Development of stirred type fruit yoghurt using wood apple (*Limonia acidissima*)

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Introduction

Consumption of fruits and milk is important for human health as they are good sources of protein, vitamins and minerals (Alakali *et al*., 2008). Fruit yoghurts have been popular among milk products in the world. But, it is not very common in Sri Lankan market. In manufacturing fruit yoghurts, fruit is usually added to milk product in the form of fruit preparations or as fruit flavors. But, manufacturing fruit yoghurts, with natural fruit pulp or juice is very important to provide nutritional and natural balance diet. Yoghurt has nutritional benefits beyond those of milk. Lactose-intolerant individuals can sometimes tolerate yoghurt better than other dairy products, because the lactose in the milk is converted to glucose and galactose, and partially fermented to lactic acid, by the bacterial culture. When, underutilize fruits are concerned, wood apple is one of fruit which is cheap, highly nutritious, perishable and seasonally available fruit in Sri Lanka (Vidhyaasree, 2012). Therefore, this research was carried out to develop a stirred type wood apple yoghurt as a nutritional dessert as well as a balance diet.

Materials and Methods

Current study was carried out at Food Research Unit, Department of Agriculture, in Gannoruwa, Peradeniya. Laboratory analysis was conducted at Uva Wellassa University, Food Research Unit, Veterinary Research Institute and chemical laboratory in SGS Lanka (Pvt.) Ltd. A series of preliminary trials conducted to find out the best product for further evaluations and development. First preliminary trial was carried out to preparation of main ingredients. Under that, plain yoghurt preparation, wood apple pulp preparation and sugar and fresh milk addition were undertaken. Second preliminary trial was carried out to adjust the pH value, brix value of the product and texture, mouth feel and taste of the product. The third preliminary trial was carried out to create four different recipes. Mainly four different wood apple pulp amounts (5, 7.5, 10 and 12.5%) were added to prepare four different recipes. Sensory evaluation was conducted for colour, taste, odour, mouth feel and overall acceptability using 50 semi-trained panelists. In physicochemical analysis, pH, titratable acidity, total soluble solids, total fat, solid non fat, proximate analysis, calcium and phosphorus contents and microbial analysis yeast, mould and *Escherichia coli* were evaluated for selected product samples with SLSI recommended levels. Shelf life analysis was conducted by analyzing some physicochemical, microbiological and sensory properties of selected product sample during the 1 , 4 st th, 7 th, 11 th, 15thand 20 days of storage. Finally, cost of final product was analyzed. Sensory data were analyzed using computer aided MINITAB 14 statistical analysis package Friedman non-parametric test and physicochemical and microbial tests were analyzed using one way ANOVA at 95% level of significant.

Results and Discussion

Ten percent of wood apple pulp incorporated fruit yoghurt gave the highest estimated medians (taste – 4.25, colour – 3.875, aroma – 4.5, mouth feel – 4.25, overall acceptability – 4.625) and the highest sum of ranks for all sensory attributes. Therefore, 10% of wood apple pulp incorporated recipe (R_1) has given a desirable product. Web diagram for sensory evaluation data is shown in figure 1.

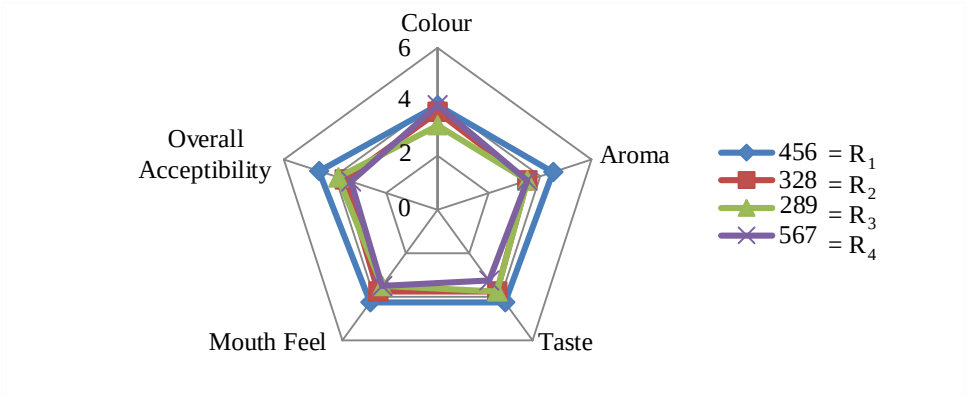

Figure 1. Web diagram for sensory evaluation data

According to physicochemical analysis (table 1), developed stirred type wood apple yoghurt product contained high protein (3.8%), calcium (166 ppm) and law fat (1%) content. Also, this newly developed product belonged to recommended level of SLSI, 1989 standard.

