The Effects of Pretreatments on Physicochemical Properties of Bamboo Shoots (*Bambusa vulgaris* schard var. *vitula*) Flour

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The Effects of Pretreatments on Physicochemical Properties of Bamboo Shoots (*Bambusa vulgaris* schard var. *vitula*) Flour

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Abstract. Bamboo shoots can be used as a single vegetable or can be mixed with other food ingredients. This study aims to determine the effect of boiling-steaming pretreatment and soaking time on physicochemical properties of bamboo shoots flour. This research used raw material namely "ampel kuning" bamboo shoots (*Bambusa vulgaris* schard var. *vitula*). The experiment used factorial completely randomized design which was arranged in two factors: soaking time and boiling-steaming pretreatment. The pretreatment of boiling-steaming affected physicochemical properties of bamboo shoots flour, especially in steaming treatment with an analysis value of water holding capacity of 10.60 g/g, swelling power of 25.9 g/g and solubility of 32.03%, crude fiber of 39.98%, 6.56% ash content, 14.29% lipid content, and 11.89% color lightness level. The soaking time affected the decrease in hydrogen cyanide (HCN) content with a value of 4.41 ppm in bamboo shoot flour.

Keywords: soaking time, boiling, steaming, bamboo shoots

1. Introduction

Bamboo shoots are part of bamboo that have high fiber content and have the potential to be flour. Bamboo shoots can be used as a single vegetable or can be mixed with other food ingredients. There are many types of bamboo in Indonesia, but commonly consumed is "betung" bamboo *(Dendroccalamus asper),* "legi" bamboo *(Gigantochloa atter),* "tabah" bamboo *(Gigantochloa nigrociliata* Kurz*)* and "ampel kuning" bamboo *(Bambusa vulgaris* schard var. *vitula)* which is found in many areas of Indonesia. A bamboo shoot is the new gentle growth of the stem apex into a young culm consisting of compressed internodes sheltered by a number of leathery sheaths. The shoots are usually harvested when they attain the height of 15-16 cm [1]. The very high water content makes bamboo shoots easily damaged after being harvested, so that further handling is needed to overcome the damage. The main damage from fresh bamboo shoots is the heavy decrease caused by the processes of respiration and transpiration, namely the presence of brown discoloration and fungal growth in the shoots that are injured during cutting [2]. Another disadvantage of bamboo shoots as food ingredients is the content of *cyanide acid* (HCN). It is reported that bamboo shoot contains cyanide as high as 0.8% [3], 0.3% [4] and 0.1% [5]. However, cyanide content is reported to decrease substantially following harvesting. Cyanide content often varies in different parts of a shoot and

between the same parts of different individuals of the same species. Bamboo shoots contain up to 0.16% total cyanide in the tip reducing to 0.01% in the base [6].

Flour is a solid particle in the form of fine or very fine grains. The powder or flour making process aimed to expand the surface of the material so that it will be easier in the further process [7]. Ampel kuning bamboo shoots *(Bambusa vulgaris schard var. vitula)* can be used by processing into dry flour so that it can reduce the power of damage and to expand the consumption power of the community. The study was carried out with a preliminary treatment in the form of boiling-steaming treatment which would previously be soaked with different soaking times. It is expected that bamboo shoots with low *cyanide acid* (HCN) content and other desired characteristics will be obtained.

2. Materials and Methods

2.1 Materials

Materials used in making bamboo shoots flour were ampel kuning bamboo shoots *(Bambusa vulgaris* schard var. *vitula)* from Banyumeneng Village, Mranggen Sub-District, Demak. Materials used for preparation and analysis, namely aquades, heksan (technical), H_2SO_4 96% (p.a.), NaOH (p.a.), filter paper, HCl (p.a.), pikrat acid solution 1%(p.a.), cloroform (p.a.), Na-karbonat (p.a.) and K_2SO_4 (p.a.) Tools used in making bamboo shoots flour namely knive (global), processing pan (Weston), baking sheet, and jar (star). While the equipment used for preparation and analysis of samples were analytical balance (SHIMADZU), cabinet dryer, reaction tube, measurung cup (IWAKI), furnace (Thermo Scientific), oven (memmerl), chromameter (FRU®), spektrofotometer (Spectroquant® Prove 300), measuring pipette, alumunium cup, porselen cup, vortex (Lab Dancer), sentrifuge tube (IWAKI), beaker glass (IWAKI), hot plate (IKA C-MAG) and soxhlet.

