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SENSORY EVALUATION OF FINGER MILLET BASED FERMENTED DRINK

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Abstract: *Investigation was planned with a view to standardize the levels of finger millet flour for preparation of fermented drink using probiotic culture. Initially, preliminary rials were conducted to finalize the levels of finger millet flour in the fermented drink. On the basis of the results of sensory evaluation of the preliminary trials, three levels of finger millet flour i. e. 3, 4 and 5 per cent were chosen for experimental trials. The experiment was laid out in Completely Randomized Design (CRD). Fermented drink samples were evaluated for sensory attributes viz; colour and appearance, flavor, consistency and overall acceptability. It was observed that the sensory attributes viz. colour and appearance, flavour, consistency and overall acceptability of fresh fermented drink samples under different treatment combinations were significant (P<0.005) at fresh as well as during storage. The colour and appearance, flavour, consistency and overall acceptability score of fresh fermented drink samples ranged from 7.26 (T_3) to 7.65 (T_2), 7.62 (T_0) to 8.42 (T_2), 7.65 (T_0) to 8.24 (T_2) and 7.69 (T_0) to 8.44 (T_2), respectively. During storage, the sensory quality i.e. colour and appearance, flavour, consistency and overall acceptability gradually decreased. The decrease in sensory score during storage was significant and may be due to sedimentation, wheying off and increase in the acidity of the fermented drink. The better quality finger millet based fermented drink can be prepared using 4% finger millet flour, 8 per cent sugar with shelf life of 15 days at refrigerated storage (5±2^{0}C).*

Key Words: *Sensory quality, Finger millet, Fermented drink.*

Introduction

Fermented foods not only provide nutrition but also confer a number of health benefits like immune system modulation, reduction in serum cholesterol, antihypertensive, anticancer and antidiabetic effect(Khetra *et al.,* 2011). Nutricereals are one of the economical and nutritious food sources in the human diet. Cereal/millets also have potential to incorporate in dairy product formulation because of their richness in fibre, oligosaccharides, free amino acids and certain minerals which promote the health of human beings. Addition of cereals into milk not only enriches its mineral value but also supplements fibre.

Finger millet (*Eleusine corcana*) is an important staple food in the eastern and Central Africa as well as some parts of India (Majumder *et al.,* 2006). It is rich in protein, iron, calcium, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals. It is a good source of diet for growing children expecting women, old age people and patients (Desai *et al.,* 2006).

Probiotics are beneficial bacteria in that they favorably alter the intestinal microflora balance, inhibits the growth of harmful bacteria, promote good digestion, boost immune function and increase resistance to infection (Helland *et al*., 2004).

Keeping these facts in view, the proposed investigation was planned to develop finger millet *(Eleusine coracana)* based fermented drink.

Material and Methods

Milk

The fresh crossbred cow milk samples were procured from Research Cum Development project (RCDP) on Cattle, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri District- Ahmednagar (Maharashtra) for preparation of fermented drink.

Brabender flour mill unit

Brabender flour mill (Model: Quadrumat Junior, Plate 1) manufactured by Western Germany available in Wheat Quality Control Laboratory, Department of Food Science and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri (M. S.) was used for preparation of finger millet flour and screening of flour was done using 60 mesh screen.

Finger millet (*Eleusine coracana*)

Good quality finger millet grains were purchased from the local market.

Sugar

Good quality sugar was purchased from local market.

Water

Sterilized water was used to prepare the fermented drink.

Starter cultutre

The freeze dried pure culture of *Lactobacillus acidophilus* was procured from the National Collection of Dairy Cultures (NCDC), Division of Dairy Microbiology, National Dairy Research Institute, Karnal, Haryana (India).

Preliminary trials

Preliminary trials were conducted using finger millet flour i.e. T_0: Control (without addition of finger millet flour), T_1: 1 gram finger millet flour + 99 ml milk,T_2: 2 gram finger millet flour + 98 ml milk,T_3 : 3 gram finger millet flour + 97 ml milk,T_4: 4 gram finger millet flour + 96 ml milk, T_5: 5 gram finger millet flour + 95 ml milk and T_6 : 6 gram finger millet flour + 94 ml milk to choose the levels of finger millet (*Eleusine coracana*) flour and water in the product. The prepared samples of product were subjected to sensory evaluation.

Preparation of finger millet flour

The decortication of finger millet, was done using standardized process. The grains were conditioned using water at 2 per cent, tempered for 1 hour and dried in shade for 2 hours and milled in Brabender flour mill. This treatment resulted in production of whitish *ragi* flour.

