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Impact of malting on nutrient and Antinutrient content of processed composite flour prepared with different grains

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Abstract
The present study entitled **"**Impact of malting on nutrient and antinutrient content of processed and unprocessed composite flour prepared with different grains**"** was carried out with objectives to assess the impact of malting on nutrients, and antinutrients to developed processed composite flour. The different types of composite flours were prepared. Processed composite flour was obtained by the mixing of malted wheat flour (MWF), malted pearl millet flour (MPMF), malted soybean flour (MSF), malted chickpea flour (MCF)and dehydrated colocasia leaves powder (DCLP) in the different ratios i.e (MWF-40%,MPMF-20%,MCF-20%,MSF-10%, DCLP 10%) and unprocessed composite flour was prepared (WF-50%,PMF-20%,CF-20%,SF-10%,) Chemical analysis was done by standardized procedure of (AOAC 2007). Comparison of nutrient and antinutrient content of processed and unprocessed composite flour was showed that there was a maximum increase in nutrient content of malted processed composite flour.

Keywords: malting, processed composite flour, unprocessed composite flour, colocasia leaves

Introduction

Composite flour refers to the mixture of different concentration of non-wheat flour from cereals, legumes, roots and tubers with wheat flour or can be a mixture of flours other than wheat flour. Composite flours are recently manufactured not only to improve nutritional composition. Cereal substitution to wheat is an economical step as well the deficiencies of wheat flour and its nutrients can be overcome by other cereal substitution.

Germination is a process widely used in legumes and cereals to increase their palatability and nutritional value particularly through the breakdown of certain anti-nutrients such as phytate and protease inhibitors. In non-germinated legume grain and cereal seeds with the exception of rye and to some extent wheat triticale and barley only little intrinsic phytate degrading activity is found but during germination a marked increase in phytate degrading activity with a concomitant decline in phytate content was observe.

Long periods of germination periods are needed to improve mineral bioavailability through germination. In developing countries plant foods are the major staples of the diet and consumption of animal source foods is often low because of economic and religious concern. Such plant based diets are however, often associated with deficits in calcium, iron, zinc and some vitamins.

A major factor contributing to these deficits particularly for diets based on unrefined cereals and legumes is that bioavailability which can be defined as the proportion of an ingested trace element in food that is absorbed and utilized for normal metabolic and physiological functions or storage **(**Jackson, 1997) [1] is poor. Bioavailability is influenced by both dietary and host-related factors (Fairweather-tait & hurrell, 1996) [2].

Material and Methods

1. Experimental site: The present investigation was carry out in the Nutrition Research Laboratory, Foods and Nutrition, Ethelind School of Home Science.

2. Procurement of raw materials: Wheat, pearl millet, chickpea, soybean and colocasia Leaves and other ingredient were purchased from local market of Allahabad district, for the preparation of composite flour.

3. Processing of wheat, pearl millet, soybean and chickpea: The soaking period (12hours), germination temperature (31^0C) and germination period (48 hours) was opted for malting. The malted wheat, millet, chickpea and soybean were Preliminary drying was done in air for 1-2 hrs. Final drying is done under sun to about 10% moisture. Vegetative parts were removed by rubbing and these foods were ground to powder and passed through the fine mesh sieve then storing in air-tight container followed by (Laxmi G *et al.,* 2015) [4].

