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PHYSICOCHEMICAL AND SENSORY PROPERTIES OF ICE CREAM PRODUCED USING RAW AND PROCESSED MILK

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Abstract — The present study was carried out to examine the effect of storage period on the physicochemical, sensory quality of Ice cream produced using Raw (Cow and Buffalo milk) and processed milk (Full cream and Standardized milk). Based on the different ratio of milk (Raw 25% cow milk and 75% buffalo milk, 50% cow milk and 50% buffalo milk, 100% cow milk, 100% buffalo milk, 25% buffalo milk and 75% cow milk) and (Processed 25% full cream milk and 75% Standard milk, 50% full cream milk and 50% standard milk, 100% full cream milk, 100% standardized milk, 25% standard milk and 75% full cream milk), the Ice cream is evaluated periodically at intervals of 15 days. According to results obtained, the properties like total solids and acidity of ice cream samples were increased significantly. While, pH and overrun decreased significantly. There are no significant changes occurred in Fat and Protein during storage. The mean sensory score of all Ice cream samples decreased significantly with progress in storage period at $-18 \pm 1^\circ\text{C}$.

Keywords— Ice cream, Raw milk, Processed Milk, Physicochemical, Sensory.

I. INTRODUCTION

Ice cream is a frozen product that is made by pasteurization and mix freezing, which includes milk components, sucrose, dextrose, corn syrup, water, egg and egg products, flavoring components, stabilizer, emulsifier and optionally other components (Kirdar, 2003). Ice cream was eaten in only different seasons by adding some sugar, sherbet, fruit or wine to the ice cream. Today, however, it is an industrial product that contains different food additives and can be consumed in all seasons (Açu, 2014). Due to a number of biochemical variations between Buffalo and Cow milk, traditional processing techniques are often unsuitable and cannot be applied directly to buffalo milk processing. The suitability of buffalo as a milk producer is now becoming more and more important throughout the world. The lack of research and knowledge on this has been a major bottleneck in

maximizing the production capacity of buffaloes. (Khedkar et al., 2016).

Milk is said to be dietary food for human. It is the first food of a newly born human being and of other mammals. It is a food that contains all the nutrients required for a newborn baby, pregnant mothers, patients and elderly people. There is no question that milk and milk products have played a key role in the development of human society and provide most of the essential nutrients in significant quantities than any other single food. It is very important for the growth and development of a newborn child. Milk contains all essential nutrients such as protein, fat, lactose, vitamins and minerals for normal growth and performs different functions for body systems.

Potassium helps maintain blood pressure. Vitamin B12 promotes healthy red blood cells and nerve tissues. Vitamin A is good for the skin and increases immunity.

Full cream milk is recommended for children, adolescents, body builders, pregnant and lactating mothers. Standardized milk is a commodity whose fat and/or non-fat (SNF) content has been standardized to a certain pre-determined amount. Under the PFA Regulations (1976), standardized milk for liquid consumption should contain at least 4.5 per cent of fat and 8.5 per cent of SNF throughout the region.

The study aims to produce ice cream with different ratios of Raw (Cow milk and buffalo milk) and Processed (Full cream and standardized milk) with different ratios as a local flavored and nutritionally supported product and to study the physio-chemical and organoleptic properties of the product.

II. MATERIAL AND METHOD

A. Material

Raw cow and Buffalo milk are purchased from the nearer village, Chidambaram. Processed milk (Full cream milk and standardized milk) are purchased from the local market. The other ingredients like sugar, butter, skimmed milk powder (SMP), Butter, Stabilizer and Emulsifier are purchased from the local market, Chidambaram.

B. Method



Ice cream production was carried in Annamalai University, Food Processing Technology Laboratory. Raw Cow and Buffalo milk are taken in five different ratios and, processed Full cream and standardized cream are taken in five different ratios. The composition of Raw milk is shown in Table 1 and Processed milk is shown in Table 2.

Table 1. Composition of Raw milk

Sample	Composition
A	100% Cow milk
B	75% Cow milk and 25% Buffalo milk
C	50% Cow milk and 50% Buffalo milk
D	75% Buffalo milk and 25% Cow milk
E	100% Buffalo milk

Table 2. Composition of Processed milk

Sample	Composition
A	100% Full cream milk
B	75% Full cream milk and 25% Standardized milk
C	50% Full cream milk and 50% Standardized milk
D	75% Standardized milk and 25% Full cream milk
E	100% Standardized milk

Weighed dry ice cream ingredients were added to milk samples and they were heat treated at 90°C for 10 minutes. Heat treated mixes were cooled to 4°C and stored at this temperature for 24 hours. Ice cream mixtures were frozen by Batch type ice cream machine at -15°C for 15 minutes. After packaging they were stored at -18±1 °C.

Physico-chemical analysis: Moisture, ash, protein and titratable acidity were determined according to AOAC (2000) method. pH of samples was measured using digital pH meter. Overrun of Ice cream was calculated on weight basis using the following formula.