2.2 Production of Bamboo Shoots Flour

Bamboo shoots used were bamboo shoots with species ampel kuning (*Bambusa vulgaris* Schard var. *vitula*). The criteria for bamboo shoots used in the experiment were fresh bamboo shoots which were harvested during the rainy season and had a length of 10-15 cm. After the selection, bamboo shoots were cut or cleaned. The slicing of yellow apple shoots was done in the form of a chip. Soaking was carried out after cutting with 200 ml of aquadest soaking every soaking that was using variations of time 0 hours, 12 hours and 24 hours. The boiling-steaming treatment was done after the boiling water was only then the bamboo shoots were inserted and the calculation time starts for 20 minutes. Drying was carried out after the initial treatment by drying it using a cabinet dryer at a temperature of 50^{o}C for 48 hours until it was dry (bamboo shoots are easily broken and not charred). The process of holding bamboo shoots was ground using a blender until smooth and sifted using a 60 mesh sieve. After becoming yellow bamboo shoot flour, the analysis will be carried out. The study was conducted using RAL factorial (Complete Random Design) design with two factors, namely steaming-boiling treatment which had previously been subjected to soaking treatment with varying length of time 0 hours, 12 hours and 24 hours.

2.3 Characterization of Bamboo Shoots Flour

The analysis carried out were physical analysis including water holding capacity (WHC), swelling power, solubility, lightness (L*). While chemical analysis include water content, ash content, lipid content, crude fiber, and HCN content.

2.4 Stastical Analysis

This research used factorial design. The Data obtained were analyzed by Variant Analysis (ANOVA) followed by real difference test DMRT (Duncan Multiple Range Test) with confidence interval 5%.

3. Results and Discussion

3.1 The Effect of Pretreatments on Water Holding Capacity

Water Holding Capacity (WHC) was the ability to absorb and hold water without heating conditions. This is needed to find out how big yellow ampel bamboo flour can absorb and hold water without heating conditions. Boiling treatment showed not significant effect, while the steaming treatment showed significant effect. The WHC value produced from the steaming process were 7.6 g/g, 10.11 g/g and 10.6 g/g, this value indicated the steaming treatment was more recommended as a preliminary treatment in making bamboo shoot flour compared to boiling treatment. The value of WHC was related to the content of food fiber in bamboo shoots. In addition to food fiber factors, the value of WHC was also influenced by the protein content of bamboo shoots.

