PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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OPEN ACCESS

Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2018.319.322

Research Article

Optimization of Taro (*Colocasia esculenta*) Starch as a Stabilizer in Physico-chemical and Sensory Evaluation of Yogurt

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Abstract

Objective: This study aimed to evaluate the effect of taro (*Colocasia esculenta*) starch addition as a stabilizer of syneresis, pH, total acidity, viscosity and the sensory evaluation of yogurt. **Methodology:** The method used experimental design with a completely randomized design consisting of four treatments and each treatment had 4 replications (P0 = Without addition of taro starch, P1 = Addition of taro starch 1%, P2 = Addition of taro starch 2% and P3 = Addition of taro starch 3%). **Results:** The results showed that the addition of taro starch as a stabilizer significantly affected ($p<0.01$) the syneresis, pH, total acidity and the viscosity of yogurt. The lowest syneresis in yogurt was observed with the addition of stabilizer taro starch at 3% = 0.98%. The optimal pH after fermentation is suitable for yogurt consumption with the addition of stabilizer taro starch from 3.74-3.98. The highest total acidity was observed in yogurt without stabilizer (0%) 1.73% but the addition of taro starch 1% and above lowered the total acidity of the yogurt. The use of taro starch as a stabilizer increased the viscosity of yogurt. Panelists assessment for the color, taste, aroma and texture of yogurt had a high score, indicating good acceptance. **Conclusion:** The addition of 1% taro starch provided the best physico-chemical and sensory evaluation of yogurt.

Key words: Yogurt, stabilizers, taro starch, sensory evaluation, physico-chemical properties

Received: September 04, 2017 Accepted: March 28, 2018 Published: June 15, 2018

Citation: Aju Tjatur Nugroho Krisnaningsih, Dyah Lestari Yulianti, Imam Thohari and Puguh Surjowardojo, 2018. Optimization of taro (*Colocasia esculenta*) starch as a stabilizer in physico-chemical and sensory evaluation of yogurt. Pak. J. Nutr., 17: 319-322.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Yogurt is a coagulated milk product obtained by lactic acid fermentation through the action of *Streptococcus thermophilus and Lactobacillus delbrueckii* spp. *bulgaricus*[1] from milk and milk products (pasteurized or concentrated milk) with or without optional addition[2]. Lactic acid bacteria have a number of well-established and potential benefits. These bacteria can improve lactose digestion, play a role in preventing and treating diarrhea and act on the immune system, helping the body to resist and fight with infection. More research must be conducted to authenticate the role that lactic acid bacteria might play in anti-tumor effects, hyper-cholesterol effects and preventing urogenital infections, alleviating constipation and treating food allergy[3].

Yogurt may have two primary defects: Variation in viscosity and/or expulsion of serum (syneresis). Processing, incubation and storage conditions have an effect on these changes. Syneresis can be reduced by adding stabilizers that interact with the casein network. Amatayakul *et al.*[4] stated that stabilizers are commonly used in cultured products to control the texture and reduce whey separation, since they impart good resistance to syneresis and provide a smooth sensation in the mouth by binding water to reduce the water flow in the food matrix space. Stabilizers enhance the viscosity and influence of the texture, creaminess and mouth feel, stabilizers also prevent separation of whey from yogurt[5].

Sulistyowati *et al.*[6] reported taro starch (*Colocasia esculenta*) as a local product with the potential to be developed as an alternative source for the stabilizer industry in Indonesia. When starch is used as a stabilizer, it is employed for its protective colloid properties to modify the physical and sensory properties of foods. Thus, this research was aimed at the development and optimization of yogurt and to evaluate the effect of taro starch (*Colocasia esculenta*) addition as a stabilizer on the syneresis, pH, total acidity, viscosity and sensory evaluation of yogurt.

MATERIALS AND METHODS

Materials

Taro starch: Taro of good quality was obtained. Taro was peeled, washed, cut and soaked in saline solution in a ratio of 4:1 (saline:taro) for 1 h to eliminate the oxalate compound. Taro chunks were crushed and extracted in a ratio of 4:1 (water:taro) and the material was squeezed using a filter cloth. The dregs of taro were added to water at a ratio of 4:1 (water:pulp taro) and re-extracted. Milk starch was deposited for 6-8 h. Starch that formed was dried at a temperature of ±60°C for ±6 h, ground and sifted with a 100 mesh sieve[7].

Preparation of yogurt: The process of making yogurt includes heating of pasteurized cow's milk to 90°C for 10 min with the addition of starch taro. The temperature is quickly brought to 43°C by immersing the glass beaker containing milk in cold water. The next stage is addition of inoculation of bacteria starter (3%). Inoculation is followed by yogurt fermentation and anaerobic incubation for 24 h at room temperature after completion of the incubation period followed by analysis the quality of yogurt.

