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Analysis of Physico-Chemical Properties of Fortified Beverage during Storage

R. Navarasam[1*], Ayyavoo Preamnath Manoharan[2], V. Appa Rao[3], T.R. Pugazhenthi[4] and K. Senthilkumar[5]
[1]Ph.D Scholar, Food Technology, College of Food and Dairy Technology, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Koduvalli, Chennai (Tamil Nadu), India.
[2]Professor and Head, Chairman, Department of Food Process Engineering, College of Food and Dairy Technology (TANUVAS), Koduvalli, Chennai (Tamil Nadu), India.
[3]Dean, Faculty of Food Sciences, Advisory Committee Member, College of Food and Dairy Technology (TANUVAS), Koduvalli, Chennai (Tamil Nadu), India.
[4]Professor, Advisory Committee Member, Department of Livestock Products Technology (Dairy Science), Madras Veterinary College (TANUVAS), Vepery, Chennai (Tamil Nadu), India.
[5]Assistant Professor and Section Head, Advisory Committee Member, Pig Breeding Unit, Post Graduate Research Institute in Animal Sciences, Kattupakkam (Tamil Nadu), India.

(Corresponding author: R. Navarasam)*
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ABSTRACT: The research was undertaken to study the physico-chemical properties of fortified beverage during the storage period. Micronutrient deficiency referred to as 'Hidden hunger' is a huge burden in terms of social, health and economic aspects. Although fruit and vegetables are capable of sufficing this need, it is difficult for the Indian population to diversify the diet on a regular basis. Moreover, No single food contains all of the vitamins and minerals we need and, therefore, a balanced and varied diet is necessary for an adequate intake of all micronutrients. To combat hidden hunger, fortified beverage is developed. Fortified beverage was prepared by incorporating the fortificants from natural source namely carrot juice (15%), moringa juice (5%), irradiated mushroom juice (6%), dates juice (2%) and seaweed juice (1%) into skim milk. Carrots are good source of beta carotene. Based on sensory analysis sugar level was optimized and added into fortified beverage. The changes in the physico-chemical properties such as pH, titratable acidy, total soluble solids, total solids and viscosity of fortified beverage were analyzed during the storage period of 0, 30, 60, 90, 120th day at ambient temperature. Statistical analysis revealed that there was a highly significant difference between the control (unfortified beverage) and treated (fortified beverage) samples. From the results obtained, the shelf life of the fortified beverage was found to be 120 days.

Keywords: Fortified beverage, Micro-nutrients, Natural resources, Physico-chemical properties, Storage study.

INTRODUCTION

Around the world, it is estimated that more than two billion people suffer from 'hidden hunger' or micronutrient deficiency (Abeshu and Geleta, 2016) with nearly half living in India. It is reported that widespread (>80% total Indian population) risk of deficiencies in calcium, vitamin A, vitamin B_{12}, folate with more localized deficiencies (<25% population) in iron, zinc, and vitamin B_6. Micronutrients comprised of vitamins and minerals which are required in small quantities to ensure normal metabolism, growth and physical well-being (Lukaski, 2004). As fruits and vegetables are good sources of many essential micronutrients that are under consumed, including iron, dietary fiber, vitamin C, vitamin A, folate (folic acid), calcium, zinc etc. they could be supplement to alleviate the micronutrient-malnutrition. Beta carotene is precursor of vitamin A which is regarded as important for combating vitamin A deficiency (VAD) (Fratianni *et al*. 2010). Carrot juice is rich in functional food components such as vitamins (A, D, B, E, C, and K) and minerals, (calcium, potassium, phosphorus, sodium, and iron). It has been noted that 100 g of carrot contains between 6 mg and 15 mg of carotenoids, mainly β-carotene (2-10 mg). Analysis of Moringa juice has revealed that the level of provitamin A in carrot made a positive impact on the moringa juice by increasing the total amount of the provitamin A to 6.64 g/100 g (Out *et al*., 2013). Date consumption is an important source of supplying vitamin and mineral in a balanced nutrition regime (Al-Shahib and Marshall 2003).

Chemical composition showed that the flesh of dates has good nutritional value, based on its dietary fibers, minerals, vitamins, natural antioxidants, and other bioactive compounds (Elleuch *et al*., 2008).

Most importantly, People in the developing countries like India could not afford to diversify their diet with adequate amounts of fruits, vegetables and animal sources of food containing micronutrients and hence deficiencies are inevitable also micronutrient deficiencies are unnoticed within the community.

On the other hand, not all the fruits and vegetables are fully processed and properly utilized due to the lack of processing techniques and unavailability of processing equipment. Since, India is the number one milk producer (198.4 million tonnes) and second largest producer of fruits and vegetables (132.03 million metric tonnes), estimated in 2019-2020 all over country and so milk based fortified beverage was developed with fruits and vegetables to meet out the consumer demand as well as effective utilization of natural resources. Keeping with all these needs, the research was carried out to develop a long-lasting fortified beverage with natural sources and the changes in physico-chemical properties such as pH, titratable acidity, total soluble solids, total solids and viscosity of fortified beverage during their storage also were analyzed to provide the knowledge of product quality and consumer acceptability.

