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Effect of different pretreatments on nutritional quality of sorghum and mothbean

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Abstract
The present study was carried out to know the effect of different pretreatments on nutritional quality of sorghum and mothbean. The process of soaking was carried out for 8 hrs at ambient temperature during this process moisture, carbohydrate, ash and vit. C content increases with a decrease in other parameters. Results obtained shows that moisture, fat, carbohydrate, protein, ash, crude fiber, iron and vit. C content of raw and soaked sorghum varied between 9.9 to 11.8%, 1.9 to 1.75%, 73.5 to 74.45%, 10.9 to 8.2%, 2.3 to 2.5%, 1.5 to 1.3%, 4.4 to 4mg/100g, 0.6 to 1.2mg/100g respectively. In mothbean germination was carried out for 24hrs at ambient temperature. Germination increases moisture, protein, iron and vit. C content with decrease in other parameters. Results obtained shows that moisture, fat, carbohydrate, protein, ash, crude fiber, iron and vit. C content of raw and germinated mothbean varied between 8.3 to 10.8%, 1.1to 1.09%, 61.03 to 57.01%, 21.7 to 24.1%, 3.5 to 3.2%, 4.2 to 3.8%, 8.9 to 9.4mg/100g, 1.84 to 10mg/100g respectively. Therefore, germination and soaking can improve the nutritional value and stability of grains.

Keywords: sorghum, mothbean, soaking, germination, nutritional quality

Introduction
Sorghum (*Sorghum bicolor* (L.) *Moench*) is the king of millets and is one of the important food crops in dry lands of tropical Africa, India and China. In India, sorghum is one of staple food crops of many states and is consumed by a large section particularly in the non-irrigated dry land areas with low rainfall. It is grown especially in the arid and semi-arid regions. The major sorghum production areas today include great plains of North America, sub-Saharan Africa, north eastern China and the Deccan plateau of central India, Argentina, Nigeria, Egypt and Mexico (Awika and Rooney, 2000) [4].

Like other plant proteins, Sorghum protein quality is poor. Inadequate intake of good quality proteins is an important factor responsible for the widespread prevalence of protein energy malnutrition. Poor nutritional quality of grain Sorghum has been attributed to the low levels of certain essential amino acids especially lysine, threonine and tryptophan and excessive content of leucine and methionine. The grain Sorghum also contain phenolic compounds namely tannins, which decrease the protein utilization (Salunkhe *et al*., 1977, Hulse, 1979) [19, 8].

Sorghum does not have gluten and hence becomes a very good ideal gluten free energy source for the people suffering from wheat or gluten allergies. Normally sorghum for consumption is used in the form of Roti, unleavened breads, porridges, boiled grains and steam cooked products such as couscous. Karnataka is second only to Maharashtra with regard to area coverage in India (Vikas, 2003) [22].

Protein quality and essential amino acid profile of sorghum is better than many of the cereals and millets. Sorghum in general is rich source of fiber and B-complex vitamins (Gopalan *et al*., 2000; Patil *et al*., 2010) [7, 16].

Mothbean (*Vigna aconitifolia L.)* is a draught resistant legume belonging to the family Fabaceae, commonly grown in arid and semiarid regions of India. It is exceptionally hardy legume and known by various other names including mat bean, Matki, Turkishgram, or dew bean. India‘s driest state, Rajasthan, is the major mothbean growing state contributing almost 86% area of the country (NAS, 1979) [10].

Moth bean is considered to be native crop of India and Pakistan and is grown during the kharif season. In the event of the grim situation of water shortages and rising agricultural input prices. Moth bean is an ideal crop to grow since it requires very low inputs (no or little water) and is grown in arid and semi arid regions of South Asia and India like Rajasthan,

Maharashtra, Madhya Pradesh and some parts of Uttar Pradesh and Punjab (Sathe and Venkatachalam, 2007) [20].

The nutritive value of grain legumes depends primarily on their nutrient and the presence or absence of antinutrient and toxic factors (Ramakrishna *et al*., 2006) [18]. Some simple and inexpensive processing technique, such as soaking, germination, and cooking are highly efficient for the reduction of antinutritional factors and for improving its organoleptic quality (Abusing *et al*., 2009) [2].

