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Research Article

Chemical and sensory evaluation characteristics of Malaysian dadih solidified with carrageenan

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Abstract

There are only a few dairy-based local products found in Malaysia and one of them is dadih. Dadih is a sweet tasting dairy dessert with soft custard like texture made originally from a mixture of buffalo milk, sugar and salt. The milk mixture was acidified to a pH which is just below the isoelectric point of milk (5.6-5.8) with whey obtained by fermenting a small amount of milk overnight with asam gelugur (*Garcinia atroviridis*) and steamed to form a gel. The destabilized casein complex coupled with the heat from the steam will induce gel formation. In this study, the traditional method was modified by adding carrageenan to gel the milk mixture, thus avoiding the use of heat. The use of carrageenan simplifies the dadih making process and also enables the addition of heat sensitive ingredients like vitamin C containing fruit juice and probiotics. This study investigated the effects of milk, sugar and carrageenan on the chemical and sensory evaluation of Malaysian dadih. Two levels each of whole milk powder (15 and 20%), sugar (4 and 6%) and 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. Milk and carrageenan were heated to 80-90°C for 10 min and then sugar and salt (0.1%) were added. The mixture was then poured into small containers and refrigerated. The sensory properties were evaluated on colour, odor, texture, taste and overall acceptability using a 7 point hedonic scale (dislike very much=1, like very much=7). Milk powder had a significant effect on pH, brix, moisture and total solids of the product. The effect of sugar on all the parameters was significant except for pH, while carrageenan had a significant effect on pH and brix of the product only. Sensory evaluation showed that the sample with formula A1B1C2 (milk 20%, sugar 4% and carrageenan 0.3%) obtained the highest score.

Keywords: dairy, dessert, additives, milk powder, *Garcinia atroviridis*, hydrocolloids, whey.

Introduction

Dadih is one of the few dairy-based products found in Malaysia as these are relatively uncommon. Dairy is a small industry here, and Malaysians generally consume a small amount of dairy products due to culture, preference and intolerance to lactose. Buffalo milk was originally used in the making of dadih. However, now, with modern machinery, buffaloes are no longer used to plough paddy fields and most dadih is now made from cows' milk. In the making of traditional dadih, whey, obtained by fermenting a small amount of milk overnight, was used to acidify a mixture of milk and sugar to a pH which is close to the isoelectric point (5.6 – 5.8) of casein to induce gel formation upon steaming. However, commercial dadih now makes use of gelling agents like agar. The use of gelling agents will simplify the dadih making process since the steaming step is omitted; this will enable the incorporation of heat labile ingredients like probiotics and fruit juice containing heat sensitive vitamins. Recent research relates to the texture improvement of dairy desserts using some form of hydrocolloids such as: gelatin in yoghurt [1] and corn-milk yoghurt [2], pectin in acidified milk drink [3], acid dairy drink [4], carrageenan in cheese-like product [5] and milk drink [6].

Other research studied future prospective gelling agents such as: addition of guar gum in skim milk [7], combination of skim milk powder and starch at different κ-carrageenan concentrations in pudding dessert [8], the addition of κ-carrageenan in dairy emulsions which contain sodium caseinate and locust bean gum [9], addition of pectin in milk protein concentrate [10], addition of pectin as a stabilizer in acidified skim milk [11] and the addition of gellan gum in acidified gel [12].

Carrageenan is a natural polysaccharide of marine products which can be obtained from seaweed. Usually Carrageenan is used as a thickener and stabilizer in many types of food products and it is also used to improve food texture. The addition of carrageenan can substitute the role of gum, gelatine and other similar texture improving agents. There are three types of carrageenan, namely kappa, lamda and iota carrageenan. However, kappa-carrageenan is more often used in food formulation. Due to this factor, κ-carrageenan was chosen as the stabilizer for this research.

The aim of this study was to investigate the effects of different formulations using different concentrations of milk powder, sugar and carrageenan on the chemical and sensory evaluation properties of Malaysian dadih solidified with carrageenan.

