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Investigation of Nutritional Composition and Physiochemical Properties of Harumanis Flour

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ABSTRACT

Harumanis is known as the most popular mango in Malaysia. During the peak season, the over ripening and mishandling postharvest will be discarded as a waste and becoming a source of pollution. Harumanis mango has high nutritional value which can be utilized for human consumption mainly as sources of fiber. Hence, this experiment had been carried out to report the determination of nutritional composition and physiochemical properties of Harumanis pulp flour (HPF) which comprises percentage of the moisture content, ash, crude fiber, fat, protein, carbohydrate and physiochemical properties color, bulk density, water and oil absorption capacity, total phenolic content and antioxidant content. Overall, HPF consist of 6.2% of moisture, 9.69% of ash, 6.09% of protein, 1.75% of fat and 22.58% of crude fiber. These values have contributed for the calculation carbohydrate (75.68%) value which is show lower than control. On chemical properties, the water absorption capacity (1.99g/g), oil absorption capacity (1.91 g/g), total phenolic content (5.64%) and antioxidant capacity is 58.49%. The physical properties, bulk density (0.68 g/ml) and color properties for HPF gave a higher shade of yellow color compared to control. Besides, these analyses were conducted using analysis of variance (ANOVA) to analyze the differences among the means.

Keywords: Harumanis Mango, Mango pulp, Flour, Nutritional Quality

1. INTRODUCTION

The idea of developing Harumanis Pulp Flour (HPF) started to address the postharvest challenges and limited handling capacity of Harumanis mango during the peak season. Harumanis mango is not only popular for fresh market in Malaysia but also for export. However, the production of Harumanis is limited due to its sensitivity to the climate during fruiting seasons (Yusuf et al., 2020). Weather change can influence flowering of Harumanis where mango need long dry periods in order to produce reproductive sprouts and to initiate flowering. Due to short harvesting period and highly seasonal nature of the mango, this results in a greater market value during Harumanis production. Where it also becomes one of the reasons of the idea which to improve the shelf life of Harumanis mango. Therefore, transforming Harumanis pulp into a flour form could serve as a sustainable approach to extend its shelf life, reduce waste, and create new opportunities for value-added product development. Harumanis mango has a high nutritional quality with beneficial effects attributed to its macronutrient, micronutrient, and phytochemical composition. The new book provides an in-depth look of Harumanis mango fruit structure, including nutritious and phytochemical characteristics, as well as changes in these aspects through development and postharvest. The three categories of nutrients contained in mango include macronutrients, micronutrients, and phytochemicals.

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Besides that, Harumanis mango is also sources of carotenoids and contains carbohydrates structural like pectin and cellulose (Maldonado-Celis et al., 2019). During the growth and maturity phases, significant biochemical, physiological, including structural transitions happened, impacting principally the nutritional and phytochemical composition, softening, and changing aroma, taste, and antioxidant activity. Harumanis mango is abundant in bioactive compounds, such as carotenoids, phenolic compounds, reducing sugar, and vitamin C, are powerful antioxidants, and their regular use has been linked to the prevention of degenerative diseases like cardiovascular disease and cancer (Liu et al., 2013).

Although various studies have explored the nutritional and physicochemical characteristics of mango-based products, limited research has been conducted on Harumanis pulp flour specifically. Understanding the nutritional composition and physicochemical behaviour of HPF is crucial for evaluating its potential as a functional food ingredient and for supporting the valorisation of local Malaysian mango resources. Hence, this study aims to investigate the nutritional composition and physicochemical properties of Harumanis pulp flour, providing scientific evidence for its potential application in food and nutraceutical product development.

2. MATERIAL AND METHODS

2.1 Material

Fully ripe Harumanis mango fruit from a local market and the pulp then were frozen to keep it fresh for further use.

2.2 Preparation of Harumanis Pulp Flour

The frozen Harumanis pulp were thawed for 12 hours at 4 °C. The Harumanis was then cut and crushed into puree. The Harumanis puree was placed in the stainless-steel pan and dried for 16 hours at temperature (60 °C). The dry Harumanis was ground for 20 seconds in a laboratory fine grinder to make fine flour, then was sieved to get a particle size of 500 microns. Aluminium foil was used to seal the package, which was stored at a temperature of 4 °C.

2.3 Proximate Composition

Proximate analysis of moisture, ash, fat, protein and crude fiber were determined according to a standard AOAC 1990 method (Akther et al., 2020). Carbohydrate had been calculated in the formula below:

Carbohydrate= [100-(moisture+ protein+crude fat+ash+cude fiber)] (1)

2.4 Color

Color was determined by using colorimeter. The colorimeter meter was calibrated properly by using white calibrating plate at standard value of L= 35.81, a= 4.92, b= 9.28, Δa= -16.25, Δb= -2.40, and ΔE= 17.70. Color characteristics such as L*: Hunter Lightness, b*: yellowness (positive value) or blueness (negative value), a*: redness (positive value) or greenness (negative value), hue angle (angle 0° to 360°), and Chroma were recorded using Spectramagic software (Ho, 2017).

