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Effect of germination on vitamin and mineral content of horse gram and green gram malt

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Abstract
The present study was conducted to investigate the effect of germination on vitamin and mineral content of horse gram and green gram malt. The horse gram and green gram were soaked in water for about 72 hrs to get the sprout. It was cabinet dried to obtain the malt. The vitamin and mineral content of horse gram reveled that, it had calcium content of horse gram and green gram were 289 and 70.86 mg/100g.The phosphorous content in horse gram and green gram were 582 and 321.68 mg/100g. The iron content in horse gram and green gram were found to be 39.5 and 5.6 mg/100g. Magnesium is present in small amount in all cells and is required for cellular metabolism. It is also present in bone along with calcium. The magnesium content for horse gram and green gram were analysed and found 177 and 184 mg/100g respectively. The results pertaining to potassium indicates the mean potassium content in horse gram and green gram was found to be 786.4 and 1241.64 mg/100g. The mineral content were increased and vitamin content were decreased over sprouting. Hence, it could be concluded that the germination process is helpful in preparation of nutritionally rich malt.

Keywords: Horse gram, green gram, sprout, malt, vitamin, mineral

Introduction
A legume is a plant or its fruit or seed in the family *Fabaceae* (or *Leguminosae*). Legumes are grown agriculturally, primarily for their grain seed called pulse. Legumes are good source of cheap and widely available proteins for human consumption. They are staple food for many people in different part of the world. Legume seeds have an average of twice as much protein as cereal and the nutritive value of the proteins are usually high. Legume 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 and Krishnamoorthi, 2013) [7].

In addition to its nutritive value the horse gram, *Macrotyloma uniflorum* (*Fabaceae*) is normally used to feed horses, though it is also commonly used in dishes. In traditional ayurvedic cuisine, horse gram is considered a food with medicinal qualities. It is prescribed for persons suffering from jaundice or water retention and as part of a weight loss diet. Although rich in proteins (20%), due to less acceptable taste and flavor of cooked products, it is consumed only by the farming community and low-income groups. Thus, it has remained an underutilized food legume. Such grain legumes are however, potential sources for preparation of protein products like concentrates and isolates. The residue left over after separation of proteins can be further processed to obtain starch. The isolated legume starches have variety of applications in food industry. 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 addition to its nutritive value.

Horse gram contains 18-29 per cent of protein, hence it can be considered on par with other pulses (Sundarraj and Thulsidas, 1986). In addition to protein, horse gram is also a good source of minerals of 3.2 g per cent, calcium (287 mg/100 g), iron (8.4 mg/100 g) and other nutrients like crude fibre (5.3 g per cent), carbohydrate (57.2 g per cent), energy (321 Kcal/100 g). Horse gram is also a good source of vitamins like thiamine - 0.42 mg, riboflavin - 0.2 mg niacin- 1.5 mg and vitamin - C 1.0 mg/ 100 g (Gopalan *et al*., 2007). The crude fibre, calcium

and iron content of horse gram are higher than the red gram which is largely consumed by majority of the Indian population.

Green gram supplies protein requirement of vegetarian population of the country. It is a protein rich staple food. It contains about 25 percent protein, which is almost three times that of cereals. It is consumed in the form of split pulse as well as whole pulse. The moong dal Khichdi is recommended to the ill or aged person as it is easily digestible and considered as complete diet. The American Heart Association recommends you get 4,700 milligrams of potassium a day. Eating a potassium rich diet helps lower blood pressure by counteracting the effects of sodium. One cup of cooked green gram contains 537 milligrams of potassium; that's more than 10 percent of the recommended daily amount.

Moong Beans are used in a variety of forms; whole dehusked, split or ground. Moong Beans are also known as Sabut Moong, Mung Pea etc. it has a sweet flavor, soft texture, and are easy to digest. It is consumed in the form of split pulse as well as whole pulse. Moong beans basically contain 23.86-27% protein, 1.15% fat, 3.32% ash, 62.62% carbohydrates, 16.3% fibre, 6.60% total sugars and 9.05% water (El-Adawy 2000).

