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The effect of gac fruit preparation addition on characteristics of yoghurt

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ABSTRACT

Gac fruit is a good source of betacarotene and lycopene. It has been recently utilized for developing various functional food products, especially for beverage category. However, little information has been provided for developing yoghurt from gac fruit. Addition of fruit to yoghurt usually effects on product characteristics such as growth of microorganisms, syneresis, viscosity and sensory acceptance. The objective of this study was therefore to evaluate the quality of gac fruit added yoghurt during storage. Gac fruit was prepared as fruit preparation containing gac fruit, sucrose, water, passion fruit juice, low methoxyl pectin and salt before mixing with yoghurt. Amount of gac fruit preparation added was varied at 5, 10 and 15% w/w. The products were then evaluated for sensory acceptance and color, and then for pH, syneresis, viscosity, and total plate count every 5 days during storage at 4 °C for 20 days. It was found that addition of gac fruit preparation at 5% w/w received the highest liking score but not significantly different from addition of which at 10% w/w (*P>0.05*). The pH of all samples slightly dropped during storage whilst syneresis progressed and viscosity increased with increasing gac fruit preparation addition. However, the viscosity of all yoghurt samples decreased during storage. Furthermore, increasing amount of gac fruit preparation influenced on product's color by lowing L* value, increasing a* and b* values. Total plate count of yoghurt samples added with gac fruit preparation changed slightly as compared to that of control in which more noticeable reduction was observed during storage.

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INTRODUCTION

Gac fruit (*Momordica cochinchinensis* Spreng) is a Southeast Asian fruit found throughout the region from Southern China to Northeastern Australia, including Thailand, Laos, Myanmar, Cambodia and Vietnam. It is a rich source of phytochemicals including lycopene, beta-carotene, lutein and phenolic compounds (Ishida *et al*., 2004; Kubola and Siriamornpun, 2011). Ferulic acid and *p*-hydroxybenzoic acid were the most evident phenolic compounds found in gac pulp (Kubola and Siriamornpun, 2011) which have been reported exhibiting antimicrobial effect (Zhou and Wu, 2012; Heleno *et al.*, 2013; Takahashi *et al*, 2015). In Thailand, the immature gac fruit is commonly consumed as vegetable while the ripe fruit is processed as commercial functional drinks (Kubola and Siriamornpun, 2011). In the extant literatures, it has been scarcely reported for incorporation with yoghurt. Incorporation of fruits in fermented milk has been reported promoting health benefits as proven by de Vrese *et al*. (2011) indicating that fruit-yogurt-like fermented milk products with living probiotic bacteria significantly shorten the duration of antibiotics-associated diarrhoea and improve gastrointestinal complaints. However, addition of fruits to yoghurt often brings about some undesirable changes in product attributes such as growth of probiotic bacteria, syneresis, viscosity and sensory acceptability (Lubbers *et al*., 2004; Kailasapathy *et al.*, 2008; Vahedi *et al*., 2008; Hossain *et al*., 2012; Chouchouli *et al*., 2013; Farahat and El-Batawy, 2013; Yousef *et al.*, 2013). To reduce syneresis, fruits are usually processed as so-called fruit preparation with hydrocolloid such as low methoxyl pectin addition (Otto *et al.*, 1981). According to the study of Kailasapathy *et al.* (2008), it was found that addition of commercial fruit preparations (mango, mixed berry, passion fruit and strawberry) at 10 g/100g did not significantly influence on viability of *Lactobacillus acidophilus* LAFTI® L10 and *Bifidobacterium animalis ssp. lactis* LAFTI®, except on *L. acidophilus* LAFTI L10 for yogurt added with passion fruit or mixed berry. The objective of this study was therefore to examine the influence of gac fruit preparation addition on characteristics of yoghurt and their changes during storage.

