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The potential and biological test on cloned cassava crop remains on local sheep

R Ginting[1], S Umar[2] and C Hanum[2]

[1] Postgraduate student of Livestock Science, Faculty of Agriculture, Universitas Sumatera Utara
[2]Lecturer of Postgraduate Program of Livestock Science, Faculty of Agriculture, Universitas Sumatera Utara
E-mail : ronistraginting@yahoo.co.id

Abstract This research aims at knowing the potential of cloned cassava crop remains dry matter and the impact of the feeding of the cloned cassava crop remains based complete feed on the consumption, the body weight gain, and the feed conversion of the local male sheep with the average of initial body weight of 7.75±1.75 kg. The design applied in the first stage research was random sampling method with two frames of tile and the second stage research applied Completely Randomized Design (CRD) with three (3) treatments and four (4) replicates. These treatments consisted of P1 (100% grass); P2 (50% grass, 50% complete feed pellet); P3 (100% complete feed from the raw material of cloned cassava crop remaining). Statistical tests showed that the feeding of complete feed whose raw material was from cloned cassava crop remains gave a highly significant impact on decreasing feed consumption, increasing body weight, lowering feed conversion, and increasing crude protein digestibility. The conclusion is that the cloned cassava crop remains can be used as complete sheep feed to replace green grass and can give the best result.

1. Introduction

Cassava plant (*Manihot utilisima*) is one kind of agricultural plants which has the potential to be grown in Indonesia. This plant is classified into *Euphorbiceace* family that is easy to grow even on dry and poor nutrient land and can resist either plant diseases or weeds. Cassava plant is easy to cultivate because the propagation of this plant usually applies branch cuttings and recently it even applies cloning technique. The production of cassava in Indonesia increases quite rapidly in the last five years from 19,321,183 tons in 2005 to 21,786,691 tons in 2009, or it increases 11.32% [1]. The increase of the production also increases the byproduct of cassava cultivation and its industry that it is potentially enough to be used as feed. The feed material comes from the cassava plant post crop products, such as cassava shoots, cassava stems, cassava tree bark and dried cassava. All are included in carbohydrate source feed that can be easily digested.

The cassava crop remains such as leaves, petioles, and young stems are much wasted at field. Some people have used the cassava crop remains as the greenery of cattle feed; for example local sheep. But the usage is limited because the crop remains are easily damaged and decayed on the field that an effort is needed to change the cassava crop remains to be the product for the raw material of cattle feed in the form of dry matter (DM). Then, it is processed to be complete feed in the form of pellet. The pellet has low content of water that it can be stored for a long time and it is practical to use for cattle.

Feed costs the most of all the production cost which takes around 70-80% of cost production [2]. The optimal use of local feed for agricultural products or the byproducts is hoped to decrease the cost for feed. Therefore, an effort is required to find the alternatives of feed material that are cheap, easy to get, good quality, and uncompetitive with human needs. The alternatives are leaves, cassava tree bark, and the byproducts of cassava agro-industry.

2. Material and Research Methodology

The first stage of research was conducted on a field of cloned cassava cultivation in Lau Tima village, Pancur Batu, Deli Serdang to measure the potential of dry matter and the second stage research was conducted at the laboratory of Livestock Biology, Livestock Department, the Faculty of Agriculture of the University of North Sumatera for biological test on sheep. The research was conducted for 4 months beginning from September until Desember 2013.

The sheep used in this research were 12 sheep with the average body weight was 7.75±1.75 kg, rations were cassava skin fruit, BIS, salt, cassava and mollasse. Drinking water was given in adlibitum way, drugs such as anthelmintic (*kalbazen*), anti bloating and vitamin.

12 units of individual sheepfold with its equipments, 12 feed and drinking water containers, scales of living weight which had the capacity of 50 kg with 50 gr sensitivity, scales which had the capacity of 2 kg with 10 gr sensitivity to weigh feed, feed chopper, cage cleaning tools like broom stick, shovel, knife and cutter, plastic pail, stationery, book of data and calculator.

