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Effects of different pretreatments on physicochemical and anti nutritional quality of moth bean

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Abstract
The present study was carried out to get rid of the effects of different household pretreatments on nutritional quality of moth bean. The process of soaking was carried out for 12hrs at ambient temperature; during this process moisture, carbohydrate, ash and vitamin C content increased with a decrease in other parameters. Results obtained shows that moisture, fat, carbohydrate, protein, ash and crude fibre content of raw and soaked moth bean varied between 8.4 to 10.02%, 1.13 to 1.21%, 60.23 to 58.76%, 21.3 to 21.09%, 3.4 to 3.2% and 4.3 to 4.1% respectively. In moth bean germination was carried out for 24 hrs at ambient temperature. After germination mmoisture, protein, iron and vitamin C increased with decrease in other parameters. Results obtained shows that moisture, fat, carbohydrate, protein, ash, crude fibre, iron and vitamin C content of raw and germinated mothbean varied between 8.4 to 10.6%, 1.13to 1.09%, 60.23 to 56.01%, 21.3 to 23.82%, 3.4 to 3.2%, 4.3 to 3.78%, 9.8 to 10.4mg/100g and 3.7to12.3mg/100g respectively. Phytic acid content of non germinated moth bean 0.731g/100g reduced to 0.383g after germination and trypsin inhibitor activity get reduced from 0.137 mg/g to 0.036 mg/g. Therefore, germination and soaking can improve the nutritional value and stability of grains thus it can be concluded from the obtained results that germinated moth beans were high in nutrients that makes it potential source for value addition in food commercialization.

Keywords: Moth bean, nutritional quality, soaking, germination, anti nutritional factors

Introduction
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) [1].

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 Rajashtan, Maharastara, Madhya Pradesh and some parts of Uttar Pradesh and Punjab (Sathe and Venkatachalam, 2007) [2]. India is the worlds’ largest producer and consumer of pulses and of moth bean. It produces around 22–25% of the total world produce of pulses (FAO, 2012) [3].

Legumes are important nutritional source in developing countries. Chickpea, pigeon pea, lentil, urad bean, mung bean, lablab bean, moth bean, horse gram, pea grass pea, cowpea and faba bean are the major pulse crops grown in India. Legumes however, are said to have low protein and starch digestibility (Ghavidel and Prakash, 2007) [4]. Legumes are generally good sources of proteins and contain on an average from 18 to 25 percent. Among such legumes is mothbean. Its seeds contain 24.1% protein, 0.8% crude fibers, 1.3% fat, 3% ash, 9.6mg iron/100gm. (Fatema *et al*., 2011) [5].

Phytochemicals are the bioactive compounds that occur naturally in plants. Leguminous seeds are important source of proteins and source of natural antioxidants. Legumes contain a number of phenolic compounds such as flavonoids, phenolic acids,and tannins.There is a considerable interesting finding natural phytochemicals and antioxidants from plants due to their role in the treatment and/or prevention of various diseases. Trypsin inhibitors reduce the incidence of certain cancers and potent anti-inflammatory nature (Gupta *et al*., 2016) [6]. Mothbean consumption of 4 times or more \week compared with less than once a week have been associated with 22% lower risk of coronary heart diseases. (Bazzano *et al*., 2001) [7].

The production of moth bean was 2.77 lakh tonnes in India during 2012–2015. Moth bean is commonly grown in arid areas of India and is consumed either as such after cooking or after

germination and cooking. Moth bean is the unexploited legumes of the tropics and subtropics grown mostly under dry-land agriculture. The chemical composition is comparable with commonly cultivated legume. Like other legume this legume is deficient in methionine and tryptophan (Pawar and Ingle, 1988) [8].

The nutritive value of grain legumes depends primarily on their nutrient and the presence or absence of anti-nutrient and toxic factors (Ramakrishna *et al*., 2006) [9]. Some simple and inexpensive processing technique, such as soaking, germination, and cooking are highly efficient for the reduction of anti-nutritional factors and for improving its organoleptic quality (Abusing *et al*., 2009) [10].

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) [11].

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 Pinho Ferreira Guine & dos Reis Correia, 2013) [12].

Materials and Methods

Materials

The raw unprocessed mothbeans were obtained from local market, Parbhani. The grains were cleaned mannually to get rid of dust, stones, twigs and other foreign materials.

The proposed research was carried out in Department of Food Processing Technology, College of Food Technology, VNMKV, Parbhani.

Sample preparation

Soaking

Mothbean grains were kept steeped for 12 hr in potable water.

Germination

Moth bean flour was produced by using method described by Mankotia and Modgil (2003) [13]. Moth bean 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±2 ^{0}C. 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±3 ^{0}C 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.

