Indian J. Applied & Pure Bio. Vol. 37(3), 653-659 (2022). **ISSN: 0970-2091**
A web of Science Journal

Processing and Development of Papaya (*Carica papaya* L.) juice with incorporation of Whey

Florien Nkurunziza[1], Turatsinze Theoneste[2], Uwimana Sandrine[2], Bitwayiki Clement[2], Sushil Kumar Upadhyay[1,*] and Anil K. Sharma[1,*]

[1]Department of Biotechnology, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala-133207 (India)
[2]College of Agriculture, Animal Science and Veterinary Medicine, University of Rwanda, East Africa
***Corresponding author(s) Email: *** anibiotech18@gmail.com; upadhyay.k.sushil@gmail.com

Abstract

Fruit is the freshy part of every ovary of a flower, many people do not value the significance of having fruits as their daily meal because they take them as simple and affordable plants. Papaya (*Carica papaya* L.) is small, herbaceous, green and perennial dicotyledonous plant which plays an important role in the health of human being providing significant amount of nutrients such as vitamins, minerals fiber sugars and antioxidants. Whey which is gotten from milk products could be added to increase the medicinal and nutritive value and making it more delicious. This study provides the outline for the processing and development of juice with incorporation of whey. It contains current scholar's view on using of whey in juice production. This study will certainly help to increase the processing of papaya into different products in order to increase availability and affordability of papaya products in the market.

Fruits and vegetables embrace an important status among the health foods as they provide significant amount of nutrients, especially vitamins, minerals, fiber sugars and antioxidants. Moreover, they are refreshing and display thirst-quenching behavior[15,16,21]. Fruits and vegetables are significance elements for a balanced diet and are known for maintaining human health[3]. However, due to highly perishable nature and short shelf life of fruits and vegetables, immediate processing into preserved products becomes essential to avoid post-harvest losses. Therefore, Papaya (*Carica papaya* L.) was selected for preparation of fruit drink due to its reasonable price, ease of availability and high nutritive value. Papaya is also known as common man's fruit and belongs to Caricaceae family. Papaya possesses attractive color, luscious taste, rich source of minerals like potassium and magnesium, nutrients such as carotenoids, vitamins C, E and flavonoids which act as antioxidants;

vitamins B, folate, pantothenic acid and fibers[10].

Papaya is one of the brands tropical fruits that may require acidification, to ensure a safe product when processed by normal methods[17]. Papaya is shaped like elongated melons or pears. The flesh is deliciously sweet with musky undertone, and its texture has a soft melting quality. Papaya has black seeds and the fruit is yellow or red depending on the variety. The ripe papaya is juicy, sweet and is usually consumed fresh as a breakfast or dessert fruit. Papaya grows in Rwanda but is not cultivated like other crops, is a home garden crop. It is almost present in the rural area and people's garden.

Papaya fruits are available throughout the year. Both types of papaya, Hawaiian and Mexican are present in Rwanda. The Hawaiian varieties are commonly found in supermarkets while Mexican varieties are rarely found.In Rwanda, no industry or processing plant that processes papaya, as it is considered as less appreciated fruit compared to other processed fruits. Due to inappropriate means of processing methods in Rwanda, most of these foods are considered as non-nutritious due to ignorance.

Whey is a watery liquid by-product of dairy industry during the preparation of channa, paneer, cheese and casein[4,9,11]. It is also obtained by precipitation and removal of milk casein during cheese production[2]. World whey production is 180 to 190 $\times 10^6$ tonnes/year with an annual increment of 1-2% and only 50% of whey is utilized/processed[17,19]. Whey contains 45-50% total milk solids, 70% milk sugar (lactose), 20% milk proteins and 70-90% milk minerals and almost all the water-soluble vitamins originally present in milk[5,7,17]. So, whey disposal becomes a serious environmental pollutant being loaded with high amounts of organic matter[12]. Whey possesses preventive and curative elements responsible for treatment of ailments such as arthritis, anaemia and liver complaints[12,14,20]. Fruit and dairy/dairy waste-based products are attaining considerable attention due to delicious taste, increased energy value and high nutritional value and market for such food products has incredible potential[8,13]. Whey based fruits beverages are more suitable for health as compared to other drinks[13]. Production of nourishing pleasant whey-based fruit beverages is one of the most promising trends in the utilization of whey which is a dairy waste. The present study was planned to prepare papaya juice by incorporating different levels of whey and study its nutritional quality and storage stability.

