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Research Article

Effect of milk powder, sugar and citric acid on chemical and organoleptic properties of jackfruit-flavoured Malaysian dadih

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Abstract

Dadih is a traditional Malaysian milk product consisting of milk, sugar and salt which has been acidified with whey and steamed to form a gel. The whey is obtained by fermenting milk overnight with dried asam gelugur *(Garcinia atroviridis)*. In this study, jackfruit flavoured dadih was made by a modification of the traditional method. Jackfruit was added to improve the flavour and nutritional value of dadih. Citric acid (0.1M) was used to adjust the pH close to the isoelectric point of milk so as to destabilize the casein complex and facilitate gel formation upon steaming. This study investigated the effects of milk, sugar and initial pH on the chemical and organoleptic characteristics of jackfruit flavoured Malaysian dadih. Two levels each of whole milk powder (15 and 20%), sugar (4 and 6%) and initial pH (5.6 and 5.8) were used in a factorial experiment to assess their effects on pH, brix, moisture and total solid content of the product. The organoleptic properties were evaluated using a 7 point hedonic scale. Milk powder had a significant effect on brix, moisture and total solids but not on pH of the product. The effect of sugar on all the parameters was significant except for pH and brix, while initial pH had the opposite effect. Sensory analysis showed that jackfruit flavoured Malaysian dadih formulated with 15% milk, 6% sugar and adjusted to pH 5.8 was significantly preferred ($p<0.05$) over other formulations.

Keywords: dairy, fermented milk, *Garcinia atroviridis*, food, dessert, *Artocarpus heterophylus*

Introduction

The term dadih in Malaysia refers to a dairy based dessert which has custard like texture and is sweet in taste. Traditional Malaysian dadih has a typical flavour from the asam gelugur used in the making of whey, which is one of the ingredients used in dadih making. Whey used in dadih is obtained by fermenting a small amount of milk overnight with agam gelugur. The whey is then added to a mixture of milk, sugar and salt which is then steamed to form a gel. In Indonesia, the term dadih refers to a product which is like yoghurt and sour in taste. Modern dadih production makes use of either hydrocolloids, enzymes (rennilase) or acids. The flavour of modern dadih varies depending on the flavouring agents used like chocolate, strawberry, corn.

Jackfruit (*Artocarpus heterophyllus L*) is a good source of vitamins (especially vitamin A from β-carotene) fibre and minerals. It can be incorporated into a product to increase the nutritional content. Rahman *et al*, [1] reported that a high amount of jackfruit spoilage happened during peak fruiting season and this will cause food wastage and they also stated that the addition of jackfruit to yogurt improved the aroma, taste, colour and texture of the yogurt.

In the tropics, milk powder is preferred over fresh milk due to the difficulty in obtaining fresh milk. In the manufacture of dairy dessert, milk powder is often used because it has good protein functionality. By reconstituting with water, powdered milk provides better control to obtain the desired amount of total solids content which ultimately determines the texture of the product. Sugar has been a part of Malaysian dadih formulation because most of the consumers prefer sweet dadih as opposed to Indonesian dadih which is sour and tastes more like yoghurt. The use of sugar in dairy dessert such as ice cream was investigated by Koeferli *et al* [2]; these authors studied about ice cream related to the use of sugar with fat and non fat milk solids. They found that sugar acted as a flavour profile modifier. The pH adjustment is an important aspect in acidified milk preparations. In this study, milk needed to be acidified close to the isoelectric point of casein in order to induce gel formation upon heating. Since jackfruit is low in acid, citric acid is used to obtain the desired pH. Anema [3] noted that amounts of non-sedimentable denatured whey protein and κ-casein on heating is improved by increasing the pH prior to heat treatment.

The aim of this research was to investigate the effects of different formulations using different concentrations of milk powder, sugar and citric acid (pH) on the chemical and organoleptic properties of jackfruit flavoured Malaysian dadih.

Materials and Methods

Materials

Milk powder (Fern Leaf brand), sugar and jackfruit were purchased from a hypermarket in Penang. Ingredients used in the formulation of dadih were of food grade, while chemicals used for analysis were of analytical grade.

Methods

A factorial experiment was used with different treatments of milk powder, sugar and pH at 2 different levels. All analyses were done in triplicate. Samples were coded as follows:
A: percentage of milk powder, A1 and A2 (15% and 20%)
B: percentage of sugar, B1 and B2 (4% and 6%)
C: pH value, C1 and C2 (5.6 and 5.8).

Table 1. Various treatments and combinations.