MATERIALS AND METHODS

Gac fruit preparation for yoghurt

Ripe gac fruit was cut before its pulp being subsequently separated for an ingredient of gac fruit preparation for yoghurt. To obtain the fruit preparation, gac fruit pulp (54.68%) was mixed with sucrose (25.08), water (12.52%), passion fruit juice (6.24%), brought to heat to 100 °C followed by addition of low methoxyl pectin powder (Amid CM020, Herbstreith & Fox, Germany) (1.1%) and citric acid (0.38%), respectively. The mixture was then cooled in tap water (30 °C) to atmospheric temperature and kept at 4 °C for further yoghurt processing.

Yoghurt starting culture preparation

The mixed starter culture containing *L. bulgaricus* and *S. thermophilus* (TISTR895 and TISTR864 from Thailand Institute of Scientific and Technological Research), ratio of 1:1, was grown in MRS broth at 40-42 °C for 48 hours. The grown cells were separated by centrifugation at 6,000 rpm for 15 min, followed by washing with 0.1% peptone solution for 3 times. The solid portion was used as innoculum for yoghurt production. Yoghurt was prepared by mixing pasteurized milk (83%), whole milk powder (10.6%), sucrose (6.22%) and medium methoxyl pectin (classic AF605, Herbstreith & Fox, Germany) (0.18%), then heated at 90 °C for 5 min and subsequently cooled to 45 °C before adding solid portion of starter (0.67% w/w). The mixed milk was then incubated at 42 °C until the curd developed. The yoghurt curd was then added with gac fruit preparation at varied concentrations of 5, 10 and 15%w/w, respectively, stirred well and incubated at 40 °C until pH at 4.5 was obtained. The gac fruit yoghurt was then stored at 4 °C for quality evaluation.

Yoghurt quality evaluation

Yoghurt samples added with gac fruit preparation at varied concentrations were measured for color and sensory acceptability. Color of a sample was measured for L*, a* and b* by Hunter Lab (Model Miniscan, Virginia, USA.). Gac fruit fortified yoghurt samples were tasted by 30 untrained panels using sensory 9-point hedonic scale to determine the product acceptability. During storage at 4 °C for 20 days, yoghurt samples were taken at every 5 days for quality evaluation including pH, syneresis (Purwandari and Vasiljevic, 2009), apparent viscosity (Sakin-Yilmazer *et al*., 2014), and total plate count (Marshall, 1993). Briefly, syneresis was determined by taking 15 ml of yoghurt into test tube in which water was subsequently separated by vortex mixer for 20 min. The syneresis was calculated as percentage of separated water based on total weight of yoghurt sample. The apparent viscosity of yoghurt sample was measured by Brookfield Digital Viscometer Model 3DVT using LV4 probe at spindle rotating speed of 100 rpm.

RESULTS AND DISCUSSION

Yoghurt color and sensory evaluation

Color values of yoghurt measured as L*, a* and b* are presented in Table 1. It was found that incorporation of gac fruit preparation resulted in significant change in color to more red-yellow as indicated by lower L*, higher a* and b* ($P<0.05$) as imparted by gac fruit color. Increasing amount of gac fruit preparation resulted in lowing L* value and increasing a* and b* values ($P<0.05$). To minimize bias from product color and flavor, only gac fruit preparation fortified yoghurt samples were served to panels for sensory evaluation. Sensory quality of yoghurt evaluated as liking score for texture, color, flavor, taste and overall is shown in Table 2. It was found that addition of gac fruit preparation at 5%w/w received the highest scores for flavor, taste and overall but not significantly different from addition of which at 10% w/w ($P<0.05$). Liking scores for color and texture were not significantly influenced by experimental amount of gac fruit preparation added ($P<0.05$).

Table 1 Color of yoghurt added with varied concentrations of gac fruit preparation

Gac fruit preparation addition (%w/w)	L*	a*	b*
0	88.75±0.04[a]	3.81±0.01[a]	15.72±0.01[a]
5	78.67±0.05[b]	15.75±0.02[b]	20.05±0.02[b]
10	77.47±0.01[c]	18.27±0.01[c]	20.65±0.01[c]
15	72.77±0.01[d]	23.05±0.01[d]	22.08±0.01[d]

Footnote: Values are presented as mean ± standard deviation of 3 replications. Superscriptions indicated significant difference in mean values within each column at 95% confidence.