Germination of cereals has been used for centuries to soften the kernel structure, to increase nutrient content and availability; to decrease the content of antinutritive compounds, and to add new flavors without knowing the biochemistry behind these phenomena. Barley malting is the most widely known controlled germination process, used to produce malt for brewing purposes and food applications (Norja *et al*., 2004) [12].

Germination, a complex process causing physical, chemical and structural changes in grains, has been identified as an inexpensive and effective technology for improving cereal quality. The germination process is characterized by the growth of the embryo of the grain, manifested by the rootlets growth and increase modification of the contents of the endosperm (De Guine and Correia, 2013) [5].

Materials and Methods

The present investigation was carried out in Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani during year 2018-19.

Materials

The good quality of Sorghum and mothbean were procured from Parbhani local market.

Chemicals and Glasswares

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

Methods

Preparation of sample

Soaking of sorghum

The sorghum flour was produced using the method described by Nwakalor *et al*. (2014) [13]. The grains were soaked in clean water for 8 hours and the water was decanted. The grains were dried in a cabinet dryer at 70°C for 48 hours. The dried sorghum was milled into flour using a laboratory hammer milling machine and the milled sample was sieved (using the 40 mesh screen) to obtain the flour. The sorghum flour was packed and sealed in polyethylene bags at ambient temperature (26 ± 2 °C) until further analysis.

Germination of mothbean

Mothbean flour was produced by using method described by Mankotia and Modgil (2003) [9]. Mothbean grains were steeped in potable tap water for 12 h. Grain to water ratio was 1: 3. The soaked grains were tied in muslin cloth and allowed to germinate at ambient temperature 25±2oC. Grains were sprinkled with water. It took 24 hrs for grains to germinate. When the sprouts were 1-2 cm long germinated grains were dried in cabinet drier at 50±3oC for 12 h. The dried samples were milled to pass through a 40 mesh sieve. After grinding samples were kept in refrigerator in air tight plastic containers till further analysis was done.

Analytical methods

The Grains were analyzed for the chemical composition namely moisture, protein, fat, ash, crude fibre and minerals composition were carried out as per the method given by (AOAC, 2005) [1]. Nutrients were analyzed in duplicate and results were expressed on dry weight basis.

Proximate analysis

Different chemical properties of samples were analyzed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content

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

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

Fat

AOAC (2005) [1] method using Soxhlet apparatus was used to determine crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of oil}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [1] method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{TS - T_B \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml),
TB = Titre volume of Blank (ml), 0.014= M eq. of N

% Protein = Nitrogen × 6.25

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].

Ash

Drying the sample at 100 ^{0}C and churned over an electric heater. It was then ashes in muffle furnace at 550 0C for 5 hrs. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Initial Weight of sample}} \times 100$$

Determination of minerals

Two grams of defatted sample was weighed and heated at 550^{o}C. Then, the obtained ash were digested with concentrated Hydrochloric acid (HCL) on hot plate. The digested material was then filtered using whatman No. 42 filter paper and the final volume made to 100ml with distilled water that was further used for analysis with respects to minerals contents by using methods of AOAC (2005) [1].

Determination of Vitamin C

Vitamin C contents were determined by titrimetric methods described by (Ogunlesi *et al*., 2010) [14].

Results and Discussion

Physical properties of sorghum and mothbean

Various physical properties of sorghum and mothbean were determined, and results obtained are presented in Table 1.

Table 1: Physical characteristics of sorghum and mothbean

Physical Parameters	Sorghum	Mothbean
Colour	Chalky white	Yellow brown
Shape	Oval	Rectangular
Wt. of 1000 seed (g)	34.04	30.80
True Density (g/ml)	1.12	1.43
Bulk Density (g/ml)	0.69	0.80
Porosity (%)	38.12	38.95
Angle of repose (^{0})	26.31	27.80

*Each value represents the average of three determinations

The data given in Table 1 revealed various physical characteristics of sorghum and mothbean. The colour of sorghum was found to be chalky white whereas oval in shape. The results for weight of 1000 seed was reported to 34.04 (g), true density 1.12 (g/ml), bulk density 0.69 (g/ml), Porosity 38.12 (%), angle of repose 26.31 (^{0}) respectively. Results reported are in close agreement with these findings of Gikuru and Sifuna (2006) [6].

The colour of mothbean was found to be yellow brown whereas rectangular in shape. The results for weight of 1000 seed was reported to 30.80 (g), true density 1.43 (g/ml), bulk density 0.80 (g/ml), Porosity 38.95 (%), angle of repose 27.80 (^{0}) respectively. Results reported are in close agreement with these findings of Nimkar *et al*., (2005) [11].

