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Effect of Malting on the Anti-Nutritional Factors of Composite Flour

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ABSTRACT

Utilization of coarse cereals (barley, sorghum and pearl millet) in the diet would be very beneficial to health because it has antioxidants, phytochemicals, protein, fiber, vitamins and minerals. It prevents many disease like cancer, diabetes and cardiovascular diseases. But these cereals also contained some antinutrients as phytate, tannin and oxalate which could be responsible for its lower nutrient digestibility and availability. To overcome this problem low cost processing technique i.e. malting of cereal grains would be very effective. Flour is a commodity that can be used in our daily routine in the form of chapati, biscuits, bread, pasta, other snacks and bakery products. So considering the fact, composite flour containing barley, sorghum, pearl millet, whole wheat and defatted soy flour of four different combinations was prepared. The impact of malting on the antinutrients characteristics (phytate, tannin and oxalate content) of best acceptable ratio of composite flour was assessed using standard methods. Results indicated that malting reduced the phytate, tannin and oxalate content in the composite flour 58.7 %, 25.49 %, and 85.64 %, respectively.

Key words *Anti-nutrients, composite flour, malting.*

Antinutrients are present in almost all food sources in varying levels. They are natural or synthetic compounds that interfere with the absorption of nutrients (Oxford Dictionary of Biochemistry and Molecular Biology, 2006). One common example is phytic acid, which forms insoluble complexes with calcium, zinc, iron and copper (Cheryan, *et.al.*, 1980). Another particularly widespread form of antinutrients are the flavonoids, which are a group of polyphenolic compounds that include tannins (Beecher, 2003). These compounds chelate metals such as iron and zinc, and reduce the absorption of these nutrients. They also inhibit digestive enzymes and may precipitate proteins. Oxalic acid has the ability to form a strong bond with various minerals, such as sodium, potassium, magnesium, and calcium. When this occurs, the compounds formed are usually referred to as oxalate salts. Thus, "oxalate" usually refers to a salt of oxalic acid, one of which is calcium oxalate (Liebman, 2002). Oxalic acid and its content have deleterious effects on human nutrition and health, mainly by decreasing calcium absorption and aiding the formation of kidney stones (Savage, 2002).

It is quite possible to get rid of these antinutritional factors and hence improve the nutrient digestibility and bioavailability by using simple home level processing technique such as malting. The process of malting comprises three unit operations, steeping, germination and drying. Malting induces important beneficial biochemical changes in grains. Soaking generates grains softening and increases water availability. The enzymes produced during germination lead to the hydrolysis of starch and protein which release sugar and amino acids directly making them easily available. Drying is the final stage of the malting process and is required for stopping further growth of the kernals, reducing the moisture content and water activity, hence producing a shelf stable product with active enzymes (Mella, 2011). Many researchers reported that malting reduces the antinutrients content and increase the vitamin (A, B, C and E), mineral (calcium, manganese, copper and zinc) and protein content in the cereal grains viz wheat, barley, sorghum, pearl millet, oats, rice etc. (Yang, *et al.*, 2001; Rimsten, *et al.*, 2003; El-Adawy *et al.*, 2004; Kaushik, *et al*. 2010; Coulibaly and Chen, 2011). Additionally, the fact that malting can be carried out at potentially low cost without sophisticated and expensive equipment is an added advantage.

Composite flour has better nutritional value in respect to elements like minerals, vitamins, fibers, proteins as compared to flour obtained from any specific cereal alone. It can be consumed by all age groups from children, adolescents, adults, and the old (Dendy. 1992). In view of the benefits of malting on reducing antinutrients, the present investigation has been carried out to assess antinutritional factors (phytate, tannin and oxalate) in both malted and unmalted composite flour.