In the present study, the effects of sprouting on quality parameter such as proximate and phyto-nutrient content of their malt were determined. As, it is necessary to develop the value added food products from locally available legumes.

Materials and Methods

Horse gram (*Macrotyloma Uniflorum*) and Green gram (*Vigna Radiata*) *Var*. i.e. Shining Moong will be procured from the local market of Parbhani.

Determination of vitamin B1 (Thiamin)

Five grams of the sample was homogenized with sodium hydroxide (50 ml) it was filtered into a 100 ml flask. 10 ml of the filtrate was pipette and the colour developed by addition of 10 ml of potassium dichromate was read at 360 nm in a spectrophotometer. A blank sample was prepared and the colour also developed and read at the same wavelength.

Determination of vitamin B2 (Riboflavin)

Five grams of the ground sample was extracted with 100 ml of 50% ethanol solution and shaken for 1 h. This was filtered into a 100 ml of the extract that was pipette into 50 ml volumetric flask. Ten millilitres of 5% potassium permanganate and 10 ml of 30% H2O2 were added and allowed to stand over a hot water bath for about 30 min. and add two millilitres of 40% sodium sulphate. This was made up to 50 ml mark and the absorbance measured at 510 nm in a spectrophotometer.

Determination of calcium and magnesium (mg/100 g)

Another five ml of the mineral solution was taken in porcelain dish and this was diluted with 25ml of distilled water. A sufficient quantity of buffer solution (about 10ml) was added, followed by 3-5 drops of EBT indicator and this solution was then titrated against standard EDTA solution with constant stirring until a sky blue end point was reached. The titer volume was recorded.

Calculation

The titer volume of Ca only was subtracted from the titer volume of Ca and Mg to obtain the titer volume of Mg only. This volume was used in the equation below to determine the composition of magnesium in the sample.

Estimation of phosphorus (mg/100 g) (AOAC, 1980)

Determination of phosphorus was carried out by measuring colorimetrically the blue color formed when the ash solution was treated with ammonium molybdate and thus phosphomolybdate formed was reduced.

To an aliquot, 0.1 ml of mineral solution was added with one ml of ammonium molybdate, one ml of hydroquinone and one ml of sodium thiosulphate solutions in this order, mixing well after each addition. The volume was then made up to 15 ml with water and the solution was mixed thoroughly. After 30 minutes, the optical density of this solution was measured in a photoelectric calorimeter against a reagent blank prepared in the same way as the test, except that the test solution was omitted at 660 nm. The phosphorus content of the sample was obtained from a standard curve prepared with standard phosphate solution (range 0.01 to 0.1 mg phosphorus).

Estimation of potassium (mg/100 g) (Ranganna, 2000) [12]

Sodium / potassium in solution were atomized into an oxyhydrogen or oxyacetylene flame. The flame excites atoms of potassium causing them to emit radiations at specific wavelengths. The amount of radiation emitted is measured on a spectrophotometer. Under standard conditions, it is proportional to the concentration of sodium / potassium in the solution.

Estimation of iron (mg/100 g)

Mineral solution prepared from different genotypes were fed to the AAS having appropriate hallow cathode lamps after getting values for standard solutions.

Results and Discussion

Mineral composition of horse gram and green gram

The mineral element constitutes an important group of nutrients required by the human body for optimal functioning. Micronutrients such as calcium (Ca), phosphorous (P), iron (Fe), magnesium (Mg) and potassium (K) were analysed from horse gram and green gram was presented in the Table 1.