Quality of yogurt: Yogurt was analyzed for its physico-chemical properties. The susceptibility of yogurt to syneresis was determined by centrifuging 20 g of sample at 500 rpm for 5 min and weighing the supernatant[7]. The amount of supernatant recovered (%, v/w) was measured. Analysis of pH was achieved using a pH meter/ion 510 (Eutech) calibrated pH meter by inserting electrodes into the buffer solution at pH 7 and 4. The total acidity was measured using a 0.1% NaOH solution until the color changed to pink. The viscosity was measured using a Brooke Field viscometer (Model RVA 3D, Scientific Australia)[7]. The sensory evaluation used hedonic scale scoring.

Methods: A completely randomized design was applied and each treatment had 4 replications, (P0 = Without the addition of taro starch, P1 = Addition of taro starch 1%, P2 = Addition of taro starch 2% and P3 = Addition of taro starch 3%). The variables measured and analyzed were syneresis, pH value, total acidity, viscosity and sensory evaluation.

Statistical analysis: Data were analyzed using a one-way analysis of variance (ANOVA) and means were compared using Duncan's multiple range test, significance was accepted at $p<0.05$.

RESULTS AND DISCUSSION

Laboratory test results related to the nutritional content of the taro starch are presented in Table 1.

Effect of taro starch addition on syneresis of yogurt: Based on the analysis, the addition of starch taro stabilizer provides a highly significant difference ($p<0.01$) in the syneresis of yogurt as shown in Table 2. The treatment without the addition of stabilizer starch taro (0%) produced a higher syneresis in yogurt than treatment with taro starch stabilizers (1-3%). The syneresis of yogurt in this study ranged from 0.98-11.42%. The higher concentration of stabilizer taro starch produces lower syneresis of yogurt. Hematyar *et al.*[8] used xanthan and carrageenan gums stabilizer to decrease the syneresis of samples. This method can cause anionic hydrocolloids to interact with positive charges on the surface of casein micelles to strengthen the casein network and to reduce syneresis and are classified as adsorbing.

Effect of taro starch addition on pH of yogurt: Based on the analysis of variance, taro starch had a significant influence on the pH of yogurt (p<0.01), which ranged from 3.74-3.98. The pH of the lowest-level yogurt without stabilizer (0%) was 3.74. The use of taro starch stabilizer gave an ideal pH near the pH of yogurt after fermentation ready for consumption, namely, pH 4 as investigated by Temesgen and Yetneberk[9]. A decrease in pH is affected by the activities and growth of lactic acid bacteria (LAB), which can hydrolyze starch and convert lactose to lactic acid[10]. Lactic acid production lowers pH.

Effect of taro starch addition on total acidity yogurt: The use of taro starch as stabilizer had a significant influence on the total acidity of yogurt (p<0.01), which ranged from 1.35-1.73% as shown in Table 2. The highest value of total acidity in the treatment without taro starch stabilizer as 1.73%. Treatment with taro starch 2 and 3% did not alter total acidity, while stabilizer at 1% increased the total acidity, which was in agreement with the results of Alakali *et al.*[5], using carboxyl methyl cellulose (CMC) 0.50-1%. This acidity of yogurt produces a value of 0.90-0.91%, lower than without stabilizer, exhibiting a total acidity of 0.92%. Therefore, low acid production could be attributed to the formation of highly viscous systems that caused diffusion resistance reduced mobility of reactants. As a result, the fermentation rate of the reacting species (yogurt culture organisms and lactose) decreased.

Table 1: Nutritional value of taro starch

Nutrients	(%)
Dry matter	83.81
Ash*	0.34
Crude protein	0.08
Crude fiber	0.41
Crude fat	0.31

*Based on a 100% dry matter

Effect of taro starch addition on viscosity of yogurt: Table 3 showed that the viscosity of yogurt samples with taro starch addition is higher than the control. Addition of taro starch can increase the viscosity of yogurt. The highest values for consistency were obtained from 3% addition taro starch. The higher concentration of taro starch addition produced the thickest consistency because it had the highest viscosity. Sahan *et al.*[11] reported that viscosity can increase due to the rearrangement of protein and protein contacts. The viscosity is affected by the number of bands between casein micelles in the yogurt and their structure[12].

Effect of taro starch addition on sensory evaluation of yogurt: Panelists' assessment results for color, taste, aroma and texture of yogurt had high scores, indicating good acceptance. For sensory scores for color, taste and aroma, there were no significant differences (p>0.05) but significant differences (p<0.05) in texture were observed. Scores for color ranged between 4.00 and 4.40 for a maximum of 5 points. The color of yogurt with 3% addition of taro starch was lighter and

Table 2: Average of syneresis, pH, total acidity and viscosity of yogurt

Treatments	Syneresis (%)	pH	Total acidity	Viscosity (cps)
P0	11.42 ± 0.01^{d}	3.74 ± 0.01^{a}	1.73 ± 0.01^{c}	830.00 ± 20^{a}
P1	3.50 ± 0.01^{c}	3.95 ± 0.01^{b}	1.60 ± 0.01^{b}	1240.00 ± 22^{b}
P2	2.35 ± 0.01^{b}	3.98 ± 0.01^{b}	1.35 ± 0.01^{a}	1880.00 ± 20^{c}
P3	0.98 ± 0.01^{a}	3.92 ± 0.01^{b}	1.39 ± 0.01^{a}	2230.00 ± 25^{d}