2.1. Research Methodology

This research was conducted in two stages. The first stage research was to get the potential of the dry matter of cloned cassava crop remains in one acre. The first stage research applied random sampling method by building two frames of tile in 1 acre field as the sample. Each frame consisted of 200 cloned cassava trees and after the data of each tile were taken then the average was measured and was multiplied with the number of cassava trees in one acre. The crop remains that were taken are leaves, leaf twigs and 30 cm long young stems from the shoots.

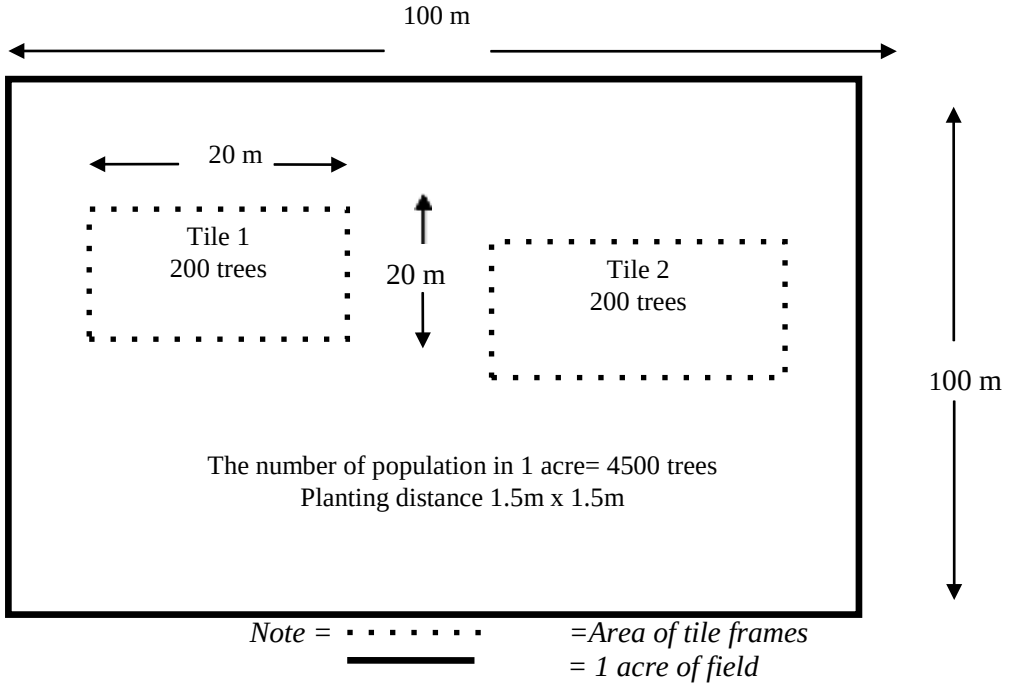

Figure 1. The way to decide tiles in 1 acre of cloned cassava field

Table 1. Feed formulation in research treatment

Treatment	P0	P1	P2
Grass	100%	50%	0
Complete Feed	0	50%	100%

Table 2 contains the composition of nutrition of complete feed which was made of raw material mostly from cassava leaves and the young stems.

Table 2. The Composition of Complete Feed for the Second Stage Research

Feed Material	Amount	CP	CF	TDN
Cassava Leaves	50.00	8.56	9.73	38.25
Young Stems	20.00	1.23	7.59	12.95
Dried Cassava	5.00	0.10	0.82	3.85
BIS	20.00	3.08	2.10	16.20
Molasses	3.00	0.02	0.01	2.43
Urea	1.00	2.02	0.00	0.00
Salt	0.50	0.00	0.00	0.00
Mineral	0.50	0.00	0.00	0.00
Total	100.00	15.02	20.25	73.68

Table 3 below contains the comparison of crude protein (CP) and crude fiber (CF) of P0, P1 and P2 feed which were used as the feed for the sheep in biological test in the second stage research.

