ISSN 2319-6432 (Print)
ISSN 2349-6433 (Online)

J Krishi Vigyan 2024, 12(4) : 865-871

DOI : 10.5958/2349-4433.2024.00149.2

Impact of Sensory Attributes in Protein Enriched Ready to Serve Papaya - Beverage during Storage

K P Sivakumar[1] K Jothilakshmi[2*], E Subramanian[3], Saravanan[4] and J Selvi[5]
Krishi Vigyan Kendra, Madurai – 625 104, Tamil Nadu, India

ABSTRACT

This study investigated the development and assessment of a protein-fortified ready-to-serve (RTS) beverage from papaya juice, enriched with milk and soy protein isolates. Different proportions of milk protein isolate (MPI) and soy protein isolate (SPI) were used to enhance the protein content. Among the formulations tested, the RTS beverage with 5% milk protein isolate and 10% soy protein isolate resulted in the highest sensory acceptability. Throughout a 60d storage period in PET bottles at room temperature, no microbial spoilage was observed, indicating good shelf stability. Sensory quality parameters, such as appearance, colour, flavour, taste and overall acceptability remained basically unaffected by the protein levels even as slight increases in titratable acidity and total soluble solids (TSS) were observed, alongside a reduction in pH, ascorbic acid, and protein content. Final protein levels in the RTS beverage were 4.7 g/100 ml for the 5% MPI formulation and 9.8 g/100 ml for the 10% SPI formulation. These results support the feasibility of commercially producing protein-fortified papaya RTS beverages are offering an innovative and nutrient-enriched option for consumers.

Key Words: Milk protein isolates, Papaya, Protein enrichment, RTS, Sensory attributes Soybean protein isolates.

INTRODUCTION

Fruit juices occupy an unique position among those product classified as beverages. Pure fruit juices, being a source of energy, phytonutrients, vitamins, and minerals are not only indispensable for maintaining health but also considered as the beverages of refreshment, which quench thirst and encourage liquid intake. They are becoming popular due to their pleasing flavour and nutritional characteristics. They contribute significantly to the vitamins especially vitamins A and C and minerals including potassium, magnesium, and calcium of the diet. They additionally contain antioxidants and phytochemicals, which have been shown to help safeguard human cells from oxidative damage. However, fruit juices are commonly low in protein. This intrinsic lack of protein in juices can be adjusted by adding a protein-rich substance that has no effect on the colour or flavour (Agarwal and Kumar, 2017).

The fortification must be such that it is highly consumed and preferred by the consumers and there is a great demand in the market. Since the demand for fruit juices in the market is increasing every year, this trend may be exploited by developing protein-enriched fruit juice beverages, as consumers are becoming increasingly conscious of how diet is linked to a healthy lifestyle. Multiple fruit juices or pulps can be mixed in different ratios to produce nectars, ready-to-serve drinks, and more. Combining juices can boost the aroma, taste, and health benefits of the beverage. Moreover, mixing can lead to the creation of new products, like a natural health drink that could also function as an appetizer.

Corresponding Author's Email - jothilakshmi.k@tnau.ac.in
1Assistant Professor (Food Science and Nutrition), CSC&RI, Madurai – 625 104, Tamil Nadu, India
2*Assistant Professor , (Food Science and Nutrition)
3 Programme Coordinator
4 Assistant professor (Veterinary and Animal Science),
5 Assistant Professor (Food Science and Nutrition), Krishi Vigyan Kendra, Thirupathisaram – 629 901, Tamil Nadu, India

Table 1. Standardization of milk and soy protein isolate enriched Papaya RTS.

Treatment combinations
T_0 - Papaya fruit juice 100%
T_1 M - Papaya fruit juice (95%) + Milk protein isolate (5%)
T_2 M - Papaya fruit juice (90%) + Milk protein isolate (10%)
T_3 M - Papaya fruit juice (85%) + Milk protein isolate (15%)
T_4 S - Papaya fruit juice (95%) + Soy protein isolate (5%)
T_5 S - Papaya fruit juice (90%) + Soy protein isolate (10%)
T_6 S - Papaya fruit juice (85%)+ Soy protein isolate (15%)

Figure 1. Protein isolate enriched Papaya RTS in PET bottles

Papaya (*Carica papaya* L.) is well known for its exceptional nutritional and medicinal properties throughout the world. Since ancient times, every part of the papaya plant, including its leaves, seeds, ripe and unripe fruits, and their juice is used as a traditional medicine (Sindumathi *et al*, 2017). Nowadays, Papaya is considered as a nutraceutical fruit due to its multi-faceted medicinal properties. Phytochemically, the whole plant contains enzymes (Papain), carotenoids, alkaloids, monoterpenoids, flavonoids, minerals, and vitamins. However, the protein content of papaya is only 0.3%. (Akathsingh *et al,* 2010). Hence, the present experiment was aimed to develop and standardise protein enriched Papaya RTS using milk and soy protein isolates. The sensory attributes and nutrient content of highly accepted protein-enriched Papaya RTS was analyzed during the storage period.