Table 1. Results of physicochemical analysis

Food constituent	Plain yoghurt (SLSI) (per 100 g)	Fruit yoghurt (SLSI) (per 100 g)	Wood Apple yoghurt (per 100 g)
pH value	4.2 – 6.5	4.2 -6.5	5.3
Brix value	20%	20% - 35%	28.4%
Titratable Acidity	0.8 – 1.25	0.6 – 1.25	0.65%
Total Solids	> 20%	> 20%	41.56%
Solid non fat	8%	> 8%	10.21%
Protein	3.5%	3.5%	3.8%
Crude fat	3% - 3.5%	0.5% - 3%	1%
Calcium	> 120 mg	> 120 mg	166 mg
Phosphorus	-	-	88.9 mg

According to the shelf life study the product can be recommend as good quality food product for 15 days shelf life period. However, during this period product must be stored in 4 C temperature in refrigerator condition. Web diagram for change of sensory data with storage time is shown in figure 2 and physicochemical data and microbial count for shelf life study is shown in table 2 and table 3.

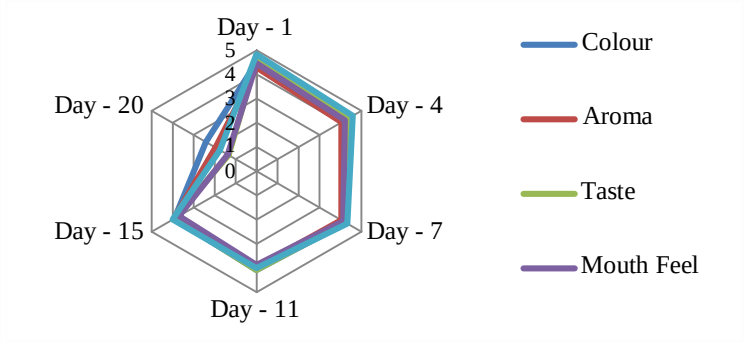

Figure 2. Web diagram for change of sensory data with storage time

Table 2. Physicochemical Data for Shelf Life Studies

Storage (days)	Mean pH	Mean Brix %	Mean Titratable Acidity %
01	5.32 ±	28.4 ±	0.65 ±
04	5.32 ±	28.4 ±	0.65 ±
07	5.29 ±	28.4 ±	0.65 ±
11	5.28 ±	28.0 ±	0.66 ±
15	5.26 ±	28.0 ±	0.66 ±
20	4.76 ±	28.0 ±	0.69 ±

According to the SLSI standards yeast count was not more than 1000 per 1 g, mould count was not more than one per 1 g and *E. coli* count must be negative in quality product.

Table 3. The Results of the Microbial Analysis for Shelf Life Studies

Test Microorganisms	Day 1	Day 4	Day 7	Day 11	Day 15	Day 20
Mean Yeast (cfu)	35	45	70	130	295	790
Mean Mould (cfu)	0	0	0	0	0	30
Mean *E. coli* (cfu)	0	0	0	0	0	0

Average commercial price for stirred flavoured yoghurt was Rs.45.00 in the August 2014. Allowing to the cost analysis, raw material cost for one wood apple yoghurt was Rs.19.77 is shown in table 4.

Table 4. Cost Analysis for Stirred Wood Apple Yoghurt Production

Main Ingredients	Amount per 100 ml cup	Price per 100 ml cup
Plain Yoghurt	84 g	Rs. 7.56
Wood Apple Pulp	13 g	Rs. 1.50
Sugar	11 g	Rs. 1.25
Fresh Cow Milk	16 ml	Rs. 0.96
Other	Labour Cost, Electricity Cost, etc.	Rs. 8.50
Total		Rs. 19.77

Conclusions

Ripe wood apple pulp can be introduced to yoghurt given the health benefits, higher sensory, physicochemical and microbiological properties. The selected best sample, 10% of ripe wood apple pulp gave acceptable results as SLSI standards. The product can be recommended as a quality food product for 15 days period under 4 C° temperature in refrigerator condition.

Acknowledgment

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