



Effect of barley malt, chickpea and peanut on quality of Barley based beverage

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Abstract: The present investigation had been done to optimize the effect of barley malt on production of barley based beverage. Malting of barley was carried out by steeping the cleaned and bold grains in tap water at 16°C for 2-3 days. The steeped grains were also germinated at 16°C for 2-3 days and the grains showing optimum growth were sorted out and kilning was done at 60°C for 1 day. Different levels of malted grain (i.e. 0, 1, 2, and 4 %) in barley extract were optimized. It was found that addition of 4 g malt to the extract was found to be effective in decreasing the viscosity and avoiding the formation of gruel like structure. There was non significant sensory change found on addition of roasted malt grain. Amylase activity of malt significantly increased on increasing time and no reducing sugars resulted at 90°C. Nutritive value of malted beverage was improved over control. Total soluble solids (TSS), viscosity, protein, fat, reducing sugar and total sugar of malted beverage was significantly increased as compared to control. Malted beverage was more organoleptically acceptable than control. Final beverage was made with 4 g malt, 25 g bengal gram and 15 g peanut per extract from 100 g barley with addition of sugar to 17°brix and homogenizing for proper mixing was autoclaved. Thus, malting could be an appropriate food-based strategy.

Keywords: Barley, Beverage, Bengal-gram, Malting, Peanut

INTRODUCTION

Beverages are an excellent medium for the addition of nutraceutical components for enrichment of the diet (Kuhn, 1988). They are produced from a wide variety of raw material of both plant and animal origin including fruits, vegetables as well as cereal grains, which provide proteins together with vitamins and minerals. Beverages produced from cereal grains, both fermented alcoholic and non-alcoholic variants are consumed globally (Akonor *et al.*, 2014).

Amongst cereals, barley (*Hordeum vulgare* L.) is an important cereal crop ranking fifth in world production (FAOSTAT, 2016) and the primary cereal used in the worldwide malt production. Barley as the key ingredient of such beverages will add not only delectable taste, colour and sweetness, but also many functional attributes, to the product. The most abundant constituent of barley beverage is water extract of barley which acts as the medium in which all other constituents are dissolved and contain only traces amount of inorganic substances. The barley based beverage is highly nutritive due to the large amounts of high quality protein, fat, β -glucan, minerals, vitamins and antioxidants. Barley β -glucan is now regarded as an important functional ingredient to lower plasma cholesterol, reduce glycaemic response, promote weight management

(Izydorczyk *et al.*, 2008) and encourage the growth of beneficial gut microflora (Brennan *et al.*, 2005).

The use of malt in cereal based beverage formulations offers new potential market for highly nutritious beverage for the Indian beverage industry (Singh *et al.*, 2008). Cereals for use in beverage production are usually germinated and dried in the process known as malting. Malting modifies the grains physically, chemically and biologically such as the hydrolysis of starch is known to reduce the viscosity of foods through amyolytic breakdown of starch, protein into sugars and amino acids, respectively that occur in malted cereals used for the production of beverages and other cereal-based food have been widely studied (Uvere and Orji, 2001).

Although, cereal proteins are deficient in some essential amino acids such as lysine and threonine while pulses contribute higher amounts of these amino acids; nevertheless, a combination of cereals and pulses can bring a balance in amino acid composition for better utilization by human body. Amongst legumes, bengal gram is the preferred legume for supplementation of barley beverage particularly in Bihar and eastern Uttar Pradesh (Mridula *et al.*, 2007). It improves overall nutrition especially the protein efficiency ratio. Chickpea (*Cicer arietinum* L.) or bengal gram is high in protein (Yust *et al.*, 2003) and is an excellent source of

Table 1. Effect of time on amylase activity at 20°C.

Time (min)	Amylase activity (g/100g)
5	0.63±0.1
10	1.36±0.12
15	1.77±0.1

Table 2. Effect of cooking temperature on viscosity.

Cooking temperature (°C)	Time (hr)	Viscosity (mPa.s)
50	1	85.3±0.20
70	1	252±1.77

Table 3. Effect of different percentage of malt grain on viscosity of beverage.

