

Development of Yoghurt Drink Enriched with Avocado Pulp (*Persea americana*)

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Abstract

Avocado (*Persea americana*) enriched yoghurt drink was prepared using different inclusion rates; 8%, 10%, 12% and 14% of avocado pulp and compared with control. pH, titrable acidity, moisture, ash, fat, total solids(TS), and solid non fat (SNF) were measured in all samples at 0, 5, 10 and 15 days of storage. Total plate count (TPC), yeast and mold and total coliform were tested for best preferred sample and control at the same intervals. 8% avocado inclusion rate was preferred significantly ($p < 0.05$). pH and acidity of 8% avocado included samples were changed from 4.41 ± 0.02 to 4.12 ± 0.05 and from $0.62 \pm 0.00\%$ to $0.71 \pm 0.01\%$ respectively. Fat content was increased significantly with avocado incorporation and it was recorded in the range of 3.0-3.2%. Moisture and SNF were reduced significantly with the storage. TS were reduced in all treatments without any significant effect (p value > 0.05). TPC was increased with storage in both samples without making any significant difference. This study revealed that 8% inclusion of avocado pulp in yoghurt drink make consumer preferred dairy product which can be improved in future studies.

Keywords: Yoghurt, drink, avocado, Storage, analysis

1. Introduction

Fermented dairy foods play a vital role in human diet throughout the world. Yoghurt is a coagulated milk product obtained by lactic acid fermentation through

the action of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, from milk and milk products (FAO/WHO, 1975). It is a nutritiously balanced food containing almost all the nutrients present in milk but in a more assimilable form (Joseph o. et al, 2011). It is easily digested, has high

nutritional value and is a rich source of carbohydrates, protein, fat, vitamins, calcium and phosphorus (El-Batawy et al, 2013).

There are main two types of yoghurt in the market; set yoghurt and stirred yoghurt. Yoghurt drinks are categorized under stirred yoghurt. It contains low viscosity which obtains by high agitation after formation of fermented coagulum (Allgeyer C. et al, 2010).

The Food and Drug Administration standard of identity for yoghurt drinks specifies $>8.25\%$ milk solids-not-fat and fat levels to satisfy nonfat yoghurt ($<0.5\%$), low-fat yogurt (2%), or yogurt ($>3.25\%$) before the addition of other ingredients (Chandan et al, 2006).

Yoghurt drinks are generally flavored with natural or artificial fruit puree or juices and consumer preference vary from country to country. Fruit flavors which have been used in yoghurt drinks are strawberry, raspberry, carrot, apple concentrates, pineapple, lemon or orange concentrates or essences (Tamime Y. and Robinson R, 1999). Fruit additions have an increasing effect on yoghurt consumption (Erdogan K. and Zekai T, 2003). Among different types of fruits avocado is a common food in tropics (Bates P, 1968). Avocado is a medium energy dense (1.7 kcal/g) fruit because it contains about 80% water and dietary fiber. Unlike other fruits, avocados are low in sugar and contain 15% monounsaturated fatty acids rich oil, which helps to increase the bioavailability of carotenoids (Victor F et al, 2013). The fat in avocado is predominantly monounsaturated oleic acid, which has been shown to reduce blood levels of the low-density lipoprotein (LDL) cholesterol that contributes to atherosclerotic heart disease (Bergh O, 1992). Avocado is rich in bioactive compounds as vitamin E and one to two times of protein than other fruits. (Manal S. et al, 2013).

Today consumers are concerned about health and nutrition within food products at the reasonable price (Nuzhat H. et al, 2003). When it comes to quenching a consumer's thirsty for healthy yoghurt drinks, natural products are more concerned. Thus keeping a view in importance of adding natural avocado pulp in yoghurt drinks this study was planned to determine the best avocado incorporation rate in yoghurt drinks and the optimizing the organoleptic and chemical characteristics of product.

