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Physicochemical and Sensory Properties of Pineapple Juice Incorporated with Herbs

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Abstract

Malaysia contains a diverse range of crops, encompassing fruits, vegetables, and several types of herbs. Pineapple also is classified as a tropical fruit, along with mango, papaya, and avocado. Pineapple is a rich source of vitamin C and has a high nutritional value. However, in Malaysia, it is not very popular to combine pineapple juice with some types of herbs. The study aims to develop pineapple juice with herbal, evaluate consumer acceptance and determine physicochemical analyses of the acceptance product. In this study, the samples used were pineapple, mint, basil and celery. Using formulations P (92% pineapple, 8% dates), PM (86% pineapple, 8% dates, 6% mint), PB (86% pineapple, 8% dates, 6% basil), and PC (86% pineapple, 8% dates, 6% celery), the juices were blended with a fruit blender. Both the physicochemical and sensory properties of the resulting products were analysed. Compared to the normal yellow colour of unadulterated pineapple juice, the addition of different herbs produced varying shades of greenish-yellow and brownish-yellow. The range for pH of pineapple juice is between 3.91 to 3.45. The physicochemical analyses were in optimum value except for the TSS value. For sensory evaluation, pineapple juice added dates (4.12) and pineapple juice added with mint (3.46) were preferred by the panellist. Thus, pineapple juice added with herbs has the potential to be healthy beverage.

1. Introduction

Pineapple fruit juice offers a delicious and refreshing way to pack the body with vital nutrients. Suitable for all ages, it's well-known for its richness in antioxidants like vitamins A, C, and E, which may help reduce the risk of certain cancers (Farid, 2015) (Debnath, 2012) [17][18]. Additionally, the soluble fibre in most fruits helps lower blood cholesterol levels (Debnath, 2012)[18]. Among these nutritious options, pineapple juice stands out for its particularly high content of vitamin C and the enzyme bromelain, making it increasingly popular.

Other than that, Malaysia is very rich with spices and herbs that benefit people. One of the famous herbs in this country is mint. According to Sönmez et al., (2010) [1] the use of mint (*Mentha spicata*) may enhance the process of removing blood lactate, leading to potential improvements in athletic performance. Basil is a prominent example of a Lamiaceae plant utilized in food preparation, medicinal, and the pharmaceutical sector. Basil extract can be utilised in place of synthetic antioxidants used in vegetable oils due to its abundance of components with high antioxidant activity. The other herbs that have more nutrients and people often use is celery (*Apium graveolens*) is a type of flowering plant from the Apiaceae family. The soft stems and leaves are

used as a vegetable either cooked or as a side dish with a sweet, crunchy and fragrant taste. Celery leaves are a cure for lowering high blood pressure (Yusni 2018) [2].

Health-conscious individuals are actively seeking the potential health benefits in their food and drinks. While maintaining a balanced diet and regular exercise are crucial for long-term health, some find it challenging to consume all necessary nutrients through solely whole foods. Consuming healthful beverages can bridge this gap and help reduce dependence on sugary drinks laden with artificial Flavors and added sugar.

Therefore, this study focused on the research into the development pineapple juice with herbal (mint, basil and celery and the physicochemical properties that are being conducted to promote the sensory attributes and consumer acceptability of pineapple juice with herbal.

2. Materials and Methods

2.1 Materials Specifications

The main components utilized in these analyses are pineapples and several varieties of herbs. The pineapple (*Ananas comosus*) was collected from Ayer Hitam, Kluang, Johor. The fresh herbal like mint, basil and celery were brought from nearby market at Muar.

2.2 Methods

2.2.1 Preparation of Juice

The pineapple and other varieties of herbs were thoroughly cleaned under tap water, and any foreign objects were removed after an intensive inspection. The pineapple fruit was peeled off and cut into little pieces. The herbs were also finely cut. To prepare the herbal pineapple juices, four different formulations were used. Each formulation followed the same basic steps: blending pineapple juice with a juice blender. Next, to remove any pulp or larger particles, the blended juice was then passed through a double-layered muslin fabric. To extend its shelf life and ensure safety, the juice was then pasteurized in a water bath at 85°C for 30 minutes.

