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Effect of germination treatment on chemical and nutritional properties of horse gram

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Abstract

The germinated and raw horse gram was thoroughly tested for composition of chemicals, minerals and nutrition. Results for protein and carbohydrate contain substantially varied were found to be 21.66%, 22.50% and 58.11%, 58.50% for germinated and raw horse gram respectively. Minerals Calcium content of germinated and raw horse gram was 114 and 269mg/100 g, Potassium 415 and 774.2 mg/100 g, iron 7.45 and 38.10 mg/100 g. The mean length, breadth and thickness values obtained were 4.9, 1.64 and 1.75 mm, respectively. The mean bulk density and true density are 0.692 g and 1.25 kg / m³ of raw horse gram respectively.

Keywords: Horse gram, germination, nutritional properties, chemical composition

Introduction

Legumes are good sources of cheap and widely available proteins for human consumption. They are staple foods for many people in different parts of the world. Legume seeds have an average of twice as much protein as cereals and the nutritive value of the proteins are usually high. Legumes seeds are of prime importance in human and animal nutrition due to their high protein content (20-50%) and have historically been utilized mainly as the whole seeds. Recently, they are now being fractionated into their main constituents which are starch and protein. (Marimuthu M. And Krishnamoorthi K, 2013) [8].

Horse gram (*Dolichos uniflorus*) is a twining herb of old world tropics cultivated in India for food and fodder, sometimes placed in the genus *Dolichos*. The original Latin name for horse gram was *Dolichos biflorus*, which was later changed to *D.uniflorus*. An exact synonym for horse gram is *Macrotyloma uniflorus*. The members of species *Macrotyloma uniflorum* include *Macrotyloma uniflorum* var. *stenocarpum* and *Macrotyloma uniflorum* var. *uniflorum*. Horse gram is popularly called as "Madras Bean" due to the principal cultivation and rural production of this legume before the separation of these states from Madras Presidency state, India (Chinnasawamy, 2010) [2].

The nutrient composition and flour functionality of horse gram seeds and their flour characteristics. The objective of the present study was to evaluate horse gram seed with the aim of quantifying physiochemical and functional properties information that might serve as a guide to exploit its potential and benefits for human and animal nutrition. The proximate compositions (%) were determined as moisture content (6.72 ± 0.02), ash (2.24 ± 0.12), total dietary fibre (12.14 ± 0.35), crude carbohydrate (58.32 ± 0.10), crude fat (1.25 ± 0.15), crude protein (22.12 ± 0.18) and resistant starch (2.15 ± 20). The functional properties of, swelling capacity(ml), Water solubility index(%), oil absorption capacity(%) and water absorption capacity(g/100g),swelling index are 1.43 ± 0.12 , 7.56 ± 0.15 , 80.76 ± 0.10 , $142.14 \pm 0.20\%$, $0.46 \pm 0.15\%$ respectively. Foaming capacity, foaming stability and emulsifying capacity, emulsion stability were investigated as 38.16 ± 1.0 , 35.12 ± 0.11 and 52.15 ± 0.25 , $50.32 \pm 0.41\%$ respectively Marimuthu *et al.*, (2013) [7, 8].

Horse gram is legume of the tropics and subtropics, grown mostly under dry-land agriculture. The chemical composition is comparable with more commonly cultivated legumes. Like other legumes, these are deficient in methionine and tryptophan, though horse gram is an excellent source of iron and molybdenum. Dehusking, germination, cooking, and roasting have been shown to produce beneficial effects on nutritional quality of horse gram legumes. Though it require prolonged cooking, a soak solution (1.5% NaHCO₃+ 0.5% Na₂CO₃ + 0.75% citric acid) has been shown to reduce cooking time and improve protein quality (Kadam and Salunke, 1985) [6].

