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Research Article

STUDIES ON SHELF LIFE OF MILK BASED MALTED RAGI PORRIDGE

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ABSTRACT

The present study was undertaken with an objective to evaluate the effects of malting on the shelf life and sensory evaluation of the porridge. Based on the results of sensory evaluation, it was found that 5% malted ragi flour in milk was the optimum level to develop porridge. The shelf life studies and further sensory evaluation of control and experimental porridge samples were carried out at three days interval (starting from the fresh sample) up to 15 days at refrigeration temperature (4±1^{0}C). Malting was observed to have significant (P=0.05) positive influence on sensory attributes in terms of colour and appearance, flavour, consistency and overall acceptability. It also resulted into improved microbial shelf life of porridge when compared with control (unmalted ragi porridge) throughout the storage period. From the present study, it was concluded that 5% malted ragi flour and milk can prove as a judicial combination for the development of an organoleptically acceptable and microbiologically safe food up to 9 days of refrigeration storage.

Key words: Milk, ragi, malting, porridge, shelf life

Growing consumption of dairy foods is bringing important nutritional benefits to a large segment of the population of developing countries (FAO, 2013). Milk driven value added products have an important place in the dietary regimen of human beings. Milk and dairy products are generally very rich in nutrients namely lipids, proteins, carbohydrates, minerals, vitamins and water and thus provide an ideal growth environment for many microorganisms (Muehlhoff *et al.,* 2013). Milk has always been a choice of innovation for food researchers to meet the ever changing consumer's preferences. Dairy foods and their nutrients are not consumed in isolation and no single food can supply all essential nutrients. Balance and variety is fundamental to healthy eating (Muehlhoff *et al.,* 2013).

Finger millet (Ragi, *Eleusine coracana*) is a prominent drought resistant crop and used as a staple prime food in India as well as African countries (Devi *et al*., 2014). Shobana *et al.* (2013) reported that finger millet serves as a good source of carbohydrate (72.0%), protein (7.3%), dietary fiber (11.5%), amino acids and phytochemicals (phenolic compounds). It is nutritionally rich in minerals such as calcium, magnesium, phosphorous and manganese which are essential for the normal growth of body tissue and energy metabolism. Malting of ragi improves its digestibility, sensory and nutritional quality as well as has pronounced effect in the lowering of antinutrients. The malted and fermented ragi flours are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001). Finger millet koozh serves as an ideal low calorie diet for all age groups especially growing infants and pregnant women (Subastri *et al*., 2015). In recent days, traditionally processed foods have poor scientific consideration and its commercialization has been restricted. Ragi has some of the inherent qualities which make it superior compared to other cereals for malting and preparation of malted foods (Verma and Patel, 2013). Due to its significant nutritive value, milk driven processed finger millet food preparations should be analyzed for their microbiological and sensory properties for their certification as quality food for consumers. Hence, the present study was undertaken to determine the effect of malting on shelf life of milk based ragi porridge at refrigeration temperature (4±1 ^{0}C) for 15 days.

MATERIALS AND METHODS

The present research work was carried out in the Department of Livestock Products Technology of this university. Adequate quantity of brown ragi ('Indaf-15' cultivar), homogenized toned milk (Amul Taaza), sugar, flavor (cardamom) and polystyrene cups for storage were procured from local market. Chemicals used in the study were of analytical grade. Plate count agar, violet red bile agar and potato dextrose agar media were procured from Hi-media.

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Preparation of Porridge: The control (milk based unmalted ragi porridge) sample was prepared by incorporating unmalted ragi flour (5%) in homogenized toned milk (200ml) along with the addition of sugar (6%) and flavor (a pinch of cardamom powder). Ragi grains were germinated, dried, roasted and milled to obtain malted ragi flour (Verma and Patel, 2013) for use in experimental ragi porridge. The ragi porridges were processed and prepared as per the method followed by Jain *et al.* (2016).

