Effect of malting and fermentation (Lactic acid) on the Composition and Functionality of Barley flour

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Introduction

Barley (*Hordeum vulgare*), like all other true cereals, is a member of the grass family. Globally, barley is the fourth most produced cereal, after maize, rice and wheat [1].

Total barley production in Nepal is around 25,000 tons per year and among them about 90% produced from hill and mountain region[2].

The statistics published by the Food and Agriculture Organization of the United Nations rank Morocco as first world user of barley for human consumption. Many associate barley with brewing and beer, but barley is also healthful food, recently approved by Food and Drug Administration (FDA) to be labeled as heart-healthy due to the cholesterol lowering property[11].

Pearled barley flour, flack and grits are used in breakfast cereals, stews, soup, pilaf mixes, bakery blends and baby food. In Russia, Poland, Japan, Tibet and India, pearled grits or flour are in many traditional dishes [7].

Significance of the study

- Barley foods can be considered as functional foods, particularly since the Food and Drug Administration (FDA) health claim approval in 2006.
- As a food grain, barley is probably the least understood of the small grains and has been largely ignored by major cereal companies and consumers alike even though barley has many desirable attributes.
- Hulled barley contains 60-63% of carbohydrates, 12-15% of proteins and 2-3% of lipids and besides this it contains higher amount of vitamins such as B complex, Pantothenic acid; folic acid, minerals like phosphorus, calcium, potassium, magnesium, iron, etc.[4]
- It is seen that about 18% of barley starch is broken down during malting.
- During lactic acid fermentation of cereal flour, carbohydrate composition is modified as a result of microbial metabolism and, to some extent, due to activation of inherent enzymes in the cereal[5].
- The quantity as well as quality of the food proteins as expressed by biological value, and often the content of water soluble vitamins is generally increased, while the anti-nutritional factors show a decline during fermentation[6].

Objectives

Our study aimed to increase the simpler component in the barley flour to make barley more available to human consumption in addition to some flavoring and micro-nutritional value development.

Methods

The raw materials used in the experiment were naked barley. Four kilograms of naked barley was collected from National Agriculture Research Council (NARC) Tarahara, Sunsari.

Chemicals, glassware and equipments were used for the present work as available from the laboratory of Central Campus of Technology, Hattisar, Dharan.

Malting

The cleaned 2 kg barley were then immersed in tap water in a stainless steel tray to increase the moisture content of the grain to 42-46 %.

Barley grains were steeped for 24 hours which brought the moisture to the required level.

Following steeping, the grains were then spread over a plastic tray and covered with moistened muslin cloth. Few drops of water were also sprayed at an interval of 6 hours to prevent the drying of grain.

Germination was carried out at a room temperature of 28±2º C, and 85±2% RH.

Drying was done in three stages

- 50-60°C till 25% moisture
- 70°C till 12% moisture
- 71-90°C till moisture dropped to 4-5%.

The grains were then rubbed and sprouts were removed with the help of screen. The malt then was milled as above method and the flour was further analyzed.

Fermentation

The fermentation of the flour was done accordance with Onesmo (2011). 600g of both the malted and regular flours from malted and non-malted kernels were fermented.

To start the fermentation process, the flour samples were mixed with 1200ml of tap water at ratio of 1:2 (grain(g) to liquid(ml)) and 60g of yogurt (obtained from a local market containing active cultures including *L. acidophilus*) to obtain a final mixture of 1800 g of slurry.

The slurry was stirred by hand and covered with aluminum foil then fermented at 25°C for 72 h. After fermentation, the slurry was transferred to a pan into a thin layer. The pans were put into a oven at 65°C for 24 hours.

