9. Effect of organic fertilizer and application of charcoal on quality of potato tuber variety atlantic

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Effect of organic fertilizer and application of charcoal on quality of potato tuber variety atlantic

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Abstract. The widely cultivated tuber in Indonesia is Granola. The Granola tuber is appropriate for table potato and not for processing one. The cultivation of potato cultivar Atlantic for processed potato should be increased. This research aimed to examine the quality of potato cultivar Atlantic with organic farming and compare their properties with a conventional system. Potato tuber cultivar Atlantic was cultivated with conventional and organic fertilizer. Fertilization was performed following the practices of the local farmers. Three types of charcoal produced from wood, husk, and coconut shell were applied at three different concentrations. The cultivation was conducted in the greenhouse located in the area of potato cultivation, at 1,300 m above sea level. Selected quality parameters of potato tuber regarding the processing and nutritional properties were determined: weight of yield, moisture and ash content and brightness of flour that produced from the tubers. The present study shows that organic fertilizer and charcoal application could contribute to the quality of potato tuber cultivar Atlantic. However, application of organic fertilizer and charcoal during cultivation does not increase significantly of tubers 'properties. Further research for cultivation in the field is required to confirm this result.

1. Introduction

Potatoes are also the tubers that are widely used as a source of carbohydrates after corn, rice and wheat. Apart from being consumed directly, potatoes are used as raw material for food industries such as French fries and potato chips. The demand for potatoes for processed food is always increasing from year to year and even imports are still being carried out to meet this need. This is due to the limited productivity of potatoes for processing in Indonesia. The dominant cultivated variety in Indonesia is Granola that is not recommended for the processing tubers. However, it is possible to use Granola for chips production by modification of process, for example application of edible coating from several sources [1,2].

Potatoes as the raw materials for chips production have different physical and chemical standards from table potatoes. The properties that are considered in the potato processing industry products such as French fries and potato chips are the color of the final product, the texture of the product, and the shape of the final product which is influenced by the chemical composition and physical characteristics of the raw material. In the potato processing process, there is a change in the physical and chemical properties of the raw material which will be an indicator of the quality of the final

product. Changes in physical and chemical properties are influenced by the physical and chemical characteristics of the raw materials such as sugar content which will affect the color and moisture content which will affect the texture of the final product [3]. The potato processing industry in general does not apply additional treatment to minimize cost and potency of reducing the quality of the final product. Therefore, the quality of fresh potatoes as raw material for the potato processing industry is very important to be considered.

One of the potato varieties that is most suitable as raw material for the potato processing industry is the Atlantic variety because of its ability to produce bright colored and crispy products. However, this variety has lower productivity compared to other varieties in Indonesia. One of the causes of low productivity of Atlantic potato varieties is the improper way of planting and fertilizing [4]. Fertilization aims to increase nutrients in the soil because the nutrients provided by the soil are very limited. Fertilization is also carried out to help with nutrients needed by plants [5], especially potatoes, which have short and fine roots. The short and smooth roots of the potato can cause the nutrient absorption of the potato plant to be low [6]. Alternatives for producing potato tubers with certain characteristic have been conducted, for example cultivation on the medium altitude area [7] and modifying fertilization and irrigation to the tubers [4]. Other treatments have been studied in order to assist fertilization. Previous research reported that charcoal application could be as an alternative. In addition to the conventional fertilizer, charcoal was added during the cultivation. The use of charcoal as a medium for fertilization has been studied, one of which is in peppers planting [8]. Moreover, the application of the charcoal from coconut shell had applied during rice cultivation [9].

There are two types of fertilizers that can be used in potato cultivation, namely organic fertilizers and chemical fertilizers. Organic fertilizers that can be used are manure as much as 7-10 tones / ha of *bokhasi*, 15-20 tones / ha of chicken manure or 20-30 tones / ha of cow manure; while chemical fertilizers inclusive N of 100-150 kg / ha which is equivalent to 476-714 kg of ZA fertilizer / ha or 217-326 kg of urea / ha, 150-200 kg / ha of P_2O_5 which is equivalent to 416-555 kg of SP 36 / ha of fertilizer, 100-150 kg / ha of K_2O which is equivalent to 166-250 kg of KCl fertilizer / ha. Previous research reported that there is possibility on utilizing charcoal from coconut shell for application of organic fertilizer [10].