The 1000 grains from raw, soaked, germinated moth beans were observed for length and width was measured with vernier caliper. Weight volume ratio (density) was determined by noting changes in water level after adding 1000 grains.

Analytical methods

The Grains were analyzed for the chemical composition namely moisture, protein, fat, ash, crude fiber and minerals composition were carried out as per the method given by (AOAC, 2005) [14]. 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). It was calculated using following formula.

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

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:

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

Fat

AOAC (2005) 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) method. Percentage of nitrogen and protein calculated by the following equation:

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

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, calculated by subtracting the measured protein, fat, ash and moisture from 100.

Determination of minerals

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

Determination of Vitamin C

Vitamin C contents were determined as per the voltammetric and titrimetric methods described by Ogunlesi *et al*., (2010) [15].

Trypsin inhibitor activities

Trypsin inhibitor activity of legume samples were measured according to the procedure of Roy and Rao (1971) [16].

Results and Discussion

Physical properties of mothbean

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

Table 1: Physical characteristics mothbean

Physical Parameters	Raw Mothbean	Soaked mothbean	Germinated mothbean
Colour	Yellow brown	Yellow brown	White brown
Shape	Oblong-Rectangular	Oblong	Oblong
Wt. of 1000 seed (g)	32.70	63.80	60
Density (g/ml)	1.54	0.92	1.74
Width(mm)	5.13	4.97	6.06
Length(mm)	5.10	6.31	8.12

*Each value represents the average of three determinations

The data given in Table 1 revealed various physical characteristics of moth bean. The colour of moth bean was found to be yellowish brown where as oblong in shape. After germination it becomes whitish brown. The results of raw moth bean for weight of 1000 seed was reported to 32.70 (g), density 1.54 (g/ml), width 5.13(mm), length 5.10(mm) respectively. While wt of 1000 grains increases during soaking to germination from 63.80 g to 60 g, density from 0.92 to 1.74 (g/ml),width from 4.97 to 6.06 (mm) and length from 6.31 to 6.06 (mm). Results reported are in close agreement with these findings of K. Mankotia and R. Modgil (2003).

Nutritional composition of raw, soaked and germinated moth bean

The data pertaining to nutritional composition of raw, soaked and germinated moth bean were determined and results obtained and illustrated in Table.3

Table 3: Nutritional composition raw and germinated mothbean

Nutrient content	Mean value		
	Raw mothbean	Soaked mothbean	Germinated mothbean
Moisture (%)	8.4±2.0	10.02±2.0	10.6±1.2
Fat (%)	1.13±0.5	1.21±0.5	1.09±0.03
Carbohydrate (%)	60.23±0.5	58.76±0.5	56.05±0.20
Protein (%)	21.3±1.43	21.09±1.3	23.82±0.45
Ash (%)	3.4±1	3.2±1	3.2±0.15
Crude fiber (%)	4.3±0.3	4.1±0.3	3.78±0.52
Iron (mg/100g)	9.8±1	9.94±1	10.4±0.6
VitC (mg/100g)	3.7±0.2	7.4±0.2	12.3±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 vitC content of raw and germinated mothbean varied between 8.4 to 10.6%, 1.13to 1.09%, 60.23 to 56.05%, 21.3 to 23.82%, 3.4 to 3.2%, 4.3 to 3.78%, 9.8 to 10.4mg/100g, 3.7to12.3mg/100g respectively. Results reported are in close agreement with these findings of (Mankotia and Modgil, 2003 and Singh *et al*., 2018) [17]. Germination increases moisture, protein, iron and vitC content with a decreases 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) [18]. It was also possible that the increase in protein was due to the uptake of water during germination. Higher true protein may be due to synthesis of new protein. Similar have been reported by (Padamshree *et al*., 1987) [19]. 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).

Table 4: Effect on anti nutritional factors due to germination

Anti nutritional factor	Raw mothbean	Germinated mothbean
Phytic acid(g/100g)	0.731	0.383
Trypsin inhibitor activity(mg/g)	0.137	0.036

Phytic acid content reduced from raw moth bean 0.731g/100g to germinated moth bean 0.383 g/100g. While trypsin inhibitory activity also reduced from 0.137 to 0.036 mg/g respectively during raw state and germinated state.

Conclusion

The present investigation reveals that soaking and germination of mothbean enhances the nutritional quality just before the development of food products. These processes also significantly reduce the anti-nutritional components in the same. Therefore, moth bean can be used in combination with 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 vitC content. Therefore, germination and soaking can improve the nutritional value and stability of grains.

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