are more conscious about their food.

The trend of consumers towards natural cure through dietary modification is the reason for the immense popularity of functional foods. The nutraceutical and functional foods have marked their importance being associated with positive impact on health and reducing the risk of disease along with other natural health products (Shahidi, 2009).

At present functional foods play a significant role in health promotion and disease prevention? The consumers demand has increased for a product with taste, safety, convenience and nutrition. Thus nutrition has emerged as added dimension in the chain of food product development (Shahidi, 2005). There are many foods which are associated with health benefits and are used or sold under a variety of names like designer foods, novel foods, medical foods, nutraceutical and functional foods.

Hyperlipidemia is an adverse condition that causes many health problems like obesity, diabetes and other heart diseases. Heart diseases have caused 50% of the victims in past years. Atherosclerosis is a major disorder caused by the oxidation of poly-unsaturated fatty acids. Antioxidants like β-carotene and vitamin E can be used to prevent CVDs and lipid per oxidation. Increase in platelet aggregation and hyperlipidemic play a vital role in the progress of cardiovascular diseases (Melander *et al.,* 2015).

Hyperlipidemic and CVDs cause deaths of around 17 million people annually around the globe. Moreover, one of the major reasons contributing to various lifestyles related problems is improper fat distribution in body. Increased level of cholesterol in blood plasma is the most important reason of chronic heart diseases. Disorder that results in increasing the cholesterol level is diabetes mellitus, cholestasis and also insufficiency of thyroid glands (Singha *et al.,* 2011).

These diseases can get worse due to disturbance in triglycerides and lipoprotein levels in serum. Taking an approximately linear relation between mortality and coronary diseases, with every 12 mg/dl increase in serum cholesterol level and observed death rate increased up to 12%.

In modern days, nutraceutical along with functional foods are being used as a diet therapy due to their health boosting effects. Scientists have discovered numerous bioactive compounds which play significant role to tackle many physiochemical problems. In addition, with natural products herbs and spices are also being used for their various medicinal characteristics (Shahidi, 2009).

Flaxseed (*Linumusitatissimmum*) is also name as jawas, alsi and aksebija which belongs to a family *Linaceae*. Canada has leading production of flaxseed (about 38% of worldwide production) followed by China, United States and India. Due to presence of bioactive compounds flaxseed is a useful source to produce functional food products (Pradhan *et al.,* 2010). Flaxseed is a potential source of linolenic acid and alpha-linolenic acid. These two polyunsaturated fatty acids are helpful in maintaining various physiological functions like cholesterol metabolism.

Flaxseed oil also has lipid lowering properties so it can be used as fish oil substitute. In comparison with soy protein and casein protein, flaxseed protein is beneficial in triglyceride levels and reducing plasma cholesterol (Bhathena*et al.,* 2002).

Chinese utilized the oil extracted from sesame during the 4th century as a remedy for diseases of gums and tooth aches. Oil of sesame seeds is well renewed to lower down the cholesterols because of its increased polyunsaturated fat volume other beneficial medicinal use of sesame include treatment for headaches, dizziness and blurred vision. Research in the current era points out that antioxidant rich foods are helpful in fighting against heart related problems and cancer. Therefore, plant driven antioxidants are of much concern. *Sesame indicum*L is used for savory purpose in the Asian cooking (Saydut*et al*., 2008).

Several previous studies illustrated that dietary sesame lignans show beneficial properties like lowering serum cholesterol and level liver damage, enhancing α- tocopherol availability, vitamin E activities, and reducing thiobarbituric acid reactive substance (TBARS), which plays a role in aging process by causing lipid per oxidation in membranes (Kato *et al*., 2005).

Materials and methods

The present project was conducted in University of Agriculture, Faisalabad. For the purpose, Functional and Nutraceutical Food Research Section situated in National Institute of Food Science and Technology (NIFSAT) was used. Efficacy trials and bio evaluation of sesame and flaxseed was done in order to probe their therapeutic potential against hyperlipidemic and its associated problems. Materials used during the study and protocols followed are as under;

Procurement of raw materials

Sesame and flaxseed were bought from local market to explore their potential against hyperlipidemic. Rats were purchased from University of Agriculture, Faisalabad for efficacy trials. Reagents and standards were procured from Merck (Merck KGaA, Darmstadt, Germany) and Sigma-Aldrich (Tokyo, Japan). Moreover, diagnostic kits of Cayman Chemicals (Cayman Europe, Estonia), Bioassay (Bioassays chemical Co. Germany) and Sigma-Aldrich were used.

Sample preparation

Straw, dust and small stones were removed from sesame and flaxseed in order to clean them. They were then grounded and resultant powder of both samples was checked for quality characteristics individually and then chemical as well as biological attributes of sesame and flaxseed powder were analyzed.

Proximate analysis

For each sample, three replicates were prepared. Then these samples were analyzed for their proximate composition including moisture content, ash content as well as crude protein, fat and fiber contents. Each procedure was performed according to respective protocols (AOAC, 2016).

Content of moisture

Both raw samples were dried in order to determine their moisture content, both raw samples were dried. For this purpose they were put in hot air oven and temperature used was 105±5 °C till constant weight. The method followed was according to guidelines of (AOAC, 2016).

Crude protein

According to the procedures of (AOAC, 2016) Method No. 984-13, Kjeldahl apparatus was used for determination of protein proportion of both sesame and flaxseed. Following the procedure, the sample in grounded form first digested with concentrated sulphuric acid and digestion mixture until the color became transparent green.

