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Effect of malting on nutritional composition of Mothbean

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Abstract
The present study was carried out to study the nutritional quality and effects of malting on minerals specifically. In the malting process, the soaking (12hrs), germination (24hrs) and drying (12hrs) was carried out during this process. Results obtained showed that moisture, protein, fat, carbohydrate, ash and crude fibre content of raw mothbean were 9.29±0.25%, 21.53±0.3%, 1.24±0.2%, 60.13±0.87%, 3.41±0.01%, 4.4±0.1% respectively. Results obtained also showed that calcium, iron, phosphorus, magnesium content of raw and malted mothbean were varied between 202.33±2.51 to 180±1.42%, 9.41±0.2 to 11.3±0.4%, 218±2.64 to 200.4±2.52%, 230.38±1.05 to 237.5±1.09% respectively. Therefore, the malting process helps in improving the nutritional value and can be concluded from the obtained results that malted mothbean were high in nutrients which makes it an important source for value addition in food commercialization.

Keywords: Mothbean, malting, germination, nutritional, composition

Introduction
Mothbean, scientifically known as *Vigna aconitifolia* L., is a leguminous plant known for its ability to withstand in drought like conditions which belongs to the Fabaceae family. It is typically grown in arid and semi-arid regions of India. It is a versatile plant is known by various names such as mat bean, matki, turkish gram, or dew bean. The state of Rajasthan, recognized as India's driest region, holds a significant role in Mothbean cultivation and contributes to approximately 86 per cent of the total cultivation area in the country (NAS, 1979) [13]. Native to India and Pakistan, moth bean is traditionally cultivated during the kharif season. Moth bean is an advantageous crop due to its minimal resource requirements, particularly its low water consumption, hence it overcomes the challenges like water scarcity and rising agricultural input costs. It thrives in arid and semi-arid regions which includes the states like Rajasthan, Maharashtra, Madhya Pradesh, as well as specific areas in Uttar Pradesh and Punjab (Sathe and Venkatachalam, 2007).
Mothbean has been recognized as a promising protein-rich food source that contains substantial amounts of protein and calcium. According to (Ismail *et al*., 2007), it has the potential to serve as a valuable supplement to cereal-based diets. Moth bean, however, stands out in this category. Its seeds contain protein 24.1%, crude fibres 0.8%, fat 1.3%, ash 3% and iron 9.6 mg/100 grams (Fatema *et al*., 2011) [6].
Phytochemicals are natural bioactive compounds found in plants. Leguminous seeds are a significant source of proteins and natural antioxidants. Within legumes, various phenolic compounds like flavonoids, phenolic acids, and tannins can be found. There is substantial interest in exploring these natural phytochemicals and antioxidants from plants due to their potential role in preventing and treating various diseases. For instance, trypsin inhibitors have been linked to a reduced risk of certain cancers and possess strong anti-inflammatory properties.
Many traditional methods of food preparation, such as malting, enhances the nutritional value by reducing certain antinutrients. These processing techniques are widely employed in societies where cereals and legumes constitute a significant portion of the diet (Hotz and Gibson, 2007). Malting involves controlled germination followed by controlled drying of the kernels. The primary aim of malting is to facilitate the development of hydrolytic enzymes, which are not present in ungerminated grains (Dewar, 2003; Latha and Muralikrishna, 2009). Malting enhances nutrient content by breaking down complex compounds into simpler ones, facilitating easier digestion. Malting also helps in increasing the bioavailability of micronutrients like iron and calcium.

Iron is essential for boosting blood levels and preventing anemia, while calcium contributes to stronger bones and the formation of healthy teeth (Singh, 2018) [18].

Materials and Methodology

Selection of ingredients

The initial step involved acquiring unprocessed Mothbean from the local market in Parbhani. These raw grains underwent a manual cleaning process to eliminate any dust, stones, twigs or other extraneous materials. The research was conducted at the Department of Food Chemistry and Nutrition located within the College of Food Technology at Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV) in Parbhani.