Procedure of malting process

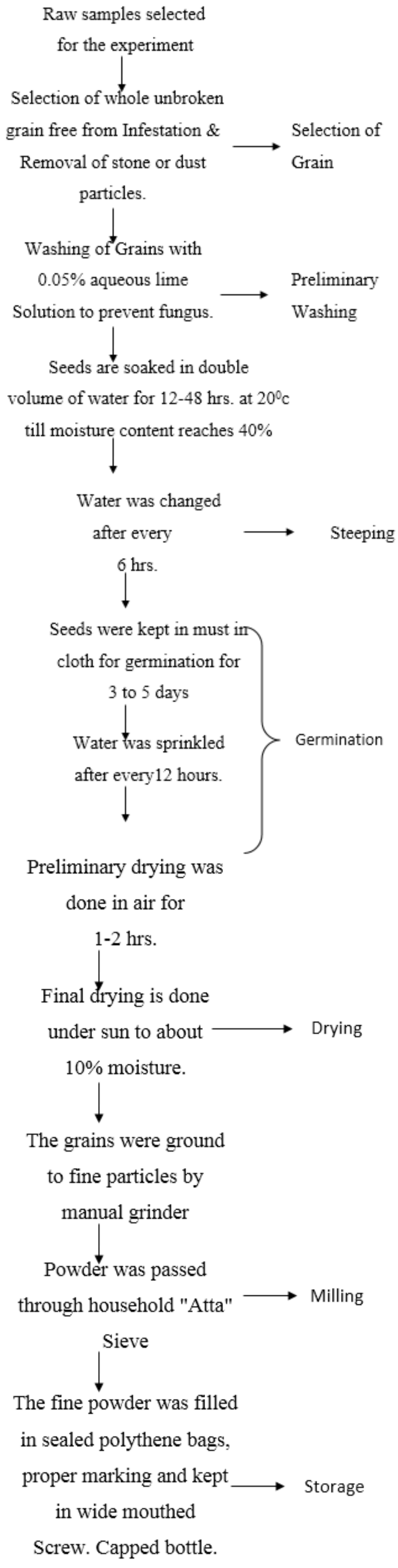
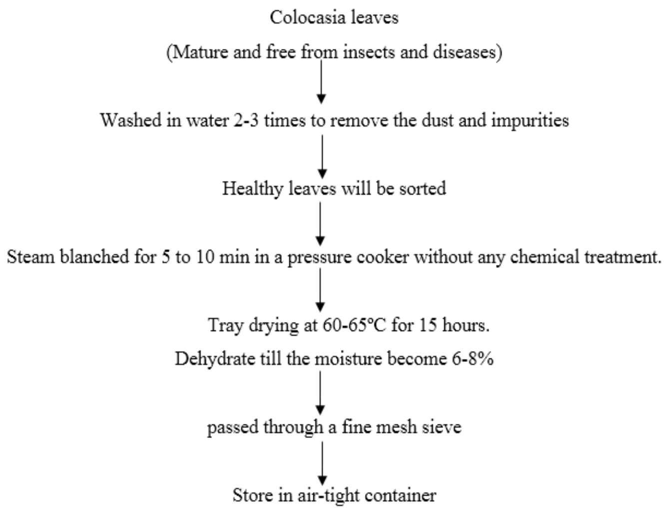


Fig 1.1 Processing: of Wheat, Pearl millet, Chickpea and Soybean

4. **Preparation of colocasia leaves powder:** The leaves were thoroughly washed in water 2-3 times to remove the dust and impurities. Healthy leaves will be sorted then steam blanched for 5 to 10 min in a pressure cooker without any chemical treatment. (sheetal gupta *et al.,* 2008) [3] Then the leaves were dried at a temperature of 50 to 60^0 C for 12-15 hours till 6-7 percent moisture remains (Singh *et al.* 2006). The dried leaves were then turned to homogeneous powders passed through a fine mesh sieve and store in air-tight container.



5. **Preparation of composite Flour:** The composite flours were obtained by the mixing of selected cereals, pulse, millets and green leafy vegetables such as malted wheat flour (MWF), malted pearl millet flour (MPMF), malted soybean flour (MSF), malted chickpea flour (MCF) and dehydrated colocasia leaves powder (DCLP) in the different ratio i.e ((MWF-40%,MPMF-20%,MCF-20%,MSF-10%,DCLP 10%) and unprocessed composite flour was prepared with *(WF-50%,PMF-20%,CF-20%,SF-10%,).*
6. **Analysis of nutritive value and antinutritional factors of composite flour:** Method described by was used for determination of nutrients composition of the nutrients and micronutrients enriched composite flour. This includes estimation of proximate composition, minerals and vitamins of the composite flour such as moisture, ash, fat, crude fibre, and protein, iron, calcium, zinc, beta carotene, phosphorus and vitamin C. Antinutritional factors such as phytate, tannin, phenols and oxalate was also determined by using standard.

