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Development of jelly drink from cultivated banana pseudo stem juice (*Musa sapientum* L.) and pineapple juice supplemented with pineapple pulp

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Abstract

This study sought to create a new jelly drink using the pseudo stem juice from cultivated banana plants and pineapple juice supplemented with pineapple pulp (CBPP jelly drink). A total of five formulations of pineapple juice/pineapple pulp ratio (20/0, 15/5, 10/10, 5/15, and 0/20) revealed that the selected ratio of pineapple juice/pineapple pulp was the ratio of 5/15 w/w. However, the evaluation panels rated the texture liking score at 5.9 (<6.0) by preference test (9-point hedonic scale), and therefore the addition of kappa-carrageenan was tested to improve this texture liking score of the CBPP jelly drink. The four formulations were varied by the amount of kappa-carrageenan (0.4%, 0.5%, 0.6%, and 0.7% w/w of all ingredients). As a result, the sensory evaluation showed that the optimal gelling agent was 0.5% kappa-carrageenan because the texture was appropriate in both elastic and softness parameters. The optimal formulation of the developed CBPP jelly drink consists of cultivated banana pseudo stem juice 73%, pineapple pulp 15%, natural cane sugar 6.7%, pineapple juice 5%, citric acid 0.3%, and kappa-carrageenan 0.5% (w/w of all ingredients). The developed jelly drink contained 13.56% crude fibre, 7.30 N hardness value, and 0.994 water activity. The colour of the product was light orange-yellow with L* a* b* value = 52.11, 1.23, and 18.10 respectively. The aerobic plate count and yeast and mould were less than 10 CFU/g. For antioxidant potential, they had 51.1% DPPH scavenging activity. The consumer acceptability test using 100 consumers indicated that the product was liked very much (Overall liking score = 7.2) and 95% of the consumers accepted the product.

1. Introduction

Bananas are grown throughout the world's tropical and sub-tropical regions and are the fruit of the herbaceous *Musa* plant (Aurore *et al*., 2009). They are a popular fruit all around the world and are rich in nutrients (Wall, 2006; Mohapatra *et al*., 2010). Following the process of harvesting, significant quantities of waste products are generated, namely, the banana pseudo stem, which can be used to make ropes or plates which are biodegradable, along with other items in common daily use (Shiva *et al*., 2018). Only a negligible amount is considered food. The banana pseudo stem has been reported to contain fibre, total carbohydrates, and cellulose (Saravanan and Aradhya, 2011; Ho *et al*., 2012). The banana pseudo stem is highly perishable because it comprises a high level of moisture content and has a short shelf life (Ho *et al*., 2012). The banana pseudo stem is rich in fibre content and it helps in weight control. The high fibre content relieves constipation. Other key components are potassium and vitamin B6, which can act as a diuretic to relieve the body of toxins. Therefore, the juice of the pseudo stem may be capable of dissolving pre-formed stones in the urinary bladder, as well as inhibiting the production of additional stones (Saravanan and Aradhya, 2011; Lakshman *et al*., 2015). Interest in the banana pseudo stem has been prolonged in recent times due to bioactive compounds (polyphenols). They are secondary metabolites that possess properties such as radical scavenging activity, which bring on health benefits such as obesity, diabetes (type II), glucose homeostasis, and systemic inflammation (Cao *et al*., 2019; Fraga *et al*., 2019, Lau *et al*., 2020).

Another major global fruit crop is pineapple (*Ananas comosus* L.), considered the queen of fruits as a

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consequence of its delightful fragrance and taste (Bartolome *et al*., 1995). It is ranked as the third most significant fruit from the tropics in terms of importance in world production, behind the banana and citrus according to Joy and Rajuva (2016). It is particularly juicy and flavoursome and offers a number of beneficial health properties. It is high in water content, sugars, vitamins A, C and beta-carotene, carbohydrates, fat, protein, fibre, antioxidants, and ash (Hemalatha and Anbuselvi, 2013). Pineapple juice is also popular worldwide, as it can be generated as a byproduct of the canning process. It takes various forms, including blended, single strength, and reconstituted or concentrated, and plays a role in drink flavouring as well as contributing to a range of other products (Arthey, 1995; De Carvalho *et al*., 2008).