Proportion of Malt grain (%)	Viscosity (mPa.s)
0	N.R
1	N.R
2	980.6±2.96
4	249±2.18

*N.R: Not Recorded

both soluble and insoluble fibre, vitamins and minerals, especially calcium, phosphorous, iron, and magnesium (Brennan *et al.*, 2005; Agriculture and Agri-Food Canada, 2006b). It is relatively inexpensive, and has been associated with the prevention of cardiovascular disease, managing type-2 diabetes and lowering low density lipoprotein cholesterol levels. Insoluble dietary fibre present in chickpea has been associated with reducing the incidence of colon cancer, whereas soluble fiber has been demonstrated to have a beneficial effect on weight loss and weight management (Agriculture and Agri-Food Canada, 2006a). Peanut (*Arachis hypogaea*) is good sources of Ca, P and Fe (Gopalan *et al.*, 1998) and it is usually consumed as raw, boiled, roasted and in the form of confectionary items and sweets. Addition of peanut in beverage not only improves the nutritional quality of beverage but also enhance the flavor of beverage.

Beverage can be made either from roasted barley or legumes alone or combination of both with added flavorings (Mridula *et al.*, 2010). Roasting improves the flavor, texture and nutritive value of grains (Siegel and Fawcett, 1976) and eliminates most of the anti-nutritional or toxic factors in legumes either partially or wholly (Liener, 1973). Roasting of malt had been applied in brewing for colour and aroma development in beer. A similar application to malted barley would subsequently improve the colour and enhance the flavor, aroma and other sensory characteristics of its non-

alcoholic beverage. Keeping these facts in mind, objectives of research was decided to optimize the process for beverage development and evaluate the quality of nutritious beverage.

MATERIALS AND METHODS

Collection of material: The present investigation was carried out in Processing Laboratory of the Centre of Food Science and Technology, CCS Haryana Agricultural University, Hisar. The Barley grain, Bengal gram and Peanuts were procured from local market, Hisar.

Preparation of barley malt: Cleaned barley grains were washed in tap water to remove floating and fast sinking extraneous materials and steeped at 16°C for 48 hrs. The steeped grains were then spread evenly in a single layer on the moist absorbent cotton covered with a sheet of ordinary filter paper in enameled trays and incubated for germination at 16°C for 72 hrs in a BOD incubator. The grains showing optimum growth were sorted out and kilned at 60°C for 24 hrs. The cured grains were lightly rubbed by hands and screened to remove the rootlets. The kilned malt is roasted at 150 °C for 6 min.

Optimization of processing parameters for beverage preparation: Aqueous extract of ground malt was first evaluated for effect of time and temperature on amylase activity which was estimated by (A.O.A.C. 1995). Beverage was optimized for malt grain (0, 1, 2 and 4 % per 100 gram barley extract), roasted malt (0, 2, 5 and 10 %) and cooking temperature (50 and 70 °C). Selected on the basis of viscosity of the beverage which was determined by using viscometer (Rheology International, Shannon, Ireland) and expressed in mPa.s. The spindle No. 4 and spindle speed 50 rpm were used. Addition of roasted malt to the beverage was selected on the basis of sensory evaluation.

Preparation of barley based nutritious beverage: Selected proportion of malt was added to the standardized formulation of barley based beverage by (Sheetal, 2008) (Fig. 1)

Evaluation of beverage: Prepared malted beverage and control (without malt) beverage was analyzed for TSS by using hand refractrometer, Acidity of the beverage was calculated by standard method of A.O.A.C. (1990). Protein of beverage was estimated by standard method of A.O.A.C. (1995). Fat content of beverage was estimated by the Gerber method (BIS, 1989). To-

Table 4. Effect of roasted malt grains on sensory scores of beverage prepared from 100 g barley grains with 4 g malt grains, 25 g bengal gram and 15 g peanut.

*RMG Levels (g)	Colour and Appearance	Taste	Flavor	Mouthfeel	Overall acceptability
0	7.6±0.37	7.9±0.34	7.6±0.3	8.0±0.38	7.7±0.3
2	7.7±0.29	7.9±0.14	7.9±0.3	8.1±0.3	7.9±0.3
5	7.6±0.28	7.4±0.37	7.1±0.46	7.5±0.3	7.4±.3
10	7.7±0.36	7.4±0.37	7.3±0.5	7.4±0.4	7.5±.3
C.D. (≤0.05)	N.S	N.S	N.S	N.S	N.S

* Roasted Malted grain (RMG), N.S : Non-significant, C.D.= Critical difference

Table 5. Physico-chemical properties of control or malted beverage.