Table 3. Analysis of the Content of CP and CF of Feed Material of P0, P1, P2 for the Research

Feed Material	Amount(%)	CP(%)	CF(%)
P0	100	10.62	23.25
P1	100	12.82	21.75
P2	100	15.02	20.25

(Cattle Feed Laboratory of PT. Sabas Indonesia feed mill Medan, 2014)

2.2. The Research Parameter

The potential of the dry matter of cloned cassava crop remains in one acre is counted by building two frames of tile in 1 acre of field as the sample. Each tile contains 200 cassava tress and after that the data of dry matter are taken from the pieces of the crop remains such as the leaves, leaf twigs and 30 cm long young stems from the shoots in each tile then the average of the dry matter weight of each tree is taken in the form of dry matter and after that it is multiplied with the number of cassava trees in one acre that we can get the potential of dry matter in one acre in one period of 11 month-cloned cassava crop.

Body weight gain can be measured by dividing the difference of body weight (last weight – initial weight) with the length of weighing day. It is done once a week stated in gram per head per day.

$$\text{DBWG} = \frac{\text{last weigh t} - \text{initial weight (gr/head)}}{\text{length of keeping (day)}}$$

Feed consumption is achieved by counting the difference between the amount of feed given with the remains of the feed daily and is stated in gram per head per day.

Feed Consumption = feed which is given (in % of DM) – the remaining feed (in % of DM)

Feed conversion is measured by dividing the average number of dry matter consumption per head per day with the production of average number of body weight gain per head per day.

$$\text{Feed Conversion} = \frac{\text{Feed consumed (gr/head)}}{\text{DBWG (gr/day)}}$$

The crude fiber digestibility can be measured with the formula:

$$\text{CFD} = \frac{\text{CF Consumptio n - CF Feces}}{\text{CF Consumptio n}} \text{x100\%}$$

The consumption of feces excretion (CF) is achieved in the measuring time during the collection period within a week.

Crude protein digestibility can be measured with the formula:

$$\text{CPD} = \frac{\text{CP Consumptio n - CP Feces}}{\text{CP Consumptio n}} \text{x100\%}$$

CP Consumption and feces is achieved in the measuring time during the collection period within a week.

2.3. The Research

2.3.1. The First Stage Research. The crop remainings which are taken are leaves and leaf twigs and young shoot stems. The average length of the chopping from the shoots until the young stems is achieved by conducting repeated measuring. Then, all the leaves, leaf twigs and the length of the young stems which are taken is in accordance with the average of chopping that we get. Then the fresh weight is weighed then they are dried and then we get the dry weight. After the data of each tile are taken then the average potential of dry matter from each tree are taken in the form of dry matter and after that it is multiplied with the number of casava trees in one acre that we can get the potential of dry matter in one acre.

2.3.2. The Second Stage Research. The second stage research is done by doing the following steps: the preparation of sheepfold, sheep randomizing and the giving of feed and drinking water.

Before beginning the research**,** the sheepfold and all equipments are cleaned and washed. Then the liming is done on the floor and the wall of the sheepfold before the keeping process. Then the sheepfold and all the equipments are sprayed with *Rhodallon* (10 ml / 2.5 litre of water dosage).

The sheep used in this research are 12 sheep. The placement of the sheep is with random system which does not differ the sheep body weight. Before the weighing of the sheep initial body weight is done.

The feed given is fresh grass. The fresh grass is mixed with complete feed in the form of pellet and pelleted feed. Then feed and drinking water are given in adlibitum way. The water is changed everyday and the water container is cleanly washed. The crop remains are weighed to know the cattle consumption. Before the research is conducted, adaptation is done for a week.

2.4. The Pathway of Complete Feed Processing

The pathway of complete feed processing is shown in Figure 2.

