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THE APPLICATION OF TAMARIND KERNEL POWDER IN THE MANGO SAUCE

Wayu koosamart, Nutha Veerasugwanit and **Weerachet Jittanit***

Department of Food Science and Technology, Faculty of Agro-Industry, Kasetsart University, 50 Ngam Wong Wan Road, Chatuchak, Bangkok 10900, Thailand.
*Corresponding author e-mail: fagiwcj@ku.ac.th

ABSTRACT

Tamarind seed has been well-known as a perfect source of xyloglucan that has functional properties that can be applied in food products. In this research, the tamarind seeds were processed to be tamarind kernel powder (TKP) and then it was added into the mango sauce as the stabilizer. The aim was to study the effects of using TKP as the stabilizer on the quality of mango sauce in comparison with the application of xanthan gum that is the common stabilizer of sauce. The mango sauce samples were determined their water activity, consistency, viscosity, color and sensorial quality. The result indicated that the addition of either TKP or xanthan gum at 0.25-0.5 %w/w could raise the viscosity and diminish consistency of mango sauce significantly whereas the water activity values were insignificantly different among samples. Furthermore, it appeared that the samples added with xanthan gum obtained less consistency values but more viscosity and sensorial scores than that of TKP. The color values of samples with TKP were significantly different from those with xanthan gum. The samples added xanthan gum became darker than the addition of TKP. Although the TKP caused the less preference in characteristics of mango sauce when comparing with xanthan gum, the better result might be achieved if TKP was processed to be more purified xyloglucan. The outcome of this work showed the possibility of utilizing the tamarind seed that is commonly by-product to be a valuable food additive for food industry.

Keywords: Mango Sauce, Tamarind Kernel Powder, Tamarind Seed, Xanthan Gum, Xyloglucan

1. INTRODUCTION

Mango (*Mangifera indica*) is a major economic fruits in Thailand with the export value more than 1,300 million baht in January to May 2013 (Office of Agricultural Economics, 2013). The processing of fresh mango to be mango sauce is one of the interesting alternatives to raise the market value of fresh mango. Mango sauce can be either consumed by dipping with some fried foods or applied as an ingredient in stir-fried dishes such as sweet and sour fish.

One of key ingredients in mango sauce is stabilizer. The stabilizer that is commonly applied for producing sauce is xanthan gum. Nonetheless, some kinds of stabilizers are deemed as the possible and attractive substitutes of xanthan gum especially the stabilizers that can be manufactured from by-product of food industry.

Tamarind seed is a main by-product of the tamarind processing plants in Thailand. It has been well-known by a number of scientists as a perfect source of xyloglucan. Its chemical structure consists of D-galactose, D-xylose and D-glucose at the ratio of 1:2.25:2.8 (York *et al*., 1990; Nishinari *et al.*, 2009). Xyloglucan is a water soluble polymer that can be used either for raising the viscosity of solution or as a gelling agent. It can tolerate to a wide range of pH and temperature. Xyloglucan is also called “aging free starch” because of its starch-like properties but more stable (Nishinari *et al.*, 2009).

Due to its functional properties, in this research, the tamarind seeds were processed to be tamarind kernel powder (TKP) and then it was added into the mango sauce as the stabilizer. The aim was to study the effects of using TKP as the stabilizer on the quality of mango sauce in comparison with the application of xanthan gum. The mango sauce samples were determined their quality attributes comprising water activity, consistency, viscosity, color and sensorial quality. The outcome of this work would indicate the potential of utilizing tamarind seed that is by-product to produce TKP for applying in the food industry.

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2. MATERIALS AND METHODS

2.1 Preparation of TKP

Initially, the tamarind seeds were roasted on a pan for 10 min prior to soaking in water overnight. After that, the seeds were dried by hot air oven (Binder, model FD 53, Binder GmbH, Germany) at 70 ^{o}C for 12 h before manually removing the seed coat and milling by pin mill (Ngow-huat-yoo, Thailand) to obtain 40 mesh TKP.

2.2 Mango sauce production

Ripe mangoes (cv. Nam Dok Mai) were purchased from the market. After peeling and cutting, mango pieces were homogenized by Philips blender (HR2061, Netherland). The homogenized mango was mixed with other ingredients at the ratio of mango: vinegar: sugar: honey: salt at 79.91: 3.75: 15.47: 0.57: 0.30 by weight. This recipe was considered as the control sample. Then, the control sample was divided to be five portions. Four of them were used for preparing four different specimens consisting of (1) control recipe added with xanthan gum 0.25% by weight, (2) control recipe added with xanthan gum 0.5% by weight, (3) control recipe added with TKP 0.25% by weight and (4) control recipe added with TKP 0.5% by weight.

The samples from five different recipes (including control) were processed to be mango sauces by heating them at 70 °C until reaching the solid content of 30 °Brix. The samples were filled into glass bottles and stored in refrigerator at approximately 4 °C prior to quality determination and sensory evaluation.

