

Development of Finger millet (*Eleusinecoracana*) incorporated symbiotic drinking yoghurt

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Introduction

Sri Lankan yogurt market is characterized by intense competition prompting leading players to differentiate themselves by focusing on health benefits, branding, and incorporation of different ingredients. Yoghurt is a popular fermented dairy product due to its health benefits as a functional food in addition to its nutritional benefits (Robinson and Tamime, 1999). High calorie yogurt drink that contains any kind of a cereal powder is completely a new product concept to the Sri Lankan market. Therefore, the objective of the current study was to develop a health beneficial probiotic drinking yoghurt by incorporating finger millet as a cereal which can be used as a breakfast food, sport supplement and also as a weaned food for toddlers. Nutritionally, finger millet is used as a whole grain, it is higher in protein and minerals in comparison to all other cereals and millets. According to previous studies, finger millet is also known for several health benefits such as anti-diabetic, antitumorigenic, atherosclerogenic effects, antioxidant and antimicrobial properties which are mainly attributed due to its polyphenol and dietary fiber contents (Dykes and Rooney, 2007; Chethan, 2008). Therefore this study was conducted to develop a cereal based probiotic yoghurt drink which can be promoted as a natural source of high calorie that can be consumed as an alternative for the imported, artificial and expensive sport nutrition's and weaned foods.

Methodology

The study was conducted at the research and development and quality assurance laboratories in Ceylon cold stores PLC, Ranala, Kaduwela. In the preliminary trial 1 most compatible sugar percentages for different incorporation levels of finger millet flour from the three experimental forms (roasted flour, germinated flour and raw slurry) were selected. Then preliminary trial 2 was carried out using ranking method to select the best finger millet incorporation levels (4 %, 5 %, 6%, 7% and 8 % (w/w)) for each incorporation form. The best sugar percentages and incorporation levels of finger millet from preliminary trials were used in next steps of

experiments. Sensory evaluation 1 was carried out to select the best form/type of finger millet flour to incorporate out of three forms. In second sensory evaluation, the most suitable stage for finger millet incorporation was determined by using two treatments. Each sensory evaluation was conducted with 30 untrained panellists and color, taste, aroma, mouth feel and overall acceptability were considered as sensory properties. Finally proximate analysis, physico- chemical and microbial analysis were conducted for the selected final probiotic drinking yoghurt by comparing with a control sample. Probiotic lactic acid bacteria enumeration was carried out using the selected final product by pour plating on MRS media to find out the effect of finger millet incorporation on the viability of probiotic lactobacilli. Selected final product was compared with a control sample and enumeration was done at 1, 7 and 14 days interval.

The sensory data were analyzed using Friedman non-parametric test with 95% significance by using Minitab 16 software. Complete Randomized Design (CRD) was conducted and data obtained from chemical and microbiological tests were analyzed using analysis of variance (ANOVA) using the SAS 9.0 software. Significant means of treatments were separated using the Least Significant Difference test (LSD) ($P < 0.05$).

Results and Discussion

According to the results of the series of preliminary trials 5% (w/w) was selected as the best incorporation level from each three finger millet forms and 8 % (w/w) sugar as the compatible sugar percentage. In the first sensory evaluation for selecting best form/type of incorporation out of three experimental forms, germinated /malted flour incorporated yoghurt was selected as the best due to higher preference than other two. There was a significant difference ($P < 0.05$) between treatments regarding and overall acceptability. Second sensory evaluation revealed, 5 % (w/w) germinated (malted) finger millet flour incorporated (Addition before fermentation) drinking yoghurt have the higher preference compared to the other treatment with respect to all the sensory parameters considered ($p < 0.05$). The selected composition of synbiotic drinking yoghurt is given in Table 01.

Table 01. Composition of the selected final product

Ingredient	Percentage (w/w)
Raw milk	84.54 %
Sugar	8 %
Stabilizer	0.25 %
Finger millet (Germinated flour)	5 %
Skim milk powder	0.83 %
Dairy cream	1.37 %

In the shelf life evaluation of the final product, there was a significant difference ($p < 0.05$) in lactic acid development (Titratable acidity) during cold storage between control drinking yoghurt sample and germinated finger millet flour incorporated yoghurt.

During the 21 days of storage period, titratable acidity of the selected final product was between $0.68\% \pm 0.08$ to $0.89\% \pm 0.08$. During the storage period of 21 days, pH of the control yoghurt sample reduced from 4.58 ± 0.09 to 4.25 ± 0.09 and pH of germinated finger millet flour incorporated yoghurt reduced from 4.62 ± 0.09 to 4.38 ± 0.09 . The pH drop of both treatments is due to the acid development as a result of the activity of lactic acid bacteria (Tammie and Robinson, 1999). Yeast and mold and *E.coli*, Coliform counts of the both germinated finger millet flour incorporated drinking yoghurt and control were not exceeding SLS standards for yoghurt during 21 days of refrigerated storage.

The probiotic *lactobacilli* count in both experimental and control yoghurt samples have decreased over the storage period (Figure 1). Reason for that may be the low pH (high acid development with the time) levels. Low pH level of the fermented milk products was directly affected the survival of probiotic bacteria. However, as shown in the figure probiotic *lactobacilli* population in germinated finger millet flour incorporated drinking yoghurt is higher compared to the control sample. Finger millet contains prebiotic substances such as resistant starch, oligosaccharides, crude fibers and also it acts as fermentable substrates for growth of probiotic microorganisms (Dykes and Rooney, 2007; Chethan, 2008). There is a significant difference in probiotic bacteria population over the storage period between control and germinated finger millet flour incorporated yoghurt sample ($p < 0.05$).

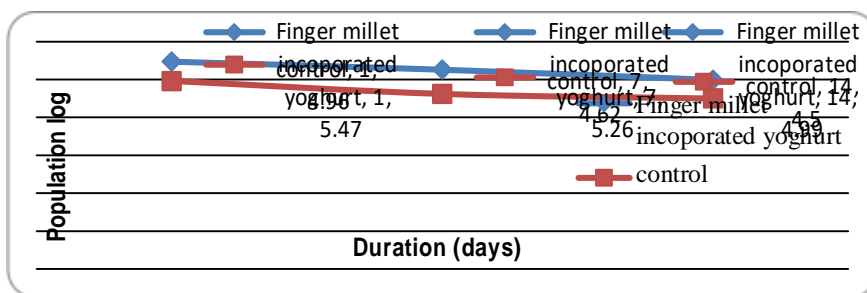


Figure 01: Changes of probiotic lactobacilli population during refrigerated storage

Conclusions

5 % (w/w) finger millet flour incorporation level was selected as the best and germinated/malted flour was selected as the best form of incorporation while addition of finger millet before fermentation was determined as the most suitable stage of incorporation. Further, the incorporation of finger millet into the yoghurt has enhanced the survival of probiotic *lactobacilli* during refrigerated storage.

References

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