Materials and Methods

Materials

Milk powder (Fern Leaf) and sugar were purchased from a hypermarket in Penang, Malaysia. 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 carragenan at 2 different levels. 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: percentage of carrageenan, C1 and C2 (0.2% and 0.3%)

The study formulation used in the experiment is shown in Table 1.

Table 1. Code and formulation of carrageenan dadih.

Combinations	A = milk powder	B = sugar	C = carrageenan
A1B1C1	15%	4%	0.2%
A1B1C2	15%	4%	0.3%
A1B2C1	15%	6%	0.2%
A1B2C2	15%	6%	0.3%
A2B1C1	20%	4%	0.2%
A2B1C2	20%	4%	0.3%
A2B2C1	20%	6%	0.2%
A2B2C2	20%	6%	0.3%

Preparation of solidified dadih with carrageenan
Carrageenan was added to milk and heated to 80-90°C for 10 minutes. It was then removed from the heater. Sugar and salt (0.1%) were then added and stirred into the milk mixture and then poured into small containers, cooled at ambient temperature and kept refrigerated before serving.

Chemical analysis
Moisture and total solids (TS) content were measured using the AOAC (2005) method. Determination of brix was made using the Refractometer (Hanna, HI 96801USA) and pH using a pH meter (Sartorius, PB 10 Germany).

Sensory evaluation
The samples were served in small cups and evaluated by 23 untrained panelists from among the students of the food technology division of the School of Industrial Technology, Universiti Sains Malaysia. The samples were evaluated on colour, odor, texture, taste and overall acceptability on a 7 point hedonic scale (dislike very much=1, like very much=7).

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

Results and Discussion

Chemical properties
Data related to pH, brix, moisture and TS content of dadih solidified by carrageenan is shown in Table 2.

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

Sample	pH	Brix	Moisture	Total Solids
A1B1C1	6.47^{e}±0.02	19.93^{ab}±0.98	79.09^{b}±0.99	20.91^{a}±0.99
A1B1C2	6.48^{e}±0.01	18.63^{a}±1.21	80.64^{b}±3.98	19.37^{a}±3.98
A1B2C1	6.45^{de}±0.01	22.00^{c}±0.79	78.20^{b}±1.06	21.80^{a}±1.06
A1B2C2	6.46^{de}±0.02	20.93^{bc}±0.42	79.10^{b}±0.95	20.90^{a}±0.95
A2B1C1	6.41^{b}±0.01	25.80^{de}±1.56	74.41^{a}±0.35	25.60^{b}±0.35
A2B1C2	6.42^{bc}±0.01	24.17^{d}±1.36	75.06^{a}±1.34	24.94^{b}±1.34
A2B2C1	6.38^{a}±0.01	27.27^{e}±1.31	73.07^{a}±0.85	26.93^{b}±0.85
A2B2C2	6.44^{cd}±0.02	25.67^{de}±0.49	73.27^{a}±0.75	26.71^{b}±0.75

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

Effect of milk powder on dadih solidified using carrageenan

Milk powder had a significant (P<0.05) effect on all parameters. 20% milk powder had a significantly different effect compared to 15% milk powder on all parameters. Higher amount of milk powder led to lower pH and moisture and higher brix and TS content. The pH of final product was in the range of 6.38-6.47. Dadih with formula A2B2C2 had the lowest pH while dadih with formula A1B1C1 had the highest pH. The brix of final product was in the range of 18.63-27.27. Dadih with formula A1B1C2 had the lowest brix while dadih with formula A2B2C1 had the highest brix. Formula A2B2C2 had higher levels of milk powder, sugar and carrrageenan. Milk powder was positively correlated (P<0.05) with TS content and negatively correlated (P<0.05) with moisture. Pereira *et al*. [14] found that, beside heat treatment, solid content of milk (10-20%) influenced the textural properties of milk gel. Robinson and Tamime [15] studied yoghurt and concluded that higher total solids content of milk caused higher firmness and viscosity. Gastaldi *et al*. [16] found that dry matter increased the gel formation in an acidified milk product.

