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Performance analysis of biopharmaceutical copper machines to support sustainable agriculture in Sleman, Yogyakarta

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ABSTRACT

Indonesia has more biopharmaceuticals resources than other countries that could be developed their potency. However, biopharmaceutical farmers are still constrained in their processing. Each stage of biopharmaceutical processing such as washing, knitting, drying, and siege, farmers still use the traditional method (manual). Farmers group in Farmers groupArgo Mulyo, Wukirharjo, Sleman is one of biopharmaceutical processing farmers who processes biopharmaceuticals into spice powder. This research was conducted to analyze the performance of chopper machines in farmers group at Argo Mulyo, Wukirsari, Sleman, Yogyakarta. The assessment was conducted from January to December 2015 at farmers group of Argo Mulyo. The materials used were 3 types of rhizomes namely galangal (hard texture), ginger (medium texture), and turmeric (soft texture). Parameters observed were thickness of chopping, time of crushing, working capacity of tools, knitting results, and work efficiency of the tool. The results of the study showed that the working capacity of chopper machines in 3 types of rhizomes was significantly different, while the work efficiency of chopper machines for galangal was significantly different from ginger, but not significantly different from turmeric. The working capacity of the chopper machine in galangal is 17.28 kg/hour, ginger 24.92 kg/hour, and 29.69 kg/hour. While the work efficiency of chopper machine in galangal is 98.25%, ginger is 97.67%, and turmeric is 98.58%.

***Key words**: biopharmaceuticals, chopper machine, analysis of machine performance*

INTRODUCTION

Indonesia is known as a country with great potential in biopharmaceutical production, especially in the rift. However there are still many obstacles faced by processing farmers in developing biopharmaceutical products. One farmers group who conducts biopharmaca cultivation and processing is *Argo Mulya* Farmers group. This group has twenty one (21) groups, consisting of eleven (11) farmer groups and ten (10) groups of women farmers in Wukirharjo Prambanan Sleman. At the end of 2014, the biopharmaca

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planting area (ginger, turmeric, galingale, ginger, galangal) in Wukirharjo Village reached 43 hectares (ha), with a ginger planting area of 17 ha with potential yield per ha of at least 8 tons/ha.

Farmers in biopharmaceutical Processing currently still carry out with traditional method like washing, crushing, drying and sowing (Paramawati et al., 2007). One of the biopharmaceutical processes is cutting. The rhizome display is generally done traditionally using a knife, so that productivity is low and requires a lot of labor. This needs relatively high cost of goods. According to Mulyono et al. (1993), the manual cost of rhizome packing in Wonogiri Regency, Central Java averaged IDR 118/kg. For galangal rhizomes which have high fiber content and hard texture, knitting with knives requires more energy. According to Rokhani (1989), traditional craftsmanship results in a non-uniform slice thickness with an average capacity of 5 kg of sliced ginger/day/person. To speed up the drying process the ginger rhizome needs to be reduced in size by chopping it in split (longitudinal). The display can also be done by using a crank type chopper to improve work efficiency of knitting, uniform slice thickness, greater work capacity and quality of processed products meeting the standards (Sembiring and Yuliani, 2014). According to Paramawati et al. (2007), the use of chopper and dryer equipment produces simplicia with better quality than traditional method. This research aims to analyze the performance of chopper machines in Argo Mulyo farmers group in Wukirsari, Sleman, Yogyakarta.

MATERIALS AND METHODS

The research was conducted in the Post Harvest and Agricultural Machines laboratories of AIAT Yogyakarta and in Argomulyo Farmers group at Wukirharjo, Prambanan, Sleman, Yogyakarta as cooperator farmer groups. The study was conducted from January to December 2015.

The materials used in the study were three types of rhizomes (ginger, galangal and turmeric) produced by cooperative farmer groups. The tools used are knives, cutting boards, biopharmaceutical shading machines, basins, scales, calipers and timers.

The experimental design used was a completely randomized design with two variables studied, namely the type of rhizome (ginger, galangal and turmeric) against biopharmaceutical shading equipment in Argomulyo farmers group by six replications. Parameters observed for equipment performance analysis activities include tool capacity, % of slices are not intact, % of rhizomes are not displayed, and the thickness of the results of the slices. The data obtained were analyzed descriptively and statistically using Microsoft Excel 2010 and SPSS 17.0 software. The type of statistical analysis used was one way

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anova analysis with a 95% confidence level and continued with a real difference test (Duncan test).

