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Research Article

Formulation of Papaya Fruit Powder Incorporated Instant Drink Mix

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ABSTRACT

Papaya (*Carica papaya* L.) is a tropical fruit with excellent health benefits. However, papaya fruit with soft flesh is easily damaged and susceptible to oxidative degradation, which is not favourable for extended storage and transportation. One way of preserving papaya fruit is by drying into powdered form using spray-drying or freeze-drying techniques. The papaya fruit powder can then be transformed into various products such as instant drink mix and health supplements. This study aims to develop a suitable formulation of papaya fruit powder incorporated instant drink mix with high nutritional content and good sensory properties. Six different combinations were tried with different amount of papaya powder and other ingredients and evaluated for their physical and sensory properties. According to the results, the most liked Sample 3 has the greatest acceptability score due to its optimal flavour, aroma, and taste. Proximate analysis of Sample 3 revealed moisture content (5.3%), total carbohydrate (77.7%), total fat (0.3%), ash content (4.1%), total dietary fibre (0.2%) and protein (12.6%) which was comparable to available commercial product. Furthermore, the microbial activity test showed that the total plate count of microbes is 7.3×10^3 CFU/gm which is categorized as accepted and satisfied. This study demonstrates a practical use of powdered papaya fruit incorporated into instant drink mix that can be nutritional and convenient with good sensory properties.

INTRODUCTION

Papaya (*Carica papaya* L.) is a well-known and economically valuable fruit belonging to the family Caricaceae. It originated from Central America and is now widely cultivated in other tropical and subtropical countries such as Brazil, India, and South-East Asia (Kaur *et al.*, 2019). Due to its high nutritional and medicinal value, papaya is considered to be one of the important fruits. It is a rich source of antioxidants, phytochemicals, nutrients, and minerals.

The scientific research provides an insight into the use of papaya as a multipurpose commercial fruit crop. Papaya fruits have been proven for multifarious medical activities such as anticancer, anti-inflammatory, anti-hypertensive, wound healing, hepatoprotective, antimicrobial, antifungal, anti-fertility, histaminergic, diuretic, immunomodulatory activity, etc. (Vij & Prashar, 2015). According to recent research, papaya with anticancer agents and antioxidants such as beta-carotene, vitamin C, polyphenols, and flavonoids promote anticancer activity against human breast cancer cell line MCF-7 by blocking the proliferation, resulting in cell cycle arrest and inducing apoptosis. The production of Th1-type cytokines tends to produce proinflammatory responses to kill the intracellular parasites and foster the development of cytotoxic lymphocytes that response to the cell-mediated immune system against tumour cells (Mahendran *et al.*, 2021). Researchers found that men who regularly consumed lycopene-rich foods such as papaya had an 82 percent lower risk of prostate cancer (Yogiraj *et al.*, 2014).

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As is widely known, papaya rich in fibre keeps the digestive tract moving smoothly and protects against colon cancer. The fibre in papaya flesh can bind to toxins that cause cancer in the colon and prevent the toxins from interacting with the colon cells. The nutrients in papaya offer concerted protection to colon cells from damage by free radicals, which is known as free radical scavenging activity (Ali *et al*., 2011).

Papaya contains a high amount of protein-digesting enzyme, known as papain and chymopapain, reported having potent anti-inflammatory effects. Papain has been proven to reduce joint pain effectively and it is an excellent supplement for people with arthritis. Besides, the diseases that will be worsened by inflammation such as asthma, osteoarthritis, rheumatoid arthritis as well as wound healing can be controlled or reduced when these enzymes are consumed (Pandey *et al*., 2016). In research from Owoyele *et al*. (2008), papaya extract was able to reduce edema in a formaldehyde-induced arthritis model.

Papaya fruit contains nearly 88% of moisture and its highly perishable nature prevents storage for extended periods of time in ambient conditions. There are always losses of papaya fruit during the farm operation, such as harvesting, collecting, sorting, packaging, and transporting. As a result, processing papaya fruits appears to be a viable option for creating a variety of nutrient-dense value-added products. Various techniques have been used to prevent crop spoilage and extend shelf-life, mainly to reduce losses by converting perishable commodities into stable form to be kept for more extended periods of time (Shivani *et al*., 2020). One of such ways is drying of papaya fruit into powder by means of spray drying or freeze drying. Compared to other preservation methods such as using salt, sugar or acid, drying or dehydration is preferred as it can preserve the original taste and nutrition profile of papaya. Papaya fruit powder is a relatively stable preparation that can be used in drinks, desserts, confectionaries, and many other products.

