

Storage Stability of Noni (*Morinda citrifolia*) Incorporated Functional Ice Cream in different Packaging Materials

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Abstract

A study was carried out to prepare health giving noni supplemented ice cream and to develop eco friendly cups using arecanut sheath to utilize it to store the resultant functional ice cream. Different types of ice cream prepared by supplementing noni at 5, 7.5 and 10 % levels. Owing to the deleterious effect of the usage of synthetic plastics, which has been a greater environmental concern, eco friendly cup using areca nut sheath was developed and one rupee was the expense incurred in connection with the cost of production a 100 ml cup. The control ice cream and 7.5% noni supplemented ice cream (which was adjudged as the ideal product based on overall acceptability scores) stored in oxo biodegradable cups as well as in developed arecanut sheath cups at different storage periods i.e. from 0 to 3rd week and subjected to sensory evaluation at weekly interval. There was no significant difference observed in appearance, flavour, sweetness and overall acceptability scores between control ice cream and noni supplemented ice cream in oxo biodegradable cups up to three weeks. Similarly sensory evaluation of control ice cream in developed arecanut sheath cups at different storage period did not show any significant difference in appearance, sweetness and overall acceptability scores. On the other hand, noni supplemented ice cream showed a significant difference in appearance, flavour, sweetness and overall acceptability scores in developed arecanut sheath cups after 2 weeks of storage period. There was a significant difference in the different types of ice cream in microbial analysis and noni supplemented ice cream showed reduction in both standard plate count and coliform count which can be attributed to the antimicrobial property of the noni.

Keywords: Functional Ice cream, Noni, packaging material, storage stability

Ice cream is very popular among all sections of the people because of the food and health aspects ranging from 'taste delight to nutrient delivery'. Ice cream is a delicious, nutritious, healthful frozen dairy product and is composed of milk ingredients, sugar, stabilizer and emulsifiers with colouring and flavouring agents (De 1980). A typical compositional range for the components used in ice cream mix are 10-16% milk fat, 9-12% milk solids not fat, 9-12% sucrose, 0-0.5% stabilizers/emulsifiers, 36-45% total solids and 55-64% water (Goff, 1997).

Now-a-days, most of the consumers of today prefer food products with therapeutic value for their health benefits over their taste. Increased consumer interest in improving overall health and reducing risk for specific diseases has fuelled the demand for functional foods that provide health benefits beyond their traditional nutritional value (IFICE, 2007 & 2008).

Noni, the traditional fruit (commonly known as Noni, Great morinda, Indian mulberry, beach mulberry)

contains numerous phytochemicals, antioxidants, vitamins and micro and macronutrients has been used as a health solution to all the disease. Noni juice is the fastest growing health product in the world today and contains a unique blend of phytonutrients, selenium and proxeronine. Proxeronine is the basic building block of body immune system and noni fruit is vested with highest content of proxeronine. Noni is used as food supplement to treat health conditions such as arthritis, tumour and cancer besides various allergies and asthma (Shah and Gupta, 2006). Apart from this, about 160 phytochemical compounds have been already identified in the noni plant.

Noni is non-conventional under-utilized product fruit much valued in today's emerging overly healthy conscious societies for its therapeutic health enhancing attributes like antibacterial, anti-inflammatory, analgesic and anti-congestive properties. Noni and its products are used as a health cure against high blood pressure, respiratory problems and immune deficiencies (Shah and Gupta, 2006). In this study, an attempt has been made to incorporate *Morinda citrifolia* to Ice cream and to assess the storage stability of the product in the different eco friendly packaging cups.

MATERIALS AND METHODS

The study was carried out in the Model Dairy Plant, Department of Dairy Science, Veterinary College and Research Institute, Namakkal-637 002. All the ingredients including Noni extract were procured from the local market.

Preparation of Noni supplemented Ice cream

Noni supplemented ice cream mixes were prepared by pasteurizing (68° C for 30 min) a mix containing skim milk, cream, skim milk powder, sugar, stabilizer and emulsifiers. Ice cream was prepared by supplementing noni fruit at 5, 7.5 and 10 per cent levels. The mixes were then homogenized at 2000/500 psi and ice cream mix was kept for ageing at 4° C for 4 hours and for freezing at -4° C. After packing the ice cream were kept for hardening and storage at -23° C.