RESULTS AND DISCUSSION

A. Performance Analysis of Manual Cracks and Product Quality

In general, the biopharmaceutical rhizome is carried out manually. Manual knitting is handicraft using hand or with the help of tools (knives/pegs), but does not use electricity or fuel. Weaknesses of manual rhizome craftsmanship, low productivity and need a lot of energy (Paramawati et al., 2007) and require high costs (Mulyono, 1993). Manual crunching for large rhizomes and having a lot of fiber such as galangal requires more energy as well.

Low productivity of manual knitting can be seen from the value of work capacity produced. According to Cahyonugroho (2011) and Gunanto (2006), work capacity is the ratio between the weight of the chopped rhizomes (kg) and the time needed for chopping (hours). The assessment results show that the manual crushing capacity is very low, less than 7 kg/hour. According to Fahma et al. (2014), calculating the percentage of broken pieces is the ratio between the number of broken pieces and the total number of pieces. We modified this method by taking 50 grams of sample and repeated five times. Of the 50 grams, separated whole and not crabs. Each of these intact and unbroken chunks is then weighed. The weight of whole and non-intact slices is divided by the initial weight of the sample (50 grams). All manual knots reach efficiency of 100%. This is because of no loss with the knitting, in contrast to mechanical displays that often lose a lot when the process runs or is left in the machine.

Manual duration

Manual duration is a time needed to do manual knitting. This manual crunching activity was carried out five times by using knife assistance and three times using the ladder. The display is carried out on three types of rhizomes: ginger, galangal and turmeric. Length of time is calculated using the stopwatch. Statistically, it shows that the length of the display for both ginger, galangal and turmeric rhizomes is not significantly different (Figure 1). However, the galangal rhizome takes the longest time compared to the other two rhizomes. This is because the galangal rhizome has a harder texture. This is in accordance with Paramawati's statement (2014) that texture hardness affects the speed of knitting. .

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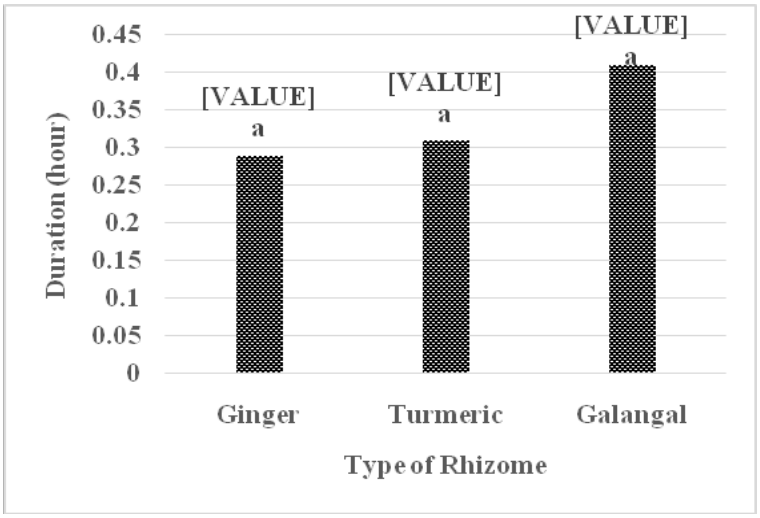

Figure 1. Duration of manual knitting of 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

Manual workload capacity

The work capacity of manual knitting is the average ability of a person trained in doing knitting on each type of rhizome. Figures 1 and 2 show a correlation that the longer the time needed to do the knitting, the smaller the work capacity and vice versa. The length of the workshops is not significantly different, not necessarily giving the results of work capacity that is not significantly different. Statistical test results show that the work capacity for each rhizome (ginger, galangal and turmeric) is significantly different. The largest manual knitting work capacity is ginger 4.63 kg/hour; Turmeric 3.55 kg/hour and galangal 2.54 kg/hour.

