Optimization of sago pulp bokashi with addition of adhesive and drying methods

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Abstract. The purpose of this study was to assist the use of organic fertilizer at farmer level. This study used Group Randomised Design factorial with 3 factors. The first factor is the long drying time (T) consisting of 3 (three) levels, namely 0 day (T1), 1 day (T2), and 2 days (T3). The second factor is the drying type (P) consisting of two levels, namely indoor (P1) and outdoor (P2). The third factor is the adhesive material (A) consisting of three levels, namely 0% (A1), 2.5% (A2), and 5% (A3). Samples were then analysed for Most Probable Number (MPN), pH, carbon test, nitrogen test, C/N ratio, and crop test. The results showed drying time (T) has a very noticeable effect on Most Probable Number, moisture content, pH, carbon element, nitrogen element, C/N ratio, and crop test. The type of drying (P) has a very noticeable effect on Most Probable Number and crop test. The adhesive material (A) has a very noticeable effect on Most Probable Number, pH, nitrogen element, C/N ratio, and crop test. The prolonged interaction of drying and drying type (TP) is very noticeable in the Most Probable Number, and crop test. Prolonged interaction of drying and drying type (PA) is very real impact and crop test, as well as a noticeable effect on the temperature of the bokashi. Long-drying interactions and drying type (TPA) have a noticeable effect on the growing bokashi test temperature. The best bokashi granule was produced in T2P1A1 sample.

1. Introduction
Bokashi products have been widely researched and developed, from various kinds of waste one of sago pulp [1], tea pulp [2] Tofu [3] and coffee powder pulp [4] and produce wet-based bokashi that still High levels of water content contained in the final product of the bokashi, thereby causing the effect of the application to the farmers who will increase the cost of transportation at the time of application in the plantation, so that the bokashi has not been effectively used to farmers. The form of bokashi also still shaped powder also causes problems for farmer’s because at the time of transportation so it is not appropriate for the time of the carriage.

But the problem of the resulting bokashi is wet-based so that farmers are difficult in their use and transport thereby adding to the cost of farmers, it is necessary to have a drying method that presses water content to the minimum limit that is sums The bokashi but does not degrade the quality of the bokashi. The addition of adhesive material that aims to bind a separate dry bokashi into a solid granule such as pellets. Water content is expected to drop but does not kill all the desired microorganisms so that
wakefulness to remain the same quality, dry bokashi can reduce the cost of the application bokashi against farmers

2. Materials and Methods

2.1 Materials
The materials used for the manufacture of bokashi in this study were cow dung, ash husk, sawdust, bran, sago pulp, fish bone flour, sago flour (adhesive material) and MOL (local microorganisms). Sago pulp was derived from the manufacture of sago flour in the area of Aceh. Fish bone flour was derived from waste disposal of wood at Lampulo Banda Aceh. MOL was made using the waste of banana fruit (Musa aromatica) and waste of papaya fruit (Carica papaya L.) which were obtained from Rukoh market in Banda Aceh.

2.2 Research Design
The research design used a group-randomised design consisting of three factors. The first factor was drying time (T) consisting of 4 levels; namely T1 = 0, T2 = 1 day, T3 = 2 days. The second factor was drying type (P) consisting of 2 levels; namely P1 = indoor, P2 = Outdoor. The third factor was adhesive material (A) consisting of 3 level; namely A1 = 0%, A2 = 2.5, A3 = 5%.

2.3 Statistical Analysis
The Data obtained is analyzed by ANOVA (Analysis of Variance). When a test of treatment shows a noticeable effect between the treatments, it will continue with the follow-up test to find out the real influence between treatment will be continued with the advanced test to know the magnitude of influence of Each of the treatment levels, using Duncan's Advanced Test (DMRT).

2.4 Process of Making a Granule-shaped Bokashi
Main ingredients were animal dung, husk ash, sawdust, and sago pulp bran 30% and 5% fish bone flour. The ingredients were mixed and stirred until homogen. Then, MOL which was diluted with water was added into the main material and was stirred until they were mixed completely. The mixed was flattened up to the height of 25 cm and was closed using a tarp. It was then fermented for 10 days with stirring once per two days. It was followed by adding adhesive materials (0%, 2.5% and 5%) and drying for 2 days indoors and outdoors. The produced bokashi was then analysed for Most Probable Number (MPN), pH, carbon element, nitrogen element, C/N ratio, and plant growth test.