MATERIALS AND METHODS

Standardization of protein enriched Papaya RTS

This study was carried in Laboratory of Food Science and Nutrition Department, Community Science College and Research Institute, Madurai. The fresh, uniform size matured papaya was procured from the wholesale fruit market and used for experimentation. The chosen fruits were thoroughly washed with tap water to remove any dust particles from their surfaces before being used for experimentation. Papaya juice was extracted using a mixer blender and juice was filtered. Filtered juice was used to standardize Papaya ready to serve beverage. Commercially available food-grade milk protein isolate and soy protein isolate were purchased from the local market and used to enrich the Papaya juice at definite proportions (Figure 1). The details of the treatments are as presented in table 1.

Organoleptic evaluation of protein enriched Papaya RTS

Data related to the effect of recipe and treatment combination and sensory attributes such as appearance, colour, flavour, taste, and overall acceptability of RTS were organoleptically evaluated by a panel of untrained judges following 9-point hedonic scale (Balaswamy, 2011).

Shelf-life studies and nutritional quality assessment of protein enriched Papaya RTS

The sensory characteristics of protein

Table 2. Sensory characteristics of developed protein enriched Papaya RTS.

Treatment	Appearance	Colour	Flavour	Taste	Overall acceptability
T_0	9.0	9.0	7.9	7.9	8.5
T_1 M	8.7	8.7	8.7	8.7	8.7
T_2 M	8.7	8.6	8.6	8.6	8.6
T_3 M	8.5	8.5	8.6	8.6	8.5
T_4 S	8.3	8.4	8.4	8.4	8.4
T_5 S	8.2	8.3	8.5	8.5	8.3
T_6 S	7.9	7.6	8.3	8.3	8.1
CD (0.05)	0.19	0.16	0.17	0.17	0.28
SEd	0.09	0.08	0.08	0.08	0.13

Table 3. Effect of treatments on appearance attribute of protein enriched Papaya RTS during storage.

Treatment	Storage periods (days)		
	Initial	30	60
T_0	9.0	8.9	8.9
T_1M	8.7	8.6	8.5
T_2M	8.7	8.5	8.5
T_3M	8.5	8.4	8.3
T_4S	8.3	8.1	8.0
T_5S	8.2	8.0	8.0
T_6S	7.9	7.5	7.4
CD (0.05)	0.19	0.07	0.19
SEd	0.09	0.15	0.09

enriched Papaya RTS beverage were evaluated during a storage period of 60 days and nutritional quality parameters were assessed initially. Crude protein content was determined by the Lowry's method and vitamin C was assessed by titration method.

Statistical Analysis

The data obtained from the different treatments were subjected to completely randomized design statistical analysis in OP stat software version to find out the impact of different treatments. (Sheoran *et al,* 1998)

RESULTS AND DISCUSSION

Effect of treatments on sensory attribute changes of protein enriched Papaya RTS

Data to study about the sensory scores of protein enriched Papaya RTS among the different treatment combinations is presented in table 2.

The RTS prepared from various combinations of milk and soy protein isolate was organoleptically evaluated to obtain the most acceptable treatment. It was found that 5% of milk protein isolate T_1 M and 10% soy protein isolate T_5S incorporated RTS was highly accepted (Table 2). After being protein-enriched and pasteurized, the 200 ml bottles of Papaya RTS were sealed and kept at room temperature (35±5°C) until further examination and comparison with a control sample. Similar study was done by Bhardwaj and Pandey (2011) and Dande (2017) and the results of the present findings were in concordant with it.

Appearance attribute of protein enriched Papaya RTS beverage

The details regarding the changes in the appearance of Papaya RTS beverage as affected by treatment combination during storage were evaluated by visual examination at initial day intervals up to 60d (Table 3). The T_0 had a clear appearance and the T_6S treatment combination had a viscous appearance. The T_4S and T_5S combinations had a light turbid appearance on the initial day. After 30d T_4S, T_5S, and T_6S treatment combinations had protein settlement at the bottom and top. The same thing in appearance was observed after 60d of storage. The T_1M and T_2M treatment combination obtained a maximum appearance score of 8.5 during storage and T_6S obtained a minimum appearance score of 7.4 on 60^{th} day of storage.