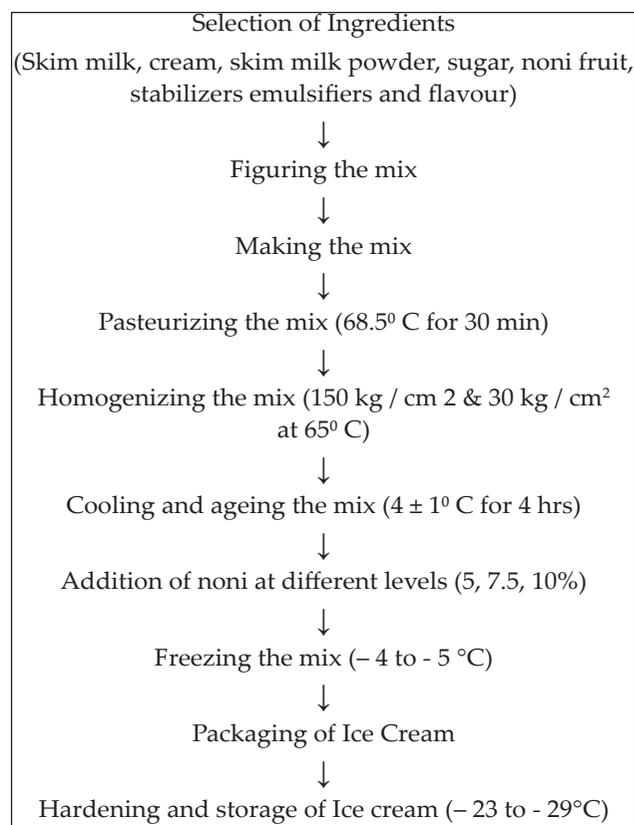


Fig. 1: Flow chart for the preparation of treatment ice cream

The noni was supplemented at different levels as follows:

1. NSIC 1 -Ice cream mix with supplementation of 5% noni
2. NSIC 2 -Ice cream mix with supplementation of 7.5% noni
3. NSIC 3 -Ice cream mix with supplementation of 10% noni.

Ice cream prepared without supplementing noni was kept as a control and designated as CIC.

Procedure for making the areca nut sheath cups

Areca nut sheaths were immersed in cold water for about 20 minutes and using a brush rubbed thoroughly in order to remove soil and dust particles. And to make it clean and sheaths were dipped in good quality water and air dried. Then by applying

pressure over the thoroughly cleaned dust free areca nut sheaths using an Aluminum die designed for the purpose, in an electrically operated machine for about 30 seconds, the bottom and lid of the cups were prepared and the edges were smoothed by using a grinding machine. The coating is used for the prepared arecanut sheath cups to retain their stability because the cups are hygroscopic and easily destroyed or collapsed by the water. So paraffin wax or lacquer (epoxy lacquer) was used as a coating material for the cups.

Microbial analysis of noni supplemented ice cream

The total bacterial and coliform counts were estimated as per method described in IS: 1479 (part III)-1977. The storage studies were carried out for the prepared ice cream in different eco friendly packaging cups. The control ice cream without addition of noni and the noni supplemented ice cream with addition of 7.5% of noni were taken in oxobiodegradable as well as in the developed areca nut sheath cups.

The data were subjected to statistical analysis by means of one way and two way analysis of variance (ANOVA) as per the procedure given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Storage studies at different storage period in different eco friendly packaging cups

Table 1, 2, 3 and 4 show the mean \pm SE scores of appearance, flavour, body and texture and overall

acceptability respectively of different ice cream (CIC and NSIC) during 0, 1, 2 and 3 weeks of storage period in different eco friendly packaging cups (OBDC and DASC) at -23° C and their analysis of variance.

The appearance scores of noni supplemented ice cream were reduced in oxobiodegradable cups after 2 weeks of storage period. And also the appearance score of the control ice cream were reduced cups after 2 weeks of storage period in developed areca nut sheath cups. The appearance score of the noni supplemented ice cream were reduced after 2 week of storage period in developed areca nut sheath cups.

