Effect of Preservatives and Pasteurization Time on Physicochemical Characteristics of Ground Red Chili

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Abstract. Red chili (Capsicum annum) is one of many kinds of vegetables produced in Indonesia. Red chili has high moisture content so it is easy to be rotten and decay. Red chili can be processed to be preserved-ground chili to maintain its shelf life and ease of use. The objective of this research was to understand the physicochemical character of ground red chilli, when during the production was used preservatives and pasteurization. The design of this research was completely randomized design with three treatments including a control. The treatment was preservative types (5% salt; 5% salt + 0.05% potassium sorbate and control), while pasteurization were 20 and 30 minutes. Parameters observed were moisture content, ash content, Total Soluble Solid (TSS), pH, water activity, chroma, dietary fiber, fat, protein, vitamin C and crude fiber. The results showed that the type of preservative had significantly effect on moisture, ash, dietary fiber, crude fiber, fat, protein, vitamin C content, TPT, pH and Aw. The moisture, dietary fiber, crude fiber and protein content, Aw, pH were decreased with the using of preservatives. Vitamin C, TPT, ash and protein content increase with the use of preservatives. Pasteurization time significantly effects on the decrease of dietary and crude fiber. The best ground chilli is obtained from a combination of 5% salt and 20 minute pasteurization that has characteristics 68.46% moisture content, 5.79% ash content, 2.13% fat content, 2.78% protein content, 171.83 ppm vitamin C, crude fiber 12.51%, 2.62% dietary fiber, 20.57° Brix TSS, 4.61 pH, and 0.92 Aw.

1. Introduction

Red chili is one of the important horticultural commodities. Red chili is consumed a lot in both fresh and processed for a variety of dishes. Fresh chilies have a bright red color and a distinctive spicy flavor that produces spicy characteristics and attractive colors in food. Red chili also contains important nutrients such as vitamin C and fiber that is beneficial for health [1]. As a horticultural commodity, red chili has a high water content, around 90% [2].

High moisture content in red chili peppers results in chili being susceptible to damage and has a short shelf life. Damage of chili is mainly due to physiological and mechanical factor. Red chili processing is one solution to increase the shelf life of chili. Red chili can be processed into chili powder, ground chili, pasta and chili sauce. Ground chili is one type of chili which is potential because it has characteristics that are similar with fresh chili, widely used in various spices and easy to process. Ground red chili, many produced by seasoned traders in traditional markets and also available in modern markets. However, according to some studies spice traders in traditional markets use preservatives and dyes that exceed the threshold that would endanger consumers [4,5].
Several studies related to ground red chili have been conducted, i.production technology of ground red chili [6], the safety of ground red chili 4,5. Food preservatives can be used to increase product shelf life [7]. Pasteurization is also one method to increase product shelf life [8]. The purpose of this study was to determine the effect of preservatives and pasteurization on the physicochemical characteristics of ground red chili.

2. Materials and methods
The research was carried out in laboratories of Bogor Agricultural Postharvest Research and Development Center from 2016 to 2017.

2.1. Materials
The materials used in this research were red chili, salt, potassium sorbat and the other chemical for analysis.

2.2. Methods
The process of ground red chili making was as follows: ground red chilies were sorted, then washed thoroughly, cut into pieces to reduce the size, then steamed for 15 minutes, and then ground using a food processor to get raw ground red chili. Raw ground red chili cooked until boil and hold for 5 minutes. During cooked, preservatives were added according to the treatment. The next process was packaging ground red chili with standing pouches aluminum foil. Packaged ground red chili, then pasteurized. The duration of pasteurization was in accordance with the treatment.

The design of this research is completely randomized design with three treatments including a control. The treatment was preservative types (5% salt; 5% salt + 0.05% potassium sorbate and control), while pasteurization were 20 and 30 minutes. Parameters observed were moisture content, ash content, total soluble solid (TSS), pH, water activity, colour, dietary fiber, fat, protein, vitamin C and crude fiber.

Moisture content analysis using the gravimetric method (AOAC, 2005), ash content analysis with the method of furnace, analysis of total soluble solids using refractometer, pH analysis using pH meter, analysis of water activity using Aw meter, color analysis using a color reader, analysis of fat with soxhlet method, protein analysis with Khjedal method, crude fiber analysis with gravimetric method, dietary fiber analysis using AOAC, 1995 and analysis of vitamin C by titration method. The data obtained were analyzed by analysis of variance (ANOVA) by Duncan's test using SPSS for window (ver.20) software.

3. Result and Discussion
3.1. Chemical characteristic of ground chilies
Chemical physical characteristics observed in ground red chili in this study were moisture, ash, fat, protein, vitamin C, crude fiber and dietary fiber (Table 1) and total soluble solid (TSS), pH, Aw and color / chroma (Table 2).

