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Physicochemical and Nutrient Analysis of Linseed (*Linum Usitatissimum)* Powder

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Abstract
Physical evaluation of drugs is an important parameter in detecting adulteration or improper handling of drugs. There is increasing awareness and general acceptability of the use of herbal drugs in today's medical practice. The nutrients essential for life are proteins, fat and carbohydrates, all contribute tocaloric content of the dietary, minerals including trace elements, vitamins and water. Numerous studies including same in man have demonstrated clearly that life may be sustained by nutrient mixtures. In the present study to examine the physicochemical and nutrient analysis of Linseed (*Linum usitatissimum*) powder. The physical characteristics shows that Length of the seed (5.30mm), Breadth of the seed (2.58mm), Width of the seed (1.20mm), Thousand grain weight (8.17g), Thousand grain volume (8.4ml) and Hydration capacity and index (26.94g). Significant amount of Carbohydrate, Protein, Fibre, Calcium Iron and Vitamin C were found to be raw, autoclaved, boiled and roasted linseed powder. The results of the present study concluded that raw, autoclaved, boiled and roasted linseed powder has good nutrient values.

Keywords: *Linum usitatissimum,* Physicochemical, Nutrients, Seeds

1. Introduction
Energy availability is vital for human development and is the prime mover of economic growth. As population increases and economic growth continues, the demand for energy will further rise. Since agriculture, services and industrial sectors are all driven by power, there is an ever increasing need to generate more power.
India is the seventh largest country in the world with an area of 3.3 million sq. km. and population of about 1.2 billion. As of today, a significant segment of this population does not have access to electricity and other clean fuels, and those who have electricity available to them face shortages of it regularly. According to the Central Electricity Authority estimates, the peaking shortage prevails in various regions of the country from 1.3% up to 26.1% [1]. As the economy grows and more people are provided access to electricity, this gap between demand and supply will further increase. India's primary energy consumption more than doubled between 1990 and 2011 to nearly 25,000 PJ. India's dependence on imported energy resources and the inconsistent reform of the energy sector are challenges to satisfying rising demand.

2. Need of Nuclear Power
The constant physical evaluation of drugs is an important parameter in detecting adulteration or improper handling of drugs. There is increasing awareness and general acceptability of the use of herbal drugs in today's medical practice. Although, most of these applications are unorthodox, it is however a known fact that over 80% of the world population depends on herbal medicines and product for healthy living. This rise in the use of herbal product has also given rise to various forms of abuse and adulteration of the products leading to consumers' and manufacturers' disappointment and in some instances fatal consequences. The challenge is innumerable and enormous, making the global herbal market unsafe [1]. The nutrients essential for life are proteins, fat and carbohydrates, all contribute tocaloric content of the dietary, minerals including trace elements, vitamins and water. Numerous studies including same in man have demonstrated clearly that life may be sustained by nutrient mixtures in which every component is definable chemically and soluble in water [2]. The quality and quantity of protein in the seed are basic factors important in the selection of plants for nutritive value, systematic classification and plant improvement programs [3].
The plant is a biosynthetic laboratory for multiple types of compounds including phytochemicals, vitamins and minerals. These compounds are responsible for medicinal properties of it. A systematic study of a crude drugs obtained from plants leads to the discovery

of new products with pharmaceutical importance. It is highly important to ensure quality and purity of herbal medicines in order to maximize the efficacy and minimize the adverse side effects. Correct identification and quality assurance of the starting materials is an essential prerequisite to ensure reproducible quality of herbal medicine [4]. In this context, present study has been undertaken to evaluate the Physicochemical and nutrient analysis of Linseed (*Linum usitatissimum*) powder.

2. Materials and methods

2.1. Assessment of physical parameters of linseed

Physical appearance of grain is an important characteristic which determines consumer acceptability, and hence the study of physical characteristics of the grains becomes a basic step in any research.

*Size***:** The size such as length, breadth and width of the seed was measured using vernier calipers to the nearest of 0.01 mm.

Thousand Seed weight

Thousand seed weight was measured by counting 100 seeds and weighing them in an electronic balance to an accuracy of 0.001 g and then multiplied by 10 to give mass of 1000 seeds.

Thousand grain volume

Thousand randomly selected grains were dropped in a measuring cylinder containing known volume of distilled water. The difference in volume was recorded in ml.