People are busier with their work and have less time to find a balanced meal. Developing a nutritious, ready-to-eat food product to delay hunger and simultaneously satisfy consumer demand is a challenge. Jelly drinks were initially produced to act as snacks that would counter the pangs of hunger, but they are in fact a drink containing water, sweeteners, carrageenan (that creates the jelly texture), artificial flavouring, and colouring that combine to create an end product with some unique characteristics such as colour and flavour from fruits or vegetables, chewiness, and the property of being able to be sipped using a straw (Agustin and Putri, 2014; Nuraeni *et al*., 2019). Drinking jelly is a food product that can be consumed between main meals (Permana *et al*., 2020). This product is going to be a popular food for consumers in all age groups due to its colour, flavour, and texture. In 2020, the market value of jelly drinks in Thailand was approximately 2,993 million baht, and this may grow to 3,500 million baht by the end of the year (Windmill, 2020). Thus, drinking jelly was chosen as the food model in this study.

This study had the principal objective of creating a jelly drink from banana pseudo stem juice mixed with pineapple juice supplemented with pineapple pulp (CBPP jelly drink). Accordingly, it was necessary to discover the ideal ratio in which to combine the pineapple juice with pineapple pulp, along with the most suitable concentration level for the added carrageenan, with a focus on good odour, flavour, and texture. In addition, the developed CBPP jelly drink underwent evaluation of its physical properties, chemical properties, antioxidant activity, and acceptance level by consumers.

2. Materials and methods

2.1 Materials

Cultivated banana pseudo stem (*Musa sapientum* L.) and pineapple (*Ananas comosus* L.) were obtained from Talad Tong Chom, Prachinburi province. Natural cane sugar came from Mitr Phol Group. Kappa-carrageenan was supplied by Thai Food Chemical Co., Ltd., Thailand. The citric acid (food grade) was supplied by Cofco Biochemical Co., Ltd., Thailand.

2.2 Reagents

The 1,1-diphenyl-2-picrylhydrazyl (DPPH) used in this study was purchased from Sigma-Aldrich (St. Louis, MO, USA), while all other chemicals employed were of analytical grade for this research.

2.3 The preparation of cultivated banana pseudo stem juice, pineapple juice and pineapple pulp

For cultivated banana pseudo stem juice *(CBP juice),* it was necessary first of all to remove the external layer of the cultivated banana pseudo stem to reveal the internal core, which had a diameter not exceeding 6 cm. This core was then chopped into smaller parts of approximately 1.5 × 1.5 cm in size, soaked in 2% citric acid for 5 mins, and then washed with tap water. Distilled water 1:3 (w/w) was then used to blend the pieces, whereupon a 2-layer muslin cloth was used for filtration. For pineapple juice and pineapple pulp, the pineapples were cleaned with tap water. The shell was peeled and removed using a stainless-steel knife. The pineapple was cut into small pieces (1.5 × 1.5 cm) and blended with additional distilled water 1:2 (w/w) into a puree using a fruit juice blender, before filtering through a 2-layer muslin cloth to separate the pineapple juice and pulp. After that, the juices of the cultivated banana pseudo stem, pineapple, and pineapple pulp were pasteurized at 85°C for 15 mins and stored under freezing conditions (-18°C). The juice was later brought to room temperature and used for the experiment.

In a preliminary study, the development of banana pseudo stem juice was studied. The result found that banana pseudo stem juice had an astringent taste. The improvement of this astringent taste was tested by the addition of fruit juices from various fruits including orange, pineapple, grape, papaya, carrot, and lime. The pineapple juice was selected to improve the astringent taste of the banana pseudo stem. The optimal formulation consisted of banana pseudo stem juice 73%, pineapple 20%, sugar 6.7%, and citric acid 0.3%. This formulation was chosen as the basic formulation to produce the jelly drink (Table 1) for further study.

2.4 Study of the ratio of pineapple juice to pineapple pulp (ratio of PJ:PP) optimization

Each ingredient (cultivated banana pseudo stem juice, pineapple juice/pineapple pulp ratio (20/0, 15/5,

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Table 1. CBPP jelly drink formulation and the ratio of pineapple juice and pineapple pulp

Treatment	CBP juice (%)	Pineapple juice (%)	Pineapple pulp (%)	Sugar (%)	Citric acid (%)
PJ20PP0	73	20	0	6.7	0.3
PJ15PP5	73	15	5	6.7	0.3
PJ10PP10	73	10	10	6.7	0.3
PJ5PP15	73	5	15	6.7	0.3
PJ0PP20	73	0	20	6.7	0.3