3. Results and Discussion

3.1. Most Probable Number (MPN)
The media used on Most Probable Number is a liquid medium, which is expected to grow on liquid media such as water against Most Probable Number is of a type of lactic acid bacteria. Various print Data shows Most Probable Number bokashi at varying levels of treatment ranging between 330 MPN/ML-1100 MPN/ml). The results of the prints) showed that the old treatment of drying (T), type of drying (P), adhesive material (A) as well as interactions between prolonged drying with drying type (TP) and long drying with adhesive material (TA) very noticeable effect (P ≤ 0.05) The Most Probable Number contained in the bokashi, while the interaction of treatment (PA) and (TPA) influence is not real (P > 0.05).

The method MPN used liquid medium in a container in the form of a tube Poetra, calculation is done based on the number of positive tubes that are subjected to changes in the media, either in the form of discoloration or formation Gas bubbles on the base of Durham tubes. At this MPN calculation method used the form of three dilution series, the first 10-1, 10-2 and 10-3. Then the result of the change is searched for the value of MPN in the table value MPN, and for the quantity of the bacteria then used formula [5].
Most likely the number of bokashi at the A2 level is higher than the other three levels, allegedly because food microorganisms still be satisfied with the composition of A2 raw materials, so that microorganisms can develop well. Sago Flour has a number of points needed in the process of growth of microorganism in a certain amount [6].

![Figure 1. Interaction between drying time and drying type (TP) on most probable number of Bokashi (the value followed by the same letter indicates an insignificant difference, P > 0.05, DMRT0.05, KK = 7.35%).](image1)

3.2. pH Value
Varied data shows that the value of the bokashi pH at varying levels of treatment ranged from 5.42 – 6.90 to an average of 6.13. The print result indicates that the old treatment of drying (T), adhesive material (A), and long drying with adhesive material (TA) has a very noticeable effect (P ≤ 0.05) to the pH contained in the bokashi, while the type Drying (P), treatment interactions (TP), (PA) and (TPA) influence are not real (P > 0.05).

The pH value of the interaction is strongly influenced by the adhesives that can become acidic if more and more is added to the bokashi generally acid sago flour because many contain carbohydrates that when the differentiation will be acid produce is suspected that more and more added adhesive material is increasingly higher acid than the bokashi. The process of the posting itself will cause a change in the organic material and the pH of the material itself. The value of a compost pH or a mature bokashi is usually close to neutral, the optimal pH value for the composting process ranges from 6.5 – 7.5 [7].

![Figure 2. Interaction between drying time and concentration of adhesive material (TA) on pH of bokashi (the value followed by the same letter indicates an insignificant difference, P > 0.05, DMRT0.05, KK = 7.35%).](image2)
3.3. Carbon Elements

Variety of carbon elements of bokashi at various levels of treatment ranged from 12.87% – 16.04% to an average of 14.35%. The results of various prints showed that prolonged treatment of drying (T), very noticeable effect (P, ≤ 0.05) of carbon elements contained in the bokashi, while the type of drying (P), adhesive material (A), treatment interactions (TA), (TP), (PA) and (TPA) effect is not real (P > 0.05). Drying is one method of reducing a substance simultaneously, but behind it there is energy that is used and will produce carbon [8]. In this research can be seen that the longer the drying time is done on the bokashi by lowering the moisture content contained in the bokashi, the more also the carbon value resulting from the bokashi. This can be seen in the Figure 4 above the value of carbon is very much to be observed by long drying.

![Figure 3. Effect of drying (T) on carbon elements of bokashi (the value followed by the same letter indicates an insignificant difference, P > 0.05, DMRT_{0.05}, KK = 4.68%).](image)

3.4. Nitrogen Elements

Variety of nitrogen elements of bokashi ranged from 0.71% – 1.31% to an average of 0.99%. The result indicates that the old treatment (T) and the adhesive (A), have a very noticeable effect (P ≤ 0.05) on the element of nitrogen contained in the bokashi, while the type of drying (P), treatment interaction (TA), (TP), (PA) and (TPA) effect is not tangible (P > 0.05).

![Figure 4. Effect of drying time (T) on nitrogen element of bokashi (the value followed by the same letter indicates an insignificant difference, P > 0.05, DMRT_{0.05}, KK = 9.11%).](image)
In Figure 4, we can see that increasing adhesive material would affect the value of declining nitrogen slightly. Prolonged drying can reduce and reduce the nitrogen content contained in the bokashi caused by evaporation [8]. This is one of the principles of drying down the wrong content stored in the material, so that in this bokashi the longer the drying time is done then, the resulting nitrogen value will decrease. Each organic material to be posted has different characteristics. The most important characteristic of organic matter to support the process of the posting is the level of carbon elements and nitrogen element, this is because carbon elements will be used by microorganisms as a source of energy while nitrogen element for synthesis protein [8].