Results and Discussion

Table 1 shows the proximate composition, mineral and vitamin contenton the malted processed and unprocessed composite flour. The moisture level of the unprocessed and processed malted flour leaves was found to be 11.09 percent and 8.20 percent. Moisture content is among the most vital and mostly used measurement in the processing, preservation and storage of food. So the results supports the practice of storage of the leaves in dehydrated form as the low moisture content of these leaves will prevent microbial attack and allows high storage capacity.

Crude fibre in food or plant is an indication of the level of non-digestible carbohydrate and lignin. The crude fibre obtained for processed composite flour was found 4.44 g/100 g, which was higher than the unprocessed composite flour.

High fibre content in diets have been reported to result in increased removal of carcinogens, potential mutagens, steroids, bile acids and xenobiotics by binding or absorbing to dietary fibre components and be rapidly excreted, hence these wastes will have health promoting benefits for the ruminants and non-ruminants.

Crude fat determines the free fatty lipids of a product. This property can be used as the basis in determining processing temperatures as well as auto-oxidation which can lead to rancidity (affect flavour of food). The crude fat found in periwinkle leaves is 7.69 g/100 g which is comparatively higher than the processed composite flour i.e. 6.24g/100g.

The crude protein content of processed and unprocessed composite flour was found to be 22.31g/100g and 14.7g/100g respectively, which is found similar to the findings by i.e 7.05g/100g.

The high carbohydrate content of both processed and unprocessed composite flour (64 g/100 g).similar pattern of carbohydrate content was observed in germination of foxtail millet. These changes may becaused by degradation of starch content. and lemon grass leaves (75g/100 g) shows that both leaves are very good source of energy which is found higher than those reported by i.e 46.02 g/100g and i.e 55 g/100gThe caloric value of the sample for periwinkle (354 kcal/100g) and lemongrass (344kcal/100 g) is found slightly lower when compared with those reported by i.e 369.37kcal/100 g and i.e 360.55kcal /100 g.

The iron content for periwinkle was found to be 27 mg/100g which is found much lower than those reported by i.e154.39 mg/100gand calcium content of periwinkle was found 320 mg/100g, which is found higher than those reported by i.e 232.90 mg/100g whereas for lemon grass iron content was found 22 mg/100g which is lower than those reported by i.e43 mg/100g. The calcium content of lemon grass was found 200 mg/100g which is slightly lower than the findings of i.e242 mg/100g.

The phosphorus content of the composite flour produced in this study is closer to the phosphorus content (183.1 mg/100 g) of wheat-soy flour reported by Anna *et al.* [30]. The relatively high phosphorus content of the composite flour is an indication that the flour products will help in the formation of teeth and bones in children and their proper development.

Table 2 Ash content is generally taken to be a measure of the mineral content of the original food. The high value of ash content of processed composite flour (2.48 g/100g) and UCF (2.27 g/100g) were indicative of high mineral (especially the macro-minerals) content of these leaves.

Calcium content of unprocessed composite flour was slightly higher than the processed composite flour. Calcium is essential for bone and teeth formation and development, blood clotting and for normal functioning of heart, nervous system and muscles. Calcium deficiency can lead to ricket, osteomalacia and tooth decay.

The vitamin C content of unproceesed and processed malted flour was found to be 0.015/100 g and 2 mg/100 g. Iron content was found to be highest in processed composite flour i. e. 5.95mg/100g.

Above table shows that unprocessed composite flour contain more phytate 166mg/100g than processed composite flour. Processing techniques as soaking, cooking, germination and fermentation have been found to reduce significantly the level of phytate and tannin by exogenous and endogenous enzyme formed during processing. Germination of seeds decreases tannin and phytic acid contents of the guar gum seeds with decrease in albumin fraction (Ahmed *et al*., 2006).