Effect of sugar on dadih solidified using carrageenan

The effect of sugar on all parameters was not significant (P>0.05). However, addition of 4% and 6% sugar showed significant difference in the brix value, except for the treatments with high milk (A2B1C1) and high carrageenan (A2B2C1).

Effect of carrageenan on dadih solidified using carrageenan

There was no significant difference (P>0.05) on all parameters with different levels of carrageenan.

There is no interaction (P>0.05) between milk and sugar for all parameters. The interaction between milk-carragenan and sugar-carrageenan was significant only for pH. pH of product was significantly (P<0.05) influenced by the interaction of milk, sugar and carrageenan.

Sensory evaluation of carrageenan solidified dadih

The sensory evaluation results are shown in Table 3. According to the participants, colour, taste, texture and overall acceptability were significantly different (P<0.05) among treatments. Odor, however, showed no significant difference.

Highest and lowest scores for colour were found in formula A2B1C2 (containing higher amount of milk) and A1B2C1 respectively. Generally, formulations with higher milk powder scored higher than formulations with lower milk powder. Higher amount of milk powder gave significantly (P<0.05)

higher texture scores. For overall acceptability, formulation A2B1C2 was most acceptable; this formulation had higher amount of milk and lower amount of sugar and carrageenan.

There was no significant (P>0.05) difference in the odor of all dadih formulations. A study using pectin in a fat-free stirred yoghurt was reported by Decourcelle *et al*. [17], who found that the presence of pectin in yoghurts tend to reduce the concentration of aroma compounds in the headspace of the samples.

Table 3. Colour, odor, taste, texture and overall acceptability of carrageenan Malaysian dadih.

Code	Colour	Odor	Taste	Texture	Overall acceptability
A1B1C1	5.00^{ab}±1.103	4.67^{a}±1.129	4.54^{a}±1.215	3.79^{b}±1.641	4.25^{ab}±1.327
A1B1C2	4.79^{ab}±1.103	5.04^{a}±1.083	4.71^{a}±1.301	4.63^{bc}±1.765	4.38^{b}±1.610
A1B2C1	4.25^{a}±1.700	4.58^{a}±1.349	4.71^{a}±1.546	2.75^{a}±1.294	3.42^{a}±1.472
A1B2C2	4.92^{ab}±1.100	4.54^{a}±1.021	5.29^{ab}±1.334	4.13^{b}±1.569	4.50^{b}±1.251
A2B1C1	5.00^{ab}±1.251	4.88^{a}±1.393	5.13^{ab}±1.513	5.33^{cd}±1.435	5.38^{c}±1.313
A2B1C2	5.38^{b}±1.013	4.79^{a}±0.932	5.04^{ab}±0.999	5.63^{d}±1.056	5.42^{c}±0.881
A2B2C1	4.38^{a}±1.345	4.79^{a}±1.179	4.83^{ab}±1.551	3.83^{b}±1.761	4.04^{bc}±1.706
A2B2C2	4.96^{ab}±1.042	4.71^{a}±1.122	5.63^{b}±1.345	5.67^{d}±1.404	5.33^{c}±1.404

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

For texture, the scores indicated that higher levels of milk powder were preferred by panelists. The higher percentage of milk powder gave stronger texture to the final product and panelists appreciated this. Overall acceptability scores also indicated dadih with higher percentage of milk powder was preferred. Generally, in some dairy desserts, strong (firm) texture is needed and preferred by panelists. Because of that, some dairy products are combined with starch to improve gel or texture formation, for example, the addition of rice starch in acidified milk [18] and potato starch in acid skim milk gel [19].

Conclusion

Generally, different levels of milk powder and sugar had significant effects on the chemical properties of Malaysian dadih, while carrageenan had significant effects on pH and brix of product. Sensory evaluation showed that sample with formula A2B1C2 containing higher concentrations of milk and lower concentrations of sugar and carrageenan obtained the highest score.

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