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Comparative study on quality (nutritive, physico-chemical and microbial) of prepared and commercial malted milk hot drinks in Bangladesh

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Abstract:

The study was conducted on the development of the new product, malted milk hot drinks recognized as sample A where barley is the key ingredients. The developed product was compared with the four samples recognized as Sample B, sample C, sample D and sample E that available in the local market as malted milk hot drinks. These samples were analyzed for their proximate, bacteriological and sensory

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qualities using standard methods. Moisture, Protein, Fat, Carbohydrate, Ash and Energy content was found 9.18%, 11.23%, 4.90%, 71.57%, 3.10% and 385.14 Kcal/100g, which was able to meet the young children's recommended daily allowances. The protein content of the developed product was very high (11.23) than any other samples. The acceptability of the samples was studied by a taste panel consisting of 15 panelists. There was no significant difference ($p<0.05$) in terms of the texture and overall acceptability of the samples as powder, among them Sample C (7.87) got the highest acceptability. All the samples were liked very much in terms of overall acceptability as drinks. The developed product had highly acceptable sensory values even without any addition of either of natural or artificial colour and flavour; whereas the commercial products use. The bacteriological analysis was done to see the acceptability of the products and the result was good from the bacteriological point of view; since there was no growth of investigated bacteria. The developed product was very cheap approximately 200Tk/Kg and 4 times lower than the commercial products, along with it provides more servings than others. Therefore, the product may boost us to maintain a healthier life at a cheap rate and help to alleviate malnutrition situation in Bangladesh.

Key words: Malted Milk Hot drinks, Nutritional quality, Bacteriological and Sensory qualities.

INTRODUCTION

Bangladesh is one of the twenty countries where 80% of the world's undernourished children live (Owais et al. 2015). Among nutritional disorder, malnutrition is the most common in developing countries and causes morbidity and mortality worldwide among the children (Musa et al. 2014). Due to the prevailing unfavorable economic conditions in most developing countries of the world, the incidence of protein-energy malnutrition among different age groups particularly children with an estimated 400million children being reported to be

malnourished worldwide is highly prevalent and on the increase on a daily basis (Agiriga and Iwe 2009).

In the first 1000 days of a child's life, poor nutrition can lead to irreversible stunted growth, which associated with reduced school and impaired cognitive ability and work performance (Hoque et al. 2016).Malnutrition, which affecting the health, nutritional status and school academic performance, is suffered by a significant percentage of school age children in Bangladesh (Yeasmin and Islam 2016).

Milk is an excellent source of all nutrients except iron and ascorbate. Milk has been recognized as an important food for infants and growing children (Udeozor and Oluchi 2012). Studies have shown that the consumption of milk is beneficial to the health of children and adolescents (Black et al. 2002; Spence et al. 2011). Flavored milk can increase milk consumption among both adults and children and also provides essential nutrients like plain milk and other milk products (Murphy et al. 2008). Flavored milk consumers had almost 150 kcal more energy intake compared to nonconsumers (Li and Drake 2015). Noel et al. (2013) reported that over a 2-y period, overweight children that were flavored milk consumers had less favorable changes in body fat and body weight. They suggested that overweight children should reduce consumption of flavored milk; however, they also noted that consumption of flavored milk was unlikely to be associated with body fat or weight gain for normal weight children.

Malting has been shown to be one of the most effective and convenient ways for improvement of nutritional value of cereals (Adeyemo et al. 1992; Akpapunam et al. 1996; Gernah et al. 2011); and currently there is a growing interest in the formulation of food products using the combination of composite blends of malted cereals and legumes as a way of improving nutritional quality of the product suitable for children (Agu and Aluya 2004).

In our local market there are four brands are found as malted milk hot drinks manufactured by the multinational company but there is still lack of local industries. Some malted milk hot drinks are also found of these companies as imported. The price of these products is so high and is not within the reach of rural dwellers and low income earners in the urban cities. In recent years, consumers have become more health conscious in their food choices but have less time to prepare healthful meals. As a result the market demand for "minimally processed" or "lightly processed" foods has rapidly increased (Parvin et al. 2014).