Table 1: Mineral composition of horse gram and green gram

Minerals	Horse gram malt	Green gram malt
Phosphorous (mg/100g)	582	321.68
Potassium (mg/100g)	786.4	1241.64
Magnesium (mg/100g)	177	184
Calcium (mg/100g)	289	70.86
Iron (mg/100g)	39.5	5.6

Calcium as a structural component is required for the formation and maintenance of skeleton and teeth. It is also required for normal contraction of muscles to make limbs move contraction of heart for its normal function, nervous activity and blood clotting. The calcium content of horse gram and green gram were 289 and 70.86 mg/100g.

Another major element in the body next to calcium is phosphorous. Utilization of calcium is closely linked with phosphorous, since most of the calcium in the body is deposited as calcium phosphate in the bone and teeth. Phosphorous is also a component of nucleic acids and as phosphate esters plays an important part in the cellular metabolism of other nutrients like carbohydrates, fat etc. The phosphorous content in horse gram and green gram were 582 and 321.68 mg/100g.

Iron is an essential element for the formation of hemoglobin of red cells of blood and plays an important role in the transport of oxygen. However, presence of phytates, tannins, high calcium and high fibre foods are inhibitors of iron absorption. The iron content in horse gram and green gram were found to be 39.5 and 5.6 mg/100g. Magnesium is present in small amount in all cells and is required for cellular metabolism. It is also present in bone along with calcium. The magnesium content for horse gram and green gram were analysed and found 177 and 184 mg/100g respectively.

The results pertaining to potassium indicates the mean potassium content in horse gram and green gram was found to be 786.4 and 1241.64 mg/100g. Plants foods are indeed the rich source of potassium. Proper concentration of these electrolytes inside and outside the cell is essential to maintain osmotic balance and keep cells in proper shape. The results of mineral content for horse gram are in similar with the results obtained by Gopalan *et al*., (1999). The variations in values were may be due to the genotypes, soil composition and conditions for analysis. The mineral composition of green gram was found similar with the findings of Paul *et al*., (2011) [10].

3.1.6 Vitamin content of horse gram and green gram

Vitamins are organic nutrients needed in small quantities to perform physiological role in normal functioning of the body. They do not provide energy but are necessary in the use of energy. The quantitative estimation of vitamins present in the lemongrass leaves were presented in Table 2.

Table 2: Vitamin content of horse gram and green gram

Vitamins	Horse gram	Green gram
B_1 (mg/100g)	0.38	0.622
B_2 (mg/100g)	0.1	0.11
B_3 (mg/100g)	1.42	2.248

Legumes are good source of water soluble vitamins like thaimin, riboflavin and niacin. The vitamin B_1, B_2 and B_3 in horse gram were found to contain 0.38, 0.19 and 1.42 mg/100g. The vitamin contents were found in similar with the findings of Bolbhat and Dhumal (2012) [2]. The vitamin B_1, B_2 and B_3 in green gram was found to contain 0.622, 0.236 and 2.248 mg/100g. The similar results were also observed by Ghavidel and Prakash (2006) [4].

The water soluble vitamin like B_1, B_2 and B_3 are plays an important role in keeping our bodies running like well-oiled machines. These essential nutrients helps convert our food into fuel, allowing us to stay energized throughout the day. Thiamin (B_1) helps the body make healthy new cells. It's often called an anti-stress vitamin because of its ability to protect the immune system. The riboflavin (B_2) vitamin works as an antioxidant to help fight free radicals (Particals in the body that damage cells). Niacin is to boost HDL i.e. good cholesterol.

Effect of germination on mineral content of horse gram and green gram

The concentrations of minerals (in mg/100g) in germinated horse gram and green gram were determined by Atomic Absorption Spectroscopy. In the present study, the analysis for various elements indicated that phosphorous, potassium, magnesium, calcium and iron were present in both samples which are responsible for curing many diseases as shown in Table 3. These elements play a vital role in the formation of secondary metabolites which are responsible for pharmacological actions of medicinal plants.