3. RESULTS AND DISCUSSION

3.1 Proximate Composition

The analysis was done on the Harumanis pulp flour while wheat flour and susu gold mango flour were act as control. According to table 1, it clearly showed that the mean value of moisture content among the sample were significant with the value of $p<0.05$. The moisture content of Wheat Flour (WF) was higher than Harumanis Pulp Flour (HPF) and Susu Mango Flour (SMF). According to Simsek (2020), the moisture content of flour is normally limited to 14% or less in flour specifications. The miller's goal is to keep the moisture content to be near to 14% as possible. The proximate analysis that was carried out on Harumanis pulp mango (HPF) showed that the moisture content for HPF, SMF and WF were found to be 6.2%, 4.85% and 12% respectively.

Table 1 showed that the HPF ash content was the higher compared to the other flour. HPF has a high ash level, it might be a rich source of dietary minerals. Aside from that, the high fibre content of HPF can aid to improve digestion, and the high fat nature of HPF means that adding it to baked products can boost the ability to make them with less shortening agent (Das et al., 2019). Where the ash content of HPF, SMF and WF is 9.69%, 7.3% and 5.21% respectively.
The crude fat content for HPF (1.75%) was slightly higher compared to SMF (1.29%). According to Nur Azura et al., (2020) changes in species, soil type, environment, and climate conditions may all have a role in the compositional variations. The crude protein content of SMF was higher than HPF where the reading is 7.49% and 6.09% respectively. The findings were contradicted from Noor et al., (2015) study on the protein of Perlis Sunshine mango flour from pulp (2.6%). The discrepancy in crude protein content between the prior and current research is most likely attributable to the Chokanan mango's distinct source.

Carbohydrate values were obtained from the formula by calculating the percentage of the crude fiber, protein, moisture, ash and fat in the sample. Thus by that calculation, it can be seen that HPF has the lower carbohydrate percentage compared to wheat flour (control) which is 76.27% and 79.98% respectively. The value shows the loss of some nutrients in the process of making. The crude fibre content for HPF was different from SMF where the HPF has higher fibre content which is 22.58% compared to SMF (18.89%). The fibre content in HPF were found to have higher compared to control (WF).

Table 1 Proximate composition of WF, HPF and SMF

Properties	WF (%)	HPF (%)	SMF (%)
Moisture	12.00± 0.10a	6.20± 0.42a	4.85± 0.24a
Ash	5.21± 1.97b	9.69± 0.76a	7.30± 1.97a
Crude Protein	0.13± 0.06a	6.09± 0.16b	7.49± 0.21b
Crude Fat	2.68± 0.35a	1.75± 0.23a	1.29± 0.12a
Carbohydrates	79.98± 2.39b	76.27± 0.13b	75.75± 0.72b
Crude fiber	12.89± 0.70a	22.58± 9.90b	18.89± 6.01b

Values are means of triplicates; ab means in same row with different superscripts are significantly different ($p<0.05$).

3.2 Functional Properties

As shown in Table 3, the water absorption capacity (WAC) of HPF (1.99 g/g) samples were significantly higher than the SMF (1.90 g/g) and WF (0.53g/g) samples. In order to make a regular dough, HPF absorbs more water than SMF and WF. These studies were comparable to the previous study by (Noor et al., 2015). Due to the high fibre content, the high WAC can result in high hydration properties. The studies revealed that fibres can aid hydration, which would be assumed to be owing to the hydroxyl groups in the fibre structure, which allow for more water interactions via hydrogen bonding. Researcher (Das et al., 2019) observed that composite flour dough absorbs more water than wheat flour dough, hinting those other flours, such as mango flour, must have a higher potential for water absorbent than WF.

The WF, HPF and SMF had oil absorption capacities of 1.80, 1.64 and 1.89 g oil per g of sample, respectively. According to the researchers (Das et al., 2019), WF has a far stronger swelling capability than HPF where it showed how the WF have high OAC compared to HPF. The swelling index decreased in Harumanis as the sprouted was increased. The bulk density of flour is essential because it impacts the packaging method for flour transportation (Das et al., 2019). The flour with a greater bulk density value would allow for tighter packaging and, as a result, better handling of huge amounts of flour. HPF bulk density (0.68 g/ml) was higher than SMF (0.65 g/ml) and WF (0.63 g/ml). This high bulk density can allow HPF augmented meals gain weight without increasing volume. The flour with a greater bulk density value would allow for tighter packaging and, as a result, better handling of huge amounts of flour (Sogi et al., 2013).