Preparation of fermented drink

The finger millet fermented drink was prepared by using standard technique described by De (2008) with suitable modifications.

Receiving milk
↓
Filtration/Clarification
↓
Pasteurization of milk (71^0C/15 sec.)
↓
Cooling milk (40^0C)
↓
Addition of finger millet (*Eleusine coracana*) flour
(As per treatments)
↓
Inoculation (with starter culture *Lactobacillus acidophilus* @ 1.5%)
↓
Incubation at 37^0 C (7.30 hours)
↓
Addition of sugar and water (@ 8% and 25%)
↓
Mixing
↓

Packaging in glass bottles

↓

Storage (5±2^{0}C)

Flow chart of preparation fermented drink

Experimental trials

Three levels of finger millet flour viz., 3, 4 and 5 per cent were chosen from preliminary trials and used for preparation of fermented drink by keeping 8% sugar and 25% sterilized water constant in the product.

Treatment details

T_0 : Control (without addition of finger millet flour)

T_1 : 3 gram finger millet flour + 97 ml milk

T_2 : 4 gram finger millet flour + 96 ml milk

T_3 : 5 gram finger millet flour + 95 ml milk

Storage studies

The samples of fermented drink prepared under different treatment combinations were immediately filled in sterilized 250 ml capacity glass bottles, sealed under aseptic conditions and stored at refrigerated temperature (5 ± 2^{0}C) for 20 days. The samples were withdrawn and monitored at predetermined intervals of 5 days and evaluated for sensory attributes. The evaluation of stored samples was discontinued when the product was declared spoiled by the sensory panel.

Sensory Evaluation

The fermented drink samples prepared under different preliminary and experimental trials were subjected to sensory evaluation using the method described in the IS: 6273, Part-I and Part- II (1971) adopting 9 point Hedonic scale. A panel of 5 trained judges was formulated for this purpose. The samples were coded every time to conceal their identity and were offered to the judges for evaluation of their quality attributes.

Statistical design and analysis of data

The experiment was laid out in Completely Randomized Design (CRD) with 5 replications for preliminary and 4 replications for experimental trials. The experimental data was analyzed using the Statistical methods of Snedecor and Cochran (1994).

Results and Discussion

Colour and appearance

Colour and appearance of any product is one of the important sensory attributes. On the basis of this attribute the consumer acceptability depends. The mean colour and appearance score of fresh and stored samples of fermented drink upto 20 days are presented in Table 1.

Table 1: Effect of different levels of finger millet flour on colour and appearance of fermented drink during storage

(Sensory score out of 9)

Treatment	Storage period				
	Day 0	Day 5	Day 10	Day 15	Day 20
T_0	7.51^b	7.32^b	7.26^b	7.15^{bc}	6.56^b
T_1	7.52^{bc}	7.51^c	7.35^{bc}	7.12^b	6.82^{cd}
T_2	7.65^d	7.54 ^{cd}	7.39^{cd}	7.18^{bcd}	6.78^c
T_3	7.26^a	7.11^a	6.98^a	6.75^a	6.45^a
SE ±	0.0342	0.0337	0.0331	0.0234	0.0305
CD at 5%	0.1026	0.1010	0.0991	0.0703	0.0914

From Table1, it was revealed that, the effect of treatment combinations on colour and appearance of fermented drink samples was significant ($P < 0.05$) at all the stages of storage. The colour and appearance score varied from 7.26 (T_3) to 7.65 (T_2), 7.11 (T_3) to 7.54 (T_2), 6.98 (T_3) to 7.39 (T_2), 6.75 (T_3) to 7.18 (T_2) and 6.45 (T_3) 6.82 (T_1), on day 0, 5, 10, 15 and 20th day of storage.

All the four treatment samples obtained high colour and appearance scores in the range of 'like

moderately' to 'like very much' out of maximum score of 9 (Hedonic Scale). The average colour and appearance score of freshly prepared fermented drink samples was 7.5. During storage the samples became dulled in colour, similarly formation of wheying-off was observed with advancement of storage period. It resulted in a steady and little decrease in colour and appearance score. Finally the colour and appearance score reached to 6.45(T_3) to 6.82(T_1). The dulled colour and wheying-off in the product is attributed due to biochemical changes taken place during storage (Wallace and Guisti, 2008). The fermented drink with 4 per finger millet flour had intense cream colour than rest of treatment combinations.