Combinations	A = milk powder	B = sugar	C = pH
A1B1C1	15%	4%	5.6
A1B1C2	15%	4%	5.8
A1B2C1	15%	6%	5.6
A1B2C2	15%	6%	5.8
A2B1C1	20%	4%	5.6
A2B1C2	20%	4%	5.8
A2B2C1	20%	6%	5.6
A2B2C2	20%	6%	5.8

Preparation of jackfruit puree
Jackfruit puree was made by macerating cut jackfruit with water at a ratio of 50:80 and sieving the sample through a muslin cloth to obtain the juice.

Preparation of jackfruit dadih
200 mL milk (15% or 20%) was heated to 80-90°C for 10min. The heated milk was then cooled to 40°C. Sugar, salt (0.1%) and 10mL jackfruit puree were then added. pH was adjusted using citric acid (0.1M). After that the milk mixture was poured into small containers and steamed to form gel.

Chemical analysis
Moisture and Total Solid (TS) content analysis of dadih was carried out using the AOAC method [4]. Determination of brix was made using the Refractometer (Hanna, HI 96801USA) and pH using a pH meter (Sartorius, PB 10 Germany).

Organoleptic evaluation
The samples were served in small cups and evaluated by 22 untrained panelists from among the students of the Food Technology Division of the School of Industrial Technology, USM. The samples were evaluated for colour, odour, texture, taste and overall acceptability on a 7 point hedonic scale (dislike very much=1, like very much=7).

Statistical analysis
The data collected were analyzed using Statistical Package for Social Science (SPSS), version 17.0. Means of the treatment showing significant differences ($P < 0.05$) were subjected to the Duncan Multiple Range Test.

Results and Discussion

Chemical Properties
Data related to pH, brix, moisture and TS content is shown in Table 2. pH of products ranged from 6.1-6.2. The highest pH of jackfruit dadih was found in formulation A2B2C2 (20% milk, 6% sugar

and 5.8 pH). Higher initial pH led to higher final pH of products, although in some formulations, the differences were not significant.

Brix value of samples ranged from 16.6-24.2, where A1B1C1 was the lowest and A2B2C2 was the highest. The use of 20% milk powder resulted in significantly higher ($P<0.05$) brix value compared to 15% milk powder. However, 4 and 6% sugar levels had no significant effect on brix.

Moisture content of samples ranged from 74.6-81.6, where A2B2C2 was the lowest and A1B2C2 was the highest. The result showed a trend of higher moisture content with lower percentage of milk powder. Moisture content was significantly ($P<0.05$) affected by sugar levels, where higher sugar content caused significantly lower ($P<0.05$) moisture content, except for the pair A1B1C2 and A1B2C2 where the difference was not significant.

Table 2. pH, brix, moisture and TS of jackfruit flavoured Malaysian dadih.

Code	pH	Brix	Moisture	TS
A1B1C1	$6.1^{ab}\pm0.0$	$16.6^{a}\pm0.5$	$81.5^{e}\pm0.1$	$18.5^{a}\pm0.1$
A1B1C2	$6.2^{c}\pm0.0$	$18.9^{b}\pm0.9$	$81.2^{de}\pm0.3$	$18.8^{ab}\pm0.3$
A1B2C1	$6.0^{a}\pm0.0$	$18.0^{ab}\pm0.6$	$79.8^{cd}\pm0.4$	$20.3^{bc}\pm0.4$
A1B2C2	$6.1^{ab}\pm0.1$	$18.2^{ab}\pm1.1$	$81.6^{e}\pm1.2$	$18.5^{a}\pm1.2$
A2B1C1	$6.1^{ab}\pm0.0$	$21.8^{c}\pm0.7$	$78.5^{c}\pm2.0$	$21.5^{c}\pm2.0$
A2B1C2	$6.2^{c}\pm0.0$	$23.5^{cd}\pm1.2$	$76.9^{b}\pm0.2$	$23.1^{d}\pm0.2$
A2B2C1	$6.1^{ab}\pm0.0$	$23.4^{cd}\pm1.1$	$75.6^{ab}\pm0.1$	$24.4^{de}\pm0.2$
A2B2C2	$6.2^{c}\pm0.2$	$24.2^{d}\pm1.3$	$74.6^{a}\pm0.8$	$25.4^{e}\pm0.8$

$^{a-e}$Means in the same column followed by different letters were significantly different ($P<0.05$).

TS showed negative correlation to moisture content. TS content of samples showed an increasing trend with higher milk powder content (20%). Except for the formula A1B2C2, higher sugar (6%) led to significantly higher TS content.

