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Effect of malting on nutritional profile of alfalfa seeds and development of value added fermented products

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Abstract

The nutritive quality of legumes is poor due to deficiency of certain amino acids, low protein and starch digestibility and presence of certain anti-nutritional factor. As a result, processing techniques are adopted to overcome these problems and increases the palatability of legumes. Malting is one of the simple and inexpensive traditional processing techniques that are widely accepted for achieving desirable changes in the composition of legumes. In view of the above aspects the aim of present work was to investigate the effect of malting on nutritional profile of alfalfa seeds and development of value added fermented products. The nutritional profile (moisture, ash, protein, fat, fibre, carbohydrate, calcium and iron content) of unmalted and malted alfalfa flours were analyzed with standard protocols. Fermented products viz; Dhokla and Appe were developed by incorporating malted alfalfa flour (MAF) at 10%, 15% and 20% level and organoleptic evaluated by 5-point composite Score and 9-point hedonic scale. The study data revealed that malted alfalfa flour contain significantly increased content of protein (19.6%), fibre (29.1%), iron (39.9%) and calcium (93.9%) when compared to unmalted alfalfa flour at Pd"0.05 level. Sensory evaluation showed that fermented products developed at 10% level of incorporation of malted alfalfa flour were highly acceptable and registered insignificant difference at Pd"0.05 level when compared with their respective standard products. Thus, it can be concluded that the malted alfalfa seeds contain appreciable amount of nutrients that may be used in the formulation of fermented food products and advantageous in human health.

Keywords: Alfalfa, Malting. Fermentation, Appe, Dhokla

Introduction

Legumes play a very important role in vegetarian diet of the Indian population. India is the largest consumer and importer of pulses in the world and they are consumed regularly in every household at least in one meal (Gujral *et al.,* 2013). The nutritional value of legume is gaining considerable interest in developed countries because of high content of proteins with essential amino acids, complex carbohydrates, dietary fibre, unsaturated fats, vitamins and essential minerals for the human diet (Rebello *et al.,* 2014). Epidemiological studies provide convincing evidence that a diet rich in antioxidants is associated with lower incidence of degenerative and metabolic diseases. Legumes produce primary and secondary metabolites which possess certain pharmaceutical properties that have also been reported to be associated with numerous beneficial health attributes such as hypotensive, hypocholesterolemic, antiatherogenic, anticarcinogenic, hepatoprotective and hypoglycemic properties (Ndidi *et al.,* 2014).

Alfalfa (*Medicago sativa*) is a perennial species belongs to the *leguminosae* family. It is one of the genus and most reputed medicinal plants which has the largest cultivation area in present world because of its numerous qualities such as cold resistance, salt tolerance, high yield, soil amelioration and economic benefits (Shangli *et al.,* 2017). It is considered as 'father of all plants' and green food of the millennium and one of the remarkable legumes that

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contain high amount of protein, calcium, vitamins in order to maintain proper functioning of the whole body (Dong *et al.,* 2011). It also contains high amount of bioactive components such as saponins, alkaloids, flavonoids, glycosides, phytoestrogen and phenolics with various pharmacological properties such as antimicrobial, anti-inflammatory, anticancer, anti hyper cholesterolemic and anti diabetic (Rathee *et al.,* 2009).

Several methods have been generally adopted to improve the nutritional and organoleptic qualities of legumes. Malting has been suggested as an inexpensive and effective way to improve the quality of legumes and for the elimination of the nutritional impediments of foods. It is a biotechnological technique which involves the controlled germination of a cereal grain (Laxmi *et al.,* 2015) by which the quality of a cereal can be improved for both digestibility and physiological function, particularly through the breakdown of certain anti- nutrients, such as phytate, tannin and protease inhibitors (Graham *et al.,* 2000). While fermentation is one of the oldest and most economical methods that provide a way to preserve food, destroys undesirable factors, enhance value in the area of human nutrition. Hence, in the light of the above research facts, the present study was undertaken to determine the nutritional profile of malted alfalfa seeds and development of value added fermented products.