$^{a-d}$Superscripts in the same columns indicated highly significant difference (p<0.01), P0: Concentration of taro starch 0%, P1: Concentration of taro starch 1%, P2: Concentration of taro starch 2%, P3: Concentration of taro starch 3%

Table 3: Score average sensory evaluation of yogurt

Treatments	Color	Taste	Aroma	Texture
P0	4.20 ± 0.70	3.07 ± 1.83	3.40 ± 1.12	3.80 ± 0.52^{b}
P1	4.40 ± 1.55	4.53 ± 2.20	4.40 ± 1.12	4.40 ± 1.55^{b}
P2	4.00 ± 1.07	4.47 ± 2.11	4.30 ± 1.03	3.60 ± 0.83^{a}
P3	4.10 ± 0.70	4.20 ± 1.60	4.31 ± 1.03	4.00 ± 0.00^{b}

$^{a-b}$Superscripts in the same columns indicated significantly different effect (p<0.05), P0: Concentration of taro starch 0%, P1: Concentration of taro starch 1%, P2: Concentration of taro starch 2%, P3: Concentration of taro starch 3%

led to lower panelists scores. The taste scores for the yogurt were 3.07-4.53. A strong aroma and sour taste were detected and accepted by the panelists. The best yogurt taste was for the sample with 1% addition of taro starch, while the lowest score was for yogurt without taro starch addition. The addition of taro starch did not influence the aroma of yogurt but did influence the texture due to viscosity. According to the sensory results for texture, the addition of 1% taro starch led to higher scores and was accepted by the panel.

CONCLUSION

It can be concluded that the addition of 1% taro starch provided the best physico-chemical and sensory evaluation of yogurt. This study showed that yogurt of acceptable quality and sensory evaluation can be produced using locally available taro starch. The incorporation of taro starch can improve the viscosity of yogurt.

ACKNOWLEDGMENT

The authors gratefully acknowledge the Directorate General of Higher Education, Ministry of Research, Technology and Higher Education, Republic of Indonesia for financially supporting the present project.

REFERENCES

1. Walia, A., H.N. Mishra and P. Kumar, 2013. Effect of fermentation on physico-chemical, textural properties and yoghurt bacteria in mango soy fortified yoghurt. Afr. J. Food Sci., 7: 120-127.
2. Agarwal, S. and R. Prasad, 2013. Effect of stabilizer on sensory characteristics and microbial analysis of low fat frozen yoghurt incorporated with carrot pulp. Int. J. Agric. Food Sci. Technol., 4: 797-806.
3. Wedajo, B., 2015. Lactic acid bacteria: Benefits, selection criteria and probiotic potential in fermented food. J. Prob. Health, Vol. 3, No. 2 10.4172/2329-8901.1000129.
4. Amatayakul, T., F. Sherkat and N.P. Shah, 2006. Syneresis in set yogurt as affected by EPS starter cultures and levels of solids. Int. J. Dairy Technol., 59: 216-221.
5. Alakali, J.S., T.M. Okonkwo and E.M. Iordye, 2008. Effect of stabilizers on the physico-chemical and sensory attributes of thermized yoghurt. Afr. J. Biotechnol., 7: 158-163.
6. Sulistyowati, P.V., N. Kendarini and Respatijarti, 2014. Observation the existence of taro plant genus *Colocasia* and *Xanthosoma* in Kedungkandang subdistrict and Ampel gading subdistrict, Malang. J. Produksi Tanaman, 2: 86-93.
7. AOAC., 2000. Official Methods of Analysis. 17th Edn., Association of Official Analytical Chemistry, Arlington, VA., USA.
8. Hematyar, N., A.M. Samarin, H. Poorazarang and A.H. Elhamirad, 2012. Effect of gums on yogurt characteristics. World Appl. Sci. J., 20: 661-665.
9. Temesgen, M. and S. Yetneberk, 2015. Effect of application of stabilizers on gelation and synersis in yoghurt. J. Food Sci. Qual. Manage., 37: 90-102.
10. Pundir, R.K., S. Rana, N. Kashyap and A. Kaur, 2013. Probiotic potential of lactic acid bacteria isolated from food samples: An *in vitro* study. J. Applied Pharm. Sci., 3: 85-93.
11. Sahan, N., K. Yasar and A.A. Hayaloglu, 2008. Physical, chemical and flavour quality of non-fat yogurt as affected by a β-glucan hydrocolloidal composite during storage. Food Hydrocol., 22: 1291-1297.
12. Lucey, J.A. and H. Singh, 1997. Formation and physical properties of acid milk gels: A review. Food Res. Int., 30: 529-542.