MATERIAL AND METHODS

Development of composite flour:

Four whole grains *viz,* wheat (GW 366), barley (RD 2715), sorghum (CSV 23) and pearl millet (RHB-173) were procured from the, Udaipur (Agriculture research station MPUAT) and, Jaipur, (Durgapur agriculture research station), Rajasthan respectively. Defatted soy flour was procured from soy processing unit, Mehsana, Gujarat. Procured raw material was further cleaned and steeped for 12 hours. They were germinated (48 hr), dried and

milled for further use. The coarse grain flour blends were prepared by mixing equal proportion of malted flour of barley, pearl millet and sorghum. The prepared malted coarse grain flour blend was mixed with malted whole wheat flour by replacing at a level of 10%, 20%, 30% and 40% and keeping the level of defatted soy flour at 10% in all combinations (T1-T4). Similar procedure was followed to made unmalted composite flour except malting technique was not applied to the grains. Flour standardization was done by preparing food product (*Chapati*) for selecting the best acceptable treatment through nine point hedonic scale In the preliminary trials, *chapati* was prepared with different permutations and combinations of malted composite flour in order to obtain highly acceptable product

Anti-nutrient composition:

Phytate content of the samples was estimated using the method given by Peach and Tracy, 1955, tannin contents of flour were measured by Folin-Denis method (Sadasivam and Manickam, 2003) and oxalate was estimated by the method described as NIN, 2003 with slight modifications.

Statistical analysis: Analysis of variance (ANOVA) was used to assess the difference between mean values of sensory scores of chapati and student-t-test was used for testing the difference between antinutrients composition of the malted and unmalted composite flour.

RESULTS AND DISCUSSION

Standardization of malted composite flour: Chapati is Indian unleavened flat bread which accounts for the cereal group in a balanced diet. The scores assigned by panel members for individual sensory attributes of chapati were found to be values in the range of 6.96 to 8.30 for malted composite flour (T1-T4) chapatis which permit us to draw conclusion that the product varied from liked slightly to as high as approaching a point of excellence. From the Analysis of variance a insignificant difference was found within treatments (T1-T4). So the highest level of MCG blend incorporated (40%) flour sample was selected for further analysis in view of its enhancing the nutritional value. The present findings depicting slightly to high acceptability of the chapati are in conformity with those reported by Kadam, *et al.,* 2012 where chickpea, soy and methi leaves powder were incorporated at different ratios in the wheat flour chapatis and the results revealed that the sensory scores of various attributes viz; colour, appearance, flavor, taste, texture and overall acceptability in between 6.0 to 8.7.

Antinutrients composition:

Results regarding the anti-nutrient composition are presented here:

Table 1. Antinutritional factors of malted and unmalted composite flour (mg/100g)

		Unmalted composite flour	Malted composite flour	
S.No.	**Characteristics**	Mean ± SD	Mean ± SD	T value
1.	Phytate	375.35± 4.35	155.00±4.71	59.42**
2.	Tannin	235.77±1.52	175.66±17.09	6.06*
3.	Oxalate	8.57±0.01	1.23±0.40	31.77**