Change in syneresis

Initially, syneresis of yoghurt was 1.3%. Incorporation of gac fruit preparation resulted in higher syneresis up to 5.5% at 15% gac fruit preparation addition (Figure 2). Increasing in syneresis was possibly caused by addition of water from gac fruit preparation beyond the holding capacity of hydrocolloids to maintain the gelling system. The syneresis of all samples progressed during storage up to approximately 12% but that of control remained the lowest until the last day of storage (8.1%).

Table 2 Liking scores from 9-point hedonic scale of yoghurt added with varied concentration of gac fruit preparation (n=30)

Gac fruit preparation addition (%w/w)	Liking scores				
	Texture	Color	Flavor	Taste	Overall
5	6.43±0.24[a]	6.50±0.35[a]	6.80±0.35[a]	7.07±0.42[a]	7.03±0.29[a]
10	6.57±0.24[a]	6.50±0.35[a]	6.43±0.35[ab]	6.47±0.42[ab]	6.60±0.29[ab]
15	6.10±0.24[a]	5.93±0.35[a]	6.12±0.35[b]	6.27±0.42[b]	6.37±0.29[b]

Footnote: Values are presented as mean ± standard deviation of 30 panelists. Superscriptions indicated significant difference in mean values within each column at 95% confidence.

Change in pH during storage

At the beginning, increasing amount of gac fruit preparation in yoghurt slightly increased product pH from 4.5 up to 4.6 at 15% gac fruit preparation addition (Figure 1). Nevertheless, pH of all samples decreased during storage due to activities of culture bacteria producing lactic acid.

Change in apparent viscosity

At the beginning, an increase in apparent viscosity of yoghurt was noticeably observed at the 15% addition of gac fruit preparation (from 3,983 cp to 5,230 cp) (Figure 3). On the other hand, the apparent viscosity of yoghurt at 5 and 10% of gac fruit preparation addition was slightly different from that of control from the beginning to the last day of storage. However, the apparent viscosities of all samples decreased during storage and became closed to one another at the last day of storage (2,999-3,637 cp).

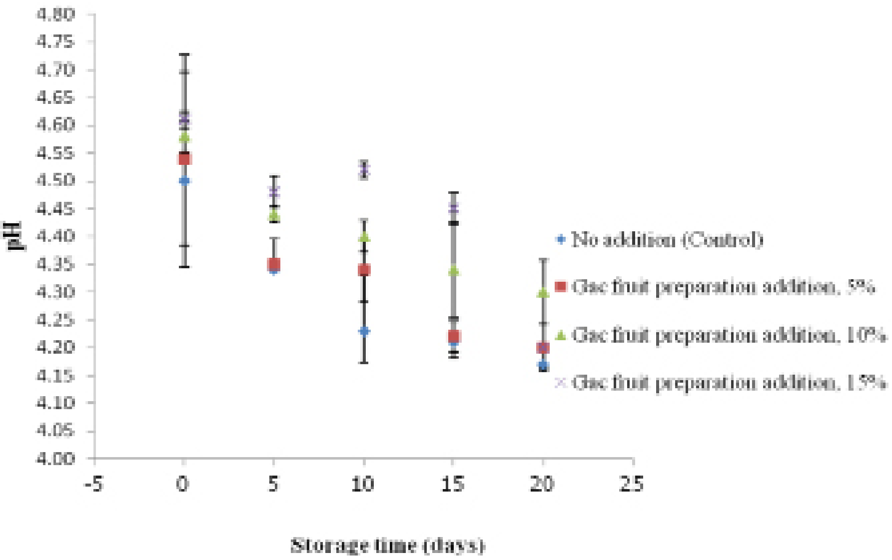

Figure1 Changes in pH during storage of yoghurt added with varied concentrations of gac fruit preparation during storage at 4 °C