Overrun%

$$= \frac{\text{wt. of ice cream mix} - \text{wt. of ice cream}}{\text{Wt. of ice cream mix}} \times 100$$

Sensory quality: Ice cream samples were evaluated by a semi trained panel of 8 judges for the attributes of texture, flavour, taste and overall acceptability scores on a 9-point hedonic scale (Larmond 1970).

III. RESULT

Some physicochemical properties of ice cream samples that were produced by Raw cow milk and Buffalo milk were

showed at Table 3. Ice cream obtained by 100% Cow milk was defined as A sample, 75% Cow milk and 25% Buffalo milk was defined as B sample, 50% Cow milk and 50% Buffalo milk was defined as C sample, 75% Buffalo milk and 25% Cow milk was defined as D sample and 100% Buffalo milk was defined as E sample.

Table 3. Effect of Storage on Physicochemical properties of Raw milk Ice cream

Ice cream type	Storage period				
	0	15	30	45	60
pH					
A	6.56	6.54	6.51	6.49	6.47
B	6.66	6.65	6.63	6.61	6.60
C	6.76	6.75	6.73	6.72	6.71
D	6.78	6.77	6.75	6.74	6.73
E	6.78	6.77	6.75	6.73	6.72
Overrun					
A	42	41.73	41.59	41.31	40.70
B	45.6	45.12	44.8	44.62	44.38
C	54.9	54.63	54.15	53.46	53.13
D	60.10	59.72	59.63	59.42	59.38
E	61.3	61.19	60.85	60.32	59.90
Total Solids					
A	27.9	28.17	28.52	29.20	29.42
B	29.18	29.72	30.23	30.95	31.13
C	30.61	31.05	31.62	32.10	32.59
D	32.19	32.46	32.90	33.43	34.1
E	37.72	37.96	38.18	38.53	38.97
Titratable acidity					
A	0.19	0.193	0.103	0.195	0.2
B	0.198	0.2	0.212	0.215	0.215
C	0.193	0.194	0.194	0.195	0.196
D	0.195	0.206	0.212	0.218	0.22
E	0.199	0.21	0.214	0.221	0.231
Protein					
A	4.31	4.31	4.32	4.33	4.33
B	4.62	4.62	4.62	4.62	4.62
C	4.82	4.82	4.82	4.83	4.83
D	4.84	4.84	4.84	4.84	4.84
E	5.12	5.12	5.12	5.12	5.12
Fat					
A	4.7	4.7	4.7	4.7	4.7
B	4.92	4.92	4.93	4.93	4.93
C	5.98	5.99	5.99	5.99	5.99
D	6.52	6.52	6.52	6.52	6.52
E	6.9	6.9	6.9	6.9	6.9



Ash					
A	0.75	0.75	0.74	0.73	0.73
B	0.75	0.74	0.74	0.74	0.73
C	0.79	0.79	0.78	0.77	0.76
D	0.89	0.89	0.88	0.87	0.87
E	0.83	0.82	0.82	0.81	0.81

Some physicochemical properties of ice cream samples that were produced by Full cream milk and Standardized milk were showed at Table 4. Ice cream obtained by 100% Full cream milk was defined as A sample, 75% Full cream milk and 25% Standardized milk was defined as B sample, 50% Full cream milk and 50% Standardized milk was defined as C sample, 75% Standardized milk and 25% Full cream milk was defined as D sample and 100% Standardized milk was defined as E sample.

Table 4. Effect of Storage on Physicochemical properties of Processed milk Ice cream

Ice cream type	Storage Period				
	0	15	30	45	60
pH					
A	6.44	6.12	5.93	5.62	5.21
B	6.34	6.11	5.90	5.72	5.32
C	6.44	6.29	5.98	5.42	5.04
D	6.54	6.09	5.84	5.28	4.85
E	6.54	6.11	5.83	5.42	5.15
Overrun					
A	41	40.62	40.17	39.64	39.21
B	44.3	43.82	43.21	42.68	42.18
C	48.6	48.11	47.58	47.10	46.52
D	51.05	50.63	50.21	49.93	49.32
E	53.8	53.21	52.84	52.15	51.84
Total Solids					
A	23.18	23.52	23.96	24.52	25.12
B	23.9	24.52	25.08	25.95	26.54
C	24.6	25.35	24.85	24.02	23.85
D	25.12	24.54	23.66	23.98	23.57
E	26.01	25.64	24.87	24.03	23.72
Titratable acidity					
A	0.216	0.219	0.228	0.234	0.238
B	0.221	0.237	0.239	0.231	0.235
C	0.226	0.235	0.239	0.241	0.242
D	0.23	0.234	0.235	0.237	0.237
E	0.232	0.236	0.238	0.239	0.24
Protein					
A	4.3	4.3	4.31	4.31	4.31
B	4.28	4.28	4.28	4.28	4.29