Materials and Methods

Collection of raw sample

Alfalfa seeds (*Medicago sativa*) were collected from the local market of Haldwani, Uttarakhand. The flour was prepared by malting technique which includes Soaking (3 h), Germination (48 h) and Kilning (4 h).

Processing and preparation of malted alfalfa flour

500g of alfalfa seeds were weighed, stored, steeped in distilled water for 3 h at room temperature and then completely drained of steep water using sieves. The drained seeds were then spread on a moistened jute sack and allowed to germinate at room temperature for 48 h. The germinated grains were manually washed with distilled water, drained and oven dried at 55°C for 4 h. The dried grains were milled using attrition mill, sieved and packaged in an airtight container for further analysis.

Selection of whole seeds free from Infest and Removal of stone or dust particles

↓

Seeds washed with 0.05% aqueous lime volume of water for 12-48 h at 20±2°C till moisture content reaches 40%

↓ → Preliminary Washing (Germination)

Water was changed after every 6 h.

↓ → Soaking

Seeds were kept in muslin cloth for germination for 48 h.

↓ → Germination

Water was sprinkled after every 12 h.

↓

Preliminary drying was done in air for 1-2 h.

↓

Finally oven drying was done for 4 h at 55°C.

↓ → Kilning

The grains were ground to fine particles by manual grinder

↓ → Milling

Powder was passed through household 'Atta' Seive

↓ → Storage

The fine powder was filled in airtight container

Nutritional Profile

Moisture content was determined by drying in an oven at 55^{0}C to constant weight. Ash content was determined by weight difference after sample mineralization at 600°C for 6 h. Fat was determined through Socs Plus system (Pelican, Model: SCS-6) by using petroleum ether. Fiber content of samples were determined by digesting dry sample with 1.25% H2SO4, followed by 1.25% NaOH solution in Fibra Plus Fiber analyzer (Pelican, Model: FES-4). Protein was determined indirectly from the analysis of total nitrogen (Crude Protein= Amount of Nitrogen×6.25) using Micro Kjeldhal method by Kel Plus analyzer (Pelican, Model: KES-061) and Carbohydrate content was determined by subtracting the content of protein, moisture, ash, fiber and fat from 100 (AOAC, 2005). Minerals such as, Iron content was determined by Wong's method whereas; Calcium content was determined by titration against standard potassium permanganate solution (Sharma, 2007).

Product development and sensory evaluation

The fermented products (Dhokla and Appe) were developed with their three variations by incorporating malted alfalfa flour (MAF) at different concentration assigned as 10 15 and 20% respectively. The evaluation of the developed fermented products were carried out by using 5 point composite scale with respect to various attributes namely; appearance, color, texture, flavor and taste whereas, overall acceptability was analyzed by 9-point hedonic rating scale.

Statistical Analysis

The results obtained were expressed as Mean ±SD and Paired t-Test of three determinations and also statistically analyzed to ascertain its significance. The significance was estimated at (pd"0.05level).

Results and discussion

Table 1 and Figure 1 shows nutritional composition for moisture, ash, fat, protein, fiber, carbohydrate of unmalted and malted alfalfa flour. Low moisture content is encouraged to safeguard the product from microbial attack and enzymatic action which may prevent spoilage (Akonor *et al.,* 2016). Unmalted and malted alfalfa flours had moisture content (g/100g) 7.36±0.40 and 8.62±0.37 respectively. This data illustrates that malted flour had significantly increased moisture content by 17.1% at p≤0.05 level when compared with unmalted flour. Similar data predicted by Gernah *et al.,* (2011) that malted *Zea mays* had 9.70±0.01g/100g of moisture content which was significantly increased by 19.7% at p≤0.05 level. Ash content is directly proportional with inorganic element content of legumes. Hence the samples with high percentage of ash contents are expected to have high concentrations of various mineral elements, which are advantage to speed up metabolic processes and improve

Table1: Nutritional composition of Unmalted and Malted Alfalfa Seeds on Dry Weight Basis