2. Materials and Methods

2.1 Preparation of yoghurt drink

Fresh cow milk was procured from the milk collecting center at Makandura, Gonawila (NWP), Sri Lanka. Cow milk was standardized up to 2.5% fat level, and after adding sugar, milk was pasteurized at 80°C/30 min. and gelatin (0.25%) was added at 38°C. Then the milk was cooled and starter culture inoculated at 45°C (3g for 100kg) and incubated for about 4 hrs until pH drops to 4.6. Resulted yoghurt was refrigerated at 4°C. Fresh ripened avocado were purchased from local market, Makandura, Gonawila (NWP), Sri Lanka. The ripen flesh was extracted, well blended until turn in to a smooth cream and pasteurized. The avocado pulp and yoghurt were blended properly. Product was packed properly and stored at refrigerated conditions. Several trials were conducted by using set yoghurt, avocado pulp, sugar and boiled water with different levels (Table 1).

Table 1: Different Formula used in Avocado-yoghurt drink development

Treatment	Yoghurt %	Sugar %	Avocado pulp%	Water %
T1	81	5	0	14
T2	73	5	8	14
T3	71	5	10	14
T4	69	5	12	14
T5	67	5	14	14

2.2 Composition Analysis

Moisture, Ash (AOAC, 1995) and pH, titrable acidity, fat, total solids and Solid non fat (SLSI, 1988) were measured during the storage. Total plate count, Yeast and mold and Total coliform were tested according to FAO, 1992. The products were analyzed for pH, titratable acidity and microbiological tests at 0, 5, 10 and 15 days of storage.

2.3 Sensory Evaluation

Avocado incorporated yoghurt drink was presented for sensory evaluations with 30 untrained panelists to select best incorporation rate using ranking test.

2.4 Statistical analysis

Data were analyzed using MS Excel, Two-way ANOVA in Minitab 15.0 at 95% CL, and SAS 9.2 software.

3. Results and Discussion

3.1 Effect of avocado addition on pH changes

pH was decreasing in each sample throughout the storage (Fig 1). The reason was an increase in acidity due to conversion of lactose to lactic acid during storage period (Nuzhat H. et al. 2003). Initial pH values descend with 14%, 12%, 10%, 8% and 0 % inclusions. It showed reduction in acidity increment with avocado incorporation. The statistical analysis indicates a significant difference between samples during storage as p value < 0.05 . The pH of these products varies between 3.4 and 4.0 according to the desired acidity and kind of fruits (Morvarid Y. et al, 2013).

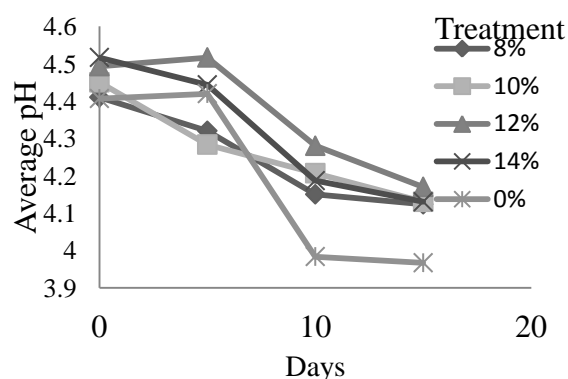


Fig. 1 Variation in pH throughout the storage period

3.2 Effect of avocado addition on acidity changes

The statistical analysis showed that there is a significant difference among samples for each testing time (except 5th day, p value > 0.05) which indicates the acidity variation trend significantly ($P= 0.00$) affect with the avocado inclusion rate. The lowest acidity values were recorded for 14% avocado pulp while the highest value for 0% at 0, 5 and 10 days.

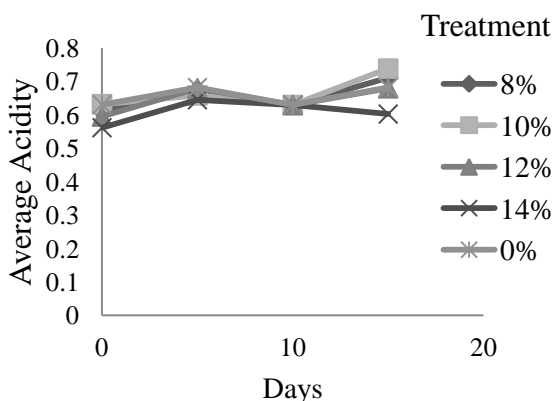


Fig 2 Changes in acidity during storage

3.3 Effect of avocado on proximate composition of yoghurt drink

Moisture: Moisture was decreased during storage although the variations were not in a particular pattern (Table 02). Increment of storage period has negatively affected for all the treatments. The effect on each treatment is significantly different ($p < 0.05$).