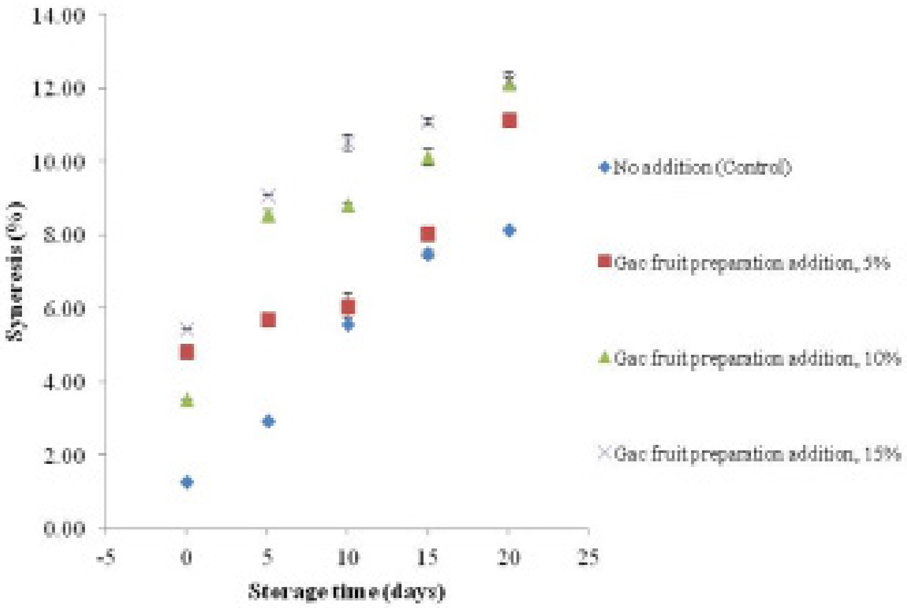

Figure 2 Changes in syneresis during storage of yoghurt added with varied concentrations of gac fruit preparation during storage at 4 °C

Change in microbial growth

Initially, yoghurt added with gac fruit preparation contained lower number of bacterial counts ($5x10^7$ cfu/g) than that of control ($8.5x10^7$ cfu/g) as a result of replacement with material containing lower microorganisms. During storage, however, the bacterial counts decreased during storage, especially dramatic drop for control (Figure 4).

The slower decrease of microbial number in gac fruit preparation fortified yoghurt could be due to additional nutrients necessary for bacterial growth such as carbon source from sucrose in the gac fruit preparation. However, it was noticed that bacterial counts in yoghurt added with 15% were the lowest after 10 days of storage. This result would suggest some antimicrobial activities from gac fruit such as ferulic acid and p-hydroxybenzoic acid (Kubola and Siriamornpun, 2011; Zhou and Wu, 2012; Heleno *et al.*, 2013; Takahashi *et al*, 2015) which became predominantly effective at higher fruit concentration.