Parameters (g/100g)	Alfalfa seeds Unmalted flour	Malted flour
Moisture	7.36±0.40	8.62±0.37 (17.1% '!)*
Ash	3.57±0.11	2.63±0.22 (26.3%"!)*
Fat	2.60±0.96	1.04±0.06 (39.3%"!)*
Protein	15.42±0.01	18.45±0.03(19.6%'!)*
Fiber	5.79±0.12	6.48±0.22 (29.1%'!)*
Carbohydrate	65.26±0.48	61.78±0.59 (5.03%"!)*

Values are expressed as Mean ±SD of triplicate determinations of unmalted alfalfa flour and malted flour on dry weight basis. * Shows significant difference at (p≤0.05) level

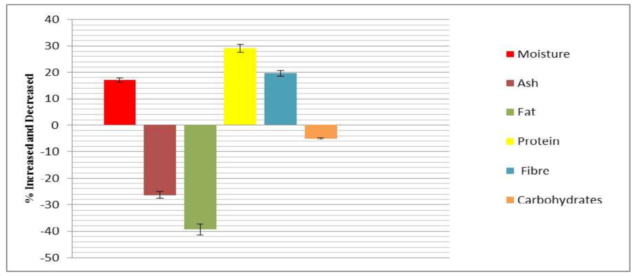

Figure 1: Present difference of unmalted and malted alfalfa flour with moisture, ash, fat, protein, fibre, carbohydrate

growth and development (Fekadu *et al.,* 2013). Unmalted alfalfa flour had higher ash content (3.57±0.11g/100g) as compare to malted flour (2.63±0.22) by 26.3% at p≤0.05 level which was comparable to the data given by Afifi *et al.,* (2012) that germinated grains of sorghum had1.20±0.07g/100g of ash content which was significantly decreased by 16.0% at p≤0.05 level when compared with raw sorghum grains.

The low fat content favors in the prevention of metabolic disorders such as cardiovascular diseases, diabetes and cancer (Showemimo and Olarewaju, 2004). Fat content (g/100g) of unmalted and malted alfalfa flours was 2.60±0.96 and 1.04±0.06 respectively. This shows that unmalted flour had increased value by 39.3% at p≤0.05 level when compared to malted alfalfa flour. Similar data predicted by Nour *et al.,* (2015) sprouted grains of sorghum had 1.33g/100g of fat content which was significantly decreased by 63.6% at p≤0.05 level when compared with raw grains. Proteins are enzymes that catalyze chemical reactions and accelerate some chemical reactions (Gbile and Adesina, 2009). Protein content (g/100g) of unmalted and malted alfalfa flour was 22.1±0.01 and 29.4±0.03 respectively. This shows that malted alfalfa flour had significantly increased protein content by 30% at pd"0.05 level. The observation is agreed with other scientific findings reported by Blessing and Gregory, (2010) that germinated *Vigna radiate* had 30.6±0.11g/100g of protein content which was significantly increased by 27.07% at p≤0.05 level when compared with raw *Vigna radiate*.

Intake of fibre may lower the serum cholesterol level and chances of having the risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer (Jain *et al.,* 2011). Fibre content (g/100g) in unmalted alfalfa seeds flour was 5.79±0.12 which was significantly decreased by 29.1% when compared with malted alfalfa flour (6.48±0.22) at p≤0.05 level. Banusha and Vasntharuba, (2013) have reported that

Table2: Mineral composition of Unmalted and Malted Alfalfa Seeds on Dry Weight Basis

Minerals (mg/100g)	Alfalfa seeds Unmalted flour	Malted flour
Iron	4.51±0.04	6.31±0.096(39.9%‘!)*
Calcium	2.49±0.22	4.83±0.20 (93.9%‘!)*

Values are expressed as Mean ±SD of triplicate determinations of unmalted alfalfa flour and malted flour on dry weight basis. * Shows significant difference at ($p \leq 0.05$) level

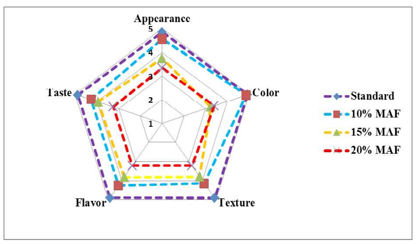

Figure 2(a). Acceptability evaluation of Dhokla by incorporating malted alfalfa flour in term of sensory attributes