The flavour scores of noni supplemented ice cream were not changed in oxobiodegradable cups upto 3 weeks of storage period. And the flavour scores of the control ice cream were not changed upto 3 weeks of storage period in developed areca nut sheath cups. The flavour scores of the noni supplemented ice cream were reduced cups after 2 weeks of storage period in developed areca nut sheath cups.

The Body and texture scores of noni supplemented ice cream were reduced in oxobiodegradable cups after 2 weeks of storage period. And the Body/Texture score of the control ice cream were reduced cups after 2 weeks of storage period in developed areca nut sheath cups. The Body/Texture score of the noni supplemented ice cream were reduced cups after 1 week of storage period in developed areca nut sheath cups.

Statistical analysis indicated that there was highly significant ($P \leq 0.01$) difference with reference to

Table 1: Appearance scores of ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Appearance score of ice cream at different storage period (Mean \pm SE) [@]				F value
	0 week	1 week	2 weeks	3 weeks	
T1	8.333 ^a \pm 0.333	8.333 ^a \pm 0.211	8.167 ^a \pm 0.365	7.667 ^a \pm 0.333	17.05**
T2	8.167 ^a \pm 0.307	8.167 ^a \pm 0.477	7.833 ^a \pm 0.307	7.333 ^b \pm 0.307	
T3	8.500 ^a \pm 0.211	8.500 ^a \pm 0.333	8.333 ^a \pm 0.333	7.500 ^b \pm 0.343	
T4	8.500 ^a \pm 0.342	8.333 ^a \pm 0.207	8.167 ^a \pm 0.308	7.333 ^b \pm 0.333	
F value	1.74 ^{NS}				

[@]Average of six trials (different superscript in a row differ significantly); ** highly significant; ^{NS} not significant; T1 - Control ice cream in Oxo biodegradable cups; T2 - Control ice cream in Developed areca nut sheath cups; T3 - Noni supplemented ice cream in Oxo biodegradable cups; T4 - Noni supplemented ice cream in Developed arecanut sheath cups.

Table 2: Flavour scores of ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Flavour scores of ice cream at different storage period (Mean ± SE) [@]				F value
	0 week	1 week	2 weeks	3 weeks	
T1	8.167 ^a ±0.477	8.000 ^a ±0.365	7.833 ^a ±0.167	7.667 ^a ±0.307	10.46 ^{**}
T2	8.000 ^a ±0.365	7.833 ^a ±0.167	7.667 ^a ±0.211	7.333 ^a .410	
T3	8.167 ^a ±0.307	8.167 ^a ±0.477	8.000 ^a ±0.365	7.667 ^a ±0.211	
T3	8.333 ^a ±0.333	8.000 ^a ±0.365	7.867 ^a ±0.428	6.833 ^b ±0.307	
F value	1.79^{NS}				

[@]Average of six trials (different superscript in a row differ significantly); ^{**} highly significant; ^{NS} not significant.

Table 3: Body and texture scores of ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Body and texture scores at different storage periods period (Mean ± SE) [@]				F value
	0 week	1 week	2 weeks	3 weeks	
T1	8.500 ^a ±0.224	8.500 ^a ±0.365	8.333 ^a ±0.495	8.000 ^a ±0.365	11.26 ^{**}
T2	8.333 ^a ±0.333	8.167 ^a ±0.307	7.833 ^a ±0.307	7.500 ^a ±0.307	
T3	8.833 ^a ±0.333	8.500 ^a ±0.211	8.167 ^a ±0.307	7.333 ^b ±0.495	
T4	8.667 ^a ±0.211	8.667 ^a ±0.307	8.000 ^b ±0.307	6.667 ^c ±0.333	
F value	1.18^{NS}				

[@]Average of six trials (different superscript in a row differ significantly); ^{**} highly significant; ^{NS} not significant.