Table 2 Functional Properties of WF, HPF and SMF

Properties	WF (%)	HPF (%)	SMF (%)
WAC	0.53± 0.33[b]	1.99± 0.19[b]	1.90± 0.32[b]
OAC	1.80± 0.08[a]	1.64± 0.10[a]	1.89± 0.21[b]
Bulk Density	63.99± 0.02[a]	68.39± 0.03[a]	65.54± 0.02[a]

Values are means of triplicates; ab means in same row with different superscripts are significantly different ($p<0.05$).

3.3 Total Phenolic Content (TPC) and Antioxidant Properties

The study on TPC showed SMF were higher than HPF. The control (7.66%) show the higher TPC than HPF (5.64%) and SMF (6.09%). This is most likely owing to factors such as maturity stage, agronomic techniques, and cultivar varieties, all of which have a significant impact on the total phenolic content of mangoes. The principal phenolic component found in mango leftovers acts as a cell defender, and its antioxidant action can be seen even at low concentrations (Tirado-Kulieva et al., 2021).

Antioxidant activity was measured by the ability of extracts to scavenge radicals on DPPH. The percentage inhibition was directly related to the sample's overall phenolic content. The antioxidant activities of SMF were higher than HPF. The antioxidant content of WF (51.50%) was lower than SMF (64.39%) and HPF (58.49%). The existence of bioactive chemicals or natural antioxidants in mango is thought to be responsible for the increase in free radical scavenging activity, which is linked to their hydrogen-donating ability (Noor et al., 2015). The presence of several bioactive chemicals in mango, such as vitamins, flavonoids, and phenols, may be responsible for its antioxidant action.

Table 3 Total Phenolic Content and Antioxidant Properties of WF, HPF and SMF

PROPERTIES	WF (%)	HPF (%)	SMF (%)
Total Phenolic Content	7.46± 0.37^{a}	5.64± 0.08^{a}	6.09± 0.66^{a}
Antioxidant	51.50± 3.20^{b}	58.49± 14.07^{b}	64.39± 13.42^{b}

Values are means of triplicates; ab means in same row with different superscripts are significantly different ($p<0.05$).

3.4 Color Analysis

The results of the examination of flour color using the CIE color space are shown in Table 4. The yellow to blue color space (b*) would be the greatest color index of wheat flour noodle out of the three CIE color spaces (lightness to darkness – L*, red to green – a*, and yellow to blue – b*). The L* values for HPF is the darkest where the result shown is 53.07 while SMF and WF is 55.6 and 79.2 respectively. The value a* in HPF is 4.8 and the b* value is 55.37. The HPF imparting the shade of light-opaque yellow (b* value) as the HPF increase compared to the control (WF). SMF also show the same result, however SMF a* and b* values is significantly lower than HPF where the study shown 4.23 (a*) and 44.43 (b*). The intensity of yellow color is proportional to the b* value. The HPF gave a higher shade of yellow color.

Table 4 Color Properties of WF, HPF and SMF

Properties	WF (%)	HPF (%)	SMF (%)
L*	79.2± 4.52^{b}	53.07± 0.93^{a}	55.6± 4.61b
a*	-1.8± 0.66^{a}	4.8± 1.3^{b}	4.23± 0.40a
b*	13.97± 1.36^{b}	55.37± 1.17^{b}	44.43± 25.44b

Values are means of triplicates; ab means in same row with different superscripts are significantly different ($p<0.05$).

4. CONCLUSION

In this study, it is worth noting that earlier research has focussed on by-products, but this is the first time a Harumanis pulp has been used. This study is a step toward minimising the vast amount of mango waste that is now discarded owing to over ripeness. As a result, Harumanis may not only produce an extruded product, but also a product fit for human consumption, with the necessary physical and chemical qualities. Harumanis mango farming and study has grown in popularity in recent years as a result of its powerful antioxidant and anti-inflammatory capabilities. Harumanis pulp, which is rejected as trash owing to over ripeness, has a good phytochemical profile and is a gold mine of nutraceutical components. The study was successful achieved as the Harumanis pulp flour showed the good nutritional values. The obtained results from the chemical analysis showed that HPF improved the nutritional value for all ash content, protein and fibre compared to the WF. The obtained results from the chemical analysis showed that the HPF improved the nutritional value for all ash content, protein and fibre compared to the WF. On the other hand, HPF has lower moisture, fat and carbohydrates content as compared to the control (WF). Chemical analysis demonstrated that fortifying HPF increased overall phenolic content as well as antioxidant inhibitory efficacy. The HPF is a good source of antioxidants and phenolic compounds. Additional research into the identification of dietary fibre is needed to provide more information on the fibre components that contributed to Harumanis pulp flour activity. Thus, the antioxidant activity like vitamin C and E in Harumanis pulp flour can also be assess for the advanced study as another sources of vitamin in food industry.

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