The aim of this study was to develop a cereal based highly nutritive supplementary food for young children of Bangladesh with a low price by using available resources and cheap technology. And also to compare and determine the acceptability and to identify microorganisms those were associated with the formulated and market available malted milk hot drinks.

MATERIALS AND METHODS

The experiment was conducted in the laboratory of the department of food processing and engineering, Chittagong Veterinary and Animal Sciences University (CVASU).

Preparation of malted milk hot drinks

Eight ingredients were used for the preparation of malted milk hot drinks. The main ingredient barley was collected from Bangladesh Agriculture and Research Institute (BARI). The other good quality commercial ingredients such as wheat flour, sugar, skim milk powder, egg, INS 500 (ii), cocoa powder and salt were collected from local market of Chittagong city. After several trials a formula was developed. The formulation of the malted milk hot drinks is given in Table-1

All ingredients were taken in a bowl, and mixed by the spoon. Then it was taken into a blender for homogenous mixing. After mixing it was collected and stored.

Sample collection

Four commercial malted milk hot drinks were available in the local market and those were collected to compare with the prepared malted milk hot drinks. Sample A is the laboratory prepared and the sample B, sample C, sample D and sample E are the commercial samples respectively.

Table 1: Formula of the prepared malted milk hot drinks

Ingredients	Percentage (%)
Barley	38
Wheat Flour	27
Sugar	13
Skim milk powder	14
Egg yolk powder	0.5
INS 500 (ii)	0.5
Cocoa powder	6.5
Salt	0.5
Total=	100

Proximate analysis

The five samples were analyzed for moisture content, ash content, crude protein, crude fat and total carbohydrate following the standard AOAC (2005) methods.

Sensory evaluation

A taste-testing panel evaluated the consumer's acceptability of developed product and the commercial collected samples. The panelists were selected from the students, teachers and employees of the Chittagong Veterinary and Animal Sciences University. The panelists (15) were requested to assign appropriate score for characteristics of appearance, colour, flavor, texture and overall acceptability of malted milk hot drinks powder and the characteristics of appearance, colour,

flavor, consistency and overall acceptability of malted milk hot drinks. All analyses were carried out in duplicate for each sample and results obtained were computed into means. The results were evaluated by Analysis of Variance and Duncan's New Multiple range Test procedures of the Statistically Analysis System (SAS, 1985).

Bacteriological Investigation

The bacteriological investigation of the samples was done in the Poultry Research and Training Centre (PRTC), Chittagong Veterinary and Animal Sciences University, six months later the product had developed in the laboratory to get an idea about the shelf life of the products.

Isolation and identification of *Staphylococcus sp*

The samples were placed into sterile Buffered Peptone Water (BPA) (Oxoid ltd, Basingstoke, Hampshire, UK) and enriched for 24 hours at 37 °C (Thaker et al. 2013). Both Mannitol salt agar medium and Blood agar base were prepared per the instructions of manufacturer (Oxoid ltd, Basingstoke, Hampshire, UK). Blood agar was prepared by adding 5% citrated-bovine blood in the blood agar base. A loopful of inoculum from enrichment were streaked on Blood Agar (Oxoid ltd, Basingstoke, Hampshire, UK) and incubated at 37°C for 24 hours for detection of hemolysis. Growth of yellow colonies on MSA (Oxoid ltd, Basingstoke, Hampshire, UK) surrounded by yellow zones as a result of fermentation of mannitol after 24 hours of incubation at 37°C indicated a positive result (Kateete et al. 2010).