Sample collection and preparation :

Papaya was procured fresh from MUSANZE market. Whey was obtained from CAVM milk processing plant. Mature and fully ripened papaya fruits were selected. Pulping of papaya was done and stored at 4±1°C until further use. Juice was prepared by using whey, water, pulp, sugar and citric acid. Different variants of beverages were formulated using three different levels of whey *i.e.*, 25%, 50%, and 75% by replacing water. The prepared products were packed in sterilized bottle (capacity 500 ml) leaving ½" head space and capped air tight. The steps involved in the preparation of whey-based papaya juice as

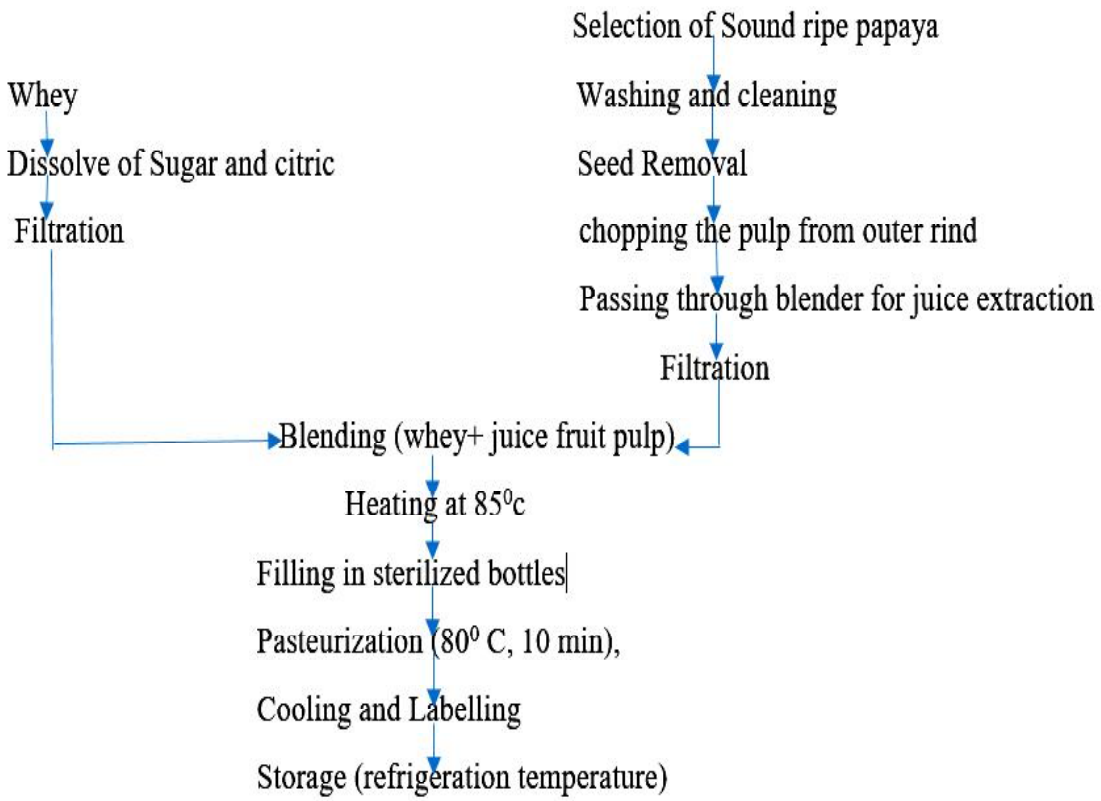

Figure 1: Processing of papaya juice with incorporation of whey

illustrated in Figure 1. After pasteurization (80°C for 10 min) followed by cooling, juice was stored at refrigeration temperature. Various parameters such as microbiological load, protein content, fat content and pH were analyzed using protocatechuic acid, distilled water, petroleum ether, sulfuric acid, NaOH, Boric acid and peptone water,