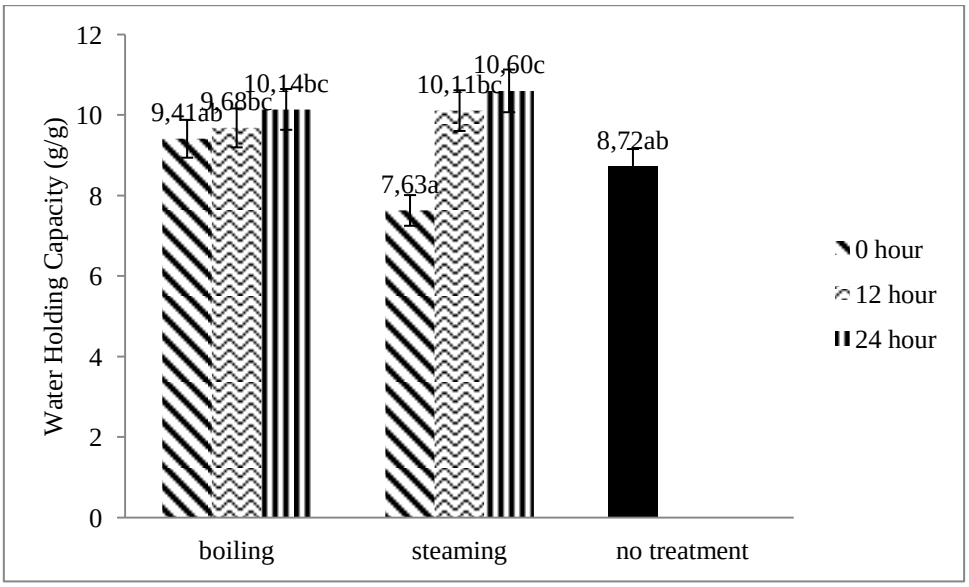

Figure 1. The effect of pretreatments on WHC diagram

3.2 The Effect of Pretreatments on Swelling Power

Swelling power was an analysis used to see the ability of starch to absorb water by measuring the amount of water absorbed by each gram of dry sample. The treatment with boiling and steaming process in Figure 2 showed that the swelling power value in the steaming treatment was higher than that of the boiling process. The steaming treatment had value of 16.98 g/g, 21.66 g/g and 25.96 g/g. Whereas the boiling treatment has the results of 18.34 g/g, 22.53 g/g, and 24.69 g/g. This was influenced by the breakdown of starch granules, where amylose and amylopectin were able to bind to water that occurs during the boiling-steaming treatment resulting in higher swelling power. Continuous heating would cause the starch granules to break so that the water contained in starch granules and water-soluble starch molecules easily gets out and enters the solution system

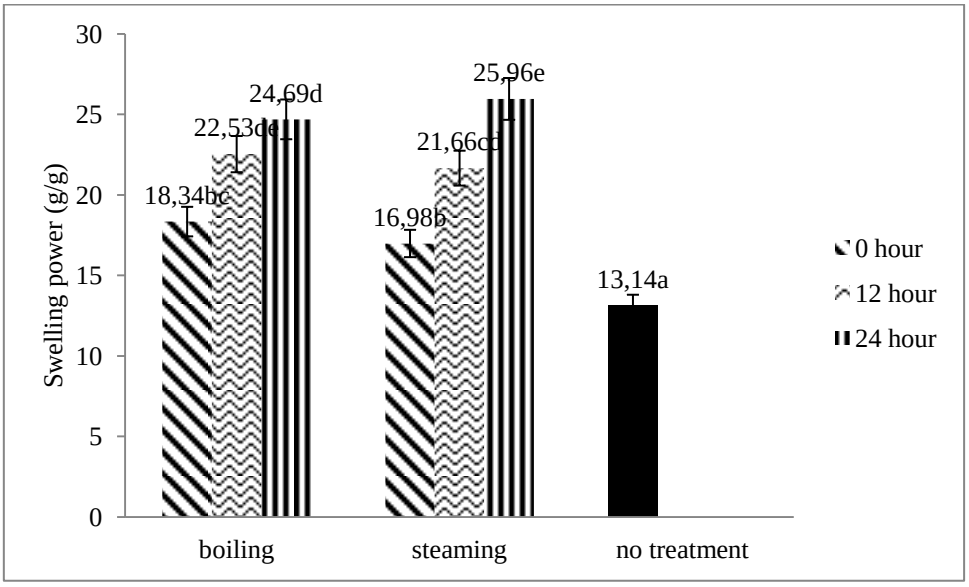

Figure 2. The effect of pretreatments on swelling power diagram

3.3 The Effect of Pretreatments on Solubility

Solubility was the ability of materials to dissolve in water. Solubility showed the properties of starch after heating. Solubility was the weight of dissolved flour and can be measured by drying and weighing a number of supernatants. Based on Figure 3, it was known that the preliminary treatment caused a decrease in the solubility of bamboo shoot flour. One factor that affects solubility was the degree of polymerization. The higher the degree of polymerization, the lower the solubility. Conversely, if the degree of polymerization was lower, the solubility will be higher. Molecular size caused increased solubility [8]. The soaking time caused the solubility of bamboo shoots flour to decrease.