10/10, 5/15, and 0/20), natural cane sugar, salt, and citric acid) was weighed for the experimental formulation (Table 1). All ingredients were blended until the mixture was homogeneous and then heated to reach a temperature of 73-75°C. The kappa-carrageenan was added at the level of 0.4% w/w of all ingredients as specified by Rattanatavon *et al*. (2020) and then the mixture of the jelly drink was pasteurized at 73-75°C for 2 mins until all ingredients had fully dissolved, whereupon the mixture was placed in a closed sterile container and allowed to stand for 1 hr at room temperature (25°C). It was subsequently cooled until an equilibrium was reached, whereupon it was stored in a refrigerator at a temperature of 4°C. The jelly drink obtained under the optimum ratio of pineapple juice to pineapple pulp was evaluated in terms of physical, chemical, and sensory evaluation.

2.5 Study of the kappa-carrageenan optimization

From previous studies, the ratio of pineapple juice to pineapple pulp (5:15% w/w) was selected and used in this study. All ingredients consisting of 73% cultivated banana pseudo stem juice (CBP juice), 20% pineapple juice and pineapple pulp (ratio of pineapple juice/ pineapple pulp = 5/15% w/w), 6.7% natural cane sugar, and 0.3% citric acid) were blended until the mixture was homogeneous. It was then heated to reach a temperature of 73-75°C. The kappa-carrageenan was added at levels of 0.4%, 0.5%, 0.6% and 0.7% w/w (KC0.4, KC0.5, KC0.6, and KC0.7) of all ingredients and then the mixture of the jelly drink was pasteurized at 73-75°C for 2 mins in order to allow all ingredients to fully dissolve, whereupon the mixture was placed in a closed sterile container and allowed to stand for 1 hr at room temperature (25°C). It was subsequently cooled until an equilibrium was reached, whereupon it was stored in a refrigerator at a temperature of 4°C. The jelly drink obtained using the optimum kappa-carrageenan level was evaluated in terms of physical, chemical, and sensory evaluation.

2.6 Measurement of the physical and chemical properties

Measurement of the physical and chemical properties of the CBPP jelly drink product involved total soluble solids, pH, water activity, texture, colour, and sensory evaluation. Assessment of the total soluble solids was carried out with a hand refractometer (ATAGO Model N-1E) 0-32 ºBrix from ATAGO Co., Ltd. (Japan). Texture analysis was performed using a texture analyser (TA.XT.Plus) from Stable Micro Systems (Godalming, United Kingdom). The TPA (texture profile analysis) test required a flat cylindrical probe P/75 along with a perforation test using a probe P2 with a 2-mm diameter. Testing involved taking measurements of the force on compression, where a 50-kg load cell was used along with a trigger force measuring 0.05 N. The product water activity was assessed with a water activity meter (AQUA LAB Model series 3TE) supplied by Meter Group, Inc. (Washington, USA). The pH value was determined via pH meter (WTW Model InoLab pH Level 1) from Mettler-Toledo (Giessen, Germany), while testing of the colour required the use of a colourimeter (Hunter Lab Model Colorflex 45/0) from Konica Minolta (Virginia, USA) in the CIELab, where L* represented lightness and the a* and b* values indicated the opposing colour coordinates, where negative a* indicated green and positive a* indicated red and negative b* indicated blue, and positive b* indicated yellow. Ten CBPP drinking jellies for each formulation were used as samples for the recording of measurements. Sensory evaluation of the CBPP jelly drink products was assessed through the use of a 9-point hedonic scale where 9 = the strongest liking, and 1 = the strongest dislike for 40 untrained panel members to determine the overall liking, colour, odour, texture, and taste of the jelly drink (Peryam and Pilgrim, 1957).

2.7 Statistical analysis

The experimental data were analysed statistically by one-way analysis of variance (ANOVA) using Statistical Software Package for Social Sciences; SPSS Inc., and IBM Co. Determination of significant differences among treatment means was performed by DMRT (Duncan's new multiple range tests) at a 95% confidence interval ($p<0.05$).

2.8 Quality analysis of the developed CBPP jelly drink

The total soluble solid was evaluated using a hand refractometer (ATAGO Model N-1E). A water activity meter (AQUA LAB Model series 3TE) was employed to assess water activity for the product, while a pH meter (WTW Model InoLab pH Level 1) was used to measure

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the pH value. Crude fibre content was determined according to AOAC methods (AOAC, 2000). Texture analysis was carried out with a texture analyzer (TA.XT.Plus), and a colourimeter (Hunter Lab Model Colorflex 45/0) was employed to obtain the colour values (CIE, L* a* b* values). Product quality was evaluated by microbial aerobic total plate count and yeast and mould following the Bacteriological Analytical Manual (BAM) methods (BAM, 2001). The inhibition percentage for the DPPH scavenging assay used to measure antioxidant activity was obtained in line with the approach recommended by Novelina *et al*. (2016).