Table 4. Effect of treatments on colour changes of protein enriched Papaya RTS during storage.

Treatment	Storage periods (days)		
	Initial	30	60
T_0	9.0	9.0	8.9
T_1M	8.7	8.6	8.5
T_2M	8.6	8.5	8.4
T_3M	8.5	8.4	8.2
T_4S	8.4	8.0	8.0
T_5S	8.3	8.2	8.1
T_6S	7.6	7.4	7.2
CD (0.05)	0.17	0.18	0.16
SEd	0.08	0.08	0.07

Table 5. Effect of treatments on flavour changes of protein enriched Papaya RTS during storage.

Treatment	Storage periods (days)		
	Initial	30	60
T_0	7.9	7.7	7.6
T_1M	8.7	8.6	8.6
T_2M	8.6	8.5	8.5
T_3M	8.6	8.4	8.3
T_4S	8.4	8.2	8.1
T_5S	8.5	8.4	8.3
T_6S	8.3	8.1	8.0
CD (0.05)	0.17	0.399	0.394
SEd	0.08	0.184	0.182

The T_1M and T_2M treatments had a good appearance because they contained less amount of protein isolate. However, the appearance of T_6S obtained a very low score due to the incorporation of a high amount of protein isolate. Similar study was done by Hemalatha *et al* (2018) and Kumar (2018). Research findings of Saied and El Zubeir (2024) have elaborated the usage of whey proteins in enriched development of Roselle, Doum and Baobab juices. It was found in their studies that there was enhancement of product colour for Roselle blends, taste enhancement and protein content increase in the case of Doum and Baobab juices through whey incorporation.

Colour attribute of protein enriched Papaya RTS

The details regarding the changes in the colour of RTS beverage as affected by treatment combination during storage were evaluated organoleptically at first-day intervals up to 60d. It was evident from the data that fresh RTS beverages had light orange colour and the T_1M, T_2M, and T_3M treatment combination had light orange to dark orange colour. T_4S, T_5S, T_6S treatment combination had a light orange to light white colour. However, with the advancement of the storage period, colour changes were observed in all the treatment. T_0 obtained the maximum colour score of 9.0 and the T_6S treatment combination obtained the minimum colour of 7.6.After 30d, a maximum colour score of 8.6 was obtained in the T_1M treatment combination and a minimum colour score of 7.4 was obtained for the T_6S treatment combination. After 60d, maximum colour score of 8.5 was obtained in the T_1M treatment combination and a minimum colour score of 7.2 was obtained for the T_6S treatment combination. However, among all the treatments, the T_6S treatment shows a minimum colour score from 7.6 to 7.2 during the storage period.

The colour and amount of the protein isolate incorporation into RTS are responsible for the final colour characteristics of all the treatment combinations.

Flavour attribute of protein enriched Papaya RTS

The flavour value of RTS beverages was significantly affected by the treatment combination and storage period from the initial to

Table 6. Effect of treatments on taste changes of protein enriched Papaya RTS during storage.

Treatment	Storage periods (days)		
	Initial	30	60
T_0	8.6	8.5	8.4
T_1M	9.0	8.9	8.7
T_2M	8.8	8.7	8.6
T_3M	8.7	8.6	8.5
T_4S	8.8	8.7	8.6
T_5S	8.7	8.6	8.5
T_6S	8.6	8.5	8.4
CD (0.05)	0.16	0.13	0.17
SEd	0.07	0.06	0.08

Table 7. Effect of treatments on overall acceptability changes of protein enriched Papaya RTS during storage.

Treatment	Storage periods (days)		
	Initial	30 days	60 days
T_0	8.5	8.4	8.3
T_1M	8.7	8.6	8.5
T_2M	8.6	8.5	8.4
T_3M	8.5	8.4	8. 3
T_4S	8.4	8.3	8.2
T_5S	8.3	8.2	8.1
T_6S	8.1	8.0	7.9
CD (0.05)	0.28	0.15	3.19
SEd	0.13	0.07	1.49

6d of storage. The flavour value was reduced with the advancement of storage period in all treatments. The control obtained the minimum flavour score of 7.9 and the T_1M treatment combination obtained the maximum flavour score of 8.7.After 30 d, a maximum flavour score of 8.6 was obtained in the T_1M treatment combination and a minimum flavour score of 7.7 was obtained for control. After 60 days maximum flavour score of 8.6 was obtained in the T_1M treatment combination and a minimum flavour score of 7.6 was obtained for T_0. Similar study was done by Priyanthi (2008).