Potatoes as industrial raw materials have different physical and chemical standards from vegetable potatoes. The things that are considered in the potato processing industry products such as French fries and potato chips are the color of the final product, the texture of the product, and the shape of the final product which is influenced by the chemical composition and physical characteristics of the raw material. In the potato processing process, there is a change in the physical and chemical properties of the raw material which will become an indicator of the quality of the final product. Changes in physical and chemical properties are influenced by the physical and chemical characteristics of the raw materials such as sugar content which will affect the color and moisture content which will affect the texture of the final product. The potato processing industry in general does not apply additional treatment to prevent excessive physical and chemical changes that will reduce the quality of the final product. Therefore, the quality of fresh potatoes as raw material for the potato processing industry is very important.

This study examines the physical and chemical quality of Atlantic potatoes grown in greenhouses using different types of fertilizers, different types of charcoal and charcoal concentrations and compares them to the physical and chemical quality standards of potato as a raw material for the potato processing industry.

2. Materials and methods

2.1. Materials and procedure

The materials used in this study were Atlantic potato varieties cultivated by the research team of the Faculty of Agriculture, Jenderal Soedirman University. Planting was carried out in a greenhouse in

Serang Village, Karangreja District, Purbalingga Regency. It is located at an altitude of approximately 1,330 m asl.

Fertilization applied were conventional fertilizer (NPK) and organic fertilizer (*Petroganik*), charcoal added in the polybag were produced from wood, husk and coconut shell. The concentration or charcoal applied in the polybag were 225 g, 450 g and 675 g. Each combination was performed for 3 replications. During the cultivation, for 81 days, the highest temperature was 30 C and the lowest one was 19 C.

The potatoes that have been harvested are weighed in total and grouped according to their diameter, which is less than 2 cm, between 2 and 4 cm, between 4 and 6 cm, between 6 and 8 cm and more than 8 cm. All these data were recorded so that the total weight of tubers produced and the number of potatoes which diameter was suitable for potatoes as industrial raw material was recorded, with a diameter between 4 and 6 cm and between 6 and 8 cm.

Tubers were analyzed for the weight, moisture content, ash content and the brightness of the flour. Moisture content measurement was conducted according to EAPR method: 5 potato tubers, washed, cleaned of dirt, dried and peeled. The tubers are cut and crushed using a blender. Five grams of sample was taken from the material to the prepared cup. The sample was heated in an oven with a temperature of 60°C for 20 hours and then heated in an oven with a temperature of 105°C for 5 hours. The sample is put in a desiccator for 30 minutes, after which it is weighed. After weighing, the sample was reheated in an oven with a temperature of 105°C for 1 hour, put in a desiccator for 30 minutes and weighed again.

2.2. Flour production

The sorted potato tubers are treated by of steam blanching for 5 minutes, dried in a cabinet dryer with a temperature of ± 600°C for ± 12 hours, milled using a blender and sieved using an 80 meshed sieve. The resulting potato flour was placed on a petri dish for further analysis of the brightness of the flour by irradiating it using a color reader (Minolta CR-10) and reading the L value notation, namely the brightness indicator on the instrument. Data obtained from the readings were recorded. Each analysis was repeated for 3 times.

3. Results and discussion

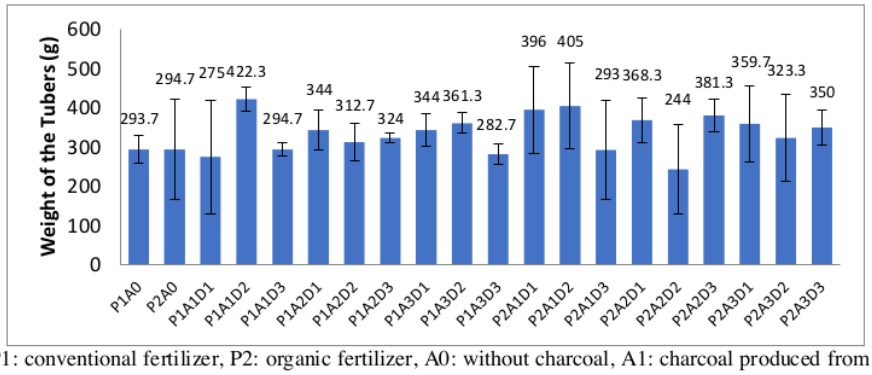
3.1. Weight of the tubers

The results of the analysis of variance showed that the treatment of the type of fertilizer, the type of charcoal and the concentration of charcoal and the interaction of all factors did not significantly affect the total weight of the tubers produced (Figure 1). It could be due to the two fertilizers used in this research contain the same amount of nutrients, namely for N of 200 kg / ha, P_2O_5 of 300 kg / ha and K_2O of 150 kg / ha. Nitrogen in fertilizers is an element involved in all plant growth processes and the formation of yields (tubers) obtained and is the one of important factors required in obtaining high yields.