Parameters	Control	Malt beverage
TSS (%)	16±0.0	17±0.0
Viscosity (mPa.sec)	260±2.1	124.8 ±3.8
Acidity (%)	0.06±0.0	0.06±0.0
Protein (%)	1.2±0.3	1.8±0.2
Fat (%)	0.7±0.2	0.9±0.34
Total sugar (g/100ml)	14.78±0.1	18.86±0.5
Reducing sugar (g/100ml)	3.00±0.1	3.17±0.5

*Control = Beverage without malt

tal and reducing sugars estimated by the described method (Hulme and Narain, 1931).

Sensory evaluation: Sensory evaluation of barley based nutritious beverages was performed using 9 point hedonic scale described by Ranganna (2008). The overall acceptability of the squash was based on the mean scores obtained from all the sensory characters (colour, appearance, flavour, taste, mouthfeel and overall acceptability). Sensory evaluation was conducted by five semi-trained judges on a nine point hedonic scale. The attributes with mean scores of 6 and above out of 9 were considered acceptable. The treatments were replicated thrice.

Data analysis: Data using completely randomized design was analyzed using OPSTAT (statistical package for agricultural workers). The data reported in all tables are an average of triplicate observations subjected to one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

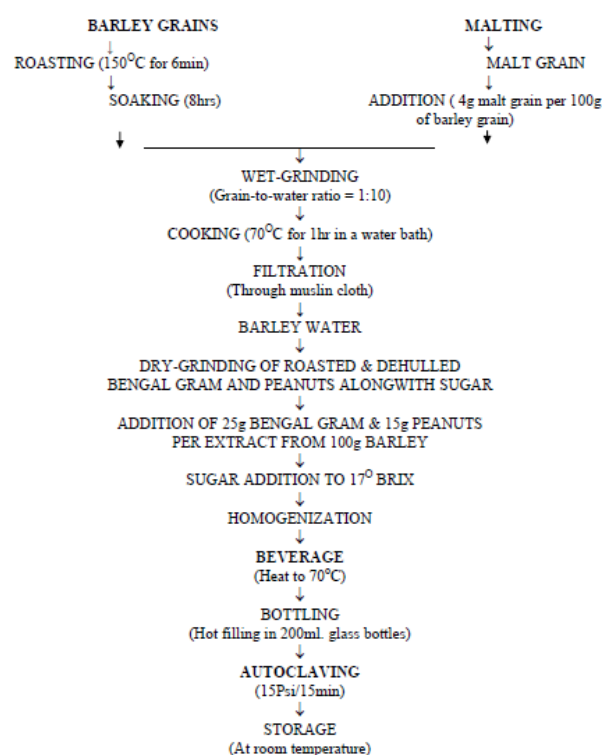
Optimization of processing parameters for beverage preparation: Effect of time on amylase activity of malt grain was depicted in Table 1. It was observed that the production of reducing sugar increased as time interval increased. It was also observed that heating at 90 °C for 20 min resulted inactivation of enzyme activity with no production of reducing sugars. Similar results for amylase activity was also studied by Makeri *et al.* (2013).

Effect of cooking temperature was shown in Table 2, revealed that viscosity of beverage was higher at 70 °C than at 50 °C but cooking at lower temperature i.e. 50 °C gives less desirable mouthfeel. Therefore high temperature of 70 °C was selected for subsequent cooking of barley extract.

Effect of addition of malt in the beverage was depicted in Table 3. It was found that no viscosity of beverage was recorded on addition of 0 % and 1 % malt grain. Whereas it was observed that viscosity decreased with increased proportion of malt grain from (2 to 4 %) per 100 g of barley extract. Viscosity of beverage decreased due to the amylolytic activity in malt grain

Table 6. Sensory evaluation of control and malted beverage.