Kjeldahl method was used to determine the release of nitrogen by a suitable titration technique[18]. Briefly, the sample was digested with sulfuric acid (oxidizing agent), anhydrous sodium sulfate and using a catalyst like copper, titanium or mercury (to speed up the reaction). For further neutralization, the solution in the digestion flask was made alkaline by addition of sodium hydroxide, which converts the ammonium sulfate into ammonia gas. The low pH in the receiving flask further converted ammonium into ammonium ion while boric acid is converted into borate ion. Titration of ammonium borate with sulfuric acid or hydrochloric acid using a suitable indicator was carried out to determine the end-point of the reaction. Nitrogen content was finally calculated after titration and then it was multiplied by the appropriate conversion factor (6.25) in calculation of the protein content.

Determination of the fat content :

Fat plays an important role in many foods. Fat contributes to the flavor of food as well as it gives texture and also mouthfeel to the food. The solvent extraction method also known as Soxhlet method was used to determine the fat content[6]. Briefly, 5g of grounded and dried sample in the thimble was placed in the soxhlet extractor. The 150ml round bottom flask was filled with 90ml petroleum ether. Placed the whole setting on a heating mantle and allowed the petroleum ether to boil. Continue the extraction process for 6hrs. Removed the condensing unit from extraction unit and allowed the sample to cool down. All the solvent after distillation was almost collected. The sample was placed in the oven followed by in the desiccator. Weighed the sample and fat content was determined as per the following formula:

$$\text{Crude fat percentage (ig)} = \frac{w2 - w1}{p} \times 100$$

Where: w_1, Empty thimble; w_2, Thimble with sample; p, Weight of sample.

Determination of microbiological load :

Microbial load or total viable count was determined using the plate count method using the standard protocol[1].

Assessment of acceptability of juice :

Panelists (10 persons) were selected randomly to conduct the sensory evaluation of all processed juice by evaluating different sensory parameters such as appearance, smell/ aroma, flavor, viscosity and overall acceptability by using hedonic scale test ranging from 1-9 from lowest to highest. After preparation of juice, the small plastic cups were labelled representing the types of juice according to the proportion of whey and papaya. The juice samples were arranged on a table for every panelist with an addition of cup of potable water and the questionnaire was near the table of each panelist. The samples were evaluated by the panelist using a 6-point hedonic scale. Each juice sample was screened for color, taste, smell/aroma, consistency, flavor, and overall acceptability.

Analysis of data :

Statistical analysis was done using mean score to evaluate the product sensory attributes and overall acceptance separately for each sample. The mean result gotten was compared to the score obtained from the questionnaire for acceptability and sensory attributes rating and then discussed.

Papaya is cultivated in Rwanda as a home garden crop and is considered as a cheaper food for the poor and a cheap source of nutrients content compared to other fruits in Rwanda, the current study will certainly help to encourage the people and government to increase production and harvesting of papaya. Nutritional composition of papaya has been elucidated in Table-1. Moreover, this kind of study will help to reduce environmental pollution caused by whey disposal as waste material from dairy industry because it requires high biological oxygen demand (BOD) in order to be decomposed. The processing of papaya into different products in order to increase availability and affordability of papaya products in the market, will also get impetus. More so the people will get encouraged to consume as much as possible papaya and papaya-based products because papaya has distinct functions

in human health especially in diabetes 2 types, obese, sportive people and those who have problems of cardiovascular functions. The study will increase the maximal use of whey in order to increase the income to the dairy industry through processing into other products. The nutritional composition of fresh whey has been highlighted in Table-2 while the ratios of ingredients in papaya juice are shown in Table 3. Moreover, analysis of proteins in the sample is equally important as proteins have different molecular structures, nutritional attributes and physiochemical properties. Proteins are a major source of energy, as well as containing essential amino-acids, such as lysine, tryptophan, methionine, leucine, isoleucine and valine, which are essential to human health. Proteins are also the major structural components of many natural foods, often determining their overall texture, *e.g.,* tenderness of meat or fish products. Food analysts are interested in knowing the total concentration, type, molecular structure and functional properties of the proteins in foods. Keeping in view of the above outcomes, production of papaya juice with incorporation of whey will encourage people to reduce this little knowledge and increase the cultivation of papaya by making the appropriate land for papaya fruit and treat the ground for cultivation as required because this may also result as a problem due to the little production and harvested papaya fruit in Rwanda, and also will lead to maximal use of whey from dairy industries.