2.9 Consumer acceptance test of the developed CBPP jelly drink

One hundred participants who lived in Prachinburi province, Thailand, were recruited in line with the following criteria: they had to be 18-60 years old, be regular consumers of jelly drinks, and be health-conscious. The questionnaires were composed of the product acceptability test and the purchase intent for the developed jelly drink. The sample was served as 150 g in a laminated pouch (Figure 1) to each consumer. Consumers evaluated the sample for overall acceptability, colour, odour, texture, and taste, through the use of a 9-point hedonic scale, where 9 = the strongest liking, and 1 = the strongest dislike (Peryam and Pilgrim, 1957).

3. Results and discussion

3.1 Optimization of the ratio of pineapple juice to pineapple pulp (ratio of PJ:PP)

Table 2 and Table 3 show the influence of the ratio

Figure 1. The developed CBPP jelly drink

of pineapple juice to pineapple pulp on the physical, chemical, and sensory properties of the CBPP jelly drink in terms of water activity, pH value, total soluble solids, hardness, and colour value. The results of the statistical analysis showed that water activity, hardness, and colour presented significant differences. It was found that increasing the pineapple pulp increased the water activity and hardness of the product ($p<0.05$) because pineapple pulp contained hemicellulose and cellulose (Aziz *et al*., 2009) which had the potential to hold water and form fibre in the CBPP jelly drink.

The colour values of the CBPP jelly drink were measured. Redness (a*) and yellowness (b*) of the CBPP jelly drink were significantly affected by pineapple pulp content ($p<0.05$). According to Table 3, high values of redness and yellowness were observed at high levels of pineapple pulp. The increase in pineapple pulp from 5% to 20% increased the values of redness and yellowness due to the colour of the pineapple pulp (orange-yellow). However, the increase in pineapple pulp decreased the lightness although this was not significant ($p>0.05$). Increasing the presence of pineapple pulp had no significant effect on the pH value

Table 2. Physical and chemical properties of the CBPP jelly drink in various ratios of pineapple juice to pineapple pulp

Treatment	Water activity (aw)	pH value^{ns}	TSS (°Bx)^{ns}	Hardness (N)	Colour value		
					L*^{ns}	a*	b*
PJ20PP0	0.963±0.001^{e}	3.50±0.01	12±0.0	3.41±0.55^{d}	54.72±0.96	1.06±0.08^{d}	16.76±0.64^{d}
PJ15PP5	0.966±0.001^{d}	3.50±0.01	12±0.0	4.23±0.46^{cd}	54.16±1.01	1.46±0.07^{c}	18.22±0.58^{c}
PJ10PP10	0.971±0.001^{c}	3.50±0.01	12±0.0	5.07±0.64^{bc}	53.76±0.72	1.70±0.22^{bc}	18.79±0.59^{c}
PJ5PP15	0.974±0.001^{b}	3.49±0.01	12±0.0	5.46±0.51^{ab}	53.23±0.90	1.94±0.21^{ab}	19.97±0.52^{b}
PJ0PP20	0.981±0.001^{a}	3.49±0.01	12±0.0	6.19±0.55^{a}	52.62±1.10	2.09±0.29^{a}	21.67±0.56^{a}

Values are presented as mean±SD. Values with different superscripts within the same column are significantly different ($p<0.05$). ^{ns} No significant difference

Table 3. Sensory properties of the CBPP jelly drink in various ratios of pineapple juice to pineapple pulp

Treatment	Colour	Odour^{ns}	Texture^{ns}	Taste^{ns}	Overall liking^{ns}
PJ20PP0	6.2±0.8^{b}	6.3±1.1	5.5±0.6	6.4±0.8	6.4±1.0
PJ15PP5	6.3±1.1^{b}	6.4±1.2	5.7±0.9	6.5±0.8	6.5±0.7
PJ10PP10	6.8±0.8^{a}	6.6±1.0	5.7±0.8	6.6±0.7	6.5±0.6
PJ5PP15	6.9±0.7^{a}	6.7±0.8	5.9±0.6	6.7±0.4	6.8±0.5
PJ0PP20	6.8±0.8^{a}	6.4±1.0	5.6±0.7	6.6±1.0	6.6±0.7

Values are presented as mean±SD. Values with different superscripts within the same column are significantly different ($p<0.05$). ^{ns} No significant difference

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or the total soluble solids for the product (p>0.05) because the pH value and TSS of pineapple juice are equal to pineapple pulp.