Samples	Colour	Appearance	Flavor	Taste	Mouthfeel	Overall acceptability
Control	8.0 ± 0.14	8.0 ± 0.34	7.0 ± 0.28	7.0 ± 0.29	7.0 ± 0.37	7.4±0.55
Malt beverage	7.7 ± 0.34	7.7±0.3	7.9±3	7.9±.34	8.0±0.29	7.8±0.13

**Fig. 1.** Flow sheet for preparation of beverage.

which hydrolyzes the polysaccharides (Uvere and Orji, 2001). Djameh *et al.*, (2015) also studied the presence of soluble high extracts of polysaccharides and free amino acids due to high diastatic activity obtained on malting of sorghum

Effect of addition of roasted malt was scrutinized in Table 4, show that four combination of malted grain and roasted malted grain were used for preparation of beverage did not show any significant improvement in sensory score of beverage. Therefore, roasted malt was not used.

Evaluation of beverage: Data presented in Table 5, show that estimated amount of protein, fat, reducing sugar and total sugar in control (1.2 %, 0.7 %, 2.39 g/ml and 14.78 g/ml) and malt (1.8 %, 0.9 %, 3.17 g/ml and 18.86g/ml), respectively. Results reveal that on addition of malt in beverage the amount of protein, fat, reducing and total sugars increased. It is related to the enzymatic activity in malt grain which was enhanced on germination and resulted in increased level of nutrients due to hydrolysis. Similar results were studied by (Obuzor and Ajaezi, 2010; Hosseini *et al.*, 2012). Kaushik *et al.* (2015) also noticed the higher nutritive value of barley malt than barley grain. It was also resulted high TSS value (17 %) in malted beverage than

control due to increased value of reducing and total sugars (Table 5). Table 5 showed that there was non-significant difference found in acidity. It scrutinized that addition of malt in the beverage not affects the pH of the beverage. Viscosity of malt beverage was reported lower than control. Lower viscosity of malt beverage related to hydrolytic activity of enzymes in malt grain. There was found (4 logcfu/g) total plate count on 2nd and 4th day respectively, it perusals microbial stability of malted beverage. These results were in agreement to Deshpande *et al.* (2004).

Sensory evaluation of beverage: The results of the trained panel sensory evaluation of the beverage are shown in Table 6. It was observed lower value of color and appearance in malted beverage than control and reflects addition of malt decrease the color and appearance of beverage. Panelist's observed increase in flavor, taste and mouthfeel in malted beverage than control. The positive influence is due to presence of reducing sugars and aroma compounds of barley malt and improved mouthfeel is related to the decrease in viscosity due to enzyme activity in malt grain (Pacala *et al.*, 2012). It was noticed that overall acceptability score of malted beverage was higher than control (without malt) which in agreement to (Akonor *et al.*, 2014 and Singh *et al.*, 2008).

Conclusion

It can be concluded from the present investigation that 4 % malt at 70 °C cooking is desirable level for obtaining the desired mouthfeel and consistency of beverage and addition of roasted malt did not improve the flavor of beverage. Study showed that inactivation of amylase activity occur at high temperature (90 °C) and addition of malt in the beverage not only enhance the nutritive value of beverage with respect to protein, fat, reducing and total sugar but also decrease the viscosity of the beverage in comparison to control (beverage without malt) which improve the consistency of the beverage. Addition of malt also improved the sensory attributes of beverage with respect to flavor, taste and mouthfeel than control with microbial stability at room temperature during 1 month storage. This information gives an idea that we can also replace fruit beverages with cereal malt beverages with improved nutritive value, taste, texture and mouthfeel.