Table-1. Nutritional composition of papaya[16].

Nutrients	Composition (%)	Vitamins	Composition (mg/100g)
Moisture	89.6	Vitamin B_2	0.04
Protein	0.5	Vitamin C	40
Fat	0.1	Nicotinic acid	0.2
Carbohydrate	9.5	Riboflavin	0.25
Calcium	0.01	Vitamin A	2020 IU/100g
Phosphate	0.01	Calorific value	40/100g
Iron	0.4	-	-

Table-2. Nutritional composition of fresh whey[7].

Particles in %	Sweet whey	Acid whey
Water	93-94	94-95
Dry matter	6-6.5	5-6
Lactose	4.5-5	3.8-4.3
Lactic acid	Traces	Up to 0.8
Total protein	0.8-1.0	0.8-1.0
Whey protein	0.6-0.65	0.6-0.65
Citric acid	0.1	0.1
Minerals	0.5-0.7	0.5-0.7
pH	6.4-6.2	5.0-4.6

Table-3. Ratio of ingredients in papaya juice

Papaya juice (ml)	Whey (ml)	Sugar (g)	Citric acid (ml)
500	-	80	10
325	125	80	10
250	250	80	10
125	325	80	10

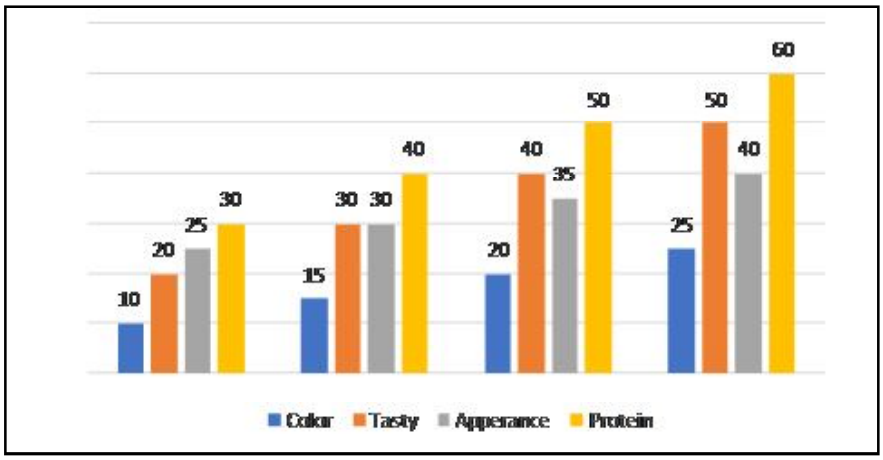

Figure 1: Four different samples of papaya juice were blended together with corresponding whey in the ratios; A (0,100), B (15,85), C (25,75) and D (35, 65), of whey and papaya juice respectively.

Four different samples of papaya juice have been blended together with corresponding whey amount in the ratios; A (0,100), B (15,85), C (25,75) and D (35, 65), whey and papaya juice respectively. After blending, the changes observed varied differently as observed in A, B and C, the changes varied in color, taste, sweetness and appearance based on the amount of whey used. The D sample (35% of whey and 65% of papaya juice) have shown significantly higher protein levels than all other samples (Figure 1).

Most parts of the *Carrica papaya*, such as the leaves, latex, fruit, bark, roots, seeds, and flowers had been used as a medicament for diseases such as dengue, diabetes mellitus, hypertension, malaria, hypercholesterolaemia, dyspepsia and constipation[9].