Table 1. Chemical characteristics of ground red chili on various treatments

| Treatment                  | Moisture content (%) | Ash content (%) | Fat content (%) | Protein content (%) | Vit C content (ppm) | Crude fiber content (%) | Dietary fiber content (%) |
|----------------------------|----------------------|-----------------|-----------------|---------------------|---------------------|------------------------|--------------------------|
| Control, 20'               | 73.09                | 1.18            | 1.41            | 3.95                | 132.53              | 11.03                  | 3.19                     |
| Control, 30'               | 72.17                | 1.26            | 1.67            | 3.60                | 131.89              | 11.01                  | 2.87                     |
| Salt 5%, 20'               | 68.46                | 5.79            | 2.13            | 2.78                | 171.83              | 12.51                  | 2.62                     |
| Salt 5%, 30'               | 67.92                | 5.68            | 2.60            | 2.33                | 171.23              | 11.71                  | 3.40                     |
| Salt 5% + potassium sorbat, 0.05%, 20' | 68.63                | 7.51            | 2.78            | 2.10                | 164.21              | 6.81                   | 2.77                     |
| Salt 5% + potassium sorbat, 0.05%, 30' | 68.55                | 7.41            | 2.57            | 2.25                | 164.80              | 10.89                  | 2.46                     |
Table 2. Physical characteristics of ground red chili on various treatments

| Treatment                  | TSS   | pH    | Aw  |
|----------------------------|-------|-------|-----|
| Control, 20'               | 12.67 | 5.13  | 0.99|
| Control, 30'               | 13.67 | 5.04  | 0.97|
| Salt 5%, 20'               | 20.67 | 4.61  | 0.92|
| Salt 5%, 30'               | 21.00 | 4.60  | 0.93|
| Salt 5% + potassium sorbat 0.05%, 20' | 22.00 | 4.66  | 0.91|
| Salt 5% + potassium sorbat 0.05%, 30' | 21.67 | 4.64  | 0.90|

3.1.1. Moisture content

Moisture is an important parameter that determines the quality of ground red chili and it is an important parameter for storage. From Table 1 it is known that the moisture content of ground red chili ranges from 68.63 to 73.09. According to Analysis of Variance, type of preservative has significantly effect to the moisture content of ground red chili (Table 3). The lowest moisture content in the use of 5% salt that was significantly different from the control. Salt has the ability to bind water, so the use of salt will reduce the moisture content of the ground red chili that produced [8, 9, 10].

Table 3. Type of preservative effects on physicochemical characteristics of ground chili

| Treatment                  | Moisture content (%) | Ash content (%) | Dietary fiber content (%) | Crude fiber content (%) | Fat content (%) | Protein content (%) | Vit. C (ppm) |
|----------------------------|----------------------|-----------------|--------------------------|------------------------|----------------|---------------------|---------------|
| Control                    | 72.63b               | 1.22a           | 3.03a                    | 11.02b                 | 1.54a         | 3.78a               | 132.21a       |
| 5% Salt                    | 68.19a               | 5.74b           | 3.01a                    | 12.11b                 | 2.36b         | 2.56b               | 171.53b       |
| Salt 5% + potassium sorbat 0.05% | 68.59a  | 7.46c           | 2.62b                    | 8.85a                  | 2.67b         | 2.18a               | 164.51b       |

3.1.2. Ash content

The ash content of ground red chili ranged from 1.18-7.51% (Table 1). This type of preservative has an effect on the ash content of ground red chili. The use of preservatives increases the ash content of ground red chili which is significantly different from the control (Table 3). The increase of ash content caused by the presence of minerals from salt and potassium sorbate. Natrium from salt would increase the ash content of ground chili. And then, potassium content from potassium sorbate also increase the ash content of ground red chili.

3.1.3. Dietary fiber

The dietary fiber of ground red chili ranged between 2.46-3.40%. Based on Analysis of Variance, the highest dietary fiber content was control treatment, but not significantly different from the use of 5% salt (Table 3). The duration of pasteurization would affects the level of dietary fiber. Pasteurization for 30 minutes results in higher dietary fiber than 20 minutes (Table 4). The heating process during pasteurization will reduce the water from ground red chili that will increases of dietary and crude fiber content.
Table 4. The effect of pasteurization on dietary fiber and crude fiber of ground red chili

| Treatment        | Dietary fiber (%) | Crude fiber (%) |
|------------------|-------------------|-----------------|
| 20’Pasteurization| 2.86<sup>a</sup>  | 10.12<sup>a</sup> |
| 30’Pasteurization| 2.91<sup>b</sup>  | 11.21<sup>b</sup> |

3.1.4. Crude fiber
The ground red chili fiber content ranges from 6.81-12.51%. The highest crude fiber in the treatment of 5% salt which was not significantly different from the control treatment but significantly different from the use of 5% salt that combined with 0.05% potassium sorbate. The result of Analysis of Variance also showed that the pasteurization time will affect the crude fiber content. Pasteurization for 30 minutes results the higher crude fiber content than 20 minutes. Similar with the content of dietary fiber, this happens because the longer the heating, the more water will be evaporated from the ingredients so that the solids content, including the crude fiber increases.