Note: *, ** Significant at 5% and 1% respectively

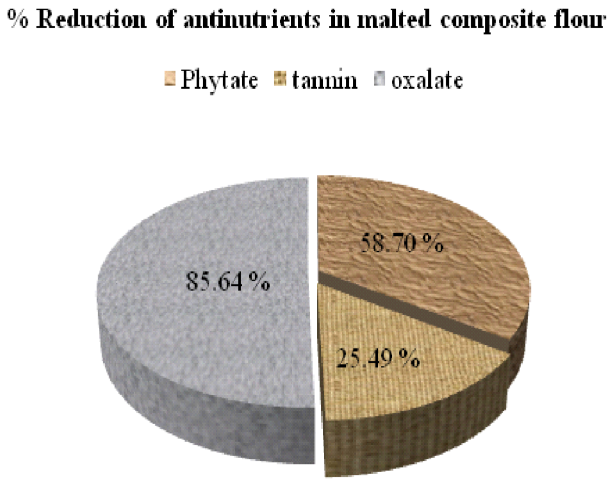

Fig 1. Percent decrease in antinutrients composition of MCF after malting

Table: 3.delineates the anti-nutrients found in the malted and unmalted composite flour. It has been found that the phytate, tannin and oxalate content were 375.35 mg/100g, 235.77 mg/100g and 8.57 mg/100g, respectively in the unmalted composite flour while the corresponding values for malted composite flour were 155 mg/100g, 175.66 mg/100g and 1.23 mg/100g, respectively. The per cent reduction of the antinutrients has been illustrated in the Fig.1 which showed that the phytate, tannin and oxalate reduced 58.7 %, 25.49 %,and 85.64 %, respectively in the malted composite flour as compared to unmalted flour significantly ($p < 0.05$). The reduction may have occurred because of the process of malting i.e. soaking, germination and drying. The decrease in the level of phytic acid during soaking may be attributed to leaching out into soaking. Other researchers have also reported decrease in the level of phytic acid during soaking and germination due to phytase activity in the germinating grains. Phytase activity was increased during germination of wheat, barley, rye and oats which hydrolyse phytate to phosphate and myoinositol phosphates by Nkama and Gbenyi, 2001; Inyang and Zakari, 2008. The observed reduction in tannin content in malted composite flour was attributed to the formation of hydrophobic association of tannins with seed proteins and

enzymes. Some loss of tannins during germination may be again due to the leaching of tannins into the water (Shimils and Rakshit, 2007).

Similar antinutrients were analyzed by Olagunju and Ifesan (2013) in raw and germinated sesame seeds. It was found that phytic acid and oxalate content of sesame seed reduced from 31.59 and 1.05mg/g to 16.20 and 0.51mg/g (49% and 51% reduction, respectively). The observed reduction in phytate content during germination of different legume seeds was apparently as a result of large increase in phytase activity. Kumar, *et al*., 2010 stated that during germination of cereals and legumes, phytate was degraded by intrinsic phytase.

A comparable study was conducted by Murugkar, *et al*., 2013 on multi-nutrient mixes in which different combinations of cereals (Corn and wheat), millets (Sorghum, Pearl millet & finger millet), pulses (split and whole green gram), fruit (papaya), vegetable (spinach) ,soy protein isolate and dairy whitener were used. The oxalic acid content in un-sprouted combinations ranged from 93.2-101.2 mg% which decreased significantly (pd"0.05) to 21.6 mg% due to malting as was found in the present investigation.

Singh and Raghuvanshi 2012, reported that malting decreased the tannin by 54% and phytin phosphorous by 58% in brown finger millet which was comparable to the present study results . On malting, loss of phytate in finger millet was observed from 41 to 33% (Deosthale, 2002; Mamrio *et. al*., 2001). Similarly, Shimelis and Raskshit (2007) reported a noticeable reduction i.e. 96% and 76% in phytic acid and tannin content, respectively in three kidney bean varieties after four days of germination.

In the light of positive effect of malting process in the reduction of antinutrients, a research has been conducted by Gahlawat and Sehgal, 1993. Four weaning foods were formulated using locally available cereals and pulses such as wheat (*Triticum aestivum*), barley (*Hordeum vulgare*) and green gram (*Vigna radiata*). The effects of domestic processing such as roasting and malting on antinutrients such as phytic acid and polyphenols of weaning foods were studied. Roasting of raw ingredients resulted in decrease in phytic acid and polyphenols from 38·9 to 40·8% and 48·4 to 51·0% respectively, whereas malting brought about decrease in phytic acid and polyphenols 56·6 to 57·6% and 61·2 to 62·7%, respectively. Thus, the study indicated that malting has a pronounced effect in lowering the antinutrients, while roasting was relatively less effective.

It can be concluded that the malting is an effective processing technique which can be used for the reduction of antinutrients and increment of flavour in the cereal flour of our daily diet. Therefore, malted composite flour can be domesticated and gradually incorporated into traditional diets like *chapati and* other flour based food products.

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