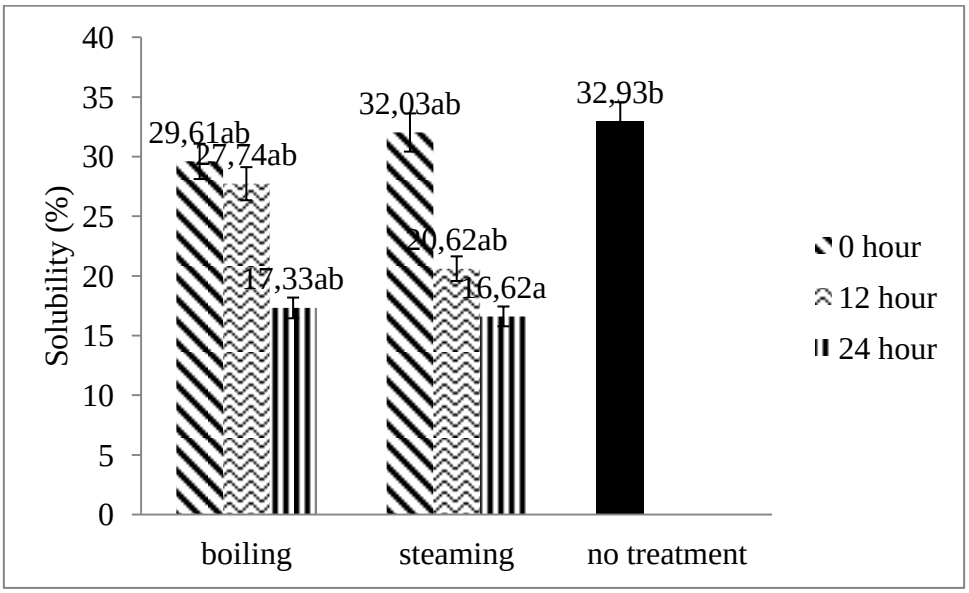

Figure 3. The effect of pretreatments on solubility diagram

Solubility and swelling power were two things that were related and occured during gelatinization. The relationship between swelling power and solubility was related to the ease of water molecules to interact with molecules in starch granules and replaced hydrogen interactions between molecules so

that the granules will more easily absorb water and produced high development. The development of granules occured when granules were heated with water and hydrogen bonds which stabilize the structure of the double helix in the crystal which was cut off and replaced by hydrogen bonds with water. The development will suppress the granule from the inside so that the granule will break and the starch molecules, especially amylose, will come out. The more amylose molecules that come out of the starch granule, the higher the solubility. Therefore, with high amylose content in general it also had a high solubility.

3.4 The Effect of Pretreatments on Lightness (L)*

Color was one of the appearance attributes of a product that often determines the level of consumer acceptance of the product. Color measurement of agricultural products can be done using a tool that can determine the brightness, red to green, and yellow to blue. Brightness level was expressed with L. L* (lightness) with a value of 0 = black and 100 = white. The steaming treatment can provide a better color brightness because the steaming process did not cause browning on bamboo shoot flour. The results of statistical tests on color analysis with brightness levels (L *) can be seen in Figure 4. L* values in all treatments had results that were not significantly different. The color brightness level (L*) in all treatments was worth 9-11. The longer the soaking the higher the brightness or brighter. The duration of soaking and steaming-boiling treatment increased the brightness of bamboo shoot flour.