MATERIAL AND METHODS

A. Materials

Skim milk (0.5% fat and 8.7% SNF), carrot juice (15%), moringa juice (5%), irradiated mushroom juice (6%), dates juice (2%) and seaweed juice (1%) were the core ingredients of fortified beverage. There were no chemicals or synthetic agents added during preparation and preservation of fortified beverage. The utensils and glasswares used were thoroughly sterilized before and after the production of fortified beverage. The flowchart for the preparation of fortified beverage is given in the Fig. 1 and Fig. 2. differentiates the fortified and unfortified beverage.

B. Methodology

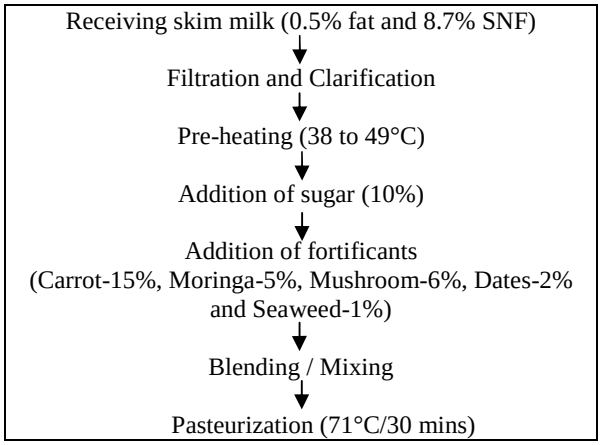

Fig. 1. Flow chart for the preparation of fortified beverage.

Fig. 2. Fortified Beverage Vs. Unfortified Beverage.

C. Physico-chemical properties of fortified beverage

(i) pH. pH meter was calibrated with commercial buffer solutions at pH 9.1 and 4.0 before measurement. pH meter was inserted in the sample and pH was recorded after stabilization (AOAC, 2000).

(ii) Titratable acidity. Titratable acidity of the fortified beverage was determined by visual titration method (Ranganna, 1986) and expressed in percentage.

(iii) Total soluble solids. The total soluble solids (TSS) content of fortified beverage was determined at ambient temperature (28±2°C) by digital Refractometer. Total soluble solids were expressed in ^{o}Brix (Ranganna, 1986).

(iv) Total solids. The total solid content (%) of fortified beverage was calculated by (AOAC, 2006) using the formula:

"Total Solids " ("%")" = 100-Moisture content"

(v) Viscosity. Viscosity of the fortified beverage was measured with a Rotational Viscometer using Spindle #3 (Ahlawat, 2007).

(vi) Statistical Analysis. The data collected on various parameters were analyzed as per the standard method described by Snedecor and Cochran (1994). The analysis of variance (two-way ANOVA) was used to study the significant difference by IBM SPSS® 20.0.

RESULTS AND DISCUSSION

A. pH

The fortified beverage contained the average pH values on storage period of 0, 30, 60, 90 and 120th day were 6.65, 6.62, 6.60, 6.59 and 5.95 and the corresponding values for fortified beverages were 6.53, 6.48, 6.48, 6.35 and 6.33 respectively. The figure 3.shows the pH values of fortified beverage and control during storage

period. From the figure, it was understood that pH of both the control and fortified beverage were decreased during the storage period under ambient temperature. The reduction in the pH was not affect the product quality and consumer acceptance as well till the end of storage period. The result was on par with Shukla *et al.* (2018) who had studied the sterilized milk based mango beverage and found out that the decrease in pH throughout the storage studies.

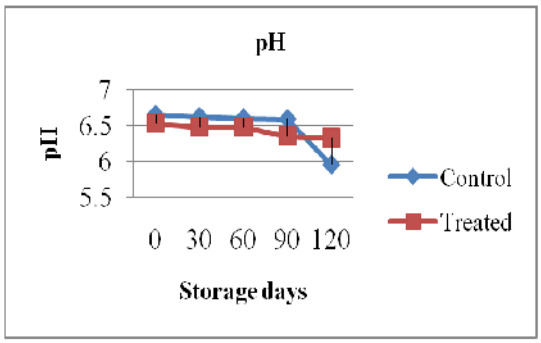

Fig. 3. pH of control and fortified beverage.

B. Titratable acidity

The mean titratable acidity of fortified beverage and control on storage period is represented in figure 4. The mean±SE titratable acidity values of fortified beverage and control during storage of 0 day were 0.144±0.000 and 0.140±0.000; 30th day were 0.146±0.000 and 0.143±0.000; 60th day were 0.148±0.000 and 0.145±0.000; 90th were day 0.153±0.000 and 0.150±0.000 and 120th day were 0.156±0.000 and 0.154±0.000 respectively. From the data obtained from analysis, it may be noticed that there was gradual increase of titratable acidity in both fortified beverage and control sample and thus the increase in acidity was directly proportional with storage days. Shukla *et al.* (2018); Shukla *et al.* (2003) were observed the increase in acidity of sterilized milk based beverage throughout the storage studies**.**