In the process of sprouting, the vitamins, minerals and protein increase substantially with corresponding decrease in calories and carbohydrate content (Chavan and Kadam, 1989). Further, sprouting of the pulses not only improves nutritive value but also digestibility. Consumption of seeds and sprouts has become increasingly popular among people interested in improving and maintaining their health status by changing dietary habits. The seeds and sprouts are excellent examples of 'functional food', lowering the risk of various diseases and exerting health promoting effects in addit (Ramesh C.K. *et al.*, 2011)^[13]

Materials and Methods

Materials

The Raw material like horse gram will be procured from the local market of Parbhani. Chemical and reagent will be obtained from laboratory, Department of Food Process Technology College of Food Technology, VNMKV, Parbhani.

Physical properties of horse gram

Thousand kernel weight

One thousand grains were counted and weighed by a digital weighing balance in three replication and mean value was recorded.

Thousand kernel volume

Volume was calculated by measuring cylinder and the amount of hexane displayed by 1000 kernels (Dutta *et al.*, 1988)^[3].

Bulk density

Twenty five gram of sound grains was weighed on the digital weighing balance and filled into the measuring cylinder earlier filled with reference solution of hexane. The increase in the level of liquid was measured after adding the grains. It is bulk density represented in g/L (Dutta *et al.*, 1988)^[3].

$$\text{Bulk Density } (\rho') = \frac{\text{Weight of grains}}{\text{Volume displayed}}$$

True density

Twenty-five of grains were filled into the measuring cylinder and volume occupied by them was measured. It was calculated by following formula and represented in g/ml (Rooney and Murty *et al.*, 1982)^[15].

$$\text{True Density } (\rho) = \frac{\text{Weight of grains}}{\text{Volume occupied}}$$

Angle of repose

It is the steepest angle between the base and slope of cone formed on a free vertical fall of grain mass to a horizontal plane when material is free falling or sliding. It was determined by making a circular pile of the grains freely falling. The height of the pile was taken (h) and its radius (r) was measured. Angle of repose was determined using a method described by (Mohsenin, 1986)^[9].

$$\text{Angle of Repose } (\phi) = \tan^{-1} (h/r)$$

Proximate composition of horse gram

Raw materials such as horse gram were analyzed for proximate composition including moisture, fat, protein, total carbohydrate, crude fiber, ash and mineral composition was

carried out as per the methods given by AOAC, 2005.

Determination of minerals composition of horse gram

Two grams of defatted sample was weighed and heated at 550°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 iron, calcium, potassium, contents by using methods Ranganna (1986)^[14].

Preparation of sample

Germination of horse gram

Germination process of whole horse gram were occurred in a Soaking of horse gram seeds in water for 12 hrs. In this study, 500 gram batch was used for each germination process and three replication was applied for each germinating time.

Preparation of germinated horse gram powder



Results and Discussion

Physical properties of horse gram

In the design and use of the end product, knowledge of physical quality attributes is important, and various individual grains have different physical characteristics that can determine the quality and application of the end product.

Table 1: Physical Parameters of horse gram

Physical Parameters	Observation
Length (mm)	4.9 ± 0.10
Breadth (mm)	1.64 ± 0.02
Thickness (mm)	1.75 ± 0.01
True Density (g/mm ³)	1.30 ± 0.05
Bulk Density (g/ mm ³)	0.692 ± 0.05
angle of repose	69.2 ± 2.00
Porosity (%)	36.2 ± 2.00

*Each value represents the average of three determinations

The data from Table 1 revealed that, the average length, breadth and thickness of horse gram were found to be 4.9 ± 0.10 , 1.64 ± 0.02 and 1.75 ± 0.01 mm. The bulk density and porosity of horse gram were calculated and found 0.692 and $36.2 \pm 2.00\%$. The angle of repose and sphericity of horse gram were found to be $69.2 \pm 2.00^\circ$. The results for physical properties of horse gram are found in similar with the Jain *et al.*, (2012)^[5] and Nimkar *et al.*, (2006)^[11].