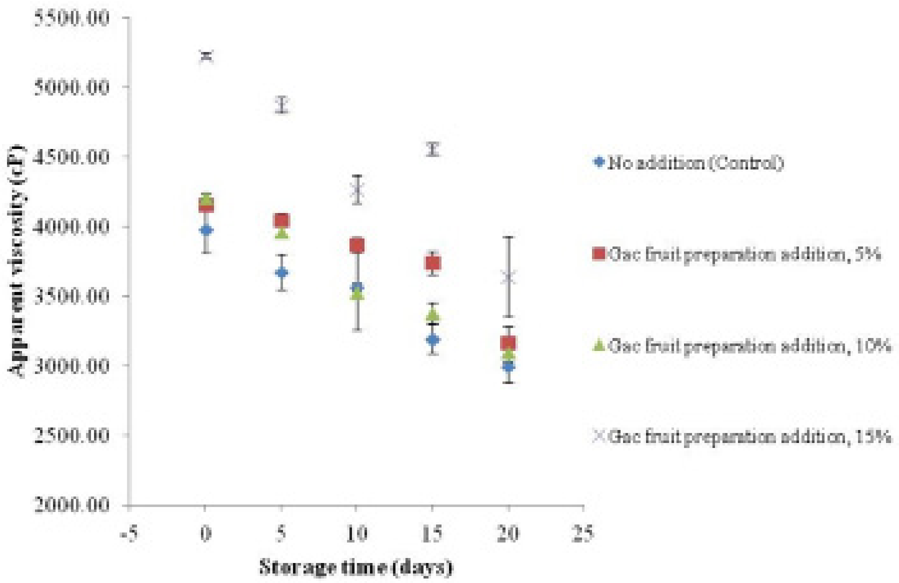

Figure 3 Changes in apparent viscosity during storage of yoghurt added with varied concentrations of gac fruit preparation during storage at 4 °C

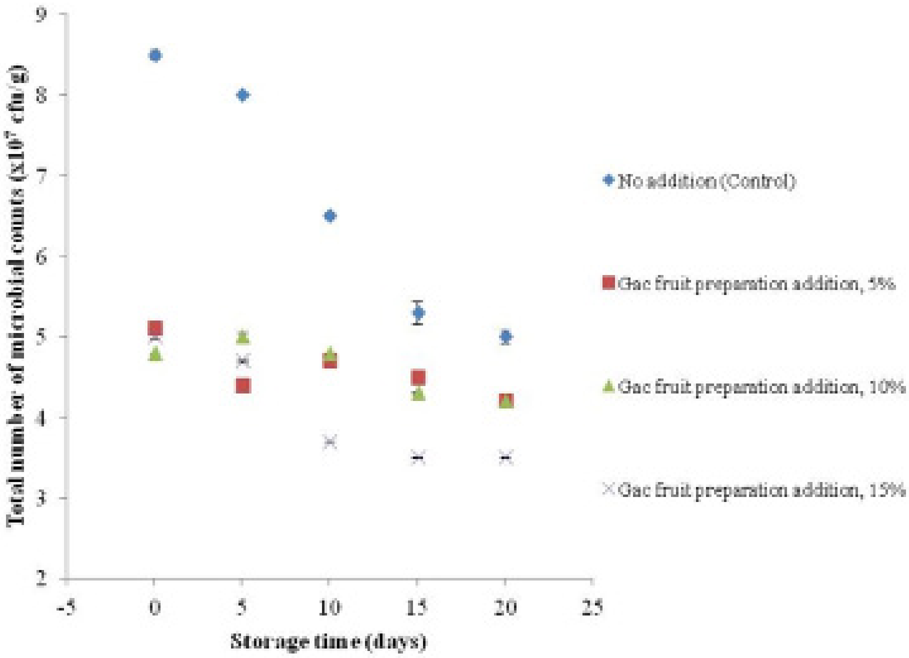

Figure 4 Changes in microbial growth during storage of yoghurt added with varied concentrations of gac fruit preparation during storage at 4 °C

CONCLUSION

Based on sensory evaluation, it could be concluded that gac fruit preparation could be added in yoghurt at 10%w/w. However, incorporation of gac fruit preparation was subjected to changes in product characteristics including color imparted by the fruit's pigments, slightly higher pH, more syneresis, and lower total bacterial counts throughout the experimental storage period at 4 °C for 20 days. Since viable probiotic bacterial counts was not analyzed in this study, further investigation is recommended.

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REFERENCES

Chouchouli, V., Kalogeropoulos, N., Konteles, S.J., Karvela, E., Makris, D.P., Karathanos, V.T. 2013. Fortification of yoghurts with grape (Vitis vinifera) seed extracts. LWT - Food Science and Technology 53: 522-529.

de Vrese, M., Kristen, H., Rautenberg, P., Laue, C. and Schrezenmeir, J. 2011. Probiotic lactobacilli and bifidobacteria in a fermented milk product with added fruit preparation reduce antibiotic associated diarrhea and Helicobacter pylori activity. Journal of Dairy Research 78(4):396-40.

