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Studies on effect of different processing treatment on nutritional quality of sorghum, green-gram and sesame seed

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Abstract
The present study done to determine the effect of processing parameters on the nutritional quality of sorghum, green-gram and sesame seed along with it, physical properties and proximate composition of these respective ingredients were analysed. Sorghum, green-gram and sesame seed were physiochemically analysed before pre-treatments as colour, shape, 1000 kernal weight, bulk density, true density, angle of repose (º) and proximate analysis for moisture content, protein content, crude fat, total carbohydrates and fiber content. Fiber content were observed as 1.7% in sorghum, 3.4% in green gram and 3.9% in sesame seed. Various treatments like flaking of sorghum, malting of green gram and roasting of sesame were done to observe the effect on nutritional composition. It was observed that after flaking of sorghum fiber content increases significantly from 1.7 to 2.8%, and malting increases fiber from 3.4 to 4.3% in green gram; effect of malting on green gram as protein, carbohydrate increases while moisture, ash, fat reduced. Roasting of sesame shows reduction in moisture content, protein, ash and fiber while increase in crude fat and carbohydrate.

Keywords: Sorghum, green gram, sesame seed, flaking, malting, roasting, physical properties, proximate composition

Introduction
The king of millets, sorghum (*Sorghum bicolor* (L.) Moench), is an important food crop in the dry regions of tropical Africa, India and China. After rice, wheat, corn and barley, sorghum is the fifth major cereal crop in the world. More than 750 million people who live in semi-arid tropical countries of Africa, Asia, and Latin America eat sorghum as their primary cereal food (Verma *et al.*, 2018) [19].

Sorghum is one of the primary food crops in many states of India and it is especially popular in non-irrigated dry land regions with little rainfall. It is primarily grown in dry and semi-arid areas. The immense plains of North America, sub-Saharan Africa, north-eastern China, the Deccan plateau of central India, Argentina, Nigeria, Egypt and Mexico are the current major sorghum producing countries (Shingote *et al.*, 2021) [13]. Sorghum is rich source of fiber as well as other nutrients like carbohydrates (70-75%), protein (11.7%) and fat (1.8%). Main component of sorghum grain is starch.

Green gram (*Vigna radiata* L.) also called as mung bean is a major pulse crop that is more popular in South east Asia, Central Africa, warmer parts of China and the United States. It is India's most prominent pulse crop. Green gram seeds are easier to digest than other pulses because they contain less raffinose, stachyose and oligosaccharides, which are linked to digestive issues and intestinal disorders. Pulses are the primary source of protein in the human diet and are grown under a variety of conditions. They are widely consumed around the world because they are an important source of dietary calories. They are primarily consumed as staple foods, particularly in Asian diets (Tilekar *et al*., 2019) [18].

Green gram is India's most prominent pulse crop. In a vegetarian diet, it is a major source of protein, fiber and minerals. The intake of green gram as well as value-added products from green gram improves people's nutritional status; it serves as a significant source of nutrients and aids in the global effort to end malnutrition (Naik *et al*., 2020) [8].

Sesame (*Sesamum indicum* L.) is considered as one of the oldest oilseeds, and it is economically significant and widely distributed throughout the world. It is a member of the Pedaliaceae family and consists of the seeds of the tropical annual sesamum indicum. It originated in the grasslands of tropical Africa and then spread quickly to India and China.

According to archaeological records, this crop has been known and used in India for over 5000 years. It is generally grown in tropical and temperate regions (Aglave, 2018) [3].
Sesame is a good source of iron, magnesium, manganese, copper and calcium, as well as vitamin B1 (thiamine) and vitamin E. Sesame oil is widely used in food industry because of its flavour and stability, as well as its high-quality cooking value. Sesamin and sesaminol lignans found in sesame oils nonglycerol fraction contributed to its oxidative stability and antioxidant properties (Najeeb *et al*., 2012) [9].

Material and Methods

The present investigation was carried out in Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani during year 2021-22.

Materials

The good quality of sorghum, green gram and sesame seeds were procured from Parbhani local market.