Taste attribute of protein enriched Papaya RTS

The taste value of RTS beverages was significantly affected by the treatment combination and storage period from the initial day to 60d. The taste value was reduced with the advancement of the storage period in all treatments. The T_6S obtained the minimum taste score of 8.6 and the T_1M treatment combination obtained the maximum taste score of 9.0. After 30d, a maximum score of 8.9 was obtained in the T_1M treatment combination and a minimum taste score of 8.5 was obtained for T_6S. After 60d maximum taste score of 8.7 was obtained in the T_1M treatment combination and a minimum taste score was obtained for T_6S and T_0.

Overall acceptability attribute of protein enriched Papaya RTS

The overall acceptability of the protein enriched RTS beverage was significantly affected by the treatment combination and storage period from the initial day to 60d. The overall acceptability value was reduced with the advancement of storage period in all treatments. The T_6S obtained the minimum overall acceptability score of 8.1 and the T_1M treatment combination obtained the maximum overall acceptability score of 8.7.After 30d, a maximum overall acceptability score of 8.6 was obtained in the T_1M treatment combination, and a minimum overall acceptability score of 8.0 was obtained for T_6S. After 60d maximum overall acceptability score of 8.5 was obtained in the T_1M treatment combination and a minimum score of 7.9 was obtained for T_6S. As per sensory evaluation,

Table 8. Nutritional quality of protein enriched papaya RTS

Treatment	TSS (°Brix)	pH	Acidity	Protein(g)	β-carotene(µg)	Ascorbic acid (mg)
T_0	15.0	5.4	0.39	0.2	632	0.75
T_1M	14.4	5.1	0.35	4.7	654	0.73
T_2M	14.7	5.0	0.37	9.7	654	0.73
T_3M	14.9	5.0	0.37	14.5	651	0.72
T_4S	14.5	4.9	0.39	4.8	653	0.72
T_5S	14.7	4.9	0.41	9.8	653	0.71
T_6S	14.9	4.9	0.40	14.6	654	0.71
CD (0.05)	NS	0.243	0.018	0.374	NS	0.037
SEd	0.327	0.112	0.008	0.173	14.505	0.017

treatment combination T_1M and T_5S had the maximum overall acceptability in the milk and soy protein isolate enriched Papaya RTS.

Nutritional quality of developed protein enriched Papaya RTS

Data about the presents of nutrients in protein enriched Papaya RTS beverage such as TSS, acidity, pH, protein, β - carotene, and ascorbic acid were recorded. Panghal *et al* (2017) experimented protein enrichment of papaya RTS with whey to increase the protein content and other nutritional parameters. It was registered that 25% of whey wastes was acceptable with good sensory scores in the development of papaya RTS based beverages.

The data on the total soluble solids content of protein enriched Papaya RTS beverage was recorded in the range from 14.4°Brix (T_1M) to 15.0°Brix ($T_{0)}$ and it was significant for different treatment combination. Same type of RTS was developed by Sasi Kumar *et al* (2012) and the results were in accordance with our present findings. In view of the preservation, date palm sap based RTS was developed by Shanta *et al* (2021), which illustrated that heat treated Date palm RTS prepared using 30% Date palm juice was highly accepted which registered TSS of 18º Brix. The increase in TSS might be due to hydrolysis of insoluble polysaccharides into simple and soluble sugars

The T_6M obtained the minimum pH content of 4.9 and the T_0 obtained the maximum pH of 5.4. Fruit juices have a low pH because they are comparatively rich in organic acids (Tasnim *et al,* 2010). The T_1M obtained the minimum acidity content of 0.35 and the T_5S treatment combination obtained the maximum acidity of 0.41. There were significant differences in the acidity of the variants of RTS containing milk protein or soy protein isolates.

Protein increased in all treatments. The T_6S obtained the maximum content of 14.6 and the T_0 obtained the minimum of 0.2. The storage period does not influence protein content. However, the treatment combination influences the protein content. In the present investigation, a significant increase in protein vs control was observed in different variants of protein enriched Papaya RTS. The different treatment combinations do not influence the β-carotene. There was no significant effect on β-carotene observed in different treatment combinations and same result was obtained in ascorbic acid content of control and protein enriched Papaya RTS.