3.1.5. Fat content
Fat content of ground chilli ranged from 1.41-2.78%. This type of preservative has a significantly different effect on the fat content of ground red chili. The use of salt combined with potassium sorbate produces ground red chilli with the highest fat content.

3.1.6. Protein content
The protein content of ground red chili ranged between 2.10-3.95%. Based on ANOVA, type of preservative has a significant effect on protein content. The lowest protein content in the use of 5% salt combined with 0.05% potassium sorbate, which is significantly different from the use of 5% salt and control.

3.1.7. Vitamin C
Vitamin C is one of the important parameters of ground red chili. Vitamin C content of ground red chilli ranged from 131.89-171.83 ppm. Based on ANOVA test, the type of preservatives has significantly effect on the level of vitamin C in ground red chili. The highest level of vitamin C was in the use of 5% salt, which was not significantly different from the 5% salt combined with potassium sorbate, but it was significantly different from the control. Vitamin C is an antioxidant that is beneficial for health. Vitamin C is soluble in water and will dissolve more easily in the presence of heating, but if it heating for long period, vitamin C will be damaged. High water content also causes high degradation of vitamin C [11]. The presence of salt will reduce the water content of the ground red chili so that it will increase the resistance of vitamin C to damage. Other literature states that preservatives will increase the stability of vitamin C [12].

3.1.8. Titratable soluble solid (TSS)
TSS ground red chili ranges from 12.67-22.00° Brix (Table 2). Type of preservative has a significantly effect on TSS of ground red chili. The use of salt that combined with potassium sorbate has the highest TSS that was not significantly different from the use of 5% salt, but significantly different from the control (Table 5). The addition of salt and potassium sorbate which dissolves in the water will increase the total soluble solids of ground red chili.
Table 5. The effect of preservatives on TSS, pH and Aw of ground red chili

| Treatment                                | TSS (°Brix) | pH    | Aw  |
|------------------------------------------|-------------|-------|-----|
| Control                                  | 13.17<sup>a</sup> | 5.09<sup>b</sup> | 0.98<sup>a</sup> |
| 5% Salt                                  | 20.83<sup>b</sup> | 4.6<sup>a</sup> | 0.93<sup>b</sup> |
| Salt 5% + potassium Sorbat 0.05%         | 21.83<sup>b</sup> | 4.65<sup>a</sup> | 0.91<sup>c</sup> |

3.1.9. **pH**

pH is one of the important parameters of ground red chili. The pH of ground red chili ranges from 4.60-5.13 (Table 2). Based on the ANOVA results, the type of preservatives has a significantly different effect on the pH of ground red chili (Table 5). The lowest average pH in the use of 5% gram was significantly different from the control, but not significantly different from the treatment of using 5% salt combined with potassium sorbate. The presence of salt that binds water, will increase the concentration of organic acids that will reduce the value of pH [11, 12, 13]. Furthermore, the addition of potassium sorbate will also stabilize the organic acid in the ground red pepper so that the pH value will decrease with the addition of potassium sorbate.

3.1.10. **Activity water**

Activity water (Aw) is one of the important parameters of ground red chili. Ground red chili expected to have a low Aw. The Aw of ground red chili ranges between 0.90-0.99 (Table 2). Based on the ANOVA test, the type of preservative has a significantly effect on Aw ground red chili (Table 5). Ground red chili with the lowest Aw value is the use of 5% salt combined with 0.05% potassium sorbit, which is significantly different from the use of 5% salt and also control. Salt and preservatives will reduce the amount of free water in the red chili so the value of the water activity will decrease [8,9,14,15].

4. **Conclusion**

From this research, its can conclude that:

1. Type of preservative had significantly effects on moisture content, ash, dietary fiber, crude fiber, protein, vitamin C, vitamin C, Total Soluble Solid, pH, and Aw.
2. The pasteurization time had significantly effect on dietary and crude fiber.
3. The best ground chili is obtained from a combination of 5% salt and 20 minute pasteurization that had higest value of vitamin C and crude fiber. Besides its, it had the lowest moisture content and water activity. The characteristics were 68.46% moisture content, 5.79% ash content, 2.13% fat content, 2.78% protein content, 171.83 ppm vitamin C, crude fiber 12.51%, 2.62% dietary fiber, 20.57° Brix TSS, 4.61 pH, 0.92 and Aw, 86.9.

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