2.3 Quality determination

All five mango sauce samples produced in this study were determined their water activity and viscosity and compared with a commercial tomato sauce sample bought from the supermarket. The water activity was measured using a “Novasina” water activity instrument, model TH2/RTD33 (Novasina AG, Lachen, Switzerland) whereas the viscosity was determined by a “Brookfield” digital viscometer model LVDV II (Brookfield Engineering Laboratories, Inc., Middleboro, MA 02346 USA) with spindle no.0 at 100 rpm. Moreover, the color of all mango sauce specimens were measured by a “Minolta” color meter model CM-3500d (Konica Minolta Sensing, Inc. Osaka, Japan) and expressed as L*, a* and b* values in CIE system while the consistency of mango sauce was determined by a “Bostwick” consistometer (CSC Scientific Company, Inc., USA). All the measurements were conducted in three replications.

2.4 Sensory evaluation

Apart from the determinations of some physical qualities of mango sauces as previously described, three samples in cases of control, control added with xanthan gum 0.5% by weight and control added with TKP 0.5% by weight were subjected to the sensory test in aspects of color, aroma, texture, taste and overall liking. The sensorial qualities were

evaluated using a 7-point hedonic scale test (7 = like extremely to 1 = dislike extremely) by 30 panelists who were randomly recruited from the students and staffs in the department.

2.5 Statistical Analysis

The software package of SPSS version 12.0 was applied for the analysis of variance (ANOVA) and Duncan's multiple range test in the statistical analysis.

3. RESULTS AND DISCUSSION

The results of quality determination in facets of water activity, viscosity, color and consistency are presented in Table 1. According to the result, it appeared that the water activity values of all mango sauce samples and commercial tomato sauce were insignificant different and fell between 0.954 and 0.969. Thus, these samples were considered as high moisture food; as a consequence, in order to extend their shelf-life, they must be controlled their pH to be high acid food, exposed to heat treatment and added some preservatives. These methods are normally applied to the tomato sauces sold in the market.

If considering the viscosity of all samples, it was found that the commercial tomato sauce has the highest viscosity. It should be due to the characteristic of raw material (tomato) and the larger amount of stabilizer applied into the commercial tomato sauce than mango sauce produced in this study. After comparing between mango sauce samples, it is clear that the addition of either xanthan gum or TKP resulted in the increase of sauce viscosity. At the same amount of stabilizer, the xanthan gum could raise the viscosity of sauce significantly more than TKP. Therefore, in order to produce mango sauce that have comparable viscosity to the commercial tomato sauce, the xanthan gum must be added more than 0.5% by weight whereas TKP must be added more than that of xanthan gum.

As it can be seen from the appearance of products which added TKP, no water release occurred because tamarind seed xyloglucan reveals a high water holding capacity with good stability (Nishinari *et al*., 2009). Moreover, the flow behavior of the tamarind seed xyloglucan solution is very close to Newtonian, and very stable against heat, pH and shear (Shirakawa & Yamatoya, 2003). In agreement with the xanthan gum samples produced in this study showed no water release. Xanthan gum forms pseudo-plastic viscous solutions, which are pH and temperature stable. The pseudo-plasticity makes xanthan gum also suitable as a stabilizer of suspensions, emulsions and foams (Brenntag, 2014)

For the color values, it is obvious that the control sample had the highest values of lightness, redness and yellowness whereas the samples added with stabilizer have alike color values between each other. The samples added xanthan gum became slightly darker than the addition of TKP. It might be explained that the stabilizer caused the restructuring of the molecules of sauce leading to the more viscosity and turbidity of sauce. The increase of turbidity due to the addition of stabilizer resulted in less lightness and less intense of color.

When considering the consistency, the value of consistency in unit of centimeter indicated the distance from the starting point that the samples naturally flew along the slope of the tray of consistometer. It is unsurprising that the samples that had higher viscosity would have lower consistency values. It is because the viscosity of fluid directly related to the friction occurring between fluid and solid surface (Incropera et al., 2007). Higher friction caused the less flowing distance or consistency value. Therefore, the control sample had the highest value of consistency whereas the sample added with xanthan gum at 0.5% had the lowest. Although the sample added with xanthan gum at 0.5% had the lowest value of consistency, it was still be able to flow for around 7 cm on the consistometer indicating that it would not be the problem when pouring the sauce out of the bottle.

The sensory test results of selected mango sauce samples consisting of control, control added with xanthan gum 0.5% by weight and control added with TKP 0.5% by weight are presented in Table 2. The reason of selecting the samples added with xanthan gum 0.5% and that added with TKP 0.5% is that these two conditions provided the viscosity values that were closer to commercial sauce product than those of 0.25%. The sensory test result showed that the panelists preferred control sample more than its counterparts in aspects of color, aroma, taste and overall liking. The samples added with TKP 0.5% was preferred only in aspect of texture but acquired the lowest score in the other attributes. It meant that the TKP could improve the texture of mango sauce but caused the unsatisfactory color, aroma and taste for the consumer. Therefore, if the sauce manufacturers intend to utilize the TKP as a stabilizer, they have to concern about its effects on the sensorial quality. The purification process should be applied to TKP in order to produce high purity of xyloglucan with less unfavorable volatiles for utilizing as a food additive in the food industry.