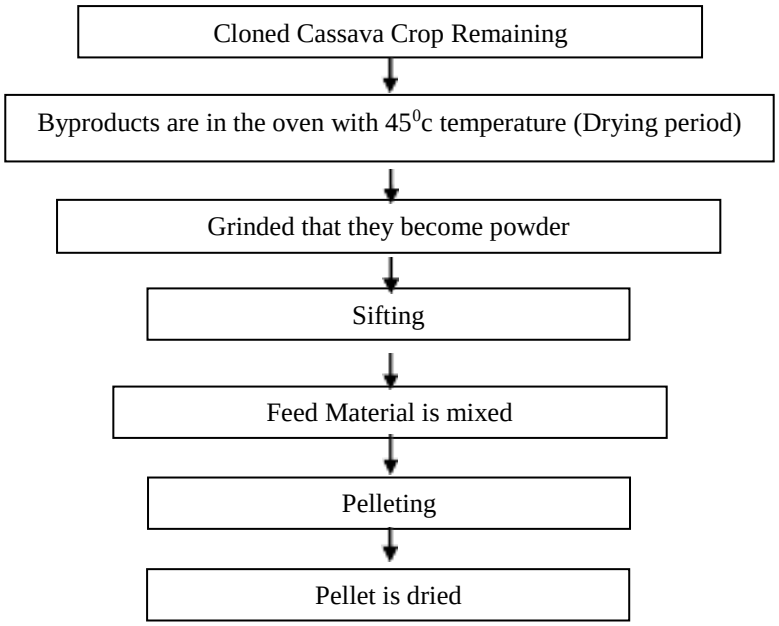

Figure 2. The pathway of complete feed proceesing

3. Result and Discussion

The result of the first stage research is measured in the form of dry matter which was taken from frames data of cloned cassava crop remaining. Table 4 is the data of the result of the first stage research to know the potential of the dry matter of cloned cassava crop remains in 1 acre of land.

Table 4. The list of recapitulation of result of the study of the potential of cloned cassava crop remains dry matter as the local male sheep complete feed

Observed Parameter	Treatment		
	P0	P1	P2
The potential of crop remaining (kg/acre/crop)			14265
Feed Consumption (kg/head/3 months)	43.01^A	26.21^B	22.37^C
Body Weight Gain (kg/3months)	2.8^A	3.26^B	4.62^B
Feed Conversion	15.45^A	8.04^B	4.90^C
Crude Fiber Digestibility (%)	65.24^a	64.68^a	65.24^a
Crude Protein Digestibility (%)	86 ^{A}	88 ^{B}	90.5^C

Note : Superscript with different alphabet to the line shows highly significant difference (P<0.01)

Table 5. Cloned cassava crop remains

Frames of Tile	Total of Fresh Weight(Kg)	Total of Dry Weight(kg)	The average of DM (kg / tree / crop)
I	3161.6	632.32	3.2
II	3108.6	621.72	3.15
Average	3135.1	627.02	3.17

Source: Result of Study (2013)

3.1. The Potential of Cloned Cassava Crop Remaining

Cloned cassava crop remains such as leaves, twigs and young stems as the raw material of complete feed are obtained with the average of 3.17 kg/tree/crop. With planting distance of 1.5m x 1.5m, the number of cloned cassava trees in 1 acre is 4500 trees. The number of cloned cassava population in 1 acre is multiplied by the average of dry matter of 1 tree that it is found the potential of cloned cassava crop remains as the raw material of complete feed per acre of cloned cassava field is 14265 kg/acre/crop. One Animal Unit (AU) needs 1140 kg of Dry Matter (DM) yearly that one acre of cloned cassava field is able to accommodate 12.5 Animal Unit (AU) or it is equivalent with 89 adult sheep (one adult male sheep is equivalent with 0.14 Animal Unit or one Animal Unit is equivalent with seven adult sheep). If we compare it with pastura grass in Indonesia, usually it can only support 1-2 Animal Unit/acre/year of cattle shepherding or it is equivalent with 7-14 sheep/goat/year. This shows that dry matter of cloned cassava crop remains has bigger potential than the dry matter of pastura grass [3].

