Effect of incorporation of finger millet (*Eleusine coracana*) on proximate composition, sensory and microbiological properties and shelf life of drinking yoghurt over refrigerated storage

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1. Introduction

Yoghurt has identified as a suitable carrier for integration of dietary fibre sources in foods. Several research studies revealed consumption of fibre enriched yoghurt may prevent or reduce diabetes, hypercholesterolemia, obesity, cancer, colonic diverticulosis and constipation, ulcerative colitis, whereas promote intestinal micro flora and gastrointestinal immunity. In addition, dietary fibres are capable of improving rheological properties and reducing syneresis in yoghurt (Dabija et al., 2018).

Cereals, fruits, vegetables and nuts are good sources of dietary fibres which are absorbed by small intestine and fermented by large intestines. Among cereals, *Eleusine coracana* (Finger millet) is an excellent source of dietary fibres occurring about 15-20%. However, it is an underutilized cereal in tropical regions, but having an immense potential in the food market due to its nutritional and medicinal values (Göksel Saraç & Dogan, 2016).

Further, previous studies demonstrated prebiotic fortification of adding dietary fibres in yoghurt, butter and buttermilk. It is notable that such fermented dairy products were only produced with traditional starter cultures. Thus, it is necessary to produce fibre-enriched yoghurt inoculated with probiotic cultures because it improves gut microbial flora and gastro intestinal immunity. It has been evident by many clinical studies that *Lactobacillus acidophilus* and *Bifidobacterium animalis* subsp. *lactis* BB-12® exhibited beneficial health effects in terms of improved gastrointestinal health and immune functions. Therefore, the aim of the study was to evaluate the effect of addition of finger millet powder on physiochemical properties and microbiological quality of drinking yoghurt.

2. Materials and Methods

Good quality finger millets were cleaned and sopped in distilled water for 1-2 minutes. The selected grains were subjected to sun drying for 3 hours under aseptic condition and then roasted at 110 ºC for 10 minutes and cooled up to room temperature. Grains were ground to 200 μm of particle size, subsequently, powder were packed and stored at room temperature.

Yoghurt was prepared as described by Prasanna et al. (2013). Probiotics cultures (*Lactobacillus acidophilus, Bifidobacterium animalis* subsp. *lactis* BB-12®) and starter cultures (*Lactobacillus delbruckii* spp. *bulgaricus, Streptococcus thermophilus*) were used. After successful fermentation, coagulum was disturbed and divided into four parts. Finger millet powder were then added at the level of 0%, 2%, 5% and 6% w/w respectively. Finally, samples were stored at 4 ºC for further analysis.

The proximate analysis, caloric value, pH and titratable acidity of yoghurt samples were tested according to AOAC (2000). Sensory attributes were evaluated by eighteen semi-trained assessors. Samples were evaluated using a 9-point hedonic scale (1 = unlike extremely, 9 = like extremely). The sensory parameters tested were the appearance, aroma, texture, taste, consistency and overall acceptability. Total number of coliform bacteria and yeast and mould counts were determined as described by SLS 393, 2016. Finally, the shelf life of yoghurt samples were tested at 14, 28 and 42 days of storage. Finally, data were analysed using the ANOVA procedure of SAS, version 9.2. All experiments were replicated in two times and the test of significance was done at 5% probability.

3. Results and Discussion

In terms of chemical composition, protein, ash and moisture contents of finger millet powder (FMP) incorporated drinking yoghurt samples were in the range of 6.20-6.28%, 2.09-2.15% and 82.5-83.5% respectively. As results revealed 5% finger millet powder fortified yoghurt samples shown the highest percentages for all components than those of other treatments. However, no significant differences observed among treatments with respect to proximate composition except ash content ($p<0.05$). All components were significantly decreased during storage period ($p<0.01$). Caloric values of all samples were shown a steady trend and fallen within the range of 207.94-212.72 kcal/kg. However, control samples exhibited lower caloric values than other treatments during storage period of 42 days.

The pH of FMP incorporated yoghurt samples significantly decreased while increasing level of addition of FMP. At the end of 42 days, pH of control samples reached to 4.22 due to over acidification. Regarding titratable acidity, significant difference was observed among treatments ($p<0.05$). During the 42 days of storage period, titratable acidity of all samples were between 0.47±1.19 to 0.73±1.19%, however, control sample recorded higher acidity than FMP incorporated samples. Kneifel et al. (1993) reported a similar trend for yogurt, in which, titratable acidity of the yoghurt samples increased during storage at 6°C due to the production of lactic acid and other organic acids by lactic cultures.

As per the microbial results, the count of coliforms were zero in all the samples until 42nd day which indicates the manufacturing of drinking yoghurt satisfied good manufacturing practices (GMP). Samples gave positive results with significant count of yeast and mould count during the 42nd days. Regarding total yeast and mould counts, 2% fortified FMP yoghurt samples fulfilled the requirements established by SLS standards for yoghurt until 42 days of refrigerated storage. The primary reason for inhibition of yeast and moulds may be due to the anti-microbial activity of finger millet or lower acidity of yoghurt (Devi et al., 2014). Further, the shelf life of yoghurt and fermented milk products are generally limited to one to three weeks.

Significant differences observed among different treatments ($p<0.05$) with respect to sensory attributes, in particularly, colour, texture, taste, consistency, flavour and overall acceptability. The highest scores for texture, consistency, colour and overall acceptability were recorded for 2% FMP drinking yoghurt. Addition of finger millet flour had a significant ($p<0.05$) influence on organoleptic properties of the product. The preference was given to yoghurts with less concentration of FMP.

4. Conclusions

In the conclusion, the addition of finger millet flour to the drinking yoghurt significantly influenced the physicochemical properties, composition and sensorial properties of drinking yoghurt. The results of this study showed that drinking yoghurt samples containing 2% and 5% finger millet flour maintained the physiochemical properties. As per the results, yoghurts with different incorporation of FMP gave negative results to coliforms that indicating the good manufacturing practices. According to the proximate, sensory and microbial results, 5% FMP incorporation level was better than other treatments during 28 days of refrigerating cold storage.