According to Evans & Ballen (2012), the demand and need for tropical fruits has steadily grown over the last two decades. Global papaya production has increased significantly, mainly due to increased production in India. Papaya is becoming increasingly important to developing countries as an agricultural export product, and its export earnings have been able to sustain thousands of people in Asia and Latin America. Exports of papaya are helping to meet the increasing demand for healthier foods in global markets.

Although the availability of papaya is high in Malaysia, so far not many commercial papaya products have been introduced in the market. This might be due to the bitter aftertaste and medicinal smell of papaya, which makes it unappealing to some people. As such, there is a need to introduce some alternative products with acceptable sensory and physicochemical properties, not only to reduce the loss of papaya fruit along its supply chain but also increase its commercial value locally. A suitable formulation needs to be developed to improve the aroma and taste by supplementing with other ingredients to obtain a desired sensory characteristic. The instant papaya drink powder mainly consists of natural papaya powders, sweetener, flavour source, thickener, and additives to make the beverage desirable, flavourful, and nutritious for health (Badsha *et al*., 2020).

In addition, the low-calorie content of papaya (32 kcal/100 g of ripe fruit) and its high nutritional value make it a preferred and excellent choice for consumers. However, it may not be convenient to carry around fresh papayas to get the nutrient. Therefore, the production of alternative papaya products from the dried powder can provide a practical solution to this problem. Such a product not only adds value to the traditional fruit and but also gives a new product that minimizes the loss of papaya fruit. This study aims to develop a suitable formulation of papaya fruit powder incorporated instant drink mix with high nutritional content and good sensory properties.

MATERIALS AND METHOD

Materials

The papaya powder used was purchased from Bionutricia Manufacturing Sdn. Bhd., Selangor, Malaysia. The skim milk powder was from BWY Holdings Sdn. Bhd., Selangor, Malaysia while carrageenan and vanilla powder were purchased from Evacaely Enterprise, Selangor, Malaysia. Fructose was obtained from Health Paradise Sdn. Bhd., Selangor, Malaysia.

All chemical reagents used in the experiments were of analytical grade, and all determinations were done in triplicates, and the results were reported on a dry weight basis. The list of chemicals used throughout the experiments is: Kjeldahl tablets which contain potassium sulphate and copper sulphate, concentrated sulphuric acid, deionized water, zinc granules, 1% boric acid with 3-4 drops of methyl-red indicator, petroleum ether, 0.128 N of sulphuric acid, and 0.313 N of sodium hydroxide.

Formulation of Drink Mix

The formulation was prepared based on the procedure described by Pakalwad *et al*. (2010) and Vennila *et al*. (2020) with some modifications. In addition, Malaysia Food Regulations 1985 was referred to ensure the formulation is safe, valid and suitable for sensory evaluation and conforms to food safety legislation of Malaysia. Only the amount of papaya powder was varied, while the amount of other ingredients was kept constant which was determined after preliminary studies (**Table 1**). Each ingredient was weighed using an electronic balance and mixed thoroughly using a dry blender to form the drink mix. The mixed powder or the reconstituted solution (25 g powder added with warm water up to 100 mL) was subjected to sensory evaluation and physical characterisation.

Table 1 Formulation of papaya powder drink mix (amount shown in grams, g)

No.	Papaya powder	Milk powder	Fructose	Carra-geenan	Vanilla Flavour	Total weight	% of papaya powder
1	15.5	20.0	14.0	0.5	4.0	54	28.7
2	13.5	20.0	14.0	0.5	4.0	52	26.0
3	11.5	20.0	14.0	0.5	4.0	50	23.0
4	9.5	20.0	14.0	0.5	4.0	48	20.0
5	7.5	20.0	14.0	0.5	4.0	46	16.3
6	5.5	20.0	14.0	0.5	4.0	44	12.5

Sensory Evaluation

The sensory evaluation of papaya milk powder was conducted by 30 panelists aged 20-35 and divided into acceptance test and descriptive test. For acceptance test, each sample was served in 25 mL and labelled. Each of the panelist evaluated the samples only once. Panelists were asked to rank the samples in terms of texture, aroma, appearance, taste, and overall acceptability without compromising or discussing, and to give each sample a different ranking according to the 5-point Hedonic scale. For the descriptive test, the panelists were requested to describe the sensory characteristic of the sample based on the appearance, aroma, taste, and texture. The order of samples presented to each subject was random to prevent bias. The panelists were asked to provide the features of the samples directly after tasting without further discussion.