The results are in agreement with Jain (2009) who reported that the colour and appearance of the oat based functional fermented product declined slightly i.e., from 8.37 on 14th day to 8.10 on 28th day of refrigerated storage as compared to the fresh samples (8.325). Modha and Pal (2011) developed the pearl millet based fermented milk beverage with 5 per cent pearl millet solids and reported that the average scores of colour and appearance of beverage on 7th day decreased from 7.6 to 7.1.

Flavour

Flavour is one of the most important parameter for deciding the acceptability of the product. The mean flavour score of fresh and stored samples of fermented drink are presented in Table2.

Table 2: Effect of different levels of finger millet flour on flavour of fermented drink during storage

(Sensory score out of 9)

Treatment	Storage period				
	Day 0	Day 5	Day 10	Day 15	Day 20
T_0	7.62^{a}	7.4^{a}	7.14^{a}	7^{b}	6.44^{cd}
T_1	8.34^{c}	8.3^{c}	7.86^{c}	7.42^{c}	6.38^{bc}
T_2	8.42^{cd}	8.42^{d}	8.04^{d}	7.54^{d}	6.38^{bc}
T_3	7.82^{b}	7.74^{b}	7.52^{b}	6.84^{a}	6.28^{a}
SE $\pm$	0.0372	0.0369	0.0356	0.0328	0.0292
CD at 5%	0.1114	0.1101	0.1064	0.0986	0.0876

The addition of different levels of finger millet flour significantly ($P<0.05$) influenced the flavour of the product (Table 2) at all the stages of storage.The average flavour score of freshly prepared fermented drink samples was 8.05. The mean flavour score of fermented drink samples were decreased from 7.62 to 6.44, 8.34 to 6.38, 8.42 to 6.38 and 7.82 to 6.28 for treatments T_0, T_1, T_2 and T_3, respectively from day 0 to 20th day of storage. Jain (2009) observed that the flavour score for the samples of oat based functional fermented product declined from 6.88 to 5.99 during 0 to 28 days of refrigerated storage.

The mean sensory score for flavour of fermented drink ranged from 6.28 (T_3) to 6.44 (T_0) on the 20th day of storage period. Treatment T_0, T_1 and T_2 were at par, whereas T_3 significantly differed from rest of treatments under study.

The flavour score for the treatment T_2 was 8.42 to 7.54 on 15thday which is between 'like extremely' to 'like very much' followed by T_1 and T_3. The decreasing trend of flavour was observed with due course of time and the declining trend was faster in T_3. Significant ($P<0.05$) changes were observed in the flavor during storage intervals. The decrease in the flavour may be attributed to loss of freshness which is inherent with any food product.

The increase in acidity during storage had direct and negative impact on flavour profile of the samples. The sensory score for flavour of fermented drink samples declined fasteron 15th day onwards. The samples deteriorated on the 20th day of storage period.

This decrease in flavour might be due to proteolytic and lipolytic activities of microorganisms in the product and might be due degradation of

phenolic compounds which are unstable and undergo numerous enzymatic and chemical reactions during storage (Hala *et al.*, 2014). Modha and Pal (2011) developed the fermented milk beverage with 5 % pearl millet solids and reported that the average scores of flavour score of a beverage on 7th day decreased from 7.2 to 6.95. The decrease in flavour scores may be mainly attributed to increase in acidity of beverage during storage period.

Consistency

The mean score for consistency of fresh and stored samples of fermented drink are presented in Table3.

The addition of finger millet flour in the fermented drink significantly (P<0.05) influenced the consistency of the product.The average consistency score of freshly prepared fermented drink samples was 8.0.

There was significant (P<0.05) influence on consistency of the fermented drink due to addition of finger millet flour during storage period of 20 days. It was revealed that, addition of finger millet flour significantly decreased the consistency of fermented drink samples during storage up to 20th day. The consistency score decreased from 7.65 to 6.26 (T_0), 8.2 to 6.36 (T_1), 8.24 to 6.3 (T_2) and 7.91 to 6.18 (T_3), on day 0, 5, 10, 15 and 20th day of storage. On 15th day of storage the highest score was obtained by treatment T_1 (7.46) and lowest was received by T_3 (6.18).