Table 5 shows that the average of the dry matter of cloned cassava crop remains is 14,265 kg/acre/production. It means that cloned cassava crop remains can be used as the source of alternative feed to develop the integration of sheep farm with cassava that it can increase the additional value of cassava plantation. If it is compared to setaria green grass in a year, it can produce fresh green grass as much as 60-100 tons/acre/year (water content is around 70%) that cloned cassava crop remains has smaller potential compared to the special cultivation system of setaria grass which is made to be the source of sheep feed but the added value of the integration system is achieved.

3.2. Feed Consumption

Feed consumption is cattle's capability to consume a certain amount of feed which is fed in a certain range of time. Feed consumption can be measured by the subtraction of the amount of the feed given with the feed remains. The feed given during the research is in the form of pellet and fresh green grass. The feed is given in *adlibitum* way. The consumption of weaning off local male sheep during the research can be seen in Table 4 and Figure 3.

Table 4 shows that the highest average of feed consumption is seen in P0 treatment as much as 43.01 kg/head/3 months and the lowest average of feed consumption is seen in P2 treatment as much as 22.37kg/head/3 months. The result of statistical analysis shows that Feed Treatment which is used is each of P0, P1, P2 feed treatments are significantly different ($P<0.05$) on the consumption of local male sheep feed.

Table 4 shows the lowest feed consumption is seen in P2. This is influenced by the form of feed that in P2, the feed is in the form of pellet. The feed in the form of pellet has lower level of consumption than the green grass feed. This is caused by the different level of density of feed where pelletized feed has higher level of density than green grass feed. The feed processing shows the decrease of feed consumption level. This is in accordance with Hofman [4] who says that the processing of pelletized feed will usually have effect of the increase of nutrition density in feed. The increase of feed density is one of the important factors in increasing feed efficiency.

3.3. Body Weight Gain

Body weight gain is the difference of the last body weight with the initial body weight in a certain time (kg/head/3 months). Table 4 shows that the highest average of body weight gain can be seen in P2 treatment as much as 4.62kg/head/3 months or 51.33 gr./head/day and the lowest weight gain is seen P0 treatment as much as 2.8 kg/head/3 months or 31.11 gr./head/day. The feeding of feed by using pelletizing technology increases feed density and can remove the selection of certain feed components, therefore pelletization guarantees the achievement of certain nutritional intake more in accordance with what was calculated at the time of the making of ration formula. The increase of density and the removal of the selection of feed component affects nutritional intake that it is more efficient in body weight gain.

The feeding of feed using cassava byproducts based complete feed with 100% level shows significant effect on sheep body weight gain. This is because as a whole, cassava byproducts are easily degradated in rumen. Meanwhile P1 and P2 body weight gain does not show significant difference. This is because the comparison of nutritional content of P1 and P2 is not significantly different and with the existence of the mix of complete feed pellet in P1 feed. The composition of complete feed pellet which contains NPN (Non Protein Nitrogen) can trigger rumen microbe. Zinc content in cassava skin is really high compared to zinc content in the tuber. Cassava skin contains very high vitamin A which is as much as 11000 S.I and zinc content is as much as 2 mg each kg (DM), which indicates that cassava leaves can be used as quite good source of vitamin A and zinc [5], which is needed for sheep growth.

3.4. Feed Conversion

Table 4 shows that the highest feed conversion average is seen in P0 treatment with as much as 15.451 and the lowest feed conversion is seen in P2 treatment with as much as 4.905.

Variance analysis shows that the treatment of giving P0, P1, P2 rations has different significant effects ($P<0.05$) on the conversion of local male sheep feed.