Ash: The statistical analysis showed that the difference of ash content among different samples is significant ($p < 0.05$). Initially control sample has the lowest ash content of 0.37% where that value varies in the range of 0.49- 0.53% for avocado incorporated treatments. According to the results, avocado incorporation may be positively effect on ash content.

Fat: The addition of avocado pulp has significantly increased the fat content ($p < 0.05$). Avocado contains about 14% of fat. This has directly affected on the fat level. Within the storage fat content reduced for all the samples. The reduction in fat under the influence of storage appeared due to lipolytic activity of microflora or due to acidic pH during storage.

Total Solids (TS): Total solid content has increased with addition of avocado pulp at the initial point of storage. The variation of TS content of different samples was observed in close range during storage (Table 03). The reduction was higher in avocado incorporated samples than control sample. As the p value > 0.05 the effect of different treatments were not significant.

Solid Non Fat (SNF): The SNF content has reduced in every sample during the storage period significantly (p value < 0.05) (Table 03). With the time, rate of reduction has changed in all. By the end of the storage control sample has found with highest value compared to other samples incorporated with

avocado. Reduction of the SNF during storage can be due to the reduction of total solids and fat which is accordance with the finding of Tamime et al. in 1999.

3.4 Sensory Analysis

First Sensory Trial: According to the results of ranking preference test, panelists have selected the 8% avocado incorporation as the best. The statistical analysis showed that there is significant difference among 4 treatments for sweetness and overall acceptability (p values < 0.05). There was no significant difference for color and texture (p values > 0.05) (Table 04).

Second Sensory Trial: The statistical analysis revealed that there is significant preference for sensory attributes; color, texture, taste and overall acceptability related to 8% avocado yoghurt drink over the plain yoghurt drink (p values < 0.05). However, lower preference was observed for flavor in avocado incorporated sample than plain drinking yoghurt (Figure 03). The slight bitter taste occurred with the pasteurization would be affected for it.

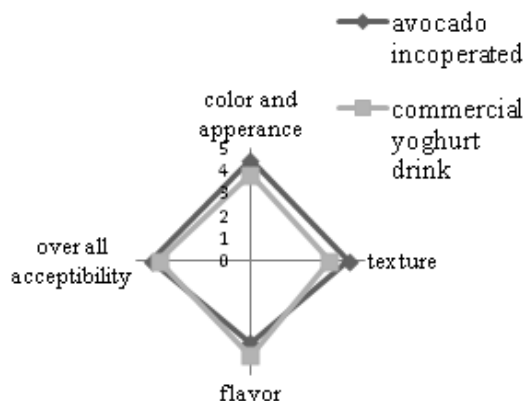


Fig. 03 Mean score for sensory parameters of avocado incorporated and plain yoghurt drink

3.5 Microbiological Analysis

The best preferred 8% avocado sample and plain yoghurt drink were used in microbiological analysis.

Total Plate Count: It is generally accepted that the yoghurt should contain 10^7 CFU of viable bacteria per ml of yoghurt (Chougrani et al, 2009). Count has increased throughout the storage. Although the plain yoghurt drink has recorded higher count than the avocado incorporated, the effect of treatment was not significant (p values > 0.05) (Table 05).

Treatment	Mean Moisture (%)±SD				Mean Ash (%)±SD			
	Storage period				Storage period			
	0 day	5 days	10 days	15days	0 days	5 days	10 days	15 days
8%	81.31±0.22	81.19±0.73	80.99±0.16	80.65±0.17	0.40±0.09	0.46±0.03	0.49±0.14	0.53±0.03
10%	81.65±0.20	81.28±0.80	80.76±0.15	78.11±0.79	0.46±0.07	0.49±0.12	0.50±0.01	0.55±0.02
12%	81.36±0.23	79.87±0.29	79.23±0.61	79.10±0.34	0.36±0.05	0.38±0.06	0.49±0.08	0.56±0.13
14%	81.19±0.20	80.18±0.29	79.64±0.47	78.27±0.29	0.43±0.01	0.49±0.02	0.51±0.03	0.53±0.00
Control	84.91±2.48	83.07±1.53	80.96±0.09	80.78±0.01	0.37±0.03	0.43±0.03	0.50±0.00	0.52±0.01