Sample preparation

Mothbean malted flour was produced by using the method described by (Mankotia and Modgil, 2003). Mothbean grains were steeped in potable tap water for 12 hr. Grain to water ratio was 1:3. The soaked grains were tied in a muslin cloth and allowed to germinate at an ambient temperature of 25±2^{0}C. Grains were sprinkled with water. It took 24 hr for grains to germinate. When the sprouts were 1-2 cm long, the germinated grains were dried in cabinet drier at 50±3^{0}C for 12 hr. After drying, the rootlets were removed and samples were milled to pass through a 40-mesh sieve. After grinding samples were kept in air-tight plastic containers till further analysis was done.

Proximate Analysis

Different chemical properties of samples were determined for moisture content, ash, fat, protein and carbohydrate. The results were expressed as the average value, and each determination was made three times.

Moisture content

Moisture content was determined as per the method given by AOAC (2005).

$$\% \text{ Moisture content} = \frac{\text{Initial weight (g) - Final weight (g)}}{\text{Weight of the sample}} \times 100$$

Ash

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

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

Fat

The AOAC (2005) method using Soxhlet apparatus was used to determine the crude fat content of the sample.

$$\% \text{ Fat content} = \frac{\text{Weight of ether extract}}{\text{Weight of sample taken}} \times 100$$

Protein

Protein content was determined using AOAC (2005) method. The percentage of nitrogen and protein is calculated by the following equation.

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

Where,
T_s = Titre volume of sample (ml),
T_B = Titre volume of Blank (ml), 0.014= M eq. of N
% Protein = Nitrogen × 6.25

Crude fibre

The crude fibers were determined according to the methodology described by Ranganna (2011) [19].

Total carbohydrate

The 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.

Mineral contents

The sample will be analyzed for its mineral profile following AOAC (2000).

Result and Discussion

Chemical composition of Mothbean

The chemical constituents determine the nutritional and biochemical profile of the raw material. The Table 1 depicts the nutritional profile of the Mothbean used for the research study.

Table 1: Chemical composition of Mothbean

Chemical properties (%)	Mothbean
Moisture	9.29±0.25
Protein	21.53±0.3
Fat	1.24±0.2
Carbohydrate	60.13±0.87
Ash	3.41±0.01
Crude Fibre	4.4±0.1

The above tabulated data represents the chemical composition of the Mothbean. It is found that the moisture content of the Mothbean is 9.29±0.25% and the protein content of the Mothbean was estimated as 21.53±0.3%, which was related to the protein content of the Mothbean reported by (Wankhede and Ramteke, 1982) [20]. The ash content of the Mothbean showed remark levels i.e., 3.41±0.01% which has similar reporting with, (Deshmukh and Pawar, 2020) [21] which shows the ash content of the Mothbean was 3.4%.

Minerals composition of Mothbean

The levels of mineral concentration in Mothbean were determined by Atomic Absorption Spectroscopy (AAS). The present study has reported the profound minerals in raw Mothbean in Table 2 below,

Table 2: Minerals composition of Mothbean

Minerals (mg/100g)	Values
Calcium	202.33±2.51
Phosphorus	218±2.64
Magnesium	230.38±1.05
Iron	9.41±0.2

Data obtained from Table 2 revealed that the calcium content of the Mothbean was found 202.33±2.51mg/100g and phosphorus, magnesium and iron content of Mothbean was found 218±2.64mg/100g, 230.38±1.05mg/100g and 9.41±0.2 mg/100g respectively.

Effect of germination on minerals composition of Mothbean malt

Malting is an important process and helps in increasing the bioavailability of some micronutrients while other minerals were less affected during germination.

Table 3: Minerals composition of Mothbean malt

Minerals (mg/100g)	Values
Calcium	180±1.42
Phosphorus	200.4±2.52
Magnesium	237.5±1.09
Iron	11.3±0.4

The significant loss of calcium was observed in Mothbean due to the leaching in the external medium. A slight increase in magnesium content was noticed in Mothbean after 24 hr of germination.

Legumes serve as a valuable phosphorus sources, with phytate phosphorus being the main stored form. As germination progresses, there is a consistent decline in phytate phosphorus levels. This reduction in the phytate phosphorus caused development of phytase activity during germination. The enhancement of phytase activity promotes the breakdown of phytic acid into inositol and inorganic phosphate, as observed in the study by Reddy *et al*. in 1978 [15]. Phytate ions forms complexes with divalent or trivalent metal ions, resulting in the formation of insoluble compounds.

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