Tannin content was found to be highest in unprocessed composite flour. Total phenol content was found to be highest in 134.5 mg/100g followed by processed composite flour i.e. 94.11mg/100g. Oxalate content was also found to be highest in unprocessed composite flour. On sprouting the oxalic acid content decreased significantly ($p \leq 0.05$) and ranged from 21.6-77.6 mg% During germination, oxalate oxidase gets activated which breaks down oxalic acid into carbon di oxide and hydrogen peroxide and releases calcium (Illett, 1998) [5]. The effect of this change was seen correspondingly on calcium content of the mix which increased on sprouting as oxalic acid is known to interfere with calcium absorption. The maximum effect was seen in Combination 4 in which calcium content increased from 107.7 to 145.2 mg%. A 32.6% decrease in oxalic acid content of Combination 4 increased its calcium content by approximately 35% due to the sprouting of finger millet.

Table 4 shows that total polyphenol content was found to be highest in processed composite flour i.e. 102mg/100g which was higher than the unprocessed composite flour. Ramesh *et al*., (2011) [8] reported that on sprouting of green gram its antioxidant potential increases either due to increased amount of phenols or similar compounds or activation of enzymes. Therefore, sprouting increases the functional components in mixes improving quality of mixes. Free radical scavenging activity was found to be highest in processed composite flour.

Table 1: Impact of malting on (12h steeping and 48 h Germination) on proximate composition of composite flour (MWF-40%+MPMF-20%+MCF-20%+MSF-10%+DCLP-10%) (*Per* 100 gm).

Nutrients	Unprocessed composite flour	Processed composite flour
Moisture (g)	11.09±0.51	8.20±0.62
Protein (g)	14.07±0.48	22.31±1.10
Fat (g)	7.69±0.23	6.24±0.23
Crude fibre (g)	2.14±0.36	4.44±0.06
Carbohydrate (g)	75.4±0.43	64.5±0.47
Energy (Kcal.)	374±1.12	403±1.14
Phosphorus (mg)	322±1.17	284±0.94

* Results are mean ±SD of three determinations.

Table 2: Impact of malting (12h steeping and 48 h Germination) on minerals and vitamins of composite flour (MWF-40%+MPMF-20%+MCF-20%+MSF-10%+DCLP-10%) (per100 gm.)

Nutrients	Unprocessed composite flour	Processed composite flour
Total ash (g)	2.27±0.07	2.48±0.09
Calcium (mg)	100.3±2.8	115.38±2.7
Iron (mg)	4.07±0.3	5.95±0.4
Zinc (mg)	3.82±0.2	8.48±0.6
Vitamin-C (mg)	3.0±0.5	62±1.16
βcarotene (μg)	202.75±1.08	3400±3.12

* Results are mean ±SD of three determinations.

Table 3: Impact of malting (12h steeping and 48 h Germination) on antinutritional factors of composite flour (MWF-40%+MPMF-20%+MCF-20%+MSF-10%+DCLP-10%) (per100 gm.)

Antinutritional composition	Unprocessed composite flour	Processed composite flour
Phytate (mg)	166±0.05	67.2±0.04
Tannin (mg)	48.0±0.04	19.08±1.13
Total phenols (mg)	134.5±0.41	94.11±1.10
Oxalate (mg)	28.4±0.05	14.6±0.07

* Results are mean ±SD of three determinations.

Table 4: Impact of malting on Antioxidant activity of prepared composite flour (*Per* 100g).

Antioxidant content	Unprocessed composite flour	Processed composite flour
Total polyphenol Content (mg)	85±1.05	102±1.09
DPPH % (Free radical scavenging activity) (mg)	51.30±0.09	89.78±1.05

* Results are mean ±SD of three determinations.

Conclusion

The chemical analysis of malted processed composite flour revealed that blending of cereals, pulse and millet significantly increased the fat, fiber and protein, antioxidant content during malting when compared with unprocessed composite flour. Protein contents were increased with malted Pearl Millet, Chickpea, Soybean, wheat flour. In terms of micronutrient content there was a huge difference was found Zinc content of processed and unprocessed composite flour. On the basis of present study it was concluded that composite flour from different cereals can be prepared. These composite flours will have improved nutritional value and health benefits.

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