Hydration capacity/ index

Hydration capacity was calculated as the difference in weight of seeds after soaking for 24 hours. It was expressed as weight per gram [5]. Hydration index was calculated by using the formula given by [6].

$$\text{Hydration index} = \frac{\text{Hydration capacity per 1000 seeds}}{\text{Original dry weight of 1000 grains}} \times 100$$

2.2. Physiochemical properties of linseed powder (LSP)

Physiochemical analysis is a method of investigating physiochemical system that makes possible to determination of the nature of the interactions between the components of a food and the physical properties and composition of the food. The principles of physiochemical analysis were established in the late 19th century by J.Gibbs.

a) Physical properties of processed linseed powder

The physical properties of the all processed linseed powder were analyzed. The physical characteristics such as rehydration ratio, water absorption capacity, oil absorption capacity and bulk density of the processed linseed powder were analyzed.

2.3. Rehydration characteristics

Rehydration quality of linseed powder was determined by rehydration test [7]. Ten gram of dehydrated samples were placed in glass beakers, 200 ml of water was added and heated at 40-45^{o} c for 60 min. The excess water was drained off through filter paper (Whatman Nr 4). The drained samples were weighed. Rehydration (Rr)

$$Rr = \frac{C}{D}$$

C=Drained weight of rehydration sample, D= Weight of hydrated sample

Bulk Density (BD)

The BD of the seed powder was determined by the method of Ige *et al.* [8]. A specified quantity of the sample was put into an already weighed 5 ml measuring cylinder (W1); it was gently taped to eliminate air spaces between the powder in the measuring cylinder and the volume was noted. The new mass of the sample and sample was determined. The BD was computed as

BD = W2-W1

Vol. of sample used

Water and Oil absorption

These were determined as described by Beuchat [9]. The powder (1g) was mixed with 10 ml distilled water for water absorption and 10ml of oil for oil absorption in a Kenwood blender for 30 seconds. The samples were then allowed to stand at 25ºC for 30min and centrifuged at 3500ppm for 30min. The supernatant was decanted and discarded. The weight of water or oil absorbed by 1g of flour was calculated and expressed as water or oil absorption capacity [9, 10].

2.4. Chemical analysis of processed linseed powder

Chemical Characteristics like Proximate composition and fatty acids profile of the all processed seeds powder was done.

Moisture

A known amount of sample was weighed into a previously weighed moisture cup and dried in an oven at 60ºC to a constant weight (Anon, 2003) and moisture content calculated as follows:

$$\text{Moisture (\%)} = \frac{\text{Weight of sample before drying (g)} - \text{Weight of sample after drying (g)}}{\text{Sample weight (g)}} \times 100$$

Protein

The nitrogen content of the processed linseeds powder was assessed by Kjeldahl method using Pelican Kelplus equipment. Protein was calculated by multiplying with a factor 6.25 [11].

$$\text{Protein (\%)} = \frac{\text{Titre value-Blank x N. of HCl x 14.007 x 6.25}}{\text{Sample weight (g)}} \times 100$$

Carbohydrate Content

The total carbohydrate content was determined (Egan *et al.*, 1981), by the formula;

Carbohydrate (%) = 100-(% Moisture+ % Proteins + % Lipids +% Ash).

Determination of vitamin and mineral composition

Vitamin C (mg) was determined using AOAC method. Calcium was determined using Jenway Digital Flame Photometer (PFP7 model). Iron content was determined using NIN method. All the estimations were done in triplicates and a comparison of the nutritive value of the dried samples was done to find out the best method of processing.

3. Result and discussion

3.1. Physio-chemical characteristics of selected linseed

Physical characteristics of processed linseed

The physical characteristics of the selected linseed like thousand grain weight, thousand grain volume and hydration capacity and index are given in table-1.

Table 1: Physical characteristics of Linseed

Sl. No	Physical Characteristics	Raw
1	Length of the seed	5.30mm
2	Breadth of the seed	2.58mm
3	Width of the seed	1.20mm
4	Thousand grain weight	8.17g
5	Thousand grain volume	8.4ml
6	Hydration capacity and index	26.94g

The length, breadth and width of the linseed were 5.30mm, 2.58 and 1.20mm respectively while thousand grain weight of the linseed is 8.17g, thousand grain volumes is 8.4ml and the hydration capacity is 26.94g respectively.

Kernel size and shape may be important for domestic processing of pumpkin seeds. The variability in size and shape affect cooking time and cooking uniformity between and within the accessions [12], observed that not all the seeds cook at the same rate.