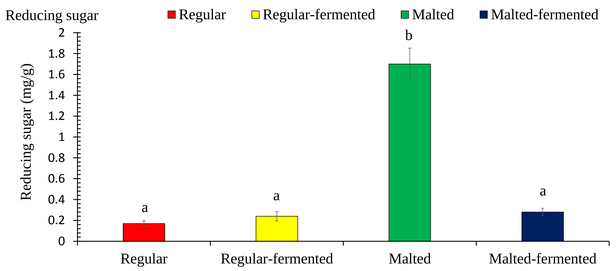
Reducing sugar was determined by Lane and Eynon method, The soluble protein was determined by Kjeldahl method from the process given by (Ranganna, 2008).

Water absorption capacity was determined using the method described by Sefa-Dedeh *et al.* (2004) by using centrifuge at 3000 rpm for 15 min.

Results

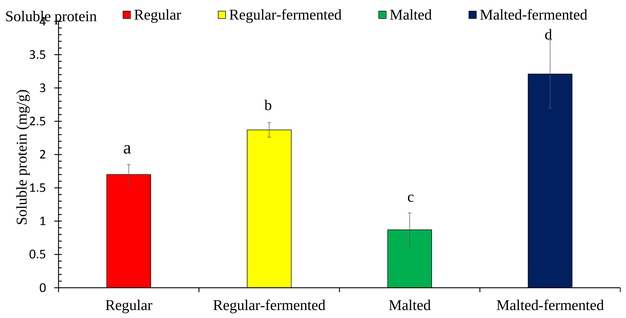
Reducing sugars

There was no significant different between non-malted barley flour and fermented flour, the results is in agreement with previous study Paramithiotis *et al.* (2007) which shows most of the lactic acid bacteria like *L. sanfranciscensis*, *L. paralimentarius* could not ferment the sucrose and maltose but they can easily ferment the simpler form of sugar. Amount of reducing sugar of regular, regular-fermented, malted and malted-fermented were found to be 0.1767, 1.7333, 0.24, 0.28 mg/g respectively.



Soluble proteins

An increase in soluble protein could be due to both solubilization of barley flour during fermentation and structural changes in storage protein (prolamines and glutelins) during malting, hence making them available to enzymatic attack.

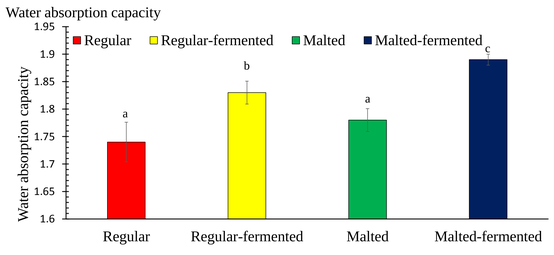


Water Absorption

Water holding capacity is the ability of a protein matrix to absorb and retain bound, hydrodynamic, capillary, and physically entrapped water against gravity.

There was an increase in water absorption capacity, with malted and fermented flours taking up more water, and the difference was significant ($p>0.05$). This increased solubility could be as a result of the increase in amount of soluble sugars present in the malted and fermented flours.

Water-soluble products of hydrolysis accumulates in the grain during malting which is also responsible for the increase in the water holding capacity of barley flour.



Note: Bars with different alphabets are significantly different ($P<0.05$) Statistical analysis was done from GenStat.

Key findings

This study demonstrate that:

- Malting process can increase reducing sugar from 0.18 mg/g to 1.73 mg/g
- Water soluble protein get enhanced from 1.7 mg/g to 3.21 mg/g by the process of malting and LAB fermentation of barley flour.
- Water absorption get increase significantly from regular flour 1.74 ml/g to malted flour 1.8 ml/g and malted-fermented flour1.89ml/g

Conclusions

The malting of barley and lactic acid fermentation of flour can be used as various supplementary food preparation. The flour has high nutritive value in the context of reducing sugar and soluble protein. It is easily digestible since it has simpler form of flour constituent. The nutritional losses during cooking is low because of its low gelatinization temperature. The flour also contribute high water holding capacity and slightly acidic nature which can enhance the preservation properties of flour.

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