Physical Characteristic Analysis

Water activity was measured using a LabMaster water activity meter, while total soluble solid (TSS) was analysed by using a digital refractometer MA871. Before the analysis, the digital refractometer was calibrated by distilled water. Then, a drop of the sample was placed onto the refractometer's sample port and the result was read (Chang, Tan & Pui, 2020). pH was recorded with a digital pH meter at room temperature. Colour was determined using the colorimetric data obtained from the Chroma Meter CR-400. The L*a*b coordinates of the Commission Internationale de l'Eclairage (CIE) were used to determine colour differences, *ΔE* as described by Lakshan *et al*. (2019).

Proximate and Microbial Analysis

Proximate analysis is a quantitative analysis of macromolecules to analyze the chemical composition of the samples. The moisture content measurement method was oven drying method by Raja *et al*. (2019) while the protein content was measured by Kjeldhal method described by Hayes (2020). Besides, Soxhlet extraction with petroleum ether (AOAC Method 945.16), described by Nielsen (2017) was used to measure the fat content. For crude fiber content, gravimetric determination after chemical digestion and solubilization as presented by Farzana & Mohajan (2015) was referred, while the determination of ash content is by microwave dry ashing. Subtraction calculation method by Pauter *et al*. (2018) was used to determine carbohydrate content.

For microbial activity, total plate count was determined based on the method of AOAC 990.12, while coliform using AOAC 998.08 and 991.14. The result was expressed as colony forming unit (CFU) per g of dry matter.

RESULTS AND DISCUSSION

Sensory Evaluation

Figure 1 represents the average responses from 30 respondents (15 males and 15 females, age 20-35, non-smoking, no illnesses related to sensory characteristics, not colour blind and no strong preferences for or dislike for papaya) for papaya milk reconstituted samples. The respondents rated the sample based on their acceptability and preferences. Sample 1 had the highest average score for appearance because the amount of papaya powder in the sample is the highest, resulting in a more vivid perception of colour. The bitter taste was obvious in Sample 1 due to the considerable amount of papaya powder present, causing less preference. Additionally, Sample 1 also scored the lowest in aroma and texture, indicating that high papaya fruit powder content greatly affects the acceptability of the drink. For the descriptive test, the result is summarised in **Table 2**. The enzymatic papaya aroma was noted in Sample 1, affecting respondents' preferences while Sample 3 showed optimal and mellow aroma. The presence of milk powder and decreasing amount of papaya powder effectively improve the texture or body of the drinks.

Overall, Sample 3 which was described as having a delicate salmon pink hue, being sweet, smooth, and creamy in texture received the greatest overall acceptance score and the respondents reported that the amount of papaya powder in Sample 3 was optimal and most acceptable.

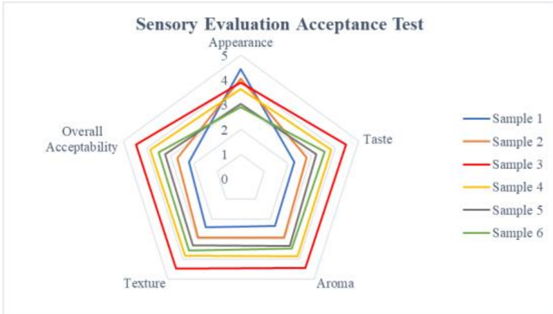

Figure 1 Sensory evaluation acceptance test result

Table 2 Summary of sensory evaluation descriptive test

Attributes	Description
Appearance	The highest papaya powder concentration appears as pale salmon pink, with the colour turning to milky white as the amount of papaya powder decreases.
Taste	Sample 1 which consists of the highest papaya powder amount showed bitter taste.
Aroma	Sample 1 with the highest proportion of papaya powder was described as bitter with a hint of enzymatic papaya aroma while Sample 3 showed a smooth and creamy flavour with the optimal amount of papaya powder.
Sweetness	Sample 3 received the greatest overall acceptance score. Sweet overload, on the other hand, has an effect on the preferences of responders in sample.

Physical Characteristic Analysis

Table 3 shows the summary of physical analysis for all six samples which include water activity, total soluble solid (TSS), pH and colour differences.