3.2. Physical characteristics of selected Linseed powder

The Physical characteristics of selected Linseed powder such as drying ratio, rehydration ratio, bulk density, water absorption capacity and oil absorption capacity is shown in table-2.

Table 2: Physical characteristics of selected Linseed powder

Sl. No	Physical parameters	Amount			
		Raw	Autoclaved	Boiled	Roasted
1	Drying ratio	24	27	25	30
2	Rehydration ratio	15.60	12.36	12.02	17.36
3	Bulk density	4.6	4.4	4.5	4.8
4	Water absorption capacity	6.3	6.5	6.7	6.8
5	Oil absorption capacity	2.3	2.4	2.3	2.0

Results of Dehydration ratio of the processed linseeds were 24 in raw, 27 in autoclave, 25 in boiled and 30 in roasted linseeds. Based on rehydration ratio raw, autoclave, boiled and roasted seeds were 15.60, 12.36, 12.02 and 17.36 respectively. The water absorption capacity of the processed linseeds were 6.3 in raw, 6.5 in autoclaved, 6.8 in roasted and 6.7 in boiled seeds respectively. Bulk density of the processed linseed was 4.6, 4.4, 4.5 and 4.8 in raw, autoclave, boiled and roasted linseeds respectively. Regarding oil absorption capacity of the linseeds were 2.3, 2.4, 2.3 and 2.0 in raw, autoclave, boiled and roasted linseeds respectively.

The differences in the water absorption capacities may be explained by their respective contents of hydrophilic constituents such as carbohydrates, which bind more water than protein and lipids [13] explained that both carbohydrates and lipids are soluble in water, probably due to the fact that water (as a medium) aids in the breakdown of complexes of starch and protein in to their simpler forms (that is, mono saccharides and amino acids). It also could be attributed to the high content of lipids and proteins in the flour. The water absorption capacity depends on the hydrophobicity of proteins and the polar amino-acids are the preferred sites of the interactions between water and proteins [14]. When the lipid content is high in the flour, the water absorption decreases because lipids block the polar sites of the proteins attenuating the absorption of water [15].

3.3. Nutrient profile of Linseed Powder

The nutrient content of the raw, autoclaved, boiled and roasted linseed powder is shown in the table-3.

Table 3: Nutrient analysis of Linseed powder

Sl. No	Nutrient	Raw	Autoclaved	Boiled	Roasted
1	Moisture (%)	4.37	1.92	3.23	1.54
2	Carbohydrate (g)	33.05	29.53	23.94	27.60
3	Protein (g)	23.93	24.75	24.43	25.58
4	Fibre (g)	3.21	3.12	2.81	2.62
5	Calcium (mg)	263.95	295.85	297.1	297.25
6	Iron (mg)	11.70	15.45	12.61	14.01
7	Vitamin C	600	500	400	500

The nutrient content of raw linseed powder indicate that the moisture 4.37%, carbohydrate 33.05g, protein 23.93g, fibre 3.21g, calcium 263.95mg, iron 11.70mg and vitamin C 600mg respectively. The nutrient content of autoclaved linseed powder indicate that the moisture 1.92%, carbohydrate 29.53g, protein 24.75g, fibre 3.12g, calcium 295.85mg, iron 15.45mg and vitamin C 500mg respectively. The nutrient content of boiled linseed powder indicate that the moisture 3.23%, carbohydrate 23.94g, protein 24.43g, fibre 2.81g, calcium 297.1mg, iron 12.61mg and vitamin C 400mg respectively. The nutrient content of roasted linseed powder indicate that the moisture 1.54%, carbohydrate 27.60g, protein 25.58g, fibre 2.62g, calcium 297.25mg, iron 14.01mg and vitamin C 500mg respectively. The earlier study conducted by [16] in which he has found significant improvement in the proximate composition (ash, fat, protein and fiber) of full fat flaxseed flour supplemented with whole wheat flour [17] reported about 28% dietary fiber in flaxseeds.

Results of the study demonstrated that physical characteristics shows that Length of the seed (5.30mm), Breadth of the seed (2.58mm), Width of the seed (1.20mm), Thousand grain weight (8.17g), Thousand grain volume (8.4ml) and Hydration capacity and index (26.94g). Significant amount of Carbohydrate, Protein, Fibre, Calcium Iron and Vitamin C were found to be raw, autoclaved, boiled and roasted linseed powder. The results of the present study concluded that raw, autoclaved, boiled and roasted linseed powder has good nutrient values.

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