3.2. Moisture content of the tubers

The moisture content of the ingredients will affect the texture of the final product, if the amount of moisture content is too low it will give a hard and brittle product and if the amount of moisture content is too high it will give a product that is too wet and soggy. The higher the moisture content will also cause the costs and time spent for production to be higher.

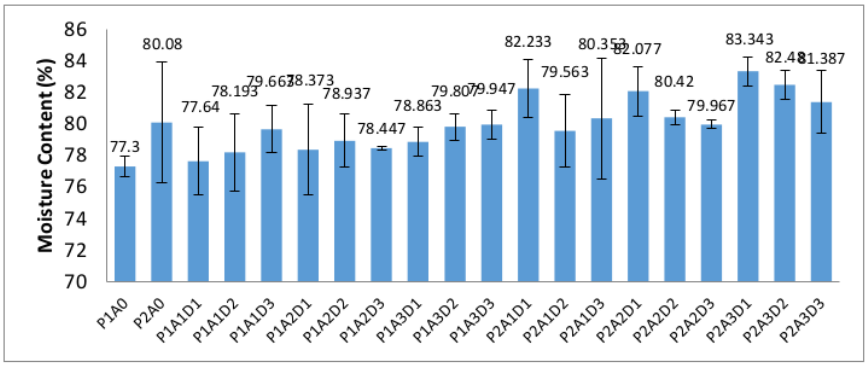
The results of the analysis of variance showed that the type of fertilizer had a significant effect on the moisture content of the potato tubers produced (Figure 2). This is because the type of fertilizer will affect moisture absorption in plants. Nutrients received by plants have various effects on plants, including potassium which will affect the work of stomata and moisture absorption. In addition, potassium has an effect on controls stomata, co-factors of various enzymes and increases plant immunity against disease.



P1: conventional fertilizer, P2: organic fertilizer, A0: without charcoal, A1: charcoal produced from wood, A2: charcoal produced from husk, A3: charcoal produced from coconut shell, D1: 225 g charcoal/polybag, D2: 450 g charcoal/polybag, D3: 675 g charcoal/polybag.

Figure 1. Weight of tubers produced by the treatments

The moisture content of potato tubers produced by the use of chemical fertilizers is lower than organic fertilizers. This is because chemical fertilizers have a higher solubility and salt index than organic fertilizers, but their high solubility causes chemical fertilizers to decompose more easily in moisture. The ease with which chemical fertilizers decompose in moisture causes the potential for nutrient loss due to leaching by groundwater which is higher than organic fertilizers. In addition, organic matter in organic fertilizers is known to improve soil physical condition which will increase root development so that it has a positive effect on moisture absorption and more nutrients in plants. The moisture content of Atlantic potato tubers was produced by a single factor, namely chemical fertilizers, which produced Atlantic potato tubers with a moisture content of 78.27%, while organic fertilizers were 81.07%.



P1: conventional fertilizer, P2: organic fertilizer, A0: without charcoal, A1: charcoal produced from wood, A2: charcoal produced from husk, A3: charcoal produced from coconut shell, D1: 225 g charcoal/polybag, D2: 450 g charcoal/polybag, D3: 675 g charcoal/polybag.

Figure 2. Moisture content of tubers

3.3. Ash content of the tubers

The results of the analysis of variance showed that the type of fertilizer had a significant effect on the ash content of the potato tubers produced (Figure 3). Therefore, the type of fertilizer contributed to the composition of the ash content of Atlantic potato tubers. The ash content of Atlantic potato tubers produced by the use of chemical fertilizers was lower than that of organic fertilizers. This is because chemical fertilizers are easier to wash (leaching) by groundwater than organic fertilizers. Previous

research reported that organic fertilizers increase the absorption of moisture and nutrients in plants [11]. Potassium is the element that most contributes and is followed by phosphorus in the ash content of potato tubers. Potassium is the element that most contributes and is followed by phosphorus in the ash content of potato tubers. Charcoal has the potential to absorb and release nutrients because it has a large surface area and is approximately the same as soil colloids. The results of the analysis of variance also showed a significant effect on the interaction of the type of fertilizer and the concentration of charcoal on the ash content of the resulting potato tubers. This can be due to the increased concentration of charcoal which will increase the absorption and release of nutrients. The increase in the concentration of charcoal used was followed by an increase in the ash content of the potato tubers produced in chemical fertilizers while decreasing in organic fertilizers. This is because organic fertilizers already have nutrient binding agents so that charcoal use is less effective. Organic fertilizers have the ability to bind nutrients and substrates for soil microbes. Organic fertilizers can improve soil structure, organic matter encourages granulation, reduces plasticity and increases moisture holding. Minerals in a material are indicated by the ash content in the material. In addition, the ash content also shows the purity and cleanliness of a material. The higher the ash content of a material, the more mineral content it contains.