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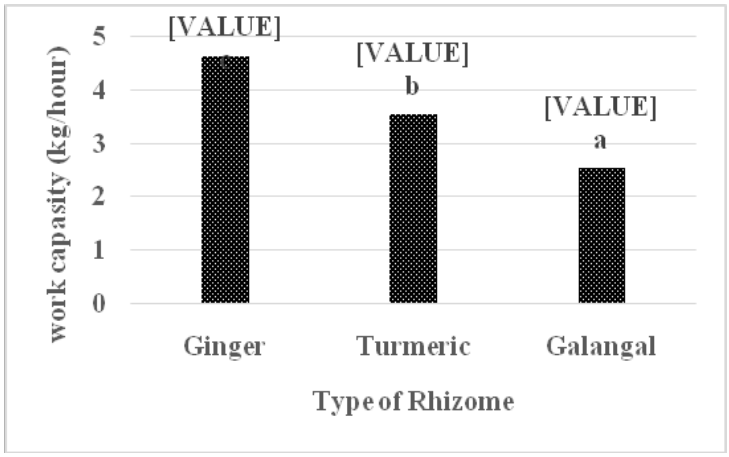

Figure 2. The working capacity of manual knitting of 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

Slice thickness of manual knitting

Manual results show that the thickness of wet simplicia slices for the three types of rhizomes was not significantly different from the range between 1.86 - 2.13 mm. The thickness of the simplicia of ginger is the highest compared to the simplicia of galangal and turmeric. The thickness of the simplicia will affect the speed of the drying process.

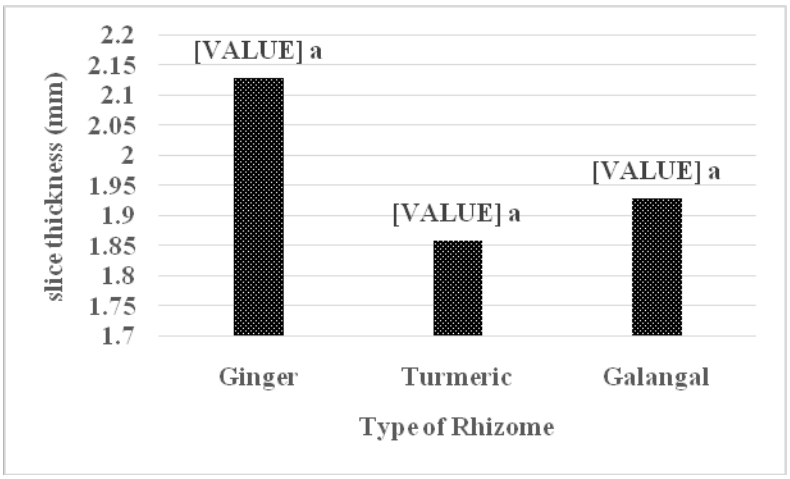

Figure 3. Slice thickness resulting from manual knitting of 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

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The integrity of the slices of manual knitting

This is evident in the manual handiwork, that the galangal rhizome produces the lowest percentage of slice integrity (77.60%) while the very soft turmeric rhizome has the highest percentage of slice integrity (93.32%). Statistically the percentage of slice integrity for the three types of rhizomes is significantly different (Figure 4).