Table 3 Physical characteristic of the formulated instant papaya drink samples

Parameter	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Water activity	0.369 ±0.001	0.369 ±0.001	0.368 ±0.001	0.363 ±0.001	0.358 ±0.001	0.355 ±0.001
Total soluble solid (Brix)	16.700 ±0.100	16.433 ±0.058	16.167 ±0.058	16.067 ±0.116	16.033 ±0.058	15.900 ±0.100
pH	6.437 ±0.015	6.447 ±0.055	6.450 ±0.010	6.457 ±0.032	6.473 ±0.035	6.497 ±0.055
Colour difference *ΔE*	0.206 ±0.028	0.307 ±0.036	0.232 ±0.050	0.303 ±0.039	0.239 ±0.042	0.232 ±0.050

In general, all of the samples had water activities ranging from 0.355 to 0.369, which was a good result. When the water activity of a food sample is less than 0.95, it indicates that the sample does not have enough moisture to enable the growth of bacteria, yeast, and mould, due to lack of water that is required for cell metabolism. Due to the fact that water activity has an impact on food stability, it is necessary to bring it to a reasonable level. The United States of Food and Drug Administration (USFDA) sets 0.85 as the upper limit of water activity for shelf stable food. This formulation demonstrated that it is a stable product.

A study conducted by Calvacanti *et al*. (2006) found that milk drinks had a total soluble solid content ranging from 13.26 to 26.30, whereas ready-to-drink juices had a total soluble solid level of 10.23 to 13.53. In this study, the papaya milk drinks showed the total soluble solid content in the range from 15.90 to 16.70.Total soluble solid indicates sugar content and thus sweetness, which is an important factor for beverages or other fruit-based products in order to have a desirable taste as perceived by the consumers.

The pH values of the papaya milk drinks obtained were slightly acid to neutral from sample 1 to sample 6, with range values of 6.44 to 6.50. Generally, a dairy or milk products tend to have pH level just below neutral as it contains lactic acid. However, the results of this investigation revealed that papaya milk drinks are slightly more acidic than regular milk products due to the presence of citric acid in papaya powder.

In terms of colour, all samples had less than 1.0 of colour difference ΔE, which is generally an insignificant difference. A colour difference of less than 1.0 is usually considered not perceptible by human eyes (Wojciech and Maciej, 2011). This is a good result because it is regarded acceptable in commercial production with a lower ΔE.

Proximate and microbial analysis

Sample 3 with the highest overall acceptability and highest rating of descriptive score among the six samples was further selected for proximate analysis and microbial test. **Table 4** lists the amount of moisture, protein, total fat, total dietary fibre, ash and total carbohydrate obtained from the proximate analysis. The protein content and total carbohydrate in Sample 3 were higher than that of the commercial sample (Taiwan papaya milk, Famous House Food Industrial Corp., Taiwan), while the fat content was lower, indicating that our formulated papaya drink could be a healthier option for the consumers. Sample 3 also contained 0.2% dietary fibre which possibly came from the papaya powder.

Table 4 Proximate analysis result for the best formulated drink mix (Sample 3) and commercial sample

Item	Sample 3 from this study (%)	Commercial papaya milk (%)
Moisture content	5.3	N/A (liquid)
Protein	12.6	6.0
Total fat	0.3	4.0
Total dietary fibre	0.2	N/A
Ash	4.1	N/A
Total carbohydrate	77.7	54.4

For the microbial test, the total plate count of microbial is 7.3×10^3 CFU/gm, while the coliform tested is less than 10 which is categorized as accepted and satisfied, as stipulated in **Table 1** to the Fifteenth Schedule of Malaysia Food Regulations 1985. This result indicates that the papaya drink mix from this study is safe and possible spoilage due to microorganism's growth in food is low which may cause unfavourable changes in flavour, concentration, texture, colour, or appearance. These results showed that this product is eventually suitable and safe for human consumption.

CONCLUSION

This study was carried out to formulate an instant drink mix from papaya powder. Sample 3 with 23% papaya powder, 40% milk powder, 28% fructose, and other additive ingredients was chosen as the most desired formulation. Overall, the sample was described as having a delicate salmon pink hue, being sweet, smooth, and creamy in texture. The proximate analysis revealed that the amount of protein and carbohydrate in Sample 3 was superior to that of commercial papaya milk sample, with lower fat content which demonstrate its potential as a healthy and nutritious drink. Results of physical analysis including water activity, total soluble solids, pH, and colour of each sample also showed that the formulation was acceptable and within reasonable range. Microbiological analysis showed that the sample contained 7.3 x10^3 CFU/gm in total plate count, indicating that it is safe for storage and human consumption. This study establishes a practical use of powdered papaya fruit incorporated into instant drink mix that can be nutritional and convenient with good sensory properties.

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