Table 3: Effect of different levels of finger millet flour on consistency of fermented drink during storage

(Sensory score out of 9)

Treatment	Storage period				
	Day 0	Day 5	Day 10	Day 15	Day 20
T_0	7.65^{a}	7.36^{a}	7.14^{a}	7.12^{b}	6.26^{ab}
T_1	8.2^{c}	8.24^{cd}	7.86^{c}	7.46^{c}	6.36^{cd}
T_2	8.24^{cd}	8.23^{c}	8.04^{d}	7.54^{cd}	6.3^{bc}
T_3	7.91^{b}	7.72^{b}	7.52^{b}	6.76^{a}	6.18^{a}
SE ±	0.0371	0.0365	0.0358	0.0327	0.0268
CD at 5%	0.1111	0.1096	0.1076	0.0983	0.0805

As the level of incorporation of finger millet flour increased the consistency of the product decreased significantly (P<0.05). It may be due to total solids content of finger millet flour, formation of clots and wheying off. The consistency of the samples under different experimental treatments became totally unacceptable on the 20th day of storage.

Modha and Pal (2011) optimized Rabadi-like fermented milk beverage using pearl millet. They reported that the consistency score of the beverage decreased from7.2 to 6.95 on 7th day of storage. Amin *et al.* (2012) studied the shelf life of dahi (yoghurt) with and without potato mash. They reported that body and consistency score decreased slowly in refrigerated samples. At refrigeration temperature (5°C) body and consistency was acceptable up to 14th days for B and C samples (18.0 ± 1.0 and 18.0 ± 1.2), up to 12th days for A sample (l9.0 ± 1.7) and up to 10th days for D sample (l8.3 ± l.5).

Overall acceptability

Overall acceptability of any product is one of the important sensory attributes of any food product. The mean score for overall acceptability of fresh and stored samples of fermented drink are presented in Table 4.

Table 4: Effect of different levels of finger millet flour on overall acceptability of fermented drink during storage

(Sensory score out of 9)

Treatment	Storage period				
	Day 0	Day 5	Day 10	Day 15	Day 20
T_0	7.69[a]	7.42[a]	7.26[a]	7.15[b]	6.32[b]
T_1	8.28[c]	8.28[c]	7.84[c]	7.44[c]	6.42[c]
T_2	8.44[d]	8.44[d]	7.96[d]	7.48[cd]	6.32[b]
T_3	7.96[b]	7.94[b]	7.72[b]	6.64[a]	6.18[a]
SE ±	0.0375	0.0374	0.0374	0.0324	0.0289
CD at 5%	0.1123	0.1120	0.1120	0.0972	0.0868

The addition of different levels of finger millet flour significantly ($P<0.05$) influenced the overall acceptability of the product (Table 4). The average overall acceptability score of freshly prepared fermented drink samples of fresh and 5th day of storage was 8.09 and 8.02. The overall acceptability scores for the samples ranged from 7.69 to 8.44, 7.42 to 8.44, 7.26 to 7.96, 6.64 to 7.48 and 6.18 to 6.42 on 0, 5th, 10th, 15th and 20th day respectively during storage period. All the treatments significantly ($P<0.05$) differed among themselves. The overall acceptability of treatment $T_1$and T_2were remained unchanged upto 5th day as compared to rest treatments. However, the overall acceptability score decreased with passage of storage period and this might be due to increase in acidity of fermented drink samples and also due to gradual increase in syneresis during storage. On 15th day of storage period overall acceptability score of samples was 7.48 (T_2) followed by treatment 7.44 (T_1), 7.14 (T_0) and 6.64 (T_3). Treatments T_1 and T_2 were at par. The treatment T_2 showed higher overall acceptability among all other treatment under study. On 20th day of storage, the mean overall acceptability score ranged from 6.18 (T_3) to 6.42 (T_2). The score obtained for all treatments were below the acceptance level as the product was sensorily became unacceptable.

The decrease in overall acceptability score with advancement of storage period may be attributed to declined colour and appearance, flavour and consistency scores of the fermented drink. It is also due to proteolysis, lipolysis and increased microbial activity, wheying-off and formation of slight sedimentation in the fermented drink samples.

The results are in agreement with the findings reported by Jain(2009) observed that the overall acceptability of all the samples of oat based functional fermented product declined marginally during entire period of refrigerated storage due to higher acidity, slight increase in lipolytic values (FFA content), proteolysis (tyrosine value) at the end of 28 days of storage.

Modha and Pal (2011) developed the fermented milk beverage with 5 per cent pearl millet solids and reported that the average scores of overall acceptability of beverage on 7thday decreased from 7.2 to 6.9. Slight decrease in overall acceptability scores may be due to marginal increase in wheying-off and increase in acidity of the beverage during storage.

Conclusion

From the present investigation, it is concluded that an acceptable quality of finger millet based functional probiotic fermented drink can be developed using 4 per cent finger millet flour, 8 per cent sugar and 25 per cent sterilized water.

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