Chemicals and Glassware's

Chemicals of analytical grade and glassware used during study was available in the department of Food Process Technology, College of Food Technology VNMKV Parbhani.

Analytical methods

According to the procedure outlined by (AOAC 2005) [1] the raw material-sorghum, green gram and sesame seed were analysed to know chemical composition as moisture, protein, fat, ash, crude fiber and total carbohydrates. Results were given after analysing triplicate sample of each component, obtained results expressed on dry weight basis.

Proximate analysis

Various chemical characteristics such as moisture content, protein, fat, ash, crude fiber and total carbohydrates were analysed. The analysis was made in triplicate and the results were expressed as the average value.

Moisture content

Moisture content was assessed using the method given by AOAC (2005) [1]. It was calculated by using following formula.

$$\% \text{ Moisture} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \text{ X } 100$$

Fat

The crude fat content of the sample was determined using AOAC (2005) [1] method and soxhlet apparatus. The crude fat percentage was calculated using following formula.

$$\% \text{ Crude fat} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \text{ X } 100$$

Protein

The protein content was calculated using the AOAC (2005) [1] technique. The percentage of nitrogen and protein calculated by following formula.

$$\% \text{ Nitrogen} = \frac{(\text{Ts} - \text{Tb X Normality of acid X } 0.014)}{\text{Weight of sample}} \text{ X } 100$$

Ts = Titre volume of sample (ml)
Tb = Titre volume of blank (ml)
0.014 = M.eq of N
% Protein = Nitrogen X 6.25

Ash

Drying the sample at 100 ºC and churned over an electric heater. It was then ashes in muffle furnace at 550 ºC for 5 hrs. It was calculated using the following formula:

$$\% \text{ Ash} = \frac{\text{Weight of ash}}{\text{Initial weight of sample}} \text{ X } 100$$

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100 phenol sulphuric acid method as given by AOAC (2005) [1].

Result and Discussion

Physical properties of sorghum, green gram and sesame seed

Various physical properties of sorghum, green gram and sesame seeds are observed and results are given in Table 1.

Table 1: Physical properties of sorghum, green gram and sesame seed

Physical Properties	Sorghum	Green gram	Sesame seed
Colour	Creamy white	Light green	Off white
Shape	Spherical	Oval	Flat oval
1000 kernal weight (g)	34.5	42.15	2.32
Bulk density (g/ml)	1.23	0.87	0.55
True density (g/ml)	1.210	1.149	1.256
Angle of repose	31°17′	32°77′	29°85′

The data given in Table 1 indicates various physical characteristics of sorghum, green gram and sesame seed such as colour which is important characteristic for determining the visual acceptance. The colour of sorghum, green gram and sesame seed was found to be creamy white, light green and off white respectively whereas, their shapes are spherical, oval and flat oval. The result of 1000 kernal weight as sorghum (34.5gm), green gram (42.15gm) and sesame seed (2.32gm). Results reported are in close agreement with (Surpam *et al*., 2019; Shukla and Awasthi 2017; Aglave 2018) [17, 14, 3]. Bulk density of material was determined and results obtained for sorghum (1.23g/ml), green gram (0.87g/ml) and sesame seed (0.55g/ml). True density was calculated and results for sorghum, green gram and sesame seed 1.210 g/ml, 1.149 g/ml and 1.256 g/ml respectively. Angle of repose (θ) for sorghum 31°17′, green gram 32°77′ and sesame seed 29°85′. The results obtained resembles with (Shingote *et al*., 2021; Pandiselvam *et al*., 2017) [13, 11].

Proximate chemical composition of - sorghum, green gram and sesame seed

Data pertaining to various chemical properties like moisture, protein, crude fat, ash, total carbohydrates and fiber were investigated and results obtained are depicted in Table 2.