The influence of pineapple pulp on attribute liking scores for colour, odour, texture, taste, and overall liking of the CBPP jelly drink at different pineapple pulp levels can be seen in Table 3. The highest liking scores for colour (6.9), odour (6.7), texture (5.9), taste (6.7), and overall liking (6.8) were found in the CBPP jelly drink substituted with pineapple juice with 15% pineapple pulp. However, the texture liking score of the CBPP jelly drink of 5.9 was equivalent only to "slightly liked". The liking score should be more than 6.0 (Resurrection, 1998). Thus, the kappa-carrageenan concentration was studied in order to improve the texture of the CBPP jelly drink.

3.2 The kappa-carrageenan optimization

Table 4 and Table 5 show the influence of kappa-carrageenan concentration on the physical, chemical, and sensory properties of the jelly drink in the context of water activity, pH value, total soluble solids, hardness, and colour value. The results of statistical analysis showed that water activity, hardness, and colour presented a significant difference. It was found that increasing the kappa-carrageenan from 0.4% to 0.7% increased the water activity and hardness of the product (p<0.05). It is important to know the optimum concentration of added carrageenan in order to produce a CBPP jelly drink product with good textural characteristics. The main kappa-carrageenan properties included the capacity to hold water within a gel, thus providing it with the ability to deliver a good texture (Piculell, 1995). To make a jelly drink product, carrageenan can be used because of its ability as a gel-forming agent (Kaya *et al*., 2015). The gel from kappa-carrageenan is brittle and produces a high amount of syneresis. In this study, however, the use of banana pseudo stems and pineapple pulp, which have high fibre content, can help reduce the amount of syneresis. Jelly drink texture is different from normal jelly products because it should be firm enough to form a jelly but soft enough to be sipped using a straw with only a small amount of syneresis presence (Hartati and Djauhari, 2017). Carrageenan concentrations influenced the hardness value, causing an increase as reported earlier by Totosaus *et al*. (2005), whose work explained how gums and sucrose compete for water, noting that when fewer water molecules reach the gum molecular chains, this could lead to an increase in the gel hardness value.

The colour values of the CBPP jelly drink were measured. Lightness (L*), redness (a*), and yellowness (b*) of the CBPP jelly drink were significantly affected by the concentration of kappa-carrageenan (p<0.05). According to Table 4, the increase in kappa-carrageenan from 0.4% to 0.7% decreased the values of lightness and increased the values of redness and yellowness. When food products undergo thermal processing, non-enzymatic browning may occur via the Maillard reaction, which results in a loss of colour and aromatic compounds (Rattanatavon *et al*., 2020). For the pH value and TSS of the CBPP jelly drink, the concentration changes of kappa-carrageenan from 0.4% to 0.7% did not lead to any significant difference (p>0.05).

When considering the mean values obtained for the attribute liking scores on the 9-point hedonic scale used in preference tests (Table 5), it could be seen that increasing the kappa-carrageenan concentration from

Table 4. The physical and chemical attributes of the CBPP jelly drink when various concentrations of kappa-carrageenan are employed

Treatment	Water activity (aw)	pH value^{ns}	TSS (°Bx)^{ns}	Hardness (N)	Colour value		
					L*	a*	b*
KC0.4	0.982±0.001^{d}	3.50±0.01	12±0.00	5.72±0.42^{d}	53.42±1.14^{a}	1.06±0.07^{c}	16.76±0.72^{c}
KC0.5	0.985±0.000^{c}	3.50±0.01	12±0.00	7.10±0.30^{c}	52.02±0.99^{ab}	1.18±0.12^{c}	18.00±0.47^{b}
KC0.6	0.988±0.001^{b}	3.50±0.01	12±0.00	8.21±0.58^{b}	51.63±1.05^{ab}	1.50±0.05^{b}	18.79±0.44^{ab}
KC0.7	0.991±0.001^{a}	3.51±0.01	12±0.00	9.62±0.60^{a}	50.05±1.11^{b}	2.53±0.08^{a}	19.62±0.53^{a}