Isolation of *Escherichia coli*

Pre-enrichment of *E. coli* were done in BPA broth (Oxoid ltd, Basingstoke, Hampshire, UK) of the samples (Thaker et al. 2013). A loopful of culture inoculates on MacConkey (Oxoid ltd,

Basingstoke, Hampshire, UK) agar. Pink colonies obtained from MacConkey agar were taken and inoculated on Eosin methelene blue (EMB) (Oxoid ltd, Basingstoke, Hampshire, UK) agar to verify whether the bacterial population was *E. coli,* or not. Dyes Eosin and Methylene Blue react with products released by *E. coli* from lactose or sucrose as carbon and energy source, forming metallic green sheen regarded as positive isolate (Virpari et al. 2013).

Isolation of *Salmonella sp*

The samples were pre-enriched in BPA (Oxoid ltd, Basingstoke, Hampshire, UK), incubated at 37˚C for 16 hours. One ml of inoculums was transferred into Selenite-cystein broth (Oxoid ltd, Basingstoke, Hampshire, UK) after pre-enrichment (Carrique-Mas and Davies 2008). A loopful of inoculums plated onto Xylose Lysine Deoxycholate (XLD) (Oxoid ltd, Basingstoke, Hampshire, UK) medium and incubated at 37˚C for 24 hrs. Black centered colony from XLD was inoculated in Brilliant Green Agar (BGA) (Oxoid ltd, Basingstoke, Hampshire, UK) and incubated as well.

Techno-economical feasibility of malted milk hot drinks

Inventory Theory's model III is applied which states that economic lot size model with uniform rate of demand, finite rate of replenishment having no shortages (Including the basic theory of Inventory Theory). All the assumptions should be made for the production of malted milk hot drinks at minimum level. Set up cost was assumed on ground reality basis at minimum level (Kumar at al. 2013).

RESULTS AND DISCUSSION

The type of ingredients and their appropriate levels in the formulation are crucial to the development of an acceptable

product (Singh et al. 2008).The proximate analysis of the developed drinks in this study showed that the drinks in this study contains high level of protein and are good source of energy which are expected due to starting raw materials. In the nutritional point of view supplementary malted milk hot drinks prepared in our laboratory was compared with the commercial malted milk hot drinks available in Bangladesh.

The protein content of the formulated milk hot drinks was 11.23g/100g where as sample B, C, D and E contained 5.48g/100g, 4.5g/100g, 8.67g/100g and 9.22g/100g respectively (Table 2).

Table 2: Analytical sensory evaluation of malted milk hot drinks powder

Quality parameters	Score (Mean)					SEM	Significance
	A	B	C	D	E		
Appearance	7.13^{a}	6.40^{a}	8.00^{b}	7.13a^{a}	7.00^{a}	0.13	**
Colors	7.27^{ab}	6.60^{a}	8.07^{b}	7.67^{b}	6.80^{a}	0.14	**
Flavours	6.20^{a}	7.60^{bc}	7.80^{c}	7.53^{b}	6.60^{ab}	0.17	**
Texture	6.73	6.60	7.40	7.60	7.13	0.15	NS
Overall acceptability	6.93	7.20	7.87	7.60	7.27	0.13	NS

N.B: A= Sample A; B= Sample B; C= Sample C; D= Sample D; E= Sample E; SEM = Standard error of mean, NS = Non significant at 5% level, ** = Significant at 1% level.

Means with different superscripts in the same row differ significantly ($p<0.05$).

The protein content of the formulated milk hot drinks was highest than the commercial malted milk hot drinks. This is because the high level of protein content of the raw material. The RDA of protein for children is 20.1g/day. According to the Indian council of Medical Research (1981) the recommended optimal protein caloric requirement for pre-scholars is 7.1% in total mixed diet. The formulated malted milk hot drinks contain 55.87% protein of the RDA requirements of protein for children. The protein rich diet is essential for the children in case of protein energy malnutrition. I think, the high level of

protein of the developed malted milk hot drinks will play an important role to remove malnutrition in Bangladesh. The proximate result of the developed product was agreed with the reported by Kumar et al. (2013).