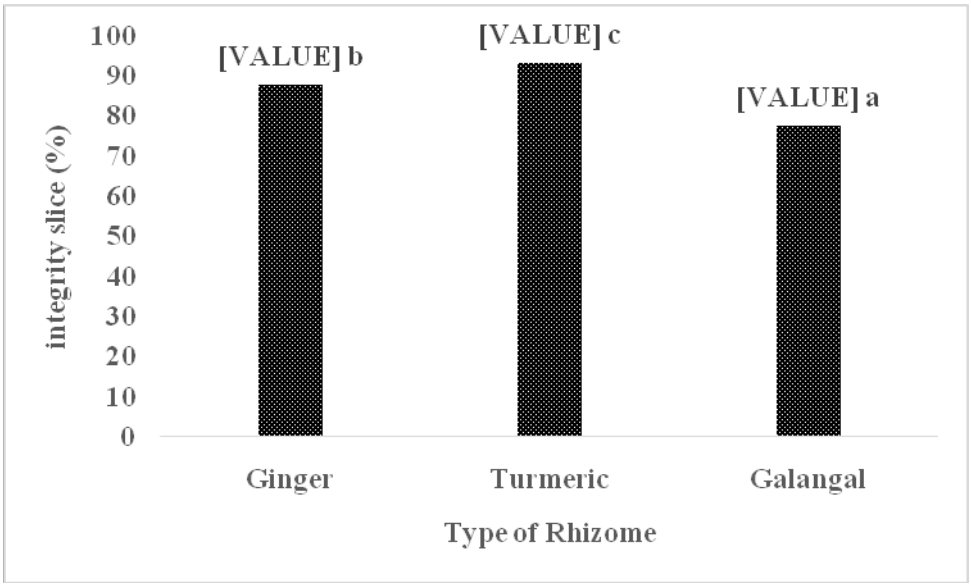

Figure 4. The integrity of slices from manual crushing of 3 types of rhizomes (Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

(a) (b) (c)

Figure 5. Results of manual galangal (a), turmeric (b) and ginger (c)

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B. Analysis of the Performance of Mechanical Crafts and Product Quality

Mechanical knocking time

Figure 6 shows that the galangal rhizome requires longer crushing time and significantly different from the other two types of rhizomes (ginger and turmeric). While the time for ginger and turmeric is not significantly different. This shows that although in the laboratory, ginger and turmeric rhizomes have different textures, but on mechanical cutting, the texture of the two rhizomes is considered to be in the same texture group, so that the time of their craftsmanship is not significantly different. The harder the texture of the rhizome, the slower the speed of the knitting.

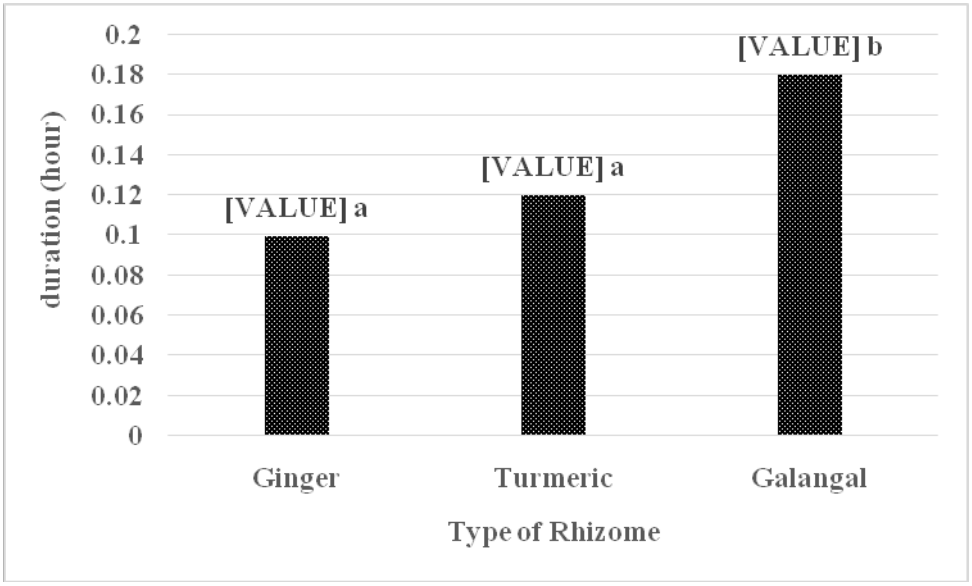

Figure 6. Mechanical crushing time for 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

Mechanical knitting work capacity

The working capacity of mechanical knitting is the ability of a tool to do the work with electricity or fuel in one unit of time. Figure 7 shows that the mechanical working capacity of the three types of rhizomes is significantly different. The longer the time to do it, the smaller the work capacity. Rhizomes with hard textures only have a working capacity of around 17 kg/hour, while

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rhizomes with soft textures have a working capacity of mechanical crafts of more than 20 kg/hour.

The mechanical work capacity of the craft is much higher than the manual crushing work capacity which only reaches 4.63 kg/hour for ginger; 3.55 kg/hour for turmeric and 2.54 kg/hour for galangal. Mechanical cranking capacity has a capacity of 6-7 times the manual crushing capacity.