Table 1 *The formulation of pineapple juice with herbs*

Ingredient of sample	Composition (%)	Code
Pineapple	92	P(852)
Dates	8	
Pineapple	86	
Dates	8	PM(591)
Mint	6	
Pineapple	86	
Dates	8	PB(247)
Basil	6	
Pineapple	86	
Dates	8	PC(301)
Celery	6	

2.3 Sensory analyses

The sensory acceptance of pineapple juice with the herbs was measured using a 5-point hedonic scale (Islam, 2021) [19]. The overall acceptability was evaluated by 50-person untrained panellists of students and staffs Universiti Tun Hussein Onn Malaysia. The panel members were requested in measuring the terms identifying sensory characteristics like colour, aroma, sweetness, sourness, aftertaste and overall acceptance on 5-point hedonic scale.

2.4 Physicochemical properties

Standard determination of physicochemical properties is important to determine the quality of pineapple. The physicochemical properties measured include pH value, colour and total soluble solid (TSS) following AOAC [5].

2.4.1 pH value

Potential of hydrogen (pH) was determined by a digital pH meter (pH700, Eutech Instruments). The amount of hydrogen ions present determines the pH value. Standardization with distilled water ensures accurate results

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when analysing sugar content later (Alqahtani et al., 2022) [3]. If the reading is 7 (neutral) it can be continued with the analysis. The analysis was continued after done in triplicate.

2.4.2 Colour

Color spectrometer (PFXi-195/1 spectrophotometric colorimeters) was used to determine the colour profit of the juices sample. Both black and white glass were utilized in the process of standardization (Assawarachan et al., 2010) [20]. In the following step, the sample was placed in a petri dish, and the color spectrophotometer was used to perform the scan. The values for L* (whiteness/darkness), a* (redness/greenness), and b* (yellowness/blueness) can be acquired from the screen (AOAC, 2016) [5]. The test was conducted in triplicate and the results were expressed as mean ± standard deviation values.

2.4.3 Total Soluble Solid (Brix°)

Refractometer (RX 5000, Atago, Japan) was used to determine the total soluble solid (Qudsieh et al., 2001) [4]. The refractometer was calibrated by using distilled water. Distilled water will be wiped clean after calibration and drop of sample was placed on the prism. The result is read as °Brix approximately at room temperature (25±2 °C) (Aadil et al., 2013) [6]. A triplicate test was carried out, and the results were presented as the mean value ± the standard deviation.

2.4.4 Statistical analyses

All the experiments were done in triplicate for each sample. Means and standard deviations between values were calculated and analyses through IBM SPSS Statistic version 27 software, using one-way analysis of variance (ANOVA) at a significant level of 0.05, differences are considered statistically significant when p-value less than 0.05 ($p < 0.05$). The significant statistical differences between the means will be compared by using Turkey's test at a significant level of 0.005 ($p < 0.005$). Mean and standard deviation were the one-way that the result was presented.

3. Results and Discussion

3.1 Sensory analyses

4 formulations were set up in preparing pineapple juice added with mint, basil and celery. The results were tabulated in Table 2.

Table 2 *Means score for each sensory attribute by untrained panellists*

Samples	Colour	Aroma	Sweet	Sour	Aftertaste	Overall acceptance
P (852)	4.26±0.88^{a}	4.34±0.85^{c}	3.78±1.13^{b}	3.86±1.14^{b}	3.92±1.05^{b}	4.12±0.90^{b}
PM (591)	3.98±1.04^{a}	3.28±1.25^{b}	3.56±1.05^{ab}	3.38±1.07^{ab}	3.42±1.27^{ab}	3.46±1.22^{a}
PB (247)	3.96±0.93^{a}	2.52±1.25^{a}	3.18±1.04^{a}	3.18±1.04^{a}	2.90±1.06^{a}	3.06±0.96^{a}
PC (301)	4.02±0.80^{a}	3.10±1.06^{b}	3.20±1.09^{a}	3.10±1.09^{a}	3.08±1.05^{a}	3.08±1.07^{a}

Values are mean ± SD. Means with different alphabet superscripts are significantly different at $p<0.05$

In terms of colour, the highest acceptance is sample P (4.26) and the lowest is sample PB (3.96). This is because sample P only included pineapple juice, however other samples also contained green herbs, and when it was heated to a pasteurized temperature, the colour turned rather darker. The chlorophyll (green pigment) is sensitive to heat and it can break into other pigments contributing to the overall darkening of the pineapple juice with herbs (Pandiselvam et al., 2023) [7].