The carbohydrate content of the formulated malted milk hot drinks was 71.57g/100 whereas sample B, C, D and E contains 78.19g/100g, 82.06g/100g, 75.61g/100g and 73.91g/100g respectively (Table 2). The formulated malted milk hot drinks contain the lowest carbohydrate content than the commercial malted milk hot drinks. This is because there is a highly significant negative correlation (r = -0.963) between the protein and carbohydrate content (Figure 1). Thus the increase in protein content reduces the carbohydrate content of the malted milk hot drinks (Parvin et al. 2014).

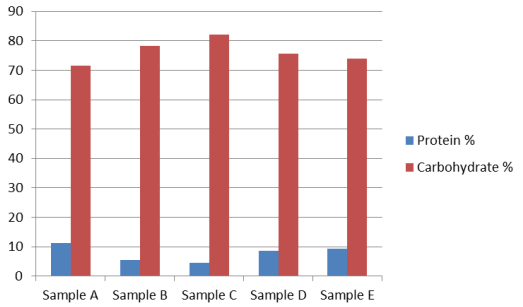

Figure 1: Protein and Carbohydrate content of the samples

The fat content of the formulated malted milk hot drinks is 4.90g/100 g and the commercial malted milk hot drinks sample B, C, D and E contains 4.94g/100g, 4.53 g/100g, 4.53g/100g, 8.46g/100g and 4.34g/100g respectively (Table 2). From the result, it was apparent that the fat content of the formulated malted milk hot drinks and the commercial brands was same except sample D. Food sample with high fat content is more liable to spoilage than one with a lower fat content (Oduro et al. 2007).The ash content of the product gives an idea of the mineral content. The formulated malted milk hot drinks had

appreciable level of ash contents (3.10g/100g) and sample B (3.09g/100g) and C (3.11g/100g) also had the same level of ash content (Table 2).

The total energy content of the children's diet must be maintained with controlled limits. An insufficient energy intake could lead to failure to thrive, whereas an energy intake in excess of requirements may lead to obesity. The "energy density" (amount of energy in a given quantity of food) is, therefore important. The energy content of the formulated malted milk hot drinks was 385.14 Kcal/100g. For the commercial malted milk hot drinks such as sample (B, C, D and E) the energy densities were 388.80, 397.28, 424.22 and 381.17 Kcal /100g respectively (Table 2).

Table 3: Analytical sensory evaluation of malted milk hot drinks powder

Quality parameters	Score (Mean)					SEM	Significance
	A	B	C	D	E		
Appearance	7.13^{a}	6.40^{a}	8.00^{b}	7.13a^{a}	7.00^{a}	0.13	**
Colors	7.27^{ab}	6.60^{a}	8.07^{b}	7.67^{b}	6.80^{a}	0.14	**
Flavours	6.20^{a}	7.60^{bc}	7.80^{c}	7.53^{b}	6.60^{ab}	0.17	**
Texture	6.73	6.60	7.40	7.60	7.13	0.15	NS
Overall acceptability	6.93	7.20	7.87	7.60	7.27	0.13	NS

N.B: A= Sample A; B= Sample B; C= Sample C; D= Sample D; E= Sample E; SEM = Standard error of mean, NS = Non significant at 5% level, ** = Significant at 1% level.
Means with different superscripts in the same row differ significantly ($p<0.05$).

The RDA of energy for children is 1350 Kcal/day (ICMR, 2010). The formulated product and the sample B and E had same energy level and supply 221.63 Kcal per serving with added sugar and milk. Dietary Guidelines for Americans suggest 3 servings/d of fat-free or low-fat milk or equivalent milk for adults and children ages 9 to 18 y (Quann and Adams 2013). Therefore, the product provide 49.25% calorie of RDA to meet the energy needs of the children.

Sensory characteristics of the developed products and the commercial malted milk hot drinks showed that the overall acceptability of the samples got the hedonic scale like very much, except sample C which got like extremely by the panelists. The results agreed with the report of Jacob et al. (2013). The results indicate that the formulated malted milk hot drinks are equally acceptable since it got the same hedonic scale of that commercial malted milk hot drinks sample B, D and E, although no artificial color and flavor were added to the formulated product which effects the score of the formulated product in terms of color and flavor (Table 3, 4).