The products were stored at refrigeration temperature for 15 days and were assessed for. microbiological parameters (APHA, 1984). A six member experienced panel of judges consisting of teachers and postgraduate students of College of Veterinary Science, LUVAS Hisar, evaluated the samples for the sensory attributes of colour and appearance, texture, flavour and overall acceptability using 9-point hedonic scale (Peryam and Pilgrim, 1957) where 9 is like extremely and 1 is dislike extremely. The test samples were presented to the panelists after assigning the suitable codes. The samples were warmed in a microwave oven for 20 sec before serving to the sensory panelists. The water was served for rinsing the mouth between the samples. The experiment was replicated thrice.

Statistical Analysis: Data obtained was subjected to statistical analysis using Duncan's Multiple Range Test by using SPSS software (Steel *et al*., 1997) for finding out the significant difference if any in the mean values.

RESULTS AND DISCUSSION

Colour and Appearance: The results indicated that malting had significant effect on the colour and appearance of treated sample up to 9th day of storage as compared to control (Table 1). Thereafter, judges scored both the products at par till the end of storage. During storage, a significant (P≤0.05) decrease in colour and appearance scores was noticed on 9th day in comparison to 0 day in both control and experimental product, however, the score was more than 7 (like moderately). Storage period had shown significant (P≤0.05) effect on colour and appearance scores of both control and experimental product on 12th day in comparison to 9th day of storage and similarly on 15th day as compared to 12th day of storage. Based on the scores given by judges, it was concluded that products (control and experimental) were acceptable up to 9th day of storage with respect to colour and appearance. Qamar *et al.* (2003) also reported that Maillard reaction was one of the most important reasons for colour loss.

Flavour: The flavour of experimental product was ranked significantly (P≤0.05) higher than control sample till 9th day of storage (Table 1). On 12th and 15th days of storage, the scores for flavour for both control and experimental product did not differ statistically but the scores were below 7 (like moderately). Results indicated that malting had a significant (P≤0.05) effect on the flavour till 9th day of storage as compared to control. On 9th day, no significant change was noticed in flavour score of experimental product over 6th day while control sample had shown a significant (P≤0.05) decrease in flavour score on 9th day as compared to 6th day. It was found that experimental product was acceptable up to 9th day of storage with flavor score more than 7 (like moderately). The decline in flavour scores over the storage period might be due to increased lipid oxidation resulting in malonaldehyde formation, liberation of free fatty acid and increased microbial load (Suresh *et al.*, 2003; Kumar and Sharma, 2004; Yadav and Sharma, 2008).

Consistency: On 0, 3rd and 15th day of storage period, experimental product was scored significantly (P≤0.05) higher than control for consistency (Table 1). Consistency scores for experimental product were at par with control sample on 6th, 9th and 12th day. Results indicated that the treatment had a significant effect on the consistency but

Table 1
Sensory scores of milk based ragi porridge stored at (4+1°C) temperature

Storage period (days)	Colour and appearance		Flavour		Consistency		Overall acceptability	
	Control	Experimental	Control	Experimental	Control	Experimental	Control	Experimental
0	7.83^{bD}±0.17	8.00^{aD}±0.00	7.83^{bC}±0.17	8.00^{aD}±0.00	7.83^{bC}±0.17	8.00^{aD}±0.00	7.83^{bE}±0.17	8.00^{aE}±0.00
3	7.66^{bD}±0.21	7.83^{aD}±0.17	7.50^{bC}±0.22	7.83^{aD}±0.17	7.83^{bC}±0.17	8.00^{aD}±0.00	7.50^{bDE}±0.21	7.83^{aDE}±0.21
6	7.50^{bCD}±0.22	7.66^{aCD}±0.22	7.33^{bC}±0.21	7.50^{aCD}±0.22	7.67^{aBC}±0.21	7.83^{aCD}±0.17	6.83^{bCD}±0.17	7.66^{aCD}±0.17
9	7.00^{bC}±0.00	7.16^{aC}±0.17	6.66^{bB}±0.21	7.33^{aBC}±0.21	7.50^{aAB}±0.22	7.67^{aBC}±0.22	6.33^{bBC}±0.21	7.50^{aBC}±0.17
12	6.50^{aB}±0.22	6.67^{aB}±0.22	6.16^{aB}±0.17	6.66^{aB}±0.21	7.16^{aB}±0.17	7.33^{aB}±0.21	6.16^{aB}±0.17	6.33^{aB}±0.21
15	5.50^{aA}±0.21	5.67^{aA}±0.22	5.33^{aA}±0.21	5.50^{aA}±0.22	6.83^{bA}±0.17	7.00^{aA}±0.00	5.33^{aA}±0.21	5.67^{aA}±0.21