The composition of digestion mixture used was (K_2SO_4:$FeSO_4$:$CuSO_4$ as 100:5:10). Digested mixture followed the dilution up to 250 mL. In next step 10 mL of digested sample and 10 mL 40% sodium hydroxide were distilled using distillation apparatus. In a separate beaker, 4% boric acid solution was taken in which liberated ammonia from distillation apparatus was collected, using methyl red as an indicator. Resultantly, by the reaction of boric acid and ammonia, ammonium borate was formed. From this nitrogen percentage of the sample was determined. For this purpose, distillate was titrated against 0.1N sulphuric acid solution until color became light golden. Nitrogen percentage (N %) was then multiplied with constant factor 6.25 to calculate protein proportion.

Crude fat

Soxhlet apparatus, using solvent hexane was used to calculate content of fat of both raw materials according to procedure of (AOAC, 2016).

Crude fiber

To find out fiber in sample which is free of fat is used; it was then added in 1.25% sulfuric acid to digest it. It takes 30 min and then sample is digestion with 1.25% sodium hydroxide for determination of crude fiber content using LabconcoFibertechas explained in (AOAC, 2016). After this, sample followed the steps of filtration and washing with distilled water.

After washing filtered residue with distilled water, it was weighed and then was put in muffle furnace till grayish white ash was obtained.

The temperature of furnace used was 550-650 oC. The fiber content was then estimated by the difference in weight of samples before and after ignition.

$$\text{Crude fiber (\%)} = \frac{\text{Weight loss on ignition (g)}}{\text{Weight of sample (g)}} \times 100$$

Total ash

Samples were directly put in muffle furnace after charring to find out ash content at 550-600˚C (AOAC, 2016).

Nitrogen free extract (NFE)

In sesame and flaxseed samples, nitrogen free extract was estimated as follows:

% NFE = 100 - (% of crude protein +% of crude fat +% of crude fiber +% of ash)

Tests for phytochemical analysis

Total phenolic content (TPC)

According to procedures described by (Deng *et al*., 2013) the method applied was Folin-Ciocalteu method to find out TPC in sesame as well as flaxseed seeds. This method follows the mechanism to reduce phosphotungstin acid to phosphotungstin blue.

This enhances the number of aromatic phenolic rings due to which absorbance increases. Purposely, nine test tubes were prepared in which Folin-Ciocalteu's reagent in amount of 250 µL was added along with 750 µL sodium carbonate was put in each tube.

The concentration of sodium carbonate used was of 20%. In these test tubes, 50 µL of prepared extract was put. Then water in distilled form was added to make volume upto 5 mL. Test tubes were kept for two hours and then UV/visible light spectrophotometer at 765 nm was used for absorbance.

Samples were run against control which was prepared by same protocol excluding sample. Total polyphenols were calculated using formula and results expressed as Gallic Acid Equivalent. Formula used to calculate total phenolic content (TPC) is as under:

TPC (mg GAE/g) = Conc. of Gallic Acid × Vol. of Extract/ Weight of Sample

Concentration of gallic acid was taken in mg/mL. While units for volume of extract and weight of sesame or flaxseed were mL and g respectively.

Results and discussion

Proximate composition of flaxseed

Proximate composition includes moisture, fat, protein, ash and fiber percentage. These parameters play an important role to decide shelf life and commercial value of the product. Flaxseed was analyzed for its proximate composition. The results indicated that moisture content in flaxseed was found to be about 13.34% and fat content as 41.04%. Similarly other parameters including protein, ash, fiber and NFE were measured as 18.40%, 3.47%, 8.13 and 15.48% respectively. It was observed that flaxseed was found as a rich source of fat and fiber content. Results of our study were found similar to the study conducted by Arriel*et al.* (2006).

Table 1. Means of Proximate Composition (%) of Flaxseed Powder.

Parameter	Value (%)
Moisture	13.34±0.14
Fat	41.04±0.17
Protein	18.40±0.19
Ash	3.47±0.21
Fiber	8.13±0.13
NFE	15.48±0.38

Table 2. Means of Proximate Composition (%) of Sesame Powder.

Parameter	Value (%)
Moisture	11.08±0.18
Fat	51.23±0.29
Protein	17.67±0.24
Ash	4.55±0.16
Fiber	3.41±0.13
NFE	12.13±0.09

Proximate composition of sesame

Sesame was also analyzed for its proximate composition. The results indicated that moisture content in sesame was found to be about 11.8% and fat content as 51.23%. Similarly other parameters including protein, ash, fiber and NFE were measured as 17.67%, 4.57%, 3.41 and 12.13% respectively. It was observed that sesame was found as a rich source of content which was measured as 51.23. Results of our study were found similar to the study conducted by Hall *et al.* (2006).

Phytochemical profile of flaxseed powder

The results indicated that TPC in flaxseed powder was measured as 190.90 mg GAE/100g. DPPH was measured as 48.37 g/100g while ABTS was measured as 6.427 %. Our results were found similar to Roy *et al.* (2009).

Table 3. Means of Phytochemicals of Flaxseed Powder.

Parameter	Value
TPC	190.90±0.49 (mg GAE/100g)
DPPH	48.37±0.64 (g/100g)
ABTS	6.427±0.43 (%)

Phytochemical profile of sesame powder

Data in the table indicates that TPC was measured as 28.29 mg GAE/100g, DPPH was measured as 43.42 g/100g and ABTS was measured as 23.61 % in sesame powder. Sesame powder indicated lower values in case of TPC and DPPH while higher values in case of ABTS as compare to the flaxseed powder. Our results were found similar to Roy *et al.* (2009).

Table 4. Means of Phytochemicals of Sesame Powder.

Parameter	Value
TPC	28.29±0.37 (mg GAE/100g)
DPPH	43.42±0.73 (g/100g)
ABTS	23.61±0.58 (%)

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