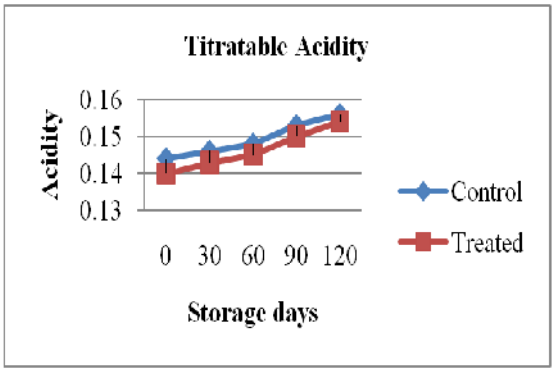

Fig. 4. Titratable acidity of control and fortified beverage**.**

C. Total soluble solids (TSS)

The figure 5.represents the average TSS values of fortified beverage and control during storage interval of 0, 3, 60, 90 and 120 days. The mean TSS values of control and fortified beverage increased gradually during storage period. The average values of fortified beverage increased from 16.87 to 18.90 storage periods of 120 days and the corresponding values for control were form 15.53 to 17.03. It was found that the increase in storage period increases TSS values of fortified beverage and control sample. The statistical analysis revealed that there was a highly significant difference between the fortified beverage and control over the storage period of 120 days at ambient temperature. The increasing trend of total soluble solids in the storage of functional beverage was reported by Randhawa *et al.* (2013).

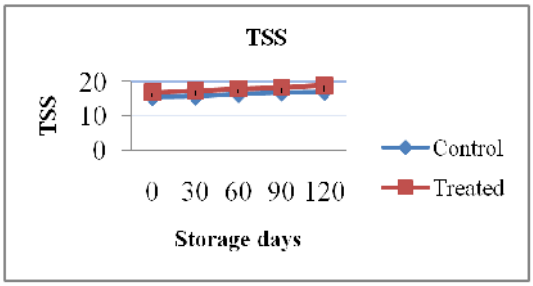

Fig. 5. Total soluble solids of control and fortified beverage.

D. Total solids

The mean±SE total solids of control and fortified beverages during storage intervals of 0, 30, 60, 90 and 120th day obtained were 9.82±0.10 and 13.30±0.11; 9.76±0.04 and 13.23±0.08; 9.56±0.042 and 13.30±0.05; 9.73±0.05, 13.03±0.042; and 9.37±0.042 and 12.78±0.05 respectively. Figure 6.shows the average total solids of control and fortified beverages during storage period at ambient temperature. From the data analysis, it was clearly understood that decrease in the total solids of fortified beverage was indirectly proportional to the successive storage days. The similar effect was obtained by Mittal and Bajwa (2014).

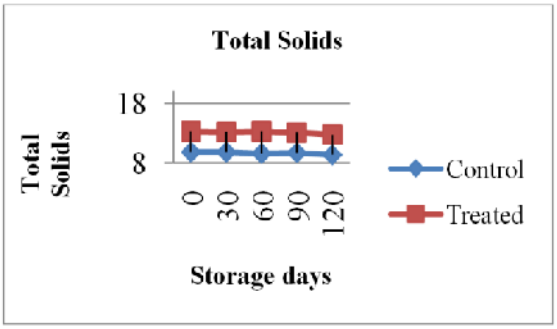

Fig. 6. Total solids of control and fortified beverage.

E. Viscosity

Fig. 7 differentiates the average viscosity of control and fortified beverages during storage period at ambient temperature. The average viscosity of control and fortified beverages during storage intervals of 0, 30, 60, 90 and 120th day obtained were 1.6 and 1.67; 1.58 and 1.61; 1.21 and 1.53; 1.16 and 1.51 and 1.07 and 1.29 respectively. Statistically it was understood that there was significant difference found between the control and fortified beverage among the successive intervals of storage period. The result was in accordance with Shukla *et al.* (2018); Mittal and Bajwa (2014) who were found out the decrease in viscosity indirectly proportional with the successive storage intervals.

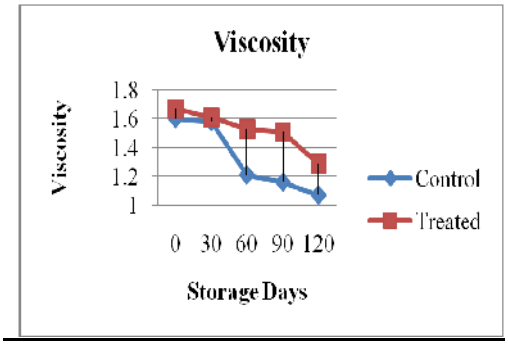

Fig. 7. Viscosity of control and fortified beverage.

CONCLUSION

This research work found out the way for the effective utilization of natural resources using staple food. The fortificants / ingredients used in this study were of natural origin and no artificial agents were added. The fortification technology applied is the recent and cost effective method to satisfy the need of ultimate consumer. The micro-nutrients such as vitamins and minerals fortified milk based beverage have been delivered positive results from this research. The nutritionals aspect of fortified beverage was greater than the unfortified beverage. From the storage study the developed fortified beverage could be stored for more than five months at ambient temperature without loss in their quality.

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Conflict of Interest. None.

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