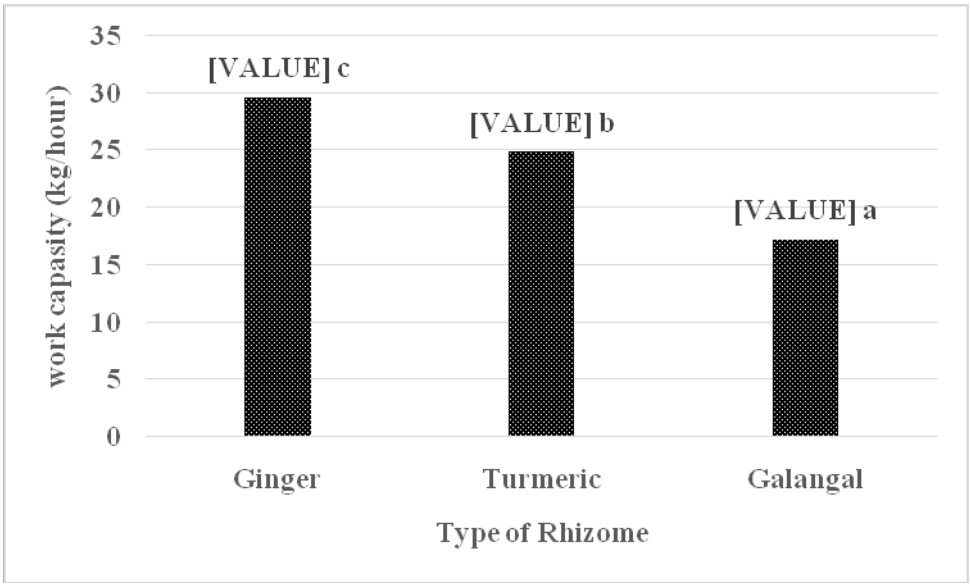

Figure 7. Working capacity of mechanical cranes for 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

Mechanical knitting efficiency

Efficiency is the ratio between output and input or the amount of output per input unit (number of outputs/input units). An activity is said to be efficient if it can get the same results as other activities but fewer resources are used (Pertiwi, 2007). Mechanical crushing efficiency reaches values above 95%. When compared to manual knitting, the efficiency of mechanical knitting is lower. But when we see the output produced is almost the same, but with much less resources (in this case time), it can be said that mechanical cutting is more efficient.

The lowest efficiency of ginger (97.67%) was significantly different from galangal and turmeric (98.25% and 98.58%) (Figure 8). This low efficiency is caused by the low output of ginger. The reason for the low output of ginger cracking is the number of ginger rhizomes left in the machine. This is due to the

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fibrous ginger's texture factor as well as the small size of the rhizome, making it easier for the ginger slices to get stuck or tucked inside the machine and knife when the knitting takes place.

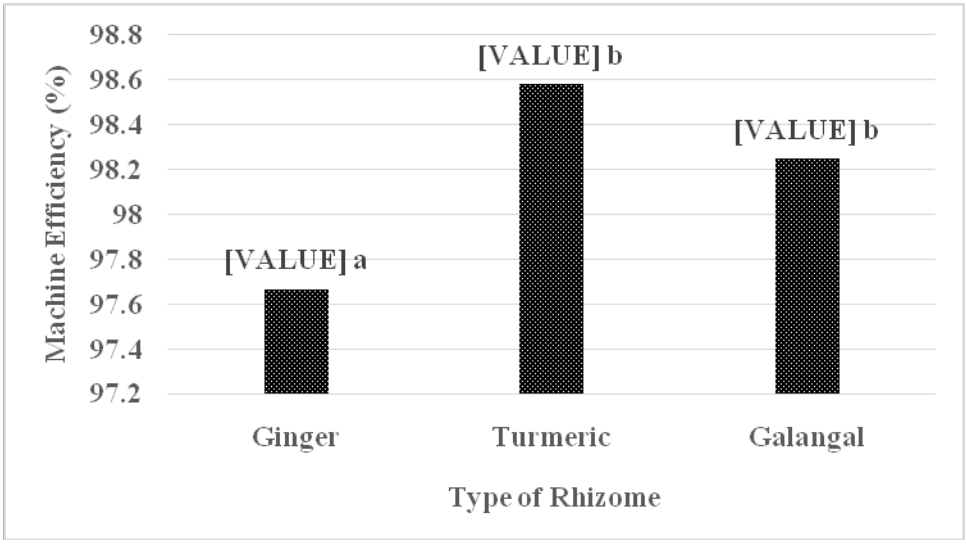

Figure 8. Efficiency of mechanical knitting for 3 types of rhizomes

(Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

Sliced mechanical cutting thickness (wet simplicia)

The thickness of the mechanical cutting results is presented in Figure 9. Ginger and galangal have the same slice thickness (2.71 mm and 2.76 mm) and are significantly different from turmeric (2.22 mm), although the numbers are not much different, ie> 2 mm. The chopper used in this study cannot adjust the position of the blade, so that the thickness of the simplicia produced is almost the same between the three types of rhizomes.