Chemical and mineral composition of raw horse gram and germinated horse gram

The data penetrating the effect of the germination treatment on various chemical and mineral compositions such as moisture, fat, carbohydrate, protein, ash and crude fiber were determined and results obtained and illustrated are table.2 and table 3.

Table 2: Proximate composition of raw horse gram and germinated horse gram

Chemical properties	Mean Value (%)	
	Raw horse gram	Germinated horse gram
Moisture (%)	6.90±0.01	7.60±0.01
Ash	2.89±0.02	3.07±0.2
Total Protein (%)	22.50±0.1	24.10±0.1
Total Carbohydrate	58.50±0.02	58.11±0.01
Crude Fibre (%)	3.17±0.2	3.09±0.1
Crude Fat (%)	1.60±0.01	1.48±0.02

*Each value represents the average of three determinations

The results of proximate composition revealed that horse gram are good source of protein, crude fibre and carbohydrate content. It is also clear from the data that horse gram contain slightly lower among fat 1.60 percent. Horse gram contains significantly higher amount of dietary fiber (3.17 per cent) and ash (2.89 per cent) which defines its nutritional value. The horse gram contain significantly higher amount of protein (22.50 per cent) and carbohydrate (58.50 per cent) respectively.

Proximate composition tests showed that germinated horse gram is a decent source of protein, crude fiber and carbohydrate content. Germinated horse gram has a moisture content of 7.60%. In general, more moisture content of raw horse gram was observed but the germinated horse gram stage increased. Germinated horse gram ash content is 3.07 per cent respectively. Ash content decreased from raw horse gram to treated stage but increased as seen in germinated stage. Germinated horse gram contains slightly reduced dietary fiber (3.09%) compared with raw horse gram. The protein content of horse gram increased on germination and found to contain 24.10%. An increase in protein content might be due to biosynthesis of protein as a result of germination (Sattar *et al.*, 1989)^[16]. Germinated horse gram contain slightly decreased carbohydrate content (58.11%), respectively. Carbohydrates in most people's diets provide the bulk of the nutrition. This is a good source of energy, since it provides energy for oxidative metabolism readily accessible. The findings obtained in this investigation are consistent with the published results Moktan and Ojha (2016)^[10].

Mineral composition of raw horse gram and germinated horse gram

Minerals are inorganic elements essential to the body as structural component and act as regulators of body process. Raw horse gram and germinated horse gram were estimated

for their mineral composition and findings pertaining to the same are reported in Table 3.

Table 3: Mineral content of raw horse gram and germinated horse gram

Minerals (mg/100g)	Raw horse gram (Mg/100gm)	Germinated horse gram (Mg/100gm)
Calcium (Ca)	269	114
Magnesium	161	132
Iron (Fe)	38.10	7.45
Potassium	774.2	415

The mineral composition of raw horse gram were analyzed and results revealed that the minerals such as calcium, iron, potassium and magnesium is 269mg/100g, 38.10 mg/100g, 774.2 mg/100g and 161 mg/100g, respectively. Result reported are in close agreement with these findings of Gopalan *et al.*, (1999)^[4] and Paul *et al.*, (2011)^[12].

Ash content was significantly decreased in germinated horse gram. The potassium and magnesium content of germinated horse gram were found 415 and 132mg/100g respectively. Also it had calcium and iron content about 114 and 7.45 mg/100g. The decreased trends after germination in legumes were studied by Tiwari *et al.*, (2017)^[18]. Result reported are in close agreement with these findings of (Silva *et al.*, 2013)^[17].

Conclusion

In the present study germinated horse gram was performed under the controlled heating environment. By the analysis, it may have been inferred that the chemical, mineral and nutritional properties were greatly affected by the process of germination. Germination process is a quick and less costly processing method that enhances legumes' textural and sensory qualities and there are also minor improvements in the finished product's nutrient composition. Going over, the content of minerals, i.e. calcium and Fe decreased through the germinating process.

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