Next, for aroma attributes, the highest acceptance is sample P (4.34) while the lowest acceptance is sample PC (3.10). This is due to pineapple aroma is more familiar and well-likes scent for most people while the aroma of basil has many abundant volatile compounds such as limonene (citrusy), α-pinene (piney), and β-pinene (peppery). The most prevalent volatile molecule in basil is linalool, which generally accounts for 30–50 % of the plant's essential oil. It smells sweet and flowery with a touch of spice and citrus (Simon et al., 1999) [8].

Then, the highest sweet attribute is sample P (3.78) while the lowest sweet attribute is PB (2.52). When combined with pineapple juice, the panellists will smell a combination of anise and clove notes due to the fructose and sucrose from the pineapple mixed with the complex scent of basil. Even though the same amount of sweetness was employed for all samples in these sweet quantities, the panellists noticed that each sample's sweetness varied.

Besides, for sour attributes the highest acceptance is sample P (3.92) and sample PB (2.90) get the lowest acceptance of sour attributes. In general, malic and citric acids are present in pineapple, with citric acid being

the primary source of the fruit's sour flavour (Pino et al., 2007)[9]. When basil is added to pineapple juice, the sour flavour is diminished because of the volatile chemicals like methyl chavicol and eugenol that basil has, it can partially or completely conceal the sourness with a peppery or herbal flavour.

As expected, the highest score in terms of overall acceptance is sample P whereas sample PB obtained the lowest score which is unexpected. Panellists responded less favourably to samples scoring between "neither like nor dislike" and "like slightly" due to a noticeable difference in certain characteristics compared to other samples. Despite this, sample P received the highest overall acceptance score from the majority, suggesting its potential for commercialization. Interestingly, this aligns with Ogori's 2021 study [21], which indicated that excessive use of herbs can negatively impact panellist acceptance.

3.2 Physicochemical Properties of Pineapple Juice with herbs

The physicochemical analyses of pineapple juice added with mint, basil and celery was tested and characterized for its pH, TSS and colour.

3.2.1 pH value

Table 3 *pH value of juice pineapple added with mint (PM), basil (PB) and celery (PC)*

Samples	pH
P	3.80 ± 0.15^{b}
PM	3.82 ± 0.06^{b}
PB	3.91 ± 0.00^{c}
PC	3.49 ± 0.34^{a}

Values are mean ± SD. Means with different alphabet superscripts are significantly different at $p<0.05$.

From Table 3, it can be observed that the mean of pH value of all the samples were within the range of 3.49 to 3.91 in the range of acid. According to Shalini (2018) [15] the pH of pineapple juice with mint is 3.9 while pineapple juice with basil is 3.5. Thus, it still follows the previous study and the reading was acceptance. The highest potential hydrogen of pineapple juice is samples PB while the lowest pH value is samples PC. The larger the fruit slice, the lower the juice output and extraction efficiency and the higher the extraction loss. It is still necessary to compare quality parameters including vitamin C, the solid-to-acid content ratio, titratable acidity, and the recovery of the aroma component to determine how the extraction process affects the nutritional and sensory quality of pineapple juice (Uckiah et al., 2009) [10]. Thus, as the pasteurization temperature increases, the pH value also decreases. (Moura et al., 1994) [11] reported that pH significantly affects the value of vitamin C, primarily influencing its stability and antioxidant activity.

3.2.2 Colour

According to Yıkmış et al., (2019) [12], colour is an essential component for choosing the most significant visual attribute of beverages. Table 4.5 showed the result of colour attributes of pineapple juice added with mint, basil and celery.

Table 4 *The result of colour attributes of pineapple juice added with mint (PM), basil (PB) and celery (PC)*

Samples	L*	a*	b*
P	10.9 ± 0.80^{b}	4.75 ± 0.06^{c}	16.32 ± 0.90^{d}
PM	0.19 ± 0.00^{a}	3.49 ± 0.40^{b}	9.35 ± 0.71^{b}
PB	0.21 ± 0.00^{a}	5.11 ± 0.15^{d}	12.70 ± 0.06^{c}
PC	0.18 ± 0.00^{a}	2.86 ± 0.36^{a}	7.86 ± 0.05^{a}

Values are mean ± SD. Means with different alphabet superscripts are significantly different at $p<0.05$.