Table 2: Effect of storage and avocado% of yoghurt drink in moisture and ash

Table 3: Effect of storage and avocado% of yoghurt drink in fat, total solids and SNF

Treatment	Mean Fat (%)±SD				Mean Total solids (%)±SD				Mean SNF (%)±SD			
	Storage period				Storage period				Storage period			
	0 days	5 days	10 days	15 days	0 days	5 days	10 days	15 days	0 days	5 days	10 days	15 days
8%	3.26±0.05	3.2±0.05	3.16±0.05	2.96±0.05	19.87±0.11	19.54±0.25	17.83±0.24	16.98±0.24	16.61±0.13	16.34±0.25	14.67±0.24	14.01±0.98
10%	3.43±0.05	3.4±0.0	3.3±0.05	3.2±0.0	19.67±0.20	18.69±0.67	17.32±0.54	17.66±0.20	16.24±0.18	15.28±0.59	14.46±0.20	14.02±0.52
12%	3.73±0.05	3.56±0.1	3.36±0.1	3.23±0.05	19.59±0.27	18.80±0.28	17.95±0.56	17.84±0.40	15.86±0.33	15.24±0.23	14.60±0.45	14.58±0.50
14%	3.93±0.05	3.6±0.05	3.6±0.05	3.3±0.1	20.39±0.14	18.61±0.34	17.57±0.46	17.81±0.03	16.46±0.16	15.01±0.34	14.51±0.08	13.97±0.46
Control	2.46±0.05	2.36±0.0	2.13±0.0	2.03±0.0	19.06±0.37	19.19±0.03	17.88±0.28	18.40±0.16	16.82±0.04	16.59±0.33	16.37±0.13	15.74±0.13

Table 4: Comparison of mean ranks of sensory characteristics with treatment

Treatment	Mean sum of ranks				
	Color	Texture	Sweetness	After taste	Overall acceptability
8%	2.86	3	3.06 ^a	3.4 ^a	3.2 ^a
10%	2.63	2.3	2.5 ^b	2.56 ^b	2.56 ^b
12%	2.33	2.56	2.46 ^c	2.2 ^c	2.33 ^c
14%	2.3	2.3	2.06 ^d	1.8 ^d	1.93 ^d

a, b Means within the same column with different superscript differ significantly (p < 0.05)

Yeast & Mold and Coliforms

Yeast & mold counts were mostly absent during the storage. The high yeasts and moulds count could be attributed to contamination from air incorporation

during stirring the different yoghurt treatments. In addition, the post contamination may be occurred in yoghurt samples from different fruit homogenates and during filling the products (El-Batawy M. et al, 2013).

Table 5: TPC of plain drinking yoghurt and avocado drinking yoghurt

Day	Plain Drinking Yoghurt	Avocado Drinking Yoghurt	Probability
	CFU/ml ($\times 10$) (mean \pm SD)	CFU/ml ($\times 10$) (mean \pm SD)	
0 Days	1.49 \pm 0.01	1.29 \pm 0.01	NSD P>(0.3550)
5 Days	2.62 \pm 0.01	2.55 \pm 0.01	NSD P>(0.6507)
10 Days	5.36 \pm 0.05	5.06 \pm 0.01	NSD P>(0.2931)
15 Days	13.86 \pm 0.11	12.16 \pm 0.16	NSD P>(0.1062)

The coliform count was absent, throughout the storage for both samples (Table 06). This can be expected as the pasteurization was used in milk, avocado pulp and water.

Table 06: Yeast & mold and coliform counts

Days	Plain Drinking Yoghurt		Avocado Drinking Yoghurt	
	Yeast & Mold	Coliform	Yeast & mold	Coliform
0	Nil	Nil	Nil	Nil
5	Nil	Nil	Nil	Nil
10	Nil	Nil	NC	Nil
15	Nil	Nil	NC	Nil

NC: Not Considerable

4. Conclusion and Future Recommendation

Avocado addition for yoghurt drink has effected for higher consumer acceptability than plain drinking yoghurt. Additionally avocado drinking yoghurt has more nutritional and therapeutic values than a plain set yoghurt. 8% of avocado addition in drinking/stirred yoghurt has resulted with good quality attributes for consumers. Thus keeping a view of acceptability of the new product, more researches need to be conducted on its shelf life.

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