The effect of citric acid on chemical and physical characteristics of andaliman (Zanthoxylum aethopodium) chili paste in retort packaging

H A Pangastuti*, L Permana, V Fitriani, D T Mareta and A Wahyuningtyas
Food Technology Study Program, Institut Teknologi Sumatera, Lampung, Indonesia
*Email: hesti.pangastuti@tp.itera.ac.id

Abstract. Andaliman chili paste is a condiment made from andaliman (Zanthoxylum aethopodium) that widely consumed as traditional food in North Sumatera, Indonesia. With the aim to improve the shelf life of the products, this research was done as a preliminary evaluation to understand the effect of citric acid concentration to chemical and sensory characteristics of andaliman chili paste packed in retort. The study design was completely randomized design with three citric acid concentration, such as 0,1%; 0,3%; and 0,5% (b/v) with chili paste without citric acid as a control. The chemical and physical properties measured were moisture content, pH, water activity, and color. The result showed that addition of citric acid did not significantly affected (P > 0.05) pH and water activity. However, it revealed that moisture content and color parameter were significantly different (P < 0.05) among all the samples.

1. Introduction
Thermal processing of foods is one of the major techniques used for manufacturing packaged shelf stable food products [1]. Retort processing technology described as processing food containers in a steam chamber using high temperature. It has been developed and applied in high-speed commercial product. Packaging material is vary from aluminium foil structure to sophisticated multilayer and high barrier laminate package [2]. Retort products are more acceptable to consumer because of their lighter, more appealing, and convenient end use [3,4]. It also helps to reduce delivery and storage cost [5].

Research about producing retort product has widely implemented, one of them as part of introducing commercialization of traditional food, such as in curry and masala [6,7,8]. With technology improvement, traditional food can reach more people and can promote better economic value.

Andaliman chili paste is one of traditional condiment that originally comes from North Sumatera, Indonesia. The chili paste made from andaliman fruit (Zanthoxylum aethopodium, also named lemon pepper), a wild and endemic plant with lemon-like aromatic odor and pungent taste. Although some researches about andaliman chili paste had already conducted [9,10], research about its commercialization were scarce. In this research, we combined retort packaging with citric acid as preservative agent, to gain longer shelf life on food. The objective of this research was evaluating chemical and physical properties of andaliman chili paste packed in retort pouch with different citric acid concentration.

2. Materials and Methods
2.1. Preparation of Andaliman Chili Paste in Retort Packaging
Andaliman, green chili, onion, garlic, candlenut, green tomato, lemongrass, and lime were purchased from the local market in Bandar Lampung, Lampung Province, Indonesia. Production of andaliman chili
paste started with steaming of chili, onion, garlic, and tomato for 15 minutes. All the ingredient added with 35 ml of vegetable oil, then mixed in food processor (Philips, HR-2057). The sample were cooked, and added with cornstarch solution. The samples were mixed while heating until fully cooked. After cooked, samples then left for cooling. Addition of citric acid was done with different concentration, such as 0%, 0.1%, 0.3%, and 0.5%.

For sterilization, 50 g of andaliman chili paste was filled into retort pouch, sealed, and sterilized in autoclave (GEA, Germany) to 121°C for 20 minutes. All processed samples were kept at 4°C for further analysis.

2.2. Determination of Moisture Content and pH
The moisture content was analyzed according to AOAC No. 990.20 [11] method. Acidity was measured using pH meter by mixing 10 g of sample with 20 ml of distilled water and filtering through Whatmann No. 4 paper. A 10 ml of filtrate were measured using a pH meter (Ohaus, ST-3100-B).

2.3. Color and Water Activity Measurement
For determination of physical properties, this research used color and water activity parameter. A colorimeter (Konica Minolta Chromameter, CR-300, Japan) was used to measure the color of processed chili paste. Analytical data was expressed as Hunter Lab scale, such as L (lightness), a* (greenness/redness), and b* (yellowness/blueness) parameters. Water activity were measured using Aw meter (Pawkit, Decagon, USA).

2.4. Data Analysis
All of the experimental data were analyzed using Analysis of variance (ANOVA) using the SPSS software package for Windows Version 23.0, and the determination of significant differences among treatment means was done by Duncan’s multiple range tests (P ≤ 0.05).

3. Result and Discussion
Effect of citric acid on moisture content and pH of andaliman chili paste is presented in Table 1. Addition of citric acid was significantly increase the moisture content of chili paste. The range value of moisture content for andaliman chili paste was higher (76.09-78.57%) than research conducted by Pa et al. [9], which were 46.03-54.18%. Addition of citric acid could reduce pH value significantly, but did not significant with additional range of 0.1%-0.5% citric acid. The decrease pH might due to citric acid which give sour and acidic tasting.

| Addition of citric acid | Moisture content (%) | pH       |
|-------------------------|----------------------|----------|
| 0%                      | 76.0864 ± 0.0399     | 4.78 ± 0.1414 |
| 0.1%                    | 76.3528 ± 0.0093     | 4.10 ± 0.0495 |
| 0.3%                    | 78.1120 ± 0.0309     | 4.13 ± 0.0495 |
| 0.5%                    | 78.5749 ± 0.0093     | 4.04 ± 0.0565 |

*Note: Means among the same column followed by the same letters are not significantly different (P > 0.05).