CONCLUSION

Based on the findings of this study, it can be concluded that the Papaya RTS enriched with 5% milk protein isolate and 10% soy protein isolate received the highest level of acceptance among all treatments. Further, the nutrient analysis revealed that the developed Papaya RTS enriched with milk and soy protein was superior in terms of nutritional quality than the Papaya RTS alone. The developed protein enriched Papaya RTS is mostly liked and preferred by the consumers of all age groups.

ACKNOWLEDGEMENT

Authors are grateful to Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India for all the financial support and rendering the technical facility to undergo this University Research project.

REFERENCES

Agarwal S and Kumar V (2017). Effect of Physico-chemical changes of RTS beverage bottle gourd juice blends with Mint and Lemon. *Int J Chem Stud* **5** (4) : 355–358.

Akathsingh, Nath A, Deka Bidyut C, Jai Prakash, Patel RK and Shahida Choudhary(2010). Studies on nutritive value of papaya (*Carcia papaya* L.) fruits at different stages for their amenability to specific use. *Trop Agric* **158**: 15-22.

Balaswamy K, Prabhakara Rao P, Nagender A and Akula S (2011). Preparation of sour grape (*Vitis vinifera*) beverages and evaluation of their storage stability. *J Food Pro Tech***2**(3) :105–104. doi:10.4172/2157-7110.1000116

Bhardwaj RL and Pandey S (2011). Juice blends-a way of utilization of under-utilized fruits, vegetables, and spices: a review. *Crit Rev Food Sci Nutr* **51**(6) : 563–570.

Dande K, Biradar S, Dadge V, Swami R and Halkude R (2017). Effect of different levels of watermelon fruit juice on acceptability of whey beverage. *Int J Agri Environ Res* **3** (2) : 2628–2636.

Hemalatha R, Kumar A, Prakash O, Supriya A, Chauhan A, and Kudachikar V (2018). Development and quality evaluation of ready to serve (RTS) beverage from cape Goose berry (*Physalis peruviana* L.) *Beverages* **4** (2) : 42. Doi:10.3390/beverages4020042

Kumar R (2018). Studies on process standardization and storage behavior of ready to serve (RTS) beverage prepared from Aonla cultivars. *J Pharma Phytochem* **7**(6) : 74–77.

Panghal A, Kumar V, Dhull SB, Gat Y and Chhikara N (2017). Utilization of dairy industry waste-whey in formulation of papaya RTS beverage. *Curr Res Nutr Food Sci* **5** (2) : 168-174. doi: 10.12944/CRNFSJ.5.2.14.

Priyanthi H, B Thilakarathne and P Prasanna (2008). *Development of a Ready to Serve (RTS) drinking using Veralu/Ceylon Olive* (*Elaeocarpus serratus*) M.Sc. Thesis. Rajarata Universuty, Sri Lanka. p. 35–56.

Saied M N and El Zubeir, I E (2024). Utilization of whey proteins in beverages using Baobab (*Adansonia digitata* L.),Roselle (*Adansonia digitata* L.) and Doum (*Hyphaenethebaica*) fruits. *Food Mater Res* **4** (1) : e016. doi: 10.48130/fmr-0024-0007.

Sasi Kumar R, Ray R, Paul P and Suresh C (2012). Development and storage studies of therapeutic ready to serve (RTS) made from blend of *Aloe vera*, Aonla and ginger juice. *J Food Process Technol* **4** (232) : 2.

Shanta FH, Rahut BK, Islam MJ, Azad MOK, Sohel MAT, Rajib MRR, and Adnan M (2021). Development of value added drinks from date palm juice (*Phoenix sylvestris*). *Heliyon* **7** (11): e08322. doi:10.1016/j.heliyon.2021.e08322.

Sheoran O.P,Tonl DS, Kaushik LS, Hasija RC and Pannu RS.(1998).Statistical software Package for Agricultural Research Workers. Recent Advances in Information theory, Statisticsc & Computer Applications by DS. Hooda & RC Hasija, Department of Mathematics statistics, CCS HAU, Hisar. 139-143

Sindumathi G, Premalatha M and Kavitha V (2017). Studies on therapeutic value of naturally flavored Papaya-Mango blended ready-to-serve (RTS) beverage. *Int J Curr Microbiol Appl Sci* **6** (12) : 878–887.

Tasnim Farzana, Anwar Hossain,M Kamal Hossain, Lopa D and Formuzual HaqueK M (2010). Quality assessment of industrially processed fruit juices available in Dhaka City, Bangladesh. *Malays J Nutr* **16**(3): 431- 438.PMID: 22691996.

Received on 9/8/2024 Accepted on 23/10/2024