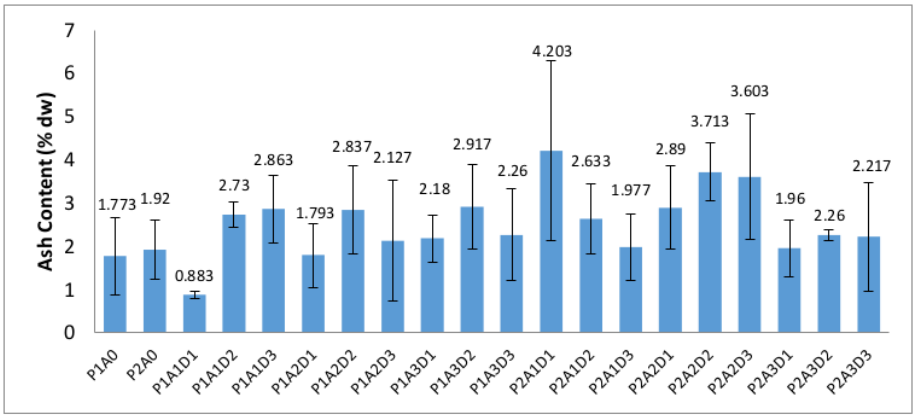


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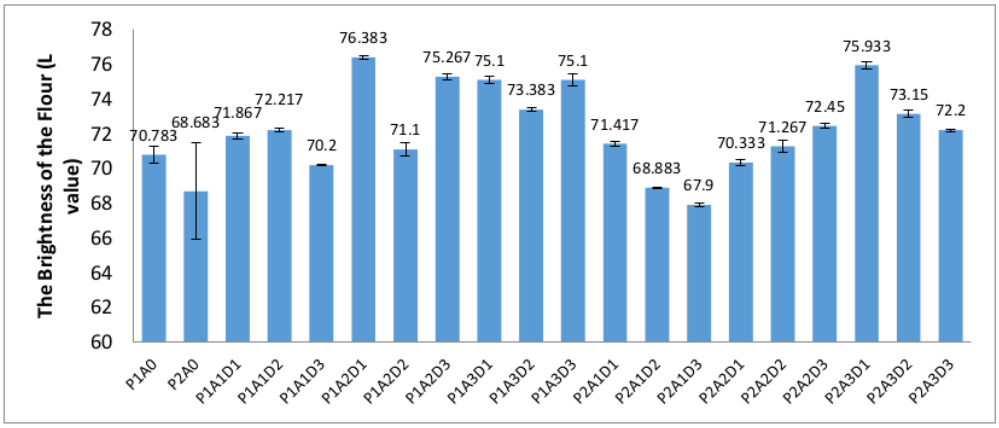
Figure 3. Ash content of tubers

3.4. Brightness of the flour produced from tubers

The results of the analysis of variance showed that the treatment of the type of fertilizer, the type of charcoal and the concentration of charcoal and the interaction of all treatments did not significantly affect the brightness level of the flour produced from the tubers variety Atlantic (Figure 4). This can be due to the fact that the potato patting process involves a blanching process, which is a heating process with the aim of inactivating the enzyme, thereby preventing enzymatic browning Consumer acceptance of flour is strongly influenced by the color of the flour. Dull flour will cause a negative impression and affect the level of acceptance.

The brightness level of Atlantic potato tuber flour produced were relatively high, ranged from 67.9 to 76.38. The higher the L-value mean the brighter the color of the flour.

The brightness level of the flour is influenced by the color of the potato tubers, Atlantic potato tubers have a white color so that it can produce a relatively high brightness level of flour. Moreover, this characteristic also contributes on the color of the product. The difference in tuber color is caused by differences in the carotene pigment content in each variety.



P1: conventional fertilizer, P2: organic fertilizer, A0: without charcoal, A1: charcoal produced from wood, A2: charcoal produced from husk, A3: charcoal produced from coconut shell, D1: 225 g charcoal/polybag, D2: 450 g charcoal/polybag, D3: 675 g charcoal/polybag.

Figure 4. L-value of the flour

4 Conclusion

The present study showed that organic fertilizer and charcoal application could contribute to the quality of potato tuber cultivar Atlantic. However, application of organic fertilizer and charcoal during cultivation does not increase the quality of the tubers. There were no effect of charcoal application on the weight of tubers and the L-value of the flour produced from the tubers. Further research for cultivation in the field is required to confirm this result

Acknowledgement

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