Table 4: Overall acceptability scores of ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Overall acceptability scores at different storage periods (Mean ± SE) [@]				F value
	0 week	1 week	2 weeks	3 weeks	
T1	8.500 ^a ±0.224	8.500 ^a ±0.342	8.333 ^a ±0.333	8.167 ^a ±0.307	12.74 ^{**}
T2	8.167 ^a ±0.307	8.167 ^a ±0.477	7.833 ^a ±0.307	7.333 ^a ±0.333	
T3	8.667 ^a ±0.211	8.333 ^a ±0.307	8.167 ^a ±0.307	7.000 ^b ±0.365	
T4	8.333 ^a ±0.333	8.167 ^a ±0.407	7.833 ^a ±0.307	6.833 ^b ±0.307	
F value	3.56^{NS}				

[@]Average of six trials (different superscript in a row differ significantly); ^{**} highly significant; ^{NS} not significant.

the storage periods and there was no significant (P>0.05) difference between the different eco-friendly packaging cups for both the control as well as treatments.

The overall acceptability scores of noni supplemented ice cream were reduced in oxobiodegradable cups after 2 weeks of storage period. And the overall acceptability scores of the control ice cream were reduced cups after 2 weeks of storage period in

developed arecanut sheath cups. And also the overall acceptability score of the noni supplemented ice cream were reduced cups after 2 weeks of storage period in developed areca nut sheath cups.

These sensory evaluation findings were closely associated with the findings of the Palich (1994) and Mahran *et al.* (1987). According to Palich (1994), with the passage of time, sensory quality of ice cream deteriorated. Organoleptic properties of the ice

cream decreased with increase in storage time and temperature (Mahran *et al.* 1987).

Microbial analysis of the noni supplemented ice cream

Ice cream supplemented with different levels of noni were analyzed for bacteriological quality and the results are presented in Table 5 and 6.

Standard plate count

Table 5 shows the mean \pm SE of standard plate count of different ice cream (CIC and NSIC) during 0, 1, 2 and 3 weeks of storage period in different eco friendly packaging cups (OBDC and DASC) at -23° C and their analysis of variance. Statistical analysis shown that with regard to control as well as treatments, there was no significant ($P > 0.05$) difference with reference to the storage periods and also there was no significant ($P > 0.05$) difference between different eco friendly packaging cups.

The standard plate count of the noni supplemented

ice cream were reduced and increased gradually in the second week of storage period. This is due to the effect of noni fruit which has the antimicrobial property in nature Locher *et al.* (1995) reported that an acetonitrile extract of the dried fruit inhibited the growth of *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Escherichia coli*, and *Streptococcus pyrogene*.

Coliform count

Table 6 shows the mean \pm SE of coliform count of different ice cream (CIC and NSIC) during 0, 1, 2 and 3 weeks of storage period in different eco friendly packaging cups (OBDC and DASC) at -23° C and their analysis of variance. Statistical analysis indicated that there was no significant ($P > 0.05$) difference with reference to the storage periods as well as between the different eco friendly packaging cups in both control and noni incorporated ice cream.

In this study the coliform count in the ice cream were reduced gradually upto 2 weeks and then the

Table 5: Standard plate count of the ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Standard plate count of the ice cream at different storage periods (Mean \pm SE) [@] (log ₁₀ cfu/g)				F value
	0 week	1 week	2 weeks	3 weeks	
T1	5.300 \pm 0.173	5.325 \pm 0.133	5.314 \pm 0.037	5.338 \pm 0.059	2.83 ^{NS}
T2	5.316 \pm 0.0120	4.867 \pm 0.096	4.790 \pm 0.042	5.153 \pm 0.014	
T3	5.314 \pm 0.098	4.863 \pm 0.096	4.837 \pm 0.136	5.204 \pm 0.018	
T4	5.318 \pm 0.138	5.344 \pm 0.546	4.806 \pm 0.045	5.345 \pm 0.137	
F value	3.72^{NS}				

@Average of six trials; ^{NS}-Not significant.