3.5 Rasion C/N Value

The print Data of the C/N bokashi ratio of the range of treatment ranges from 10.79% – 22.46% to an average of 15.18%. The results of various prints show that the long treatment of drying (T) and adhesive material (A), is very noticeable effect (P ≤ 0.05) on the C/N ratio contained in the Bokashi, while the type of drying (P), treatment interactions (TA), (TP), (PA) and (TPA) Effect is not real (P > 0.05).

The influence of adhesive material against the ratio of C/N bokashi is very important because in sago flour used as an adhesive material contains many elements-good element carbon as well as nitrogen that is needed in the manufacturing of bokashi [9]. From Figure 5, the more adhesive material was added in the manufacture of granule then the higher is due to the increased carbon elements and nitrogen that evaporates due to drying so that affects the C/N ratio of the resultant Also increasingly higher.

The lower the value of the C/N ratio generated will identify that the bokashi is getting better. According to Isroi (2005), the ideal main ingredient condition for composting has a C/N ratio of 30-40% before fermentation. At this C/N ratio of microorganisms get enough carbon for energy and nitrogen for protein synthesis. In organic materials that have a high C/N ratio, the microorganisms will lack nitrogen as a food source so that the decomposition process will run slowly, conversely if the C/N ratio is low it will lose nitrogen due to evaporation During the revamped process [7].

The C/N ratio of the optimum bokashi is 10 – 20%. According to Indriani [9], quality compost and really mature has a C/N ratio of less than 20%. The high C/N ratio indicates that the basic ingredients of compost or bokashi have not been perfectly composed. Thus, in general all the C/N bokashi ratio produced is optimum according to Indriani [9].

![Figure 5](image_url)  
**Figure 5.** The old influence of drying (T) against the C/N ratio (the value followed by the same letter indicates an unnoticeable difference, (P > 0.05), DMRT0.05, KK = 9.56%).

3.6 Growth Test Score

The height of the plant at different levels of treatment ranged from between 45.00 – 70.90 cm with an average of 55.43 cm. Also, drying time (T), drying type (P), concentration of adhesive material (A), all
treatment interactions (TA, TP and TPA) affected significantly (P ≤ 0.05) the growing test on the bokashi, whereas the interaction of treatment (PA) affects was not significantly difference (P > 0.05).

The height of the plant is suspected to affect the drying and the longer the drying the higher the crop, while the drying type is also influential because it affects drying that will reduce the content of the bokashi. Needed and can kill microorganisms inside. Furthermore, adhesive material also tends to affect the height of the plant [10].

![Figure 6. Interactions (TPA) to the height of the plant (the value followed by the same letter indicates an unreal difference, P > 0.05, DMRT_{0.05}, KK = 2.50%).](image)

The high decline of plants is suspected of the old and drying type that can decrease nutrients for soil in the form of calcium and phosphorus is good for plant growth. The height of the plant also affects the absorption of nutrients in the bokashi. The granule-shaped bokashi is generally as difficult to break down and absorbed for plants and tends to be obstructed. The plant will grow well with the availability of sufficient nutrients for its growth [11].

According Mahajoeno, 2013, Organic Fertilizer granule is a fertilizer that has been changed form the powder phase to a hard phase with the help of the material. This hard phase causes the nutrients contained like N, P and K in the granule bokashi to be difficult to break down and absorbed by plants. Therefore the growth of the plant is a little longer compared to the bokashi in general that is easy to be absorbed by plants.

Interaction of T2P1A2 treatment (long drying 1 day, drying inside the Runagan and adhesive material 2.5%) Supposedly can save the cost of production in the manufacturing of bokashi, because of the bokashi that have been granule and hard and easy to use by farmers in the garden. The granule is already granule-shaped, but it is difficult for the plant to be absorbed by the soil compared to the bokashi without the treatment of faster soil. It is seen in terms of width and height of the stem from the bottom to the end of the corn leaf that grows after 40 days. In terms of the green level of leaves.

4. Conclusion
The results showed in general the quality of the resulting bokashi has met good bokashi standards, such as the C/N ratio was still below 20. The longer the drying time, the more effect on decreasing the quality of bokashi, especially in decreasing the number of microorganisms (Most Probable Number or MPN), increasing the C/N ratio and decreasing the plant growth.

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