Farahat, A.M. and El-Bata, O.I. 2013. Proteolytic activity and some properties of stirred fruit yoghurt made using some fruits containing proteolytic enzymes. Journal of Dairy Research 78(4): 396-403.

Heleno, S.A., Ferreira, I.C.F.R., Esteves, A.P., C´ iric´, A., Glamocˇlija, J., Martins, A., Sokovic´, M. and Queiroz, M.J.R.P. 2013. Antimicrobial and demelanizing activity of Ganoderma lucidum extract, p-hydroxybenzoic and cinnamic acids and their synthetic acetylated glucuronide methyl esters. Food and Chemical Toxicology 58:95–100.

Hossain, N.; Fakruddin, M. and Islam, N. 2012. Development of Fruit Dahi (Yoghurt) Fortified with Strawberry, Orange and Grapes Juice. American Journal of Food Technology 7: 562-570.

Ishida, B.K., Turner, C, Chapman, M.H. and Mckeon, T.A. 2004. Fatty Acid and Carotenoid Composition of Gac (*Momordica cochinchinensis* Spreng) Fruit. Journal of Agricultural and Food Chemistry 52 (2): 274–9.

Kailasapathy, K., Harmstorf, I., Phillips, M. 2008. Survival of *Lactobacillus acidophilus* and *Bifidobacterium animalis* ssp. lactis in stirred fruit yogurts. LWT - Food Science and Technology 41(7): 1317–1322.

Kubola, J. and Siriamornpun, S. 2011. Phytochemicals and antioxidant activity of different fruit fractions (peel, pulp, aril and seed) of Thai gac (*Momordica cochinchinensis* Spreng). Food Chemistry 127: 1138–1145

Lubbers, S.,Decourcelle, N., Vallet, N., and Guichard, E. 2004. Flavor Release and Rheology Behavior of Strawberry Fat free Stirred Yogurt during Storage. Journal of Agricultural and Food Chemistry 52 (10): 3077–3082.

Marshall, R. T. 1993. Standard methods for the examination of dairy products. Washington DC: APHA.

Otto, W.H., Hermann, P., Turnstr, H. 1981. Apple Pectins in Baking Jams and Fruit Preparations for Dairy Products. Canadian Institute of Food Science and Technology Journal 14(3):173.

Purwandari, U.and Vasiljevic, T. 2009. Rheological properties of fermented milk produced by 635 a single exopolysaccharide producing Streptococcus thermophilus strain in the presence 636 of added calcium and sucrose. International Journal of Dairy Technology 62: 411-421.

Sakin-Yilmazer, M., Koç, B., Balkir, P., Kaymak-Ertekin, F. 2014. Rheological behavior of reconstituted yoghurt powder-An optimization study. Powder Technology 266: 433–439.

Takahashi, H., Takada, K., Tsuchiya, T., Miya, S., Kuda, T. and Kimura, B. 2015. Listeria monocytogenes develops no resistance to ferulic acid after exposure to low concentrations. Food Control 47: 560-563.

Vahedi, N., Tehrani, M. M. and Shahidi. F. 2008. Optimizing of Fruit Yoghurt Formulation and Evaluating Its Quality During Storage. American-Eurasian Journal Agricultural and Environmental Science 3 (6): 922-927.

Yousef, M., Nateghi, L., and Azadi, E. 2013. Effect of different concentration of fruit additives on some physicochemical properties of yoghurt during storage. Annals of Biological Research 4 (4): 244-249.

Zhou, X., Wu, F. 2012. Effects of amendments of ferulic acid on soil microbial communities in the rhizosphere of cucumber (*Cucumis sativus* L.). European Journal of Soil Biology 50:191-197.