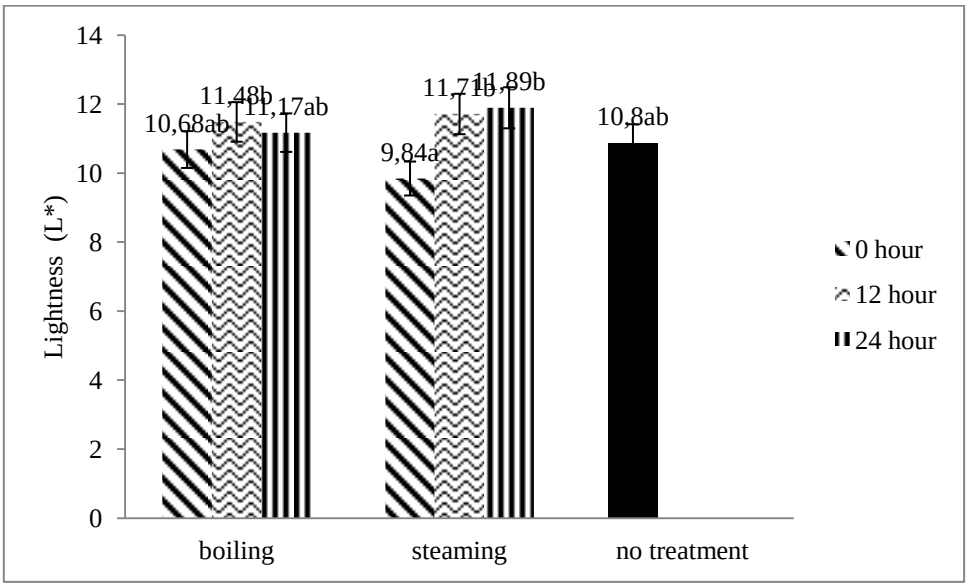

Figure 4. The effect of pretreatments on lightness (L*) diagram

3.5 The Effect of Pretreatments on Water Content

Water content is the amount of water contained in the material expressed in percent. Water content is also one of the most important characteristics of food, because water can affect the appearance, texture, and taste of food. Water content in food ingredients also determines the freshness and durability of the food, high water content resulting in easy bacteria, molds, and yeast to multiply, so that there will be changes in food. The lower the water content, the slower the growth of microorganisms multiply, so the decay process will take place faster [9].

Based on Figure 5, the results of the analysis of the moisture content of the values obtained from the soaking time with higher control of water content values at 24-hour soaking time were 9.48% and 8.28%, while the controls were 8.12%. This was because 24-hour soaking had an effect on increasing water content in yellow ampel bamboo shoots, even the highest compared to other soaking times. During retention, yellow ampel bamboo shoot flour can absorb water from the environment. The presence of boiling can cause particles to become more porous so as to increase the ability of water

absorption after drying which can then increase the water content contained in the material. However, in the soaking time of 0 hours and 12 hours the results obtained were lower.

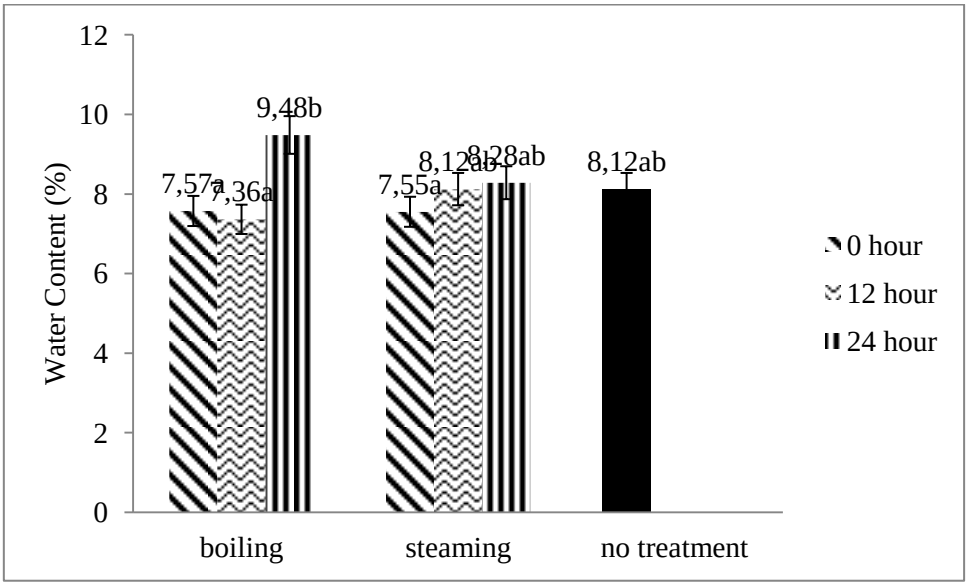

Figure 5. The effect of pretreatments on water content diagram

Based on Figure 5, it was known that boiling treatment had higher water content because in the treatment there was direct contact between water and bamboo shoots so that there was more absorption. The best treatment for processing yellow ampel bamboo flour in steaming treatment was due to the processing of flour the water content must be less to reduce rancidity or damage to flour when the water content was higher.