REFERENCES

- A. O. A. C. (1995). Official Methods of Analysis. 15th edn. Association of Official Analytical Chemists. Washington, D.C.
- Agriculture and Agri-Food Canada (2006a). Chick-peas: Situation and outlook. Bi-weekly Bulletin, 19(13). <www.agr.gc.ca> Retrieved 20.08.08.
- Agriculture and Agri-Food Canada (2006b). Lentils: Situation and outlook. Bi-weekly Bulletin, 19(7). <www.agr.gc.ca> Retrieved 21.08.08.
- Akonor, P. T. Tortoe, C. and Oduro-Yeboah, C. (2014). Physicochemical characterization of non-alcoholic beverages produced from malted roasted varieties of maize (*Zea mays*). *International Journal of Food Science and Nutrition Engineering*, 4 (1): 20-26
- A. O. A. C. (1990). Official methods of analysis. Association of Analytical chemists. Washinton D. C. 1: 73-74
- B. I. S. (1989). Chemical examination of Milk. 21: 21. Hand Book of Food Analysis Part XI: Dairy Products Bureau of Indian Standards. Manak Bhawan, New Delhi.
- Brennan, C. S. and Cleary, L. J. (2005). The potential use of cereal (1→3, 1→4) b-D-glucans as functional food ingredients. *Journal of Cereal Science*, 42: 1–13
- Deshpande, S., Bargale, P. C., Joshi, K. C., Singh, V. and Varghese, S. (2004). Enhancing the nutritive value of barley based *sattu* by soy-fortifi cation. *Indian Journal of Nutrition and Dietetics*, 41: 146–159
- Djameh, C., Saalia, F. K., Sinayobye, E., Budu, A., Essilfie, G., Mensah-Brown, H. and Sefa-Dedeh, S. (2015). Optimization of the sorghum malting process for pito production in Ghana. *Journal of Institute of Brewing*, 121: 106-112
- F.A.O.S.T.A.T. (2016). Food and agriculture organizations of the United Nations statistics division. Available at faostat3.fao.org/browse/Q/QC/E
- Gopalan, C., Ramasastri, B. V. and Balsubramaniam, S. C. (1998). Nutritive values of Indian foods NIN, ICMR, Hyderabad.
- Hosseini, E. Kadivar, M. and Shahedi, M. (2012). Physicochemical properties and storability of non-alcoholic malt drinks prepared from oat and barley malts. *Journal of Agricultural Science and Technology*, 14: 173-182
- Hulme, A. C. and Narain, R. (1931). The Ferricyanide Method for the Determination of Reducing Sugars: A Modification of the Hagedorn-Jensen-Hanes Technique. *Journal of Biochemistry*, 25 (4): 1051-1061.
- Izydorczyk, M.S. and Dexter, J. E. (2008). Barley b-glucans and arabinoxylans: Molecular structure, physicochemical properties and uses in food products – A review. *Food Research International*, 41: 850–868
- Kaushik, I. Singh, R. and Suman. (2015). Barley malt based nutritious *sattu* beverage. *Research Reach Journal of Home Science*, 15: 50-54
- Kuhn, M. E. (1998). Functional food overdose. *Food Processing*, 5: 21–30
- Liener, I. E. (1973). Toxic factors associated with legume proteins. *Indian Journal of Nutrition and Dietetics*, 10: 303-322
- Makeri, M. U. Nkama, I. and Badau, M. H. (2013). Physico-chemical, malting and biochemical properties of some improved Nigerian barley cultivars and their malts. *International Food Research Journal*, 20(4): 1563-1568
- Mridula, D. Jain, R. and Singh, K. K. (2010). Effect of storage on quality of fortified Bengal gram *sattu*. *Journal of Food Science and Technology*, 47: 119-123
- Obuzor, G. and Ajaezi, N. E. (2010). Nutritional content of popular malt drinks produced in Nigeria. *African Journal of Food Science*, 4(9): 585-590

- Pacala, M. L., Oprean, L., Tita, O., Brudiu, L., Begea, M. and Sirbu, A. (2012). Basic physical-chemical and sensorial evaluation of some fermented mashes produced from wheat, husked millet, barley malt and oat. *Procedia Engineering*, 42: 197-205
- Ranganna, S. (2008). Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata McGraw Hills Publishing Co. Ltd., New Delhi.
- Sheetal, M. (2008). Development of Nutritious Beverage from Barley with Peanut and Bengal gram. M.Sc thesis, CCS Haryana Agricultural University, Hisar.
- Siegel, A. and Fawcett, B. (1976). Food legume and processing and utilization (with special emphasis on application in developing countries). Agriculture, Food & nutrition Science Division. Int. Development Res. Centre, Ottawa, Canada, Pp. 16-24
- Singh, A. K. Tiwari, S. Singh, R. B. B. Tyagi, R. K. and Arora, S. (2008). Optimization of ingredient levels for manufacturing malted milk beverage using response surface methodology. *International Journal of Dairy Technology*, 61: 192-198
- Uvere, P. O. and Orji, G. S. (2002). Lipase Activities during malting and fermentation of Sorghum for Burukutu Production. *Journal of Institute of Brewing*, 108:256-260
- Yust, M. M., Pedroche, J., Giron-Calle, J., Alaiz, M., Millan, F. and Vioque, J. (2003). Production of ace inhibitory peptides by digestion of chickpea legumin with alcalase. *Journal of Food Chemistry*, 81: 363-369