Table 1. Effect of citric acid addition to moisture content and ph of andaliman chili paste in retort packaging

Physical parameter is an important attribute for consumer acceptability and also act as control quality in food industries. The result (Table 2) showed that addition of different concentration of citric acid affected lightness, a* parameter, and b* parameter significantly. The best color was seen in andaliman chili paste with 0.5% of citric acid addition.

Maillard and enzimatic reactions are also responsible for color degradation. Enzymes most involved in color degradation are polyphenoloxidase (PPO), peroxidase (POD), and lipooxygenase (LOX) [12]. POD and PPO were closely related to enzimatic loss of color and sensory qualities [13], while LOX related to chlorophyll destruction [14]. Thus, citric acid in chili paste acted as PPO inhibitor [15].
Andaliman chili paste with different treatment showed no significant effect on its water activity parameter. Water activity has closer relation to microbial growth and enzyme activity [16]. With higher water activity, the product will be susceptible to food spoilage.

Table 2. Effect of citric acid addition to color and water activity parameter of andaliman chili paste in retort packaging

| Addition of citric acid | Color L | Color A | Color b | Water activity |
|-------------------------|---------|---------|---------|----------------|
| 0%                      | 38.13±0.0141 | 14.00±0.0212 | 27.68±0.0495 | 0.82 |
| 0.1%                    | 38.33±0.0495 | 13.43±0.0778 | 27.84±0.0848 | 0.82 |
| 0.3%                    | 38.30±0.0141 | 13.26±0.0212 | 27.25±0.0071 | 0.80 |
| 0.5%                    | 39.84±0.0000 | 13.51±0.0212 | 28.45±0.0353 | 0.80 |

*Note: Means among the same column followed by the same letters are not significantly different (P<0.05).

Conclusion

It was found that addition of citric acid was important to retain its chemical and physical properties. The value for pH and water activity were not significantly difference (p>0.05) between the 0.1-0.5% addition of citric acid, but significant in moisture content and color parameter.

Acknowledgment

Authors would like to thank to Institut Teknologi Sumatera for providing the research grant (No. B/351/IT9.C1/PT.01.03/2019) through “Hibah Penelitian ITERA SMART 2019”.

References

[1] Gokhale S V and Lele S S 2014 Retort process modeling for Indian traditional foods Journal of Food Science and Technology 51 pp 3134–3143
[2] Shah M A, Bosco S J D, Mir S A, and Sunooj K V 2017 Evaluation of shelf life of retort pouch packaged Rogan josh, a traditional meat curry of Kashmir, India Food Packaging and Shelf Life 12 pp 76–82
[3] Mohan C O, Ravishankar C N, Bindu J, Geethalakshmi V, and Gopal T K S 2006 Effect of thermal process time on quality of shrimp kuruma in retortable pouches and aluminum cans. Journal of Food Science 71 pp S496–S500
[4] Al-Baali A G A and Farid M M 2006 Sterilization of food in retort pouches (New York: Springer Science)
[5] Dushyanthan K 2002 Manual for short course on recent trends in packaging of meat and meat products (Chennai: Madras Veterinary College) p 16–30
[6] Gopal T K S, Vijayan P K, Balachandran K K, Madhavan P, and Iyer TSG 2001 Traditional Kerala style fish curry in indigenous retort pouch Food Control 12 pp 523–527
[7] Shankar C N R, Gopal T K S, and Vijayan P K 2002 Studies on heat processing and storage of seer fish curry in retort pouches Pack Technol Sci 15 pp 3–7
[8] Sreenath G P, Anthony M X K, Nagarajarao R C, Bindu J, and Gopal TK 2007 Standardisation of process parameters for ready-to-eat squid masala in indigenous polymer-coated tin-free steel cans Int J Food Sci Technol 42 pp 1148–1155
[9] Pa E T, Sinaga H, and Ridwansyah 2019 The effect of addition of andaliman (Zanthoxylum acanthopodium DC) on the quality of andaliman condiment IOP Conf. Series: Earth and Environmental Science 260
[10] Sonangda, M., H. Sinaga, and L.N. Limbong. 2019. Effect of ratio of andaliman (Zanthoxylum acanthopodium) with garlic and aging time on the quality of sambal tuk tuk. IOP Conf. Series: Earth and Environmental Science 260
[11] AOAC 2000 Official methods for analysis 17th ed (Gaithersburg: AOAC International)
[12] Apichartsrangkoon A, Srisajjalertwajab S, Chaikhama P, and Hirun S 2013 Physical and chemical properties of Nam Prig Noom, a Thai green-chili paste, following ultra-high pressure
and thermal processes *High Pressure Research* **33** No. 1 pp 83–95

[13] Robinson D S 1991 *Oxidative enzymes in foods* ed Eskin N A M (New York: Elsevier Applied Science) p 1–45

[14] Eisenmenger M J, Reyes-De-Corcuera J I 2009 High pressure enhancement of enzymes: a review. *Enzyme Microb. Technol.* **45** pp 331–347

[15] Ali H M, El-Gizawy A M, El-Bassiouny R W I, and Saleh M A. 2015. Browning inhibition mechanisms by cysteine, ascorbic acid and citric acid, and identifying PPO-catechol-cysteine reaction products *J Food Sci Technol.* **52**(6) pp 3651–3659

[16] Troller J A 1978 *Water Activity and Food* (London: Academic Press)