Table 6: Coliform count of the ice cream at different storage period in different eco friendly packaging cups

Different types of ice cream in different types of packaging materials	Coliform count of the ice cream at different storage periods (Mean \pm SE) [@] (log ₁₀ cfu/g)				F value
	0 week	1 week	2 weeks	3 weeks	
T1	1.843 \pm 0.196	1.904 \pm 0.098	1.844 \pm 0.241	1.983 \pm 0.136	2.64 ^{NS}
T2	1.902 \pm 0.085	1.983 \pm 0.193	1.897 \pm 0.020	2.004 \pm 0.082	
T3	1.845 \pm 0.132	1.301 \pm 0.234	1.602 \pm 0.081	1.703 \pm 0.128	
T4	1.904 \pm 0.983	1.305 \pm 0.286	1.700 \pm 0.134	1.782 \pm 0.235	
F value	4.75*				

@ -Average of six trials; * - Significant; ^{NS}-Not significant.

count were increased third week of storage because of the antimicrobial effect of the noni fruit in the ice cream. Dittmar (1993) have reported a significant antimicrobial effect on different strains of *Salmonella*, *Shigella*, and *E. coli*.

CONCLUSION

Functional ice cream was prepared by incorporating different levels (5, 7.5 and 10 %) of Noni and stored at different packaging materials including eco friendly cups using arecanut sheath to study storage stability. The control ice cream and 7.5% noni supplemented ice cream stored in oxo biodegradable cups as well as in developed eco friendly arecanut sheath cups at different storage periods upto 3 weeks and subjected to sensory evaluation. There was no significant difference observed in appearance, flavour, sweetness and overall acceptability scores between control ice cream and noni supplemented ice cream in oxo biodegradable cups up to three weeks. On the other hand, noni supplemented ice cream showed a significant difference in appearance, flavour, sweetness and overall acceptability scores in developed arecanut sheath cups after 2 weeks of storage period. There was a significant difference in the different types of ice cream in microbial analysis and treatment showed reduction in both standard plate count and coliform count which can be attributed to the antimicrobial property of the noni. Hence, owing to its low cost and eco friendly nature, scaling up of the developed arecanut sheath cup for wide scale application and usage at industrial level is definitely a good proposition.

REFERENCES

- De, S. 1980. *Outlines of Dairy Technology*. Oxford university press. India. First Edn, pp. 98-101.
- Dittmar, A. 1993. *Morinda citrifolia* L.—Use in indigenous Samoan medicine. *Journal of Herbs, Spices and Medicine Plants*, **1**: 77–92.
- Goff, H.D. 1997. Colloidal aspects of ice cream—A review. *Int. Dairy J.*, **7**: 363–73.
- IFIC. International Food Information Council Foundation. Consumer Attitudes toward Functional Foods/Foods for Health. Washington, D.C.: IFIC. <http://ific.org>. 2007.
- IFIC. International Food Information Council Foundation. Food & Health Survey. Consumer Attitudes toward Food, Nutrition & Health. Washington, D.C.: IFIC. <http://ific.org>, 2008
- IS-Bureau of Indian standards: IS: 1479 (Part III) 1977. Specification for ice cream reaffirmed.
- Locher, C.P., Burch, M.T., Mower, H.F., Berestecky, H. Davis, H., Van Polel, B., Lasure, A., Vander Berghe, D.A., Vlieti-Nick, A.J. 1995. Anti-microbial activity and anti-complement activity of extracts obtained from selected Hawaiian medicinal plants. *Journal of Ethnopharmacology*, **49**: 23–32..
- Mahran, G.A., El-Alomy, H.A., El-Bagoury, E.H. and Sayed, A.F. 1987. Effect of storage temperature of milk fat on ice cream quality. *Egyptian J. Food Sci.*, **15**: 65–73 (Food Sci. Tech. Abstr., **20**: 83; 1988).
- Marshall, R.T. 1991. Fat in ice cream. *Dairy Field.*, **74** : 32.
- Palich, P. 1994. Study of changes in quality of ice cream during storage. *Chlodnictwo*, **29**: 21–5 (*Food Sci. Tech. Abstr.*, **27**: 109; 1995).
- Shah, A. and Gupta D.K. Das. 2006. Nutritional significance and health benefits of value added products derived from *Morinda citrifolia* (Indian Noni) – An overview.
- Defence Food Research Lab, Siddartha Nagar, Mysore- 570 011.
- Snedecor, G.W. and Cochran, W.G. 1994. *Statistical methods*. Eighth edition, IOWA State University press. USA.