Table 1. The values of water activity, viscosity, color and consistency of mango sauce samples and commercial tomato sauce.

Sample	Water activity (decimal)	Viscosity (cP)	Color			Consistency (cm)
			L*	a*	b*	
Control	0.962^{ns} ±0.0016	133.8^{a}±2.14	51.3^{bc}±3.13	20.4^{d}±0.33	55.8^{b}±2.61	13.7^{c}±0.15
Mango sauce added with xanthan gum 0.25% by weight	0.968^{ns}±0.0007	372.9^{d}±1.53	43.6^{a}±1.21	9.8^{a}±0.55	42.5^{a}±3.01	7.4^{a}±0.58
Mango sauce added with xanthan gum 0.5% by weight	0.969^{ns}±0.0022	404.9^{e}±3.08	44.4^{a}±0.95	11.3^{ab}±0.85	49.5^{ab}±2.09	7.3^{a}±0.46
Mango sauce added with TKP 0.25% by weight	0.964^{ns}±0.0010	181.4^{b}±0.35	47.8^{ab}±0.29	12.4^{bc}±0.26	43.3^{a}±0.19	12.7^{c}±0.10
Mango sauce added with TKP 0.5% by weight	0.964^{ns}±0.0006	293.6^{c}±2.02	55.0^{c}±0.51	13.5^{c}±0.45	44.5^{a}±3.44	11.1^{b}±0.29
Commercial tomato sauce	0.954^{ns}±0.0019	500.6^{f}±2.73	N/A	N/A	N/A	N/A

Note: L* = lightness ($0 \leq L \leq 100$); a*(+) = redness; a*(-) = greenness; b*(+) = yellowness; b*(-) = blueness; N/A = Not applicable; ns = non-significant.

All values are expressed as mean ± standard deviation (n = 3). Means with the same superscript within same column are insignificant different ($P > 0.05$).

Table 2. The sensory test result of mango sauce samples (7 = like extremely to 1 = dislike extremely)

Sample	Sensorial attribute				
	Color	**Aroma**	**Texture**	**Taste**	**Overall liking**
Control	$6.0^{c}\pm0.77$	$4.4^{b}\pm1.36$	$3.9^{ab}\pm1.20$	$4.7^{b}\pm1.26$	$4.8^{b}\pm0.95$
Mango sauce added with xanthan gum 0.5% by weight	$4.0^{b}\pm1.34$	$4.3^{b}\pm1.27$	$3.5^{a}\pm1.57$	$4.7^{b}\pm0.99$	$4.3^{b}\pm1.24$
Mango sauce added with TKP 0.5% by weight	$3.1^{a}\pm1.04$	$3.1^{a}\pm1.48$	$4.5^{b}\pm1.36$	$2.9^{a}\pm1.20$	$3.1^{a}\pm1.22$

Note: Sensorial test values are mean ± standard deviation (n = 30). Means with the same superscript within same column are insignificant different ($P > 0.05$).

4. CONCLUSION

The mango sauce samples were considered as high moisture food; therefore, they must be controlled their pH to be high acid food, exposed to heat treatment and added some preservatives in order to lengthen their shelf life. The addition of either xanthan gum or TKP helped raising the sauce viscosity. Nonetheless, xanthan gum was more efficient than TKP in increasing the viscosity of sauce. The samples added with xanthan gum or TKP had similar color values. Although the sample added with xanthan gum or TKP had the lower values of consistency than control, it was not the problem when pouring the sauce out of the bottle. The TKP could improve the texture of mango sauce but caused the unsatisfactory color, aroma and taste for the consumer. The purification process should be applied to TKP in order to produce high purity of xyloglucan with less unfavorable volatiles for utilizing in the food industry.

REFERENCES

Brenntag Food & Nutrition Europe. (2014). Hydrocolloids-How to choose? Available source: http://www.brenntag.ru/en/downloads/Food/TB_Hydrocolloids_FNFN201009.pdf, April 27, 2014.

Incropera, F. P., Dewitt, D. P., Bergman, T. L., & Lavine, A. S. (2007). Fundamentals of Heat and Mass Transfer. 6th ed., John Wiley & Sons (Asia), 1-55.

Nishinari, K., Takemasa, M., Yamatoya, K., & Shirakawa, M. (2009). Xyloglucan. In G. O. Phillips & P. A. William, Handbook of Hydrocolloids. Woodhead Publishing Limited, Abington Hall, Abington, Cambridge, England, 535-566.

Office of Agricultural Economics, Ministry of Agriculture and Cooperatives. (2013). Agricultural Export. Report on import export. Available source: http://www.oae.go.th/oae_report/export_import/export.php, July 9, 2012.

Shirakawa, M. & Yamatoya, K. (2003). Xyloglucan : Its Structure and Function. Foods Food Ingredients J. Jpn., 208, 11.

York, W. S., Van Halbeek, H., Darvill, A. G. & Albersheim, P. (1990). Structural Analysis of Xyloglucan Oligosaccharides by 1H-n.m.r. Spectroscopy and Fast-atom-bombardment Mass Spectrometry. Carbohydrate Research, 200, 9-31.