Table 3: Effect of germination on mineral content of horse gram and green gram

Minerals	Horse gram malt	Green gram malt
Phosphorous (mg/100g)	314	256
Potassium (mg/100g)	408	675
Magnesium (mg/100g)	141	136.5
Calcium (mg/100g)	121	11.6
Iron (mg/100g)	7.24	4.03

Ash content was significantly decreased in germinated horse gram and green gram malt. Trace elements play both curative and preventive role in combating diseases. The phosphorous, potassium and magnesium content of horse gram malt were found 314, 408 and 141 mg/100g respectively. Also it had calcium and iron content about 121 and 7.24 mg/100g. Ca is the most abundant element in horse gram malt. Calcium overcome the problems of high blood pressure, heart attack, premenstrual syndrome, colon cancer and keeping the bones strong and reduces the risks of osteoporosis in old age (Minisola *et al*., 2015) [8]. Iron is an essential mineral to prevent anemia and cough associated with angiotensin-converting enzyme (ACE) inhibitors (Hider *et al*., 2013) [6].

The mineral content was decreased over germination. The concentration of phosphorus was found 256 mg/100g in mung bean malt which plays a major role in the structural framework of DNA and RNA. Living cells use phosphate to transport cellular energy with adenosine triphosphate (ATP), necessary for every cellular process that uses energy (Bernhardt and Kasko, 2008) [1]. The potassium and magnesium content in green gram malt were found 675 and 136.5 mg/100g. K is helpful in reducing hypertension and maintaining cardiac rhythm. In the human body, the elements play vital role in many physiological reactions and their deficiency or excess can affect human health (Ekinci *et al*., 2004) [3]. Magnesium can help to assist the body in metabolizing protein, help the diabetic also metabolize carbohydrates and in treating diabetes (Silva *et al*., 2013). The calcium and iron content were reduced in green gram after germination and observed 11.6 and 4.03 mg/100g. The decreased trends after germination in legumes were studied by Tiwari *et al*., (2017) [13].

3.3.4 Effect of germination on vitamin content of horse gram and green gram

The vitamin content of foods subjected to processing is influenced by several factors. The first determinant factor is the chemical stability of the food mineral. In addition, the extent of processing, environmental factors, and the form in which foods are delivered can also impact their stability. The effect of this germination on vitamin content of horse gram and green gram was analyzed and obtained results are presented in Table 4.

Table 4: Effect of germination on vitamin content of horse gram and green gram

Vitamins	Horse gram malt	Green gram malt
B_1 (mg/100g)	0.33	0.45
B_2 (mg/100g)	0.19	0.236
B_3 (mg/100g)	3.65	2.05

The Table 4, showed that the thiamin content were reduced in both horse gram and green gram due to germination. The

thiamin content was found 0.33 and 0.45 mg/100g in horse gram and green gram malt respectively. While the riboflavin content was increased over germination of horse gram and green gram and found 0.19 and 0.236 mg/100g. Zieliński *et al.* (2006) showed an almost linear reduction in thiamine content during rapeseed germination and a gradual increase of riboflavin content in sprouts throughout the germination. Prodanov *et al.* (1997) [11] suggested that the conditions such as the number of rinses, light levels and the time for seed germination affected the contents of vitamins. The poor solubility in water and sensitivity to light of riboflavin could account for its low level in germinated peanut seed samples.

The vitamin B_3 (Niacin) was found to be increased with germination period. The niacin content in horse gram and green gram was found to contain 3.65 and 2.05 mg/100g. The increase in water soluble vitamin such as thiamine and niacin were also reported by Nnanna and Phillips (1989) [9] in case of cowpeas. These and previous findings suggest that germinated food grains contain significantly larger amounts of important nutrients and lower values of harmful and antinutrients than their un-germinated originals and hence they can be used to make acceptable food and feed products.

Conclusion

It was concluded from the present study, the sprouting had significant effects on vitamin and mineral content of horse gram and green gram malt. The mineral content were increased and vitamin content were decreased over sprouting. Hence, it could be concluded that the germination process is helpful in preparation of nutritionally rich malt.

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