C	4.31	4.31	4.32	4.32	4.32
D	4.31	4.31	4.31	4.32	4.32
E	4.29	4.29	4.30	4.30	4.30
Fat					
A	6.52	6.52	6.53	6.53	6.53
B	5.98	5.98	5.98	5.99	5.99
C	5.51	5.51	5.52	5.52	5.53
D	4.83	4.83	4.84	4.84	4.84
E	4.31	4.31	4.32	4.32	4.32
Ash					
A	0.7	0.71	0.72	0.73	0.73
B	0.69	0.70	0.70	0.71	0.73
C	0.69	0.69	0.70	0.70	0.70
D	0.68	0.69	0.70	0.70	0.71
E	0.69	0.70	0.71	0.71	0.72

Effect of storage on Physicochemical properties of Raw and Processed milk Ice cream:

Total solids play an important role in the quality of ice cream. Total solid content of all ice cream samples increased significantly during storage period (Table 3 and 4). The elevation in total solids of all ice cream samples may be attributed to the loss of moisture from the samples during storage. Abdullah et al. (2003) stated that there was an increase in total solid content which he analyzed soymilk and skim milk Ice cream. No significant changes occurs in the fat, protein and ash during the storage of the Raw and Processed milk Ice cream.

The acidity of all ice cream samples increased significantly during the storage period while pH value decreased progressively (Table 3 and 4). Due to the the formation of lactic acid by lactic acid bacteria (LAB) and psychrophilic bacteria during storage, the acidity of a product is increased (Murtaza et al. 2004a). The results of this study are similar to those reported by Siddique et al. (1988), Abdullah et al. (2003) and Murtaza et al. (2004a) who found that there was a gradual increase in acidity on storage of ice cream. The pH has a direct effect on the flavour perception of the dairy products (Hegenbert 1991) and a decrease in pH was observed all over the storage period. This was due to increase in titratable acidity of ice cream. The overrun of the Raw and Processed milk Ice cream is seen to be decreased during the storage.

Effect of Storage on Sensory:

The sensory score of the Raw and Processed milk Ice cream was observed for storage period of 15 day interval. There is no big difference observed in the Texture, Flavour, Taste and Overall acceptability. Slightly, there is a difference occurs during the storage. The result of sensory score is shown in the Table 5 and 6.



Table 5. Effect of storage on Sensory analysis of Raw milk Ice cream

Ice cream type	Storage period				
	0	15	30	45	60
Texture					
A	7.9	7.8	7.8	7.9	7.9
B	7.5	7.6	7.6	7.75	7.75
C	7.5	7.55	7.5	7.6	7.6
D	7.6	7.6	7.65	7.65	7.65
E	8.2	8.2	8.25	8.3	8.35
Flavor					
A	7.70	7.54	7.39	7.22	7.05
B	8.25	8.18	8.10	7.93	7.81
C	8.13	8.03	7.93	7.72	7.53
D	8.16	8.08	8.0	7.92	7.63
E	8.3	8.32	8.3	8.21	8.3
Taste					
A	7.7	7.65	7.6	7.65	7.65
B	7.9	7.8	7.8	7.75	7.75
C	7.6	7.63	7.6	7.52	7.55
D	7.53	7.25	7.05	7.05	7.1
E	8.0	7.95	7.95	7.9	7.9
Overall acceptability					
A	8.1	8.05	8.1	8.1	8.0
B	8.15	8.15	8.10	8.10	8.10
C	8.1	8.1	8.12	8.0	8.0
D	8.2	8.15	8.1	8.1	8.1
E	8.2	8.15	8.15	8.15	8.1

Table 6. Effect of storage on Sensory analysis of Processed milk Ice cream

Ice cream type	Storage period				
	0	15	30	45	60
Texture					
A	7.6	7.65	7.65	7.6	7.6
B	7.65	7.7	7.7	7.65	7.6
C	7.7	7.7	7.65	7.65	7.62
D	7.3	7.3	7.25	7.2	7.2
E	7.7	7.6	7.54	7.5	7.5
Flavour					
A	8.0	7.98	7.7	7.64	7.64
B	7.9	7.83	7.79	7.71	7.63
C	7.9	7.86	7.82	7.72	7.7
D	7.95	7.92	7.92	7.90	7.90
E	7.92	7.89	7.83	7.85	7.8
Taste					
A	7.75	7.73	7.73	7.74	7.8

B	7.8	7.83	7.88	7.88	7.86
C	7.83	7.80	7.74	7.62	7.58
D	7.78	7.53	7.28	7.19	7.2
E	8.0	8.1	8.05	8.15	8.15
Overall acceptability					
A	8.1	8.09	7.93	7.84	7.78
B	8.23	8.17	8.06	7.93	7.85
C	8.35	8.23	8.14	7.98	7.57
D	8.38	8.18	7.97	7.58	7.5
E	8.0	7.93	7.76	7.67	7.54

IV. CONCLUSION

Results of this analysis showed that as the storage period progressed, the total solid content of all samples increased due to loss of moisture during ice cream storage although no changes in protein, fat and ash content were observed during this time. Increased acidity of all ice cream samples due to lactic acid growth and decreased pH with improved storage. Reduced overrun resulting in decreased storage capacity. Sensory scores of all ice cream samples have been found to decrease slowly with storage.

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