Papaya, a worldwide available fruit which play an important role in living organisms including humans by providing significant amount of nutrients like vitamins, minerals fiber sugars and antioxidants. When combined with whey, the cost effective value of the product become multifold along with increase in medicinal and nutritional value of papaya juice. Plantation of papaya should be prioritized and improved so that there shall be no more nutritional associated diseases in the population

and whey should be well recycled and used to mitigate environmental pollution caused by whey depository, further improving the quality of papaya juice.

Conflict of interest

There exists no conflict of interest pertaining to publication of this manuscript in your esteemed Journal.

References :

1. Allen, M.J., S.C. Edberg and D.J. Reasoner (2004). *International Journal of Food Microbiology 92*(3): 265-274.
2. Amaro, T.M., D. Rosa, G. Comi and L. Iacumin (2019). *Frontiers in Microbiology 10:* 992.
3. Ayed, L., S. M'hir and M. Hamdi (2020). *Journal of Chemistry*, *20:* 1-12.
4. Chiara, M., F. Bosco and L. Marmo (2013). *Intech Open Access Publisher 1:* 760p.
5. Cruz, A.G., A.S.S. Ana, M.M. Macchione, A.M. Teixeira and F.L. Schmidt (2009). *Food and Bioprocess Technology 2:* 368-373.
6. Danlami, J.M., A. Arsad and M.A.A. Zaini (2015). *Journal of the Taiwan Institute of Chemical Engineers 47:* 99-104.
7. E.F.S.A. Panel (2010). *European Food Security Association Journal 8*(10): 1818.
8. Farrell, H.M., R. Jimenez-Flores, G.T. Bleck, E.M. Brown, J.E. Butler, L.K. Creamer, C.L. Hicks, C.M. Hollar, K.F. Ng-Kwai-Hang and H.E. Swaisgood (2004). *Journal of Dairy Science 87*(6): 1641-1674.
9. Heung, T.Y., J.Y.S. Huong, W.Y. Chen, Y.W. Loh, K.Y. Khaw, B.H. Goh and Y.S. Ong (2021). *Food Reviews International* 1-19.
10. Imaga, N.A., G.O. Gbenle, V.I. Okochi, S. Ademekan, T. Duro-Emmanuel, B. Oyeniyi, P.N. Dokai, M. Oyenuga, A. Otumara and F.C. Ekeh (2010). *Scientific Research and Essays 5*(16): 2201-2205.
11. Islam, M.Z., S. Tabassum, M. Harun-ur-Rashid, G.E. Vegarud, M.S. Alam and M. Islam (2021). *Journal of Agriculture and Food Research 4:* 100144.
12. Ismail, A.E., M.O. Abdelgader and A.A. Azhari (2011). *Advance Journal of Food Science and Technology 3*: 250-253.
13. Jurandi de Olveira G. and P. Angel Vitoria (2011). *Food Research International 44*(5): 1306-1313.
14. Pal, S. and R.B. Simone. (2013). *Obesity Reviews 14*(4): 324-343.
15. Pamplona-Roger, G.D. (2003). *Editorial Safeliz 1:* 384p
16. Radha, T. and L. Mathew (2007). *Horticulture Science Series 3:* 79-81.
17. Roman, P., G. Vatai, A. Ittzes, Z. Kovacs and P. Czermak (2012). *Journal of Food Process Engineering 35*(5): 708-714.
18. Sáez-Plaza, P., T. Michałowski, M.J. Navas, A.G. Asuero and S. Wybraniec (2013). *Critical Reviews in Analytical Chemistry 43*(4): 178-223.
19. Tunick, M.H. (2008). In: Onwulata, C.I., P.J. Huth. *Ames, Iowa: Blackwell Publishing Press 1:* 1–13.
20. Wafi, A., A.M. Yilmaz, N. Erdoğan, A.S. Yalçın and A.O. Aktan (2012). *Pathology and Oncology Research 18*(4): 817-822.
21. Yadav, D.N., R.K Vishwakarma, S. Borad, S. Bansal, A.K. Jaiswal and M. Sharma (2016). *Journal of Food Science and Technology 53*(10): 3844-3852.