ENHANCING THE SURVIVAL OF PROBIOTIC BACTERIA IN BIO-YOGHURT BY INCORPORATING COLD WATER EXTRACT OF *MARANTA ARUNDINACEA* (ARROW ROOT) RHIZOMES

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Introduction

Arrow root (*Maranta arundinacea*) is a locally available rhizomatous herbaceous plant. High levels of fructo-oligosaccharides in Arrow root may possess prebiotic properties which can be useful in manufacturing bio-yoghurts. Bio-yoghurts are manufactured by incorporating starter cultures, containing probiotics which could generate therapeutic and prophylactic properties. In order to produce therapeutic effect the minimum number of viable bacteria in a product during their whole shelf-life should be between 8-9 $\log_{10}$ CFU/g (Oliveira *et al.*, 2008). However, many studies have shown that the survival of bacteria in bio-yoghurt during storage is lower than the required number. This is a limitation faced by the fermented milk industry. This study was carried out to assess the effect of incorporation of water-soluble extract of Arrow roots on survival of lactobacilli and lactic acid bacteria during storage and overall acceptability of set-type yoghurt.

Materials and Methods

Fresh rhizomes of Arrow roots were ground and mixed with water for extracting carbohydrates. The mixture was filtered and the filtrate was kept for sedimentation. The sediment obtained after decanting the supernatant was sun dried for 10 h. The yoghurts were prepared using the method of Tamime and Robinson (2007) with slight modifications to its composition. There were four treatments as fallows: control yoghurt comprising *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Rich®, Chr. Hanson) without prebiotic; probiotic yoghurt comprising *Lactobacillus acidophilus, Bifidobacterium bifidum and Streptococcus thermophilus sub sp. Salivarius* (ABT-3, Chr. Hanson); probiotic yoghurt with 3% (w/v) cold water extract of Arrow root; and 4) probiotic yoghurt with 1.65% (w/v) inulin (Raftilose®). Treatments were triplicated. Yoghurt samples were stored at 4 °C for storage studies. Number of total lactobacilli (CFU/g), number of lactic acid bacteria (CFU/g), titratable acidity (TA) and pH were determined at 1st, 6th, 11th and 16th day of storage. The overall acceptability of yoghurts stored at 4 °C for 1 day was evaluated using 30 untrained panelists. Five-point hedonic scale from 1-like extremely to 5-dislike extremely was used for sensory evaluation. Data were analyzed using one way ANOVA and Friedman non-parametric test.

Results and Discussion

Incorporation of both cold water extract of Arrow root and inulin increased ($P<0.05$) the survival of probiotic lactobacilli during storage at 4 °C (Table 1). This observation is in

agreement with the findings of Aryana *et al.*, (2007), where the enhancement of survival of lactobacilli during storage of fat free plain yoghurt was reported. Effect of incorporation of prebiotics on the changes of titratable acidity during storage of bio-yoghurt samples are given in Figure 1. Bio-yoghurts produced using probiotic bacteria and prebiotics contained low level of acids compared to the control as reflected by the TA (Fig 1). This may probably be due to fructo-oligosaccharides in the extract which lowered post acidification and lactic acid release as reported Oliveira *et al.*, (2008). Increase of TA was higher ($P<0.05$) in inulin incorporated yoghurt than the yoghurt with cold water extract of Arrow. This could be due to higher utilization of inulin than Arrow root carbohydrates. Perhaps, cold water extract of Arrow root has lower degree of polymerization than inulin. The accepted levels of TA in set-yoghurt is 0.8 - 1.25 lactic acid % (w/w) during the shelf-life (Sri Lanka Standards, 1989). The control yoghurt and probiotic yoghurt stored at 4 °C reached maximum levels of SLS specification with respect to TA at 16th day of refrigerated storage.

The effect of the duration of storage on pH of yoghurt is not significant ($P>0.05$). The three treatments with probiotic bacteria showed higher pH values than control yoghurt. This result confirms the finding of Hekamat *et al.* (2008), who showed that standard yoghurt culture consists of *L. delbreukki* subsp *bulgaricus* and *S. thermophilus* subsp *salivarius* cause an accelerated lactic acid production during fermentation resulting low pH values.

Addition of inulin did not reduce ($P>0.05$) the overall acceptability more than control yoghurt. However, incorporation of Arrow root in yoghurt reduced ($P<0.05$) the overall acceptability more than control yoghurt. This may be due to the nature of gelatinization in Arrow root carbohydrates, which might have lead to generate granular texture in yoghurt.

Table1. Effect of prebiotics on the population of lactobacilli (*L. bulgaricus and L. acidophilus*) during storage at 4 °C

Treatments	lactobacilli counts (log_{10}CFU/ g) at days			
	1	6	11	16
Yoghurt *(L. bulgaricus)*	7.97^{b}	7.43^{b}	5.00^{b}	3.53^{b}
Probiotic yoghurt *(L. acidophilus)*	9.25^{a}	8.15^{ab}	4.82^{b}	2.90^{b}
Probiotic yoghurt with inulin *(L. acidophilus)*	9.37^{a}	8.46^{a}	5.99^{a}	4.41^{a}
Probiotic yoghurt with Arrow root (*L. acidophilus*)	9.26^{a}	8.42^{a}	6.26^{a}	4.69^{a}

[a,b]The values (mean triplicate) in the same column with the different superscript letters are significantly different ($P<0.05$).

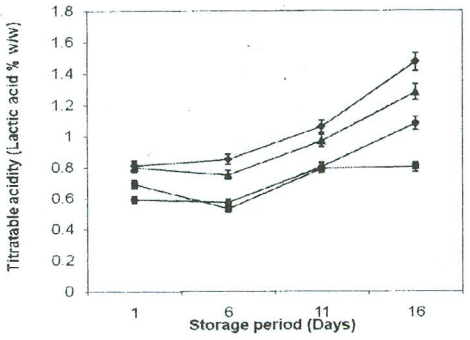

Figure 1. Changes of Titrarable acidity (TA) in Yoghurts [◆], Probiotic yoghurt [●], Probiotic yoghurt with inulin [▲] and Probiotic yoghurt with cold water extract of Arrow root [■] over a storage period of 16 days at 4 °C

Conclusion

Incorporation of cold water extract of Arrow root rhizomes and inulin increased the survival of lactobacilli and lactic acid bacteria population in bio-yoghurt during storage at 4 °C. However, inclusion of cold water extract of Arrow root rhizomes has negatively affected the smooth texture of yoghurt due to formation of granular complex carbohydrates.

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