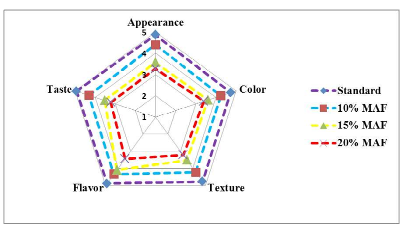

Figure 2(b). Acceptability evaluation of Appe by incorporating malted alfalfa flour in term of sensory attributes

malted grain of *Eleusine coracana* had 4.26±0.11g/100g of fibre content which was significantly increased by 8.12% at $p \leq 0.05$ level when compared with unmalted grains. Unmalted alfalfa seeds flour had significantly increased carbohydrate content (58.5±0.48g/100g) when compared with malted alfalfa flour (51.8±0.59g/100g) by 11.4% at $p \leq 0.05$ level which was comparable to the data given by Nwosu, (2013) that malted beans of *Sphenostylis sternocarpa* had 58.5g/100g of carbohydrates content which was significantly decreased by 6.84% at $p \leq 0.05$ level when compared with unmalted beans.

The iron and calcium content that is required for hemoglobin production and bone development (Leterme, 2002). Table 2 indicates that iron content (mg/100g) of unmalted and malted alfalfa flours was 4.51±0.46 and 6.31±0.09 respectively. This shows that

Table 3: Overall Acceptability Evaluation of Fermented Dhokla and Appe by Incorporating Malted Alfalfa Flour in terms of Sensory Attributes by 9 Point Hedonic Scale

Overall acceptability	Standard	10% MAF	15% MAF	20% MAF
Dhokla	8.82±0.33	8.50±0.42 NS	6.8±0.5*	6.4±0.58*
Appe	8.62±0.42	8.32±0.24 NS	6.7±0.56*	6.5±0.60*

Values are expressed as Mean ±SD of triplicate determinations of unmalted alfalfa flour and malted flour on dry weight basis. * Shows significant difference at ($p \leq 0.05$) level. NS shows non-significant difference at ($p \leq 0.05$) level.

malted flour value significantly increased by 39.9% at $p \leq 0.05$ level. Similar data predicted by Laxmi *et al.,* (2015) that malted chickpea contains 4 5.4mg/100mg of iron which was significantly increased by 17.39% at $p \leq 0.05$ level when compared with unmalted peas. The result obtained for calcium content (mg/100g) was significantly higher in malted alfalfa seeds flour (4.83±0.20) by 93.9% as compared to unmalted alfalfa flour (2.49±0.22) at $p \leq 0.05$ level that was comparable with the study reported by Plaza *et al.,* 2003 that germinated alfalfa seeds had 3.32±0.13mg/100g of calcium which was significantly increased by 102.4% at $p \leq 0.05$ level when compared with raw seeds.

The fermented products viz; Dhokla and Appe were prepared by the incorporation of malted alfalfa flour (MAF) at three different variations i.e. 10, 15, and 20% respectively which were compared with their standard product as depicted in figure 2(a) and (b). The data showed that the mean value obtained for their standard products were ranging for Dhokla (4.86±0.28 to 4.93±0.24) and Appe (4.77±0.38 to 4.92±0.32) in terms of all sensory attributes. Whereas, the mean values obtained for test products developed with 10% MAF were ranging for Dhokla (4.14±0.45 to 4.87±0.46) and Appe (4.22±0.30 to 4.41±0.07) and was found to be acceptable and comparable to standard products which showed insignificant difference at $p \leq 0.05$ level. However, incorporation of 15% and 20% MAF based products was found to be less acceptable and found to be significant at $p \leq 0.05$ level when compared to their respective standard products.

As shown in table 3, the overall acceptability for Dhokla (8.50±0.42) and Appe (8.32±0.24) developed at 10% level of incorporation with MAF were found to be highly acceptable and comparable with their respective standard products and registered insignificant difference at P≤0.05 level. However, other variations (15% and 20% incorporated MAF based products) were moderately liked by the panel members and registered to be significant different at p≤0.05 level.

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