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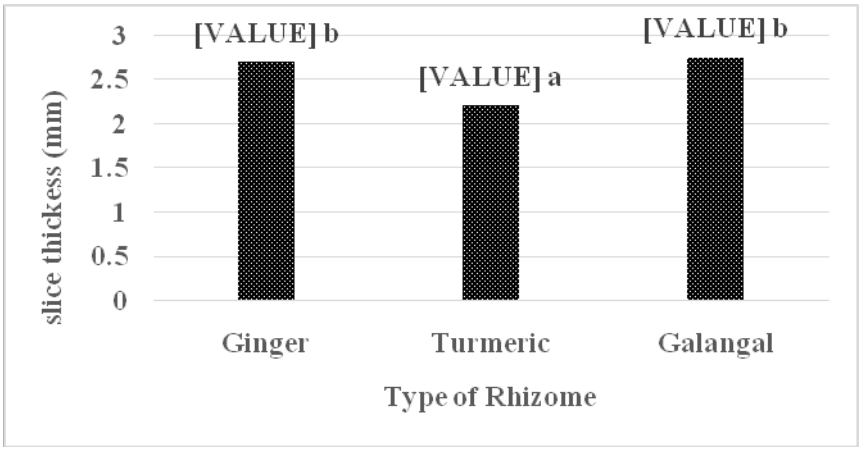

Figure 9. The thickness of the sliced mechanical results of 3 types of rhizomes (Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%)

The integrity of the slices

The integrity of sliced results showed that the simplicia of turmeric had the highest percentage of whole slices of 55.10% compared to galangal (46.40%) and ginger (39%). Of these three types of rhizomes, turmeric rhizome has the lowest fiber content. Based on Paramawati et al. (2007), galangal fiber levels ranged 12.17 - 13.47% and ginger ranged 6.77 - 7.57% while turmeric ranged from 2.87% -3.44% (Rukmana, 1994). The higher the rhizome fiber content, the harder the texture of the rhizome will be. The hardness of the rhizome texture will affect the low percentage of slice integrity that is obtained during crunching.

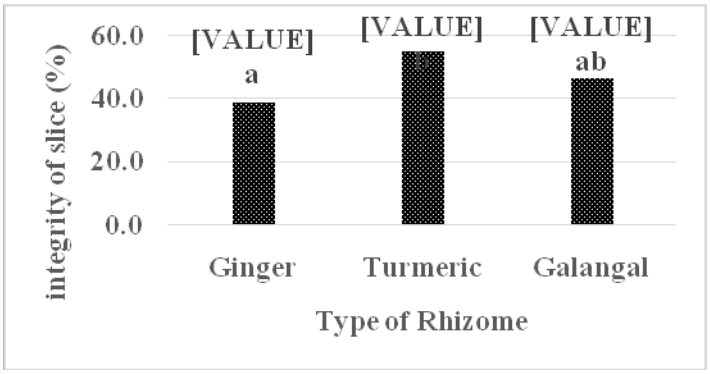

Figure 10. The integrity of the sliced mechanical results from 3 types of rhizomes (Note : the numbers followed by the same letters indicate that between treatments were not significantly different at the level of 5%).

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CONCLUSIONS

Mechanical chopper tools have a work capacity of up to 6 times compared to manual chopper, however the quality of the knitting produced is still superior to manual knitting. The working capacity of chopper machines in 3 types of rhizomes was significantly different, while the work efficiency of chopper machines for galangal was significantly different from ginger, but not significantly different from turmeric. The working capacity of the chopper machine for galangal, ginger, turmeric is 17.28, 24.92, and 29.69 kg / hour, respectively. While the work efficiency of chopper machine for galangal, ginger, turmeric is 98.25, 97.67, and 98.58%, respectively

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