The elevated levels of colour in a beverage can impact the physicochemical characteristics of the succeeding drink, particularly in terms of qualities and customer acceptance evaluations. Determination of L* refers to whiteness while the nearest negative value of L* refers as darkness (Zielińska et al., 2020) [13]. Based on Table 4, only sample P displayed white colour intensity due to there no added ingredient except dates. Although, the other three samples are nearest to darkness colour because the green plants occur in the pineapple juice. The process of pasteurized of all the sample in 75 °C for 25 minutes also due to darkness of samples.

The a* value of samples P is 10.9 that the lightest in colour compared to three sample (PM, PB and PC). The others a* value of colour is less that means the colour of it more to greenness while the highest value means

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redness. The reading of b* value for sample P is the highest which is 16.32 while the lowest b* value was held by sample PC (7.86). Overall, colour in pineapple juice added with herbs become darker and redness because of heat applied during pasteurization can induce the Maillard reaction, which is a non-enzymatic browning reaction involving the interaction of sugars and amino acids (Paravisini et al., 2017) [14].

3.2.3 Total Soluble Solid (Brix°)

Total soluble solid (Brix°) value for all samples was presented in Table 5. The highest value of TSS is samples P while the lowest is sample PM. All the samples are not significant to each other. During the process of developing the juice, the sweetener used is dates (*Phoenix dactylifera*) that are semi-dried which is a type called Deglet Noor dates. Based on Shalini et al., (2018) [15] the range of TSS value for pineapple fruit beverages flavoured with mint and basil is 18.02 and 17.34. The value of TSS in this experiment was quite different from the previous study because of the storage of dates in the chiller room (less than 4 °C). There was a reduction in non-reducing sugars during the storage period under cold temperature conditions.

Table 5 *Result of total soluble solid (TSS) of pineapple juice added with mint (PM), basil (PB) and celery (PC)*

Samples	TSS
P	13.02±0.01^{d}
PM	12.39±0.06^{a}
PB	12.78±0.01^{c}
PC	12.64±0.01^{b}

Values are mean ± SD. Means with different alphabet superscripts are significantly different at $p<0.05$

Besides, the ripeness of the pineapple may also be the cause of reading values that deviate from the previous study. It's possible that the pineapples used in the experiment were not as ripe as those utilized in the earlier research. For this reason, choosing ripe pineapples is important for ensuring that every pineapple is of the same quality. Based on the research done by Dhar et al., (2008)[16], they observed that pineapple fruits collected at various stages of maturity do not exhibit consistent quality.

4. Conclusion

In conclusion, pineapple juice added with mint, basil and celery was successfully produced using same formulations and procedures and conducted acceptance tests for sensory analysis and physicochemical analysis.

Besides, the sensory analysis result showed the majority of untrained panellist preferred pineapple juice, particularly pineapple juice added with dates (sample P) over the pineapple juice added with herbs. This is because, the panellist not common with the taste of herbs like mint, basil and celery. Although, pineapple juice added with mint got the second-highest mean score of overall acceptance after pineapple juice.

The physicochemical analysis of each sample, such as pH value, TSS and colour was determined. The pH value content of pineapple juice increased as the acidic content increased, but the TSS value content did not follow the previous study. Besides, the colour attributes of each sample still follow the previous study and get the acceptance of all untrained panellist. To address the perceived lack of sweetness, further research could explore adding natural sweeteners like stevia or honey, potentially bringing the sugar content closer to consumer preferences. However, it's crucial to carefully monitor any alterations to the natural sugar content, as it can impact the overall nutritional profile and vitamin C levels.

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Conflict of Interest

Declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

This journal requires that Nur Jannah Tokiman and Hatijah Basri take public responsibility for the content of the work submitted for review. The contributions of all authors must be described in the following manner:

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Nur Jannah Tokiman, Hatijah Basri;* ***data collection:*** *Nur Jannah Tokiman;* ***analysis and interpretation of results:*** *Nur Jannah Tokiman ;* ***draft manuscript preparation:*** *Nur Jannah Tokiman, Hatijah Basri. All authors reviewed the results and approved the final version of the manuscript.*

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