Table 2: Proximate composition of raw ingredients

Chemical composition	Sorghum	Green gram	Sesame seed
Moisture (%)	10.6	9.4	3.2
Protein (%)	8.2	23.5	21.3
Crude fat (%)	2.1	1.4	49.7
Ash (%)	2.2	3.8	2.9
Total carbohydrates (%)	72.4	54.5	8.5
Crude fiber (%)	1.7	3.4	3.9

The data given in Table 2 reveals the proximate chemical composition of raw ingredients such as sorghum, green gram and sesame seed. Various proximate compositions of ingredient were analysed and results obtained as percent moisture content of sorghum, green gram and sesame seed is 10.6%, 9.4% and 3.2% respectively; protein content of sorghum, green gram and sesame seed as 8.2%, 23.5% and 21.3% respectively. Similar results for proximate composition for sorghum, green gram and sesame seed were shown by (Kamble *et al*., 2020) [5]; (Zebib *et al*., 2015) [20]. The crude fat content of ingredient obtained as 2.1%, 1.4% and 49.7% for sorghum, green gram and sesame respectively. Ash content for sorghum 2.2%, green gram 3.8%, sesame seed 2.9%; total carbohydrate content in sorghum 72.4%, green gram 54.5%, sesame seed 8.5%. Similar trend for proximate composition of sorghum given by (Onoja *et al*., 2014; Singh *et al*., 2015) [10, 15], composition of green gram revealed similar result with (Abbas *et al*., 2007) [2], comparable findings for sesame seed with (Anilakumar *et al*., 2010) [4].

Effect of different processing treatments on chemical composition of raw material -sorghum, green gram and sesame seed

The data pertaining to various chemical properties such as moisture, protein, crude fat, ash, total carbohydrates and fiber after giving treatment to raw ingredients (sorghum to sorghum flakes; green gram to green gram malt powder; sesame seeds to roasted sesame seeds) were determined and results obtained are illustrated in Table 3.

Table 3: Proximate composition of sorghum flakes, green gram malt powder and roasted sesame seed

Chemical composition	Sorghum flakes	Green gram malt powder	Roasted sesame seed
Moisture (%)	4.9	5.6	2.7
Protein (%)	6.7	24.3	20.8
Crude fat (%)	1.1	1.3	52.6
Ash (%)	1.7	2.7	2.3
Total carbohydrate (%)	76.6	62.6	8.9
Crude fiber (%)	2.8	4.3	3.5

Proximate composition sorghum, green gram and sesame seed are observed after giving various treatment like flaking, malting and roasting. The results show effect of processing on raw material. It is observed that the moisture content, protein, crude fat, ash content of sorghum was decreased after giving treatment whereas carbohydrate and crude fiber increased significantly and result obtained as moisture 4.9%, protein 6.7%, crude fat 1.1%, ash 1.7%, total carbohydrate 76.6% and crude fiber 2.8% (Sreeramaiah and Goudar 2012, Megat *et al*., 2011) [16, 7]. Germination changes the nutritional composition of green gram. Proximate composition after germination was observed as moisture 5.6%, protein 24.3%, crude fat 1.3%, ash 2.7%, total carbohydrate 62.6% and crude fiber 4.3%. Effect of roasting on sesame seed shows reduction in moisture content, protein, ash and fiber while increase in crude fat, carbohydrate and results found as moisture 2.7%, protein 20.8%, crude fat 52.6%, ash 2.3%, total carbohydrate 8.9% and crude fiber 3.5%. Results obtained are in close resemblance with (Kongkachad and Puttongsiri, 2017) [6].

Conclusion

From the above study it is observed that various pre-treatments effects on the composition of sorghum, green gram and sesame seed. Physical properties were determined prior to processing which used in determining the machine, operation and process efficiency while studying the unit operations. During designing the equipment for operations like processing, sorting and sizing physical properties plays an important role. The components like fiber and carbohydrates increases significantly after flaking of sorghum. Germination alters the composition of green gram and results shows that protein and carbohydrate increases. Sesame seed were roasted effect shows the higher value for fat content.

Future Scope: Physical properties and proximate composition of sorghum, green gram and sesame seed were studied in present work. Analysing effect on chemical composition as mineral content or antinutritional factors after processing should be done further.

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