Nutritional composition of raw and soaked sorghum

The data pertaining to nutritional composition of raw and soaked sorghum were determined and results obtained and illustrated in Table. 2

Table 2: Nutritional composition raw and soaked sorghum

Nutrient content	Mean value	
	Raw sorghum	Soaked sorghum
Moisture (%)	9.9±1.1	11.8±0.41
Fat (%)	1.9±0.04	1.75±0.10
Carbohydrate (%)	73.5±0.4	74.45±0.20
Protein (%)	10.9±0.62	8.2±0.5
Ash (%)	2.3±0.02	2.5±0.31
Crude fiber (%)	1.5±0.01	1.3±0.65
Iron(mg/100g)	4.4±0.2	4±0.10
Vit. C(mg/100g)	0.6±0.2	1.2±0.2

*Each value represents the average of three determinations

Results given in above Table.2 indicated that the mean value for moisture, fat, carbohydrate, protein, ash, crude fiber, iron and vit. C content of raw and soaked sorghum varied between 9.9 to 11.8%, 1.9 to 1.75%, 73.5 to 74.45%, 10.9 to 8.2%, 2.3 to 2.5%, 1.5 to 1.3%, 4.4 to 4mg/100g, 0.6 to1.2mg/100g respectively. Results reported are in close agreement with these findings of (Onoja *et al.*, 2014 and Singh *et al.*, 2018) [15, 21].

Soaking increases moisture, carbohydrate, ash and vit. C content with a decreases in other parameters. The increase in moisture content was due to the uptake of water during soaking. An increase in ash content is considered to be apparently caused by the loss of starch, while a decrease can be attributed to leaching losses during soaking (Ahmed *et al.*, 2013 and Wu and Wall., 1980) [3, 23].

Nutritional composition of raw and germinated mothbean

The data pertaining to nutritional composition of raw and germinated mothbean were determined and results obtained and illustrated in Table.3

Table 3: Nutritional composition raw and germinated mothbean

Nutrient content	Mean value	
	Raw mothbean	Germinated mothbean
Moisture (%)	8.3±2.0	10.8±1.2
Fat (%)	1.1±0.5	1.09±0.03
Carbohydrate (%)	61.03±0.5	57.01±0.20
Protein (%)	21.7±1.43	24.1±0.45
Ash (%)	3.5±1	3.2±0.15
Crude fiber (%)	4.2±0.3	3.8±0.52
Iron (mg/100g)	8.9±1	9.4±0.6
Vit. C (mg/100g)	1.84±0.2	10±1.2

*Each value represents the average of three determinations

Results given in above Table.3 indicated that the mean value for moisture, fat, carbohydrate, protein, ash, crude fiber, iron and vit. C content of raw and germinated mothbean varied between 8.3 to 10.8%, 1.1to 1.09%, 61.03 to 57.01%, 21.7 to 24.1%, 3.5 to 3.2%, 4.2 to 3.8%, 8.9 to 9.4mg/100g, 1.84to10mg/100g respectively. Results reported are in close agreement with these findings of (Mankotia and Modgil, 2003 and Singh *et al.*, 2018) [9, 21]. Germination increases moisture, protein, iron and vit. C content with a decrease in other parameters. Loss of dry weight (carbohydrates) during sprouting may show apparent increases in protein, while loss of low molecular weight nitrogenous compounds during soaking and rinsing of grains cause a decrease in crude protein on sprouting (Ahmed *et al.*, 2013) [3]. It was also possible that the increase in protein was due to the uptake of water during germination. Decrease in starch content was maximum in sprouted grain this decrease might have been due to hydrolysis of starch during germination. The decrease in fat in moth bean during germination may be due to increased activity of lipase (Pawar and Ingle., 1988) [17].

Conclusion

The present investigation reveals that soaking of sorghum and germination of mothbean enhances the nutritional quality just before the development of food products. These processes also significantly reduce the antinutritional components in the same. Therefore, moth bean and Sorghum can be used as singly or in combination food products; therefore, considered to be one of the best preventable measures for disorders of protein malnutrition. The germination of moth bean increases the protein content and vit. C content. Therefore, germination and soaking can improve the nutritional value and stability of grains.

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