From these results, it was found that milk powder played a more important role than sugar and pH on moisture and TS content. Robinson and Tamime [5] concluded that higher firmness and viscosity of yoghurt is caused by higher total solids content of milk. The association of higher or lower total solid content with the final milk product properties was also noted by Allmere *et al*. [6]. They found that rheological properties of acidified skim milk gels was influenced by the concentration of protein, fat, protein and casein in milk added in a formulation. A study on plain stirred yoghurt was reported by Penna *et al*. [7] who noted that the increase of total solids content (9.3–22.7%) resulted in a significant increase in consistency index and a decrease in flow behaviour index.

Milk powder had a significant ($P<0.05$) effect on all parameters, except pH. Sugar had a significant effect on moisture and TS content, while initial pH had significant effects on final pH and brix. Interaction between milk and sugar had a significant effect on all parameters except brix. Moisture and TS content were influenced by the interaction between milk and pH.

Colour, odour, taste, texture and overall acceptability of jackfruit dadih

The organoleptic results are shown in Table 3. According to panellists, colour, taste, texture and overall acceptability showed significant difference ($P<0.05$) among samples. However, odour showed no significant difference ($P<0.05$) with different combinations of milk powder, sugar and initial pH.

Table 3. Colour, odour, taste, texture, and overall acceptability of jackfruit dadih.

Code	Colour	Odour	Taste	Texture	Overall acceptability
A1B1C1	$4.4^{ab}\pm1.5$	$4.7^{a}\pm1.1$	$4.1^{a}\pm1.4$	$4.2^{ab}\pm1.5$	$4.1^{a}\pm1.1$
A1B1C2	$4.7^{ab}\pm1.3$	$4.7^{a}\pm1.1$	$4.8^{b}\pm1.3$	$5.0^{bc}\pm1.4$	$4.6^{a}\pm1.3$
A1B2C1	$4.5^{ab}\pm1.1$	$4.5^{a}\pm1.2$	$4.2^{a}\pm1.4$	$4.0^{ab}\pm1.5$	$4.1^{a}\pm1.3$
A1B2C2	$5.3^{b}\pm1.4$	$5.0^{a}\pm1.2$	$5.3^{b}\pm1.3$	$5.3^{c}\pm1.2$	$5.4^{b}\pm1.2$
A2B1C1	$5.1^{ab}\pm1.1$	$4.8^{a}\pm1.1$	$4.6^{ab}\pm1.3$	$4.9^{bc}\pm1.2$	$4.5^{a}\pm1.4$
A2B1C2	$4.2^{a}\pm1.7$	$4.6^{a}\pm1.3$	$5.3^{b}\pm1.4$	$3.5^{a}\pm1.8$	$3.8^{a}\pm1.9$
A2B2C1	$4.6^{ab}\pm1.4$	$4.9^{a}\pm1.4$	$4.3^{a}\pm1.4$	$3.9^{ab}\pm1.7$	$4.2^{a}\pm1.3$
A2B2C2	$4.7^{ab}\pm1.0$	$4.9^{a}\pm1.2$	$5.2^{b}\pm1.5$	$3.5^{a}\pm1.7$	$3.9^{a}\pm1.6$

$^{a-c}$Means in the same column followed by different letters were significantly different ($P<0.05$).

For colour, A2B1C2 had the lowest score, whereas A1B2C2 had the highest score. There was no clear trend for colour preference in jackfruit dadih samples. A1B1C1 scored lowest, whereas A2B1C2 and A1B2C2 scored highest for taste. Significantly ($P<0.05$) higher scores were found in samples with higher initial pH (pH 5.8). The 2 levels of milk powder and sugar had no significant effect on the taste of jackfruit flavoured dadih. Panellists preferred samples which were less sour. There was no clear trend in the preference for texture. For overall acceptability, A1B2C2 had the highest score. Many factors contribute to the organoleptic evaluation in milk products. Pohjanheimo and Sandell [8] noted that subjects who considered natural content, ethical concerns and health as important food choice motives perceived sourer, thicker and more genuine yoghurt flavour as more pleasant, compared to subjects who considered convenience, price, mood and familiarity more important, evaluated sweeter and smoother yoghurt as more pleasant. Addition of other uncommon additives also affect the acceptability of milk products, such as found in the study of Kip *et al*. [9] wherein they noted that the use of inulins can improve the creamy mouth feel of low-fat yoghurts.

Conclusion

Generally, addition of milk powder and sugar significantly affected the chemical properties of jackfruit dadih analyzed in this study. In the making of jackfruit dadih, the interaction between milk and sugar has a significant impact on the chemical characteristics analyzed in this study. The formula of A1B2C2 containing lower levels of powdered milk, and higher level of sugar and initial pH, was significantly ($P>0.05$) preferred by panelists.

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