3.6 The Effect of Pretreatments on Ash Content

The ash content was related to the minerals of material. The minerals contained in a material can be two kinds of salts, namely organic salts and inorganic salts. Determination of ash content was to oxidize all organic substances at high temperatures, which was around 500-600^{o}C and then weigh the substances left behind after the combustion process. The presence of various components of ash which were easily decomposed or even evaporate at high temperatures, the temperature of ignition for each material can vary depending on the components in the material [10]. Mineral elements were also known as inorganic substances or ash content. In the combustion process, organic materials burn but inorganic substances do not, because that was called ash [9].

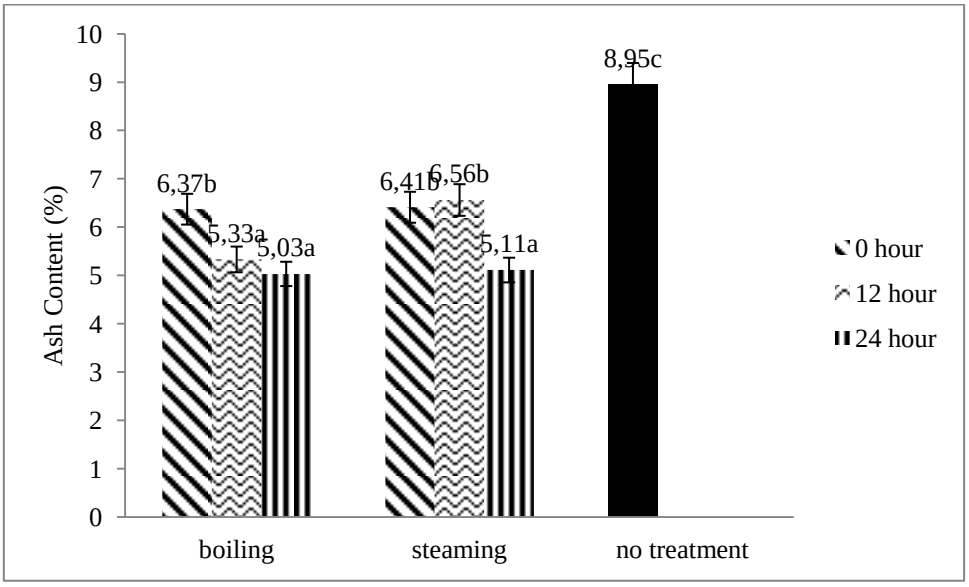

Figure 6. The effect of pretreatments on ash content diagram

Based on Figure 6, it can be seen that the ash content at the time of 0 hours treatment did not experience any real difference, as well as the soaking time 12 hours and 24 hours. Long soaking treatments compared to controls were significantly different. The results of the control ash analysis were higher than the preliminary treatment. The soaking process which was more likely to break down the components of the material that will be clearly visible. Mineral elements were organic substances or known as ash content [9].

3.7 The Effect of Pretreatments on Lipid Content

The results of the analysis of the lipid content of bamboo shoots showed that the lipid content of bamboo shoots flour for control treatment with 12 hours and 0 hours was not significantly different but in other treatments it was significantly different. Based on Figure 7, the control lipid content was higher than the treated bamboo shoot flour. This showed that the treatment results of treated yellow sticky bamboo flour showed a decrease in lipid content. The longer the soaking, the lower the lipid content.