Mean±SE; n=18; Means with different small superscripts row wise and capital superscripts column wise differ significantly (p≤0.05); Control=Milk based ragi porridge containing 5% URF; Experimental=Milk based malted ragi porridge containing 5% MRF

Table 2
Microbiological count of milk based ragi porridge stored at (4+1°C) temperature

Storage period (days)	Standard plate count		Yeast and mould count		Coliform count	
	Control	Experimental	Control	Experimental	Control	Experimental
0	$0.50^{aA}\pm0.19$	$0.50^{aA}\pm0.19$	ND	ND	ND	ND
3	$1.65^{aB}\pm0.05$	$1.39^{bB}\pm0.09$	ND	ND	ND	ND
6	$2.15^{aC}\pm0.03$	$1.76^{bC}\pm0.05$	ND	ND	ND	ND
9	$2.23^{aD}\pm0.02$	$2.00^{bD}\pm0.05$	ND	ND	ND	ND
12	$2.86^{aD}\pm0.04$	$2.43^{bD}\pm0.01$	ND	ND	ND	ND
15	$3.06^{aE}\pm0.08$	$2.95^{bE}\pm0.00$	ND	ND	ND	ND

ND=Not detectable; Mean+SE; n=06; Means with different small superscripts row wise and capital superscripts column wise differ significantly ($p\leq0.05$); Control=Milk based ragi porridge containing 5% URF; Experimental=Milk based malted ragi porridge containing 5% MRF

followed asymmetrical pattern. During storage, significantly ($P\leq0.05$) lower scores were observed on 9th day in comparison to 0 day in both control and experimental products but the scores were more than 7 (like moderately). Further a significant ($P\leq0.05$) decrease in the scores was observed on 15th day as compared to 12th day in both control and experimental products. It was observed that both products (control and experimental) were acceptable up to 12th day of storage with respect to consistency.

Overall Acceptability: From 0 to 9th day of storage, the study showed significantly ($P\leq0.05$) higher score for overall acceptability for experimental product as compared to controls (Table 1). Results indicated that treatment had a significant ($P\leq0.05$) effect on the overall acceptability of experimental product up to 9th day of storage and thereafter judges scored both the products at par till the end of the storage. It was concluded that treated products were acceptable up to 9th day of storage with respect to overall acceptability with 7.50 sensory score. Inyang and Zakari (2008) also stated that the sensory panelists rated the *fura* sample (a Nigerian cereal food) from germinated grains "high" for all the sensory parameters investigated. The present study reflects that the treated product was acceptable up to 9th day while the control product was acceptable up to 6th day of storage at refrigeration temperature. Thereafter, scores declined around 6 (like slightly) and 5 (neither like nor dislike).

Microbiological Quality: No difference was observed between control and experimental product on 0 day for standard plate count (SPC; Table 2). However, significant ($P\leq0.05$) difference was noticed between the products from 3rd to 15th day of the storage. Results pertaining to SPC showed an increasing trend in both the products over the storage period. Yeast and moulds and coliforms were not detectable throughout the storage period in both control and experimental products. Based on the observations pertaining to SPC, it was concluded that malting improved the shelf life of milk based ragi porridge. According to Odumodu and Inyang (2006), acids were produced during germination and this increased acidity helped to preserve the product.

Based on the findings of this study, it was observed that fresh milk based ragi porridge developed by using 5% of malted ragi flour had higher sensory acceptance in terms of color and appearance, flavor and overall acceptability as compared to control. Malting had a significant positive influence on all the above sensory parameters of products till 9th day at refrigeration temperature. Based on observations of microbiological analysis, it was observed that malting improved the shelf life of ragi porridge. Thus, considering the above findings, it can be summarized that the developed ragi porridge having 5% malted ragi flour can be stored organoleptically acceptable and microbiologically safe up to 9th day of storage at refrigeration (4 ± 1^0C) temperature.

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