Table 4: Analytical sensory evaluation of malted milk hot drinks

Quality parameters	Score (Mean)					SEM	Significance
	A	B	C	D	E		
Appearance	7.07	7.20	8.00	7.47	6.60	0.16	NS
Colors	6.47^{a}	7.2^{ab}	7.73^{b}	7.4^{ab}	6.60^{a}	0.15	*
Flavours	6.47^{a}	7.53^{b}	7.80^{b}	7.73^{b}	6.93^{ab}	0.16	*
Consistency	7.00	7.73	7.60	7.80	6.93	0.15	NS
Overall acceptability	7.13^{a}	8.13^{b}	8.0^{b}	7.87^{b}	7.07^{a}	0.12	**

N.B: A= Sample A; B= Sample B; C= Sample C; D= Sample D; E= Sample E; SEM = Standard error of mean, NS = Non significant at 5% level, * = Significant at 5% level, ** = Significant at 1% level.
Means with different superscripts in the same row differ significantly ($p<0.05$).

However, no significant difference in terms of appearance of the formulated products with the commercial products, which indicates positive sign for the developed product. The consistency of the developed product got the hedonic scale like moderately which prepared with lowest amount of products (80g/1L) than other commercial products and there were no significant differences in terms of consistency among the samples (Table 4). Thus, the developed product will give more serving from a fixed amount of product than the other

commercial malted milk hot drinks. The bacteriological investigation was done after six months of the preparation of the developed product. The formulated food sample and the commercial food samples were found to be totally absent from the *Salmonella Sp*, *Escherichia Coli* and *Staphylococcus Sp*. This indicates that the examined formulated malted milk hot drinks and the commercial samples were prepared from good quality raw materials, adequate thermal process and as a result of the good different processing conditions under which the production of formulates was carried out. The results agreed with the report of Parvin et al. (2014). Thus we can get an idea from these results about the shelf-life of the developed product which will be at least six months where the commercial product has a shelf-life of minimum one year. The shelf-life of the product can be increased by using the sophisticated equipments such as spray drier which will reduce the moisture content of the product below 5%.

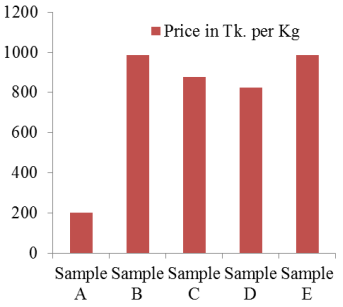

Figure 2: Commercial price of the malted milk hot drinks samples

The production cost of the developed malted milk drinks was approximately 200Tk. This price of the commercial malted milk hot drinks available in the market was around 4 times higher than the developed products (Figure 2). This is because, may be the commercial products are not manufactured in Bangladesh and may be they spent huge money in advertising the product and they imported the formulate product in Bangladesh and

they just packaged and marketed it. The price of the developed product is very reasonable and low income people can also buy this product and fulfill their nutrients requirement. Yeasmin and Islam (2016) discussed that parent's socioeconomic condition directly affects the children's health outcomes. The poor family can give the drinks to their children for nourishment. There is a positive sign of this product that it will provide more servings than other commercial products which is helpful for the poor family.

CONCLUSION

In Bangladesh, children malnutrition is an imperative health problem. To ensure growth and development of children proper nutrition is very important. Most of the malted milk hot drinks are imported in Bangladesh and these foods are usually beyond the affordable limit of people. Low cost local food ingredients were used to prepare a low cost food to meet the nutritional requirements of growing children. The formulated malted milk hot drink was found nutritionally rich and safe in bacteriological point of view comparable to commercial foods. The developed product was equally accepted by the test testing panel. This product has highly acceptable sensory values even without any addition of either of natural or artificial colour and flavour; whereas the commercial products use. This product could be an alternative of the imported commercial foods to meet the nutritional requirements of children.

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