The smallest significant difference (SSD) test is conducted to find out the difference of P0,P1,P2 treatments on the conversion of local male sheep feed. The result of statistical analysis shows that Feed Treatment which is used is each of P0,P1,P2 feed treatments are significantly different ($P<0.05$) on the conversion of local male sheep feed.

Table 4 shows that the lowest feed conversion is seen in P2. This is affected by the form of feed where the feed in P2 is in the form of pellet. Feed in the form of pellet can increase fly fatty acid and carbohydrate digestibility. This thing causes the nutritional intake of cattle is higher than cattle that consume green roughage as much as 2-5 cm.

3.5. Crude Fiber Digestibility

Table 4 shows that the digestibility of feed crude fiber in local male sheep does not show significant difference. High crude fiber digestibility is affected by the content of crude fiber in feed. Cassava byproducts based feed has no effect on the digestibility of feed crude fiber in local male sheep. This is because cassava byproducts based complete feed is easily degradated in the rumen that it can be similar with the digestibility of crude fiber which is used 100% green grass. After 24 hour incubation in sheep rumen, the loss of the dry matter of dried cassava skin is as high as 70 and 73% after ensiling process has been done. The lost of the dry matter of dried cassava becomes higher (83-84%) in 48 hour incubation.

The digestibility of crude fiber is affected by the content of crude fiber in feed and the microorganism capability in sheep rumen. The digestibility in P0, P1 and P2 treatments does not show significant difference. This is because the feed which is given in the form of complete feed is composed based on what sheep need.

3.6. Crude Protein Digestibility

Table 4 shows that the highest crude protein digestibility is seen in P2 treatment and the lowest one is seen in P0 treatment. The high digestibility is affected by the quality of the feed where in P2 treatment, the feed is composed of 85% cloned cassava crop remains. Feed that contains cloned cassava crop remains such as dried cassava, dregs and cassava skin can increase carbohydrate digestibility level and increase the total of high digestibility. This is in accordance with Zinn and Depeters [6] who say that concentrate which contains dried cassava pellet can increase the total of digestibility as much as 91%.

The highest protein digestibility is seen in P2 treatment because the treatment uses the cassava byproducts complete feed. The cassava byproducts, especially the leaves, contain tannin. Tannin in cassava leaves and tropical plants is usually in the form of polyphenolics which is not easily dissolved in water but easily ties with protein in the form of tannin, high complex protein which is tied by hydrogen. But tannin can also increase the recycling of N in rumen that it increases microbe protein

synthesis. This makes the crude protein digestibility higher. This is in accordance with Makkar [7] who says that toxic tannin for cattle can increase the recycling of N in rumen.

The content of protein in rumen also affects the digestibility level against crude protein. In P2 treatment the content of protein in feed is higher than the content of protein in feed in P0 and P1 treatment. This is in accordance with Tillman *et al* [8] who say that the crude protein digestibility depends on the content of protein in feed. Feed with low content protein, generally has low level of digestibility and feed with high content protein has high level of digestibility. The high and low level of protein digestibility depends on the content of protein in feed and the amount of protein which gets into digestive passage.

4. Conclusions

1. The potential of the dry matter of cloned cassava crop remains as the raw material of complete feed is as much as 3.17 kg/tree/crop.
2. The potential of the dry matter of cloned cassava crop remains as the raw material of complete feed in one acre is as much as 14,265 kg/acre/crop, one acre of cloned cassava field can accommodate 12.5 Animal Unit (AU) or similar with 89 adult sheep.
3. The crop remains such as leaves, leaf twigs and 30 cm long young stems of cloned cassava are processed to be the raw material of complete feed and can replace green grass.
4. The feeding of cloned cassava crop remains based complete feed has really significant effect on decreasing feed consumption, lowering feed conversion, increasing crude protein digestibility, increasing body weight gain and has no significant effect on crude fiber digestibility.
5. The result of the study shows that cloned cassava crop remains based pelletized feed can be fed 100% to local sheep and can give the best result.

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