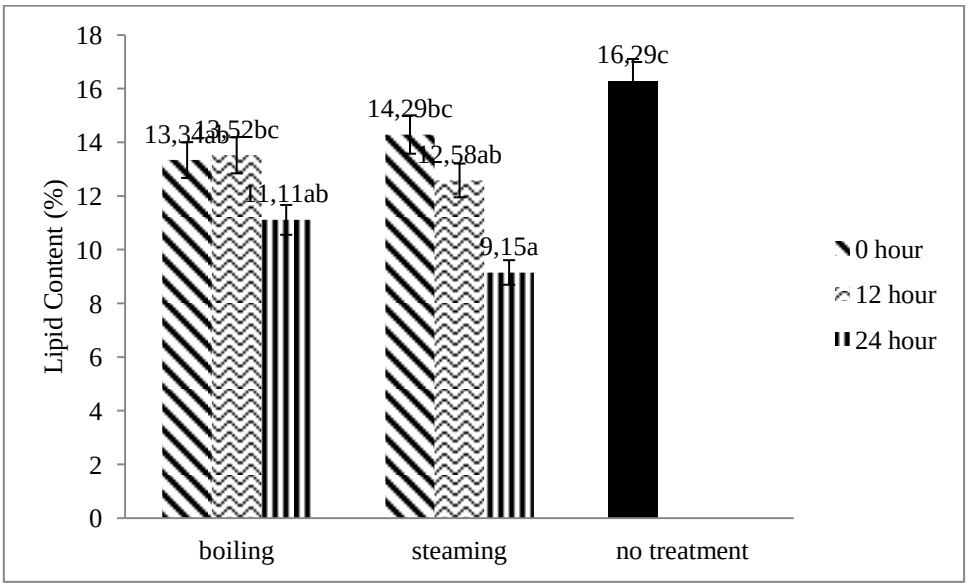

Figure 7. The effect of pretreatments on lipid content diagram

3.8 The Effect of Pretreatments on Crude Fiber

The boiling-steaming treatment had a significant effect on decreasing levels of crude fiber bamboo shoots. Based on Figure 8 the results of analysis of crude fiber levels indicated that the steaming treatment was the best treatment with increasing levels of crude fiber in bamboo shoot flour. During steaming, water vapor diffused into the food slowly and dissolved so that the components of the ingredients contained in the bamboo shoot flour decreased slightly. This decrease in crude fiber also occured in pumpkin flour [11], namely a decrease in crude fiber from 15.58% to 13.06% after steaming and boiling. Cellulose and hemicellulose were more difficult to describe and had the following properties, which give shape or structure to the tanman, insoluble in cold water or hot water, cannot be digested by human digestive fluids so it cannot produced energy, can help facilitate digestion of food, and can be broken down into glucose units by certain enzymes and microbes [9].