Values are presented as mean±SD. Values with different superscripts within the same column are significantly different (p<0.05). ^{ns} No significant difference

Table 5. Sensory properties of the CBPP jelly drink using kappa-carrageenan at various concentrations

Treatment	Colour^{ns}	Odour^{ns}	Texture	Taste^{ns}	Overall liking
KC0.4	6.8±0.8	6.4±0.6	6.0±0.6^{b}	6.7±0.6	6.7±0.8^{b}
KC0.5	7.1±0.5	6.6±0.8	6.8±0.6^{a}	6.9±0.6	7.3±0.8^{a}
KC0.6	6.9±0.8	6.5±0.7	6.6±0.6^{a}	6.8±0.7	6.9±0.8^{b}
KC0.7	6.7±0.7	6.5±0.6	5.9±0.3^{b}	6.7±0.5	6.6±0.6^{b}

Values are presented as mean±SD. Values with different superscripts within the same column are significantly different (p<0.05). ^{ns} No significant difference

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0.4% to 0.5% increased the texture and overall liking scores ($p<0.05$). In contrast, increasing the kappa-carrageenan concentration from 0.6% to 0.7% resulted in a lowering of the scores for texture and overall liking ($p>0.05$). For the CBPP jelly drink, the liking scores for colour, odour, and taste from 0.4%, 0.5%, 0.6%, and 0.7% kappa-carrageenan showed no significant differences. The CBPP jelly drink with the addition of 0.5% of kappa-carrageenan had the highest texture score (6.8 = like moderately) and overall liking score (7.3 = like very much). The addition of 0.5% of kappa-carrageenan enhanced and improved the sensory characteristics with the highest liking scores in terms of colour, odour, texture, taste, and overall liking of the CBPP jelly drink. Therefore, this formulation was selected to undergo further analysis.

3.3 The developed CBPP jelly drink qualities

The developed jelly drink offered 12ºBrix of total soluble solids, 3.50 for the pH value, 7.30 N of hardness, and 13.56% of crude fibre. The water activity of the product was 0.994. Colour values for L*, a*, b* of the developed jelly drink were 52.11, 1.23, and 18.10 respectively, and it had a light orange-yellow colour. Measurements for aerobic plate count, yeast, and mould did not exceed 10 CFU/g. The DPPH scavenging activity of the jelly drink provided 51.1% inhibition.

3.4 Consumer acceptance test of the developed CBPP jelly drink using a central location test

One hundred respondents participated in the consumer acceptance test. The respondents were aged in the range of 18 to 60 years, which was expected since the target consumers were pre-recruited. With regard to gender, the consumers were equally divided between males and females. Approximately 55% of respondents were employed and 32% of the respondents were students. Fifty-two per cent of the respondents had completed their bachelor's degree, and 35% had completed high school. Salary data revealed that 42% earned 20,001 – 25,000 baht/month.

For consumer acceptability, the liking scores in terms of colour, odour, texture, taste, and overall liking of CBPP jelly drink (mean values = 7.0, 6.7, 6.8, 7.0, and 7.2 respectively) demonstrated that the product was moderate to very much liked. The respondents accepted the CBPP jelly drink with a score of 95%, and the drink also received 95% for purchase decisions. The positive purchase intent for product costs (150 grams/laminated bag) at 10 baht, 15 baht, and 20 baht were 45%, 35%, and 20% respectively. For consumer behaviour, there is a positive relationship between consumer buying decisions and prices (the acceptable price attracts consumer consent to purchase products).

4. Conclusion

Based on the experiments, the best formulation CBPP jelly drink consists of cultivated banana pseudo stem juice 73%, pineapple pulp 15%, natural cane sugar 6.7%, pineapple juice 5%, citric acid 0.3% and kappa-carrageenan 0.5% (w/w of all ingredients). The liking scores were the highest for this particular formulation for colour, odour, texture, taste, and overall liking, while the sensory attributes were also the most highly rated. For nutritional value, the CBPP jelly drink had 13.56% crude fibre and 51.1% DPPH scavenging activity. The nutritional value of the developed CBPP jelly drink could represent a chance to deliver consumers with a healthier alternative to the common jelly drinks. The findings of this research may therefore serve to suggest a viable alternative use for cultivated banana pseudo stem waste and pineapple.

Conflicts of interest

The authors are willing to appropriately consider any potential conflict of interest and can report that there are no conflicts of interest to declare.

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