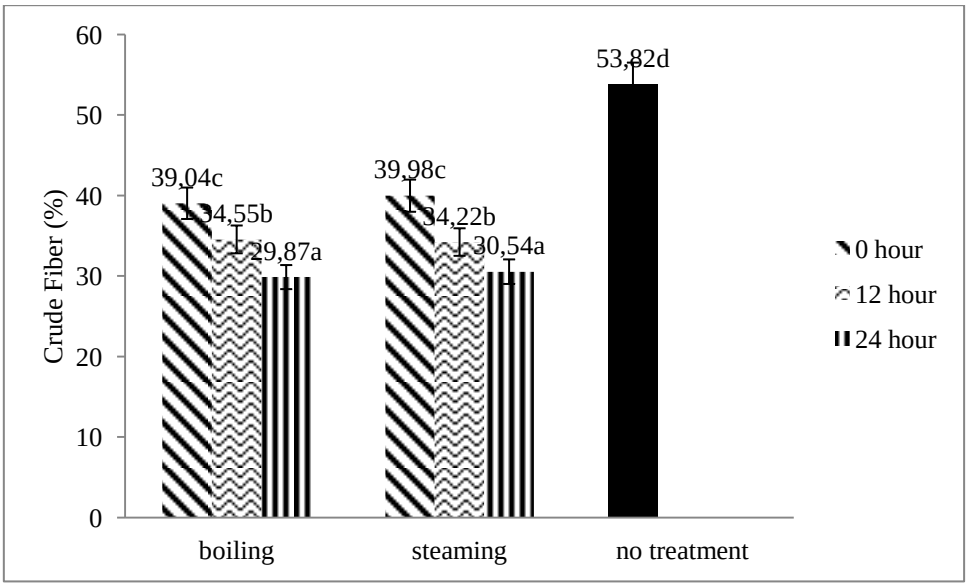

Figure 8. The effect of pretreatments on crude fiber diagram

3.9 The Effect of Pretreatments on Hydrogen Cyanide (HCN)

Based on Figure 9 it can be seen that the preliminary treatment was able to reduce the content of Hydrogen Cyanide (HCN) in bamboo shoot flour. As soaking time increases, the level of Hydrogen Cyanide (HCN) was higher too. This was because when soaking 12 hours and 24 hours Hydrogen Cyanide (HCN) was trapped or cannot decompose, while at 0 hours the bamboo shoots directly decreased due to Hydrogen Cyanide (HCN) directly decomposed along with soaking water.

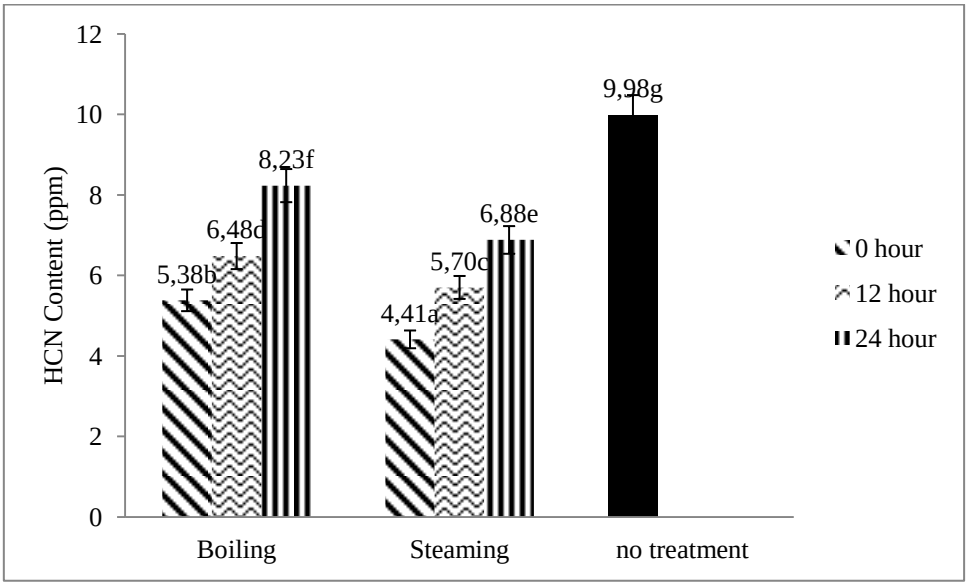

Figure 9. The effect of pretreatments on Hydrogen Cyanide (HCN) diagram

Pretreatment significantly affected the decrease in HCN content in bamboo shoot flour. This was because steaming was a method of processing bamboo shoots which can reduced cyanogenic properties. When the steaming treatment occured, the enzyme that caused the breakdown of linamarine to become inactive and HCN was not formed, then by good processing, cyanogenic glucose and hydrogen cyanide can be lost or reduced. HCN can evaporate through the steaming treatment process, so that the content of cyanide acid in bamboo shoots can be reduced.

4. Conclusion

The pretreatment of boiling-steaming affected physicochemical properties of bamboo shoots flour, especially in steaming treatment with an analysis value of water holding capacity of 10.60 g/g, swelling power of 25.9 g/g and solubility of 32.03%, crude fiber of 39.98%, 6.56% ash content, 14.29% lipid content, and 11.89% color lightness level. The soaking time affected the decrease in hydrogen cyanide (HCN) content with a value of 4.41 ppm in bamboo shoot flour.

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