Cassava Waste Processing Technology to Support the Provision of Alternative Feed on Zero Waste Management System of Livestock

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Utilization of cassava processing waste as animal feed is an attempt waste management. These efforts also support the provision of alternative feed for ruminants on zero waste management system of livestock. Feed processing technology in this study is used to evaluate proximate composition, palatability and feed consumption of cassava peel on local goat. The benefits of this research to provide information about the acceptability of processing cassava peel on local goat. Goats were grouped by weight. Processing cassava peel was used in this study by the ammoniation (T1), fermentation (T2) and the combination of ammoniation and fermentation(amofer (T3). Randomized block design (RBD) in 3 treatments with control (T0, T1, T2, T3) was used to analyze the data. Duncan test was used for further analyse. The results showed that amofer treatment can improve the palatability of cassava peel's consumption on a local goat. Amofer processing capable to develop proximate composition of cassava peel’s quality compared to ammoniation and fermentation processing. The conclusion recommended amofer processing technology should be used to increase the quality of cassava peel as feed for the livestock.

Keywords: Amofer, Palatability, Cassava Peel Processing, Feed Technology, Waste Management.

1. INTRODUCTION

Cassava, in its different forms, has been used as animal feed in many parts of the world. Cassava foliage (leaves and stem), peels and particularly the root-fresh, dried or in silage form-alone or mixed with other feed, is used in feeding different animals, including ruminant and non-ruminant species. The major factor limiting cassava consumption is its high content of cyanogenic glucosides mainly linamarin, and in a small proportion lotaustralin which during processing are hydrolysed by the endogenous enzyme linamarase to liberate hydrogen cyanide. Cassava has been classified into three based on the level of HCN in its tuber and leave and the cyanide ranged between 5 to 10 mg/100 mg fresh cassava root.1

Peel cassava as a potential fodder containing cyanide. The concentration of cyanogenic glucoside in tuber skin can be 5 to 10 times greater than in the tuber. Toxicity in cassava biomass (including the peel of the tuber) is due to release of HCN from cyanogenic glucoside contains. Total cyanide content in cassava peel ranged from 150 to 360 mg of HCN per kg of fresh weight. But the cyanide content is highly variable and influenced by the cassava plant varieties.2 The nutritional content of cassava peel is 17.45% of dry matter, 8.11% of protein, 15.20% of crude fiber, 1.29% of crude fat, 0.63% of calcium, and 0.22% of phosphorus.3 Cassava peel has a protein content at only 8.11% and 15.20% of crude fiber, refer to Ref. [6] cassava peel contains lignin of 7.2%, 13.8% of cellulose and hemicellulose 11%, it causes the low of Cassava peel digestibility.

Ammoniation serves to break bonds between cellulose and lignin, while in the process of fermentation, enzymes from various microbial cellulose will penetrate more easily into the fibrous feed material.4 Combination treatment between ammoniation and fermentation or called amofer is one way of improving the quality of fibrous feedstuffs.

HCN content can affect the taste of cassava peel and furthermore may influence the palatability of livestock. Palatability of the feed is the corollary of the appetite of the animal, which is the stimulation to eat aroused by the feed. Eating rate, especially at the beginning of the meal, is a good criterion of the animal’s appetite, and palatability of the feed is defined as all the physical (plant bearing, spines, etc.) and chemical (odour, taste, etc.) characteristics of the feed that act on appetite.12 The purpose of this study to evaluate proximate composition, palatability and feed consumption of cassava peel on local goat that treated by ammoniation, fermentation and ammoniation fermentation (amofer) processing. We hope this research can
provide information about the utilization of cassava peel waste to achieve zero waste management system of livestock.

2. EXPERIMENTAL DETAILS

Material used is the cassava peel that was processed by T1: ammoniation (4% of ammonia), T2: fermentation (using rice bran and EM4), and T3: ammoniation fermentation (amofer) by using combination treatment of T1 and T2 refer to the method of Simbolon, et al. (2016). T0 was used as control. Cassava peel preferences known by methods of cafeteria feeding. Palatability, proximate composition and cassava peel’s consumption were measured as parameters. The method to determine crude protein Kjeldahl method adopted by the AOAC (2001) as well as the proximate analysis. Randomized block design (CRD) in 3 treatments with control (T0, T1, T2, T3) was used to analyze the data. Duncan test was used for further analyse.

3. RESULTS AND DISCUSSION

The proximate composition (moisture, crude protein, crude fibre, total fat, ash and nitrogen free extract) of the four samples was determined using standard methods with four replicates. The peel of T3 contain significantly high amount of moisture, protein, total fat and nitrogen free extract compare to control (T0) as shown in Table I. Whereas crude fiber significantly decrease after amofer processing. There was a significant positive correlation exist in between ammoniation and fermentation process that increased protein and reduced crude fiber content of the cassava peel. Both processes in complementary by using urea and EM4 to improve the quality of cassava peel. EM4 which contain *Lactobacillus*, photosynthetic fungi, photosynthetic bacteria, *actinomycetes*, and yeasts have the ability to reduce levels of crude fiber and increase the digestibility of feed ingredients.

Based on Table I amofer processing increased moisture of T2 and T3 significantly. This is because the increasing in moisture content during the fermentation process takes place which is resulting in the gain on cassava peel. Weight gain of peel was in the form of water produced throughout the fermentation process. During ensilage processing, the decreasing of dry matter and the increasing levels of water caused by ensilage first stage (respiration) is ongoing. It converse glucose to CO₂, H₂O, and heat. T3 has a high protein content compare to other treatments. Increasing protein content presumably caused by the addition of urea and enzymatic reactions of microorganisms contained in EM4.

Table I. Proximt composition of cassava peel.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Moisture</th>
<th>CP</th>
<th>CF</th>
<th>Fat</th>
<th>Ash</th>
<th>NFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>72.74⁰⁺</td>
<td>9.12⁰⁺</td>
<td>25.46⁰⁺</td>
<td>1.80⁰⁺</td>
<td>7.10⁰⁺</td>
<td>56.52⁰⁺</td>
</tr>
<tr>
<td>T1</td>
<td>52.68⁰⁺</td>
<td>22.28⁰⁺</td>
<td>21.06⁰⁺</td>
<td>2.10⁰⁺</td>
<td>8.32⁰⁺</td>
<td>46.24⁰⁺</td>
</tr>
<tr>
<td>T2</td>
<td>61.22⁰⁺</td>
<td>17.91⁰⁺</td>
<td>20.25⁰⁺</td>
<td>2.86⁰⁺</td>
<td>8.51⁰⁺</td>
<td>50.47⁰⁺</td>
</tr>
<tr>
<td>T3</td>
<td>63.31⁰⁺</td>
<td>23.31⁰⁺</td>
<td>13.22⁰⁺</td>
<td>3.05⁰⁺</td>
<td>8.77⁰⁺</td>
<td>51.65⁰⁺</td>
</tr>
</tbody>
</table>

Notes: Different superscripts in the same column shows the difference significantly (P < 0.01), respectively.

Table II. Cassava peel consumption of local goat based on dry matter content.

<table>
<thead>
<tr>
<th>Cassava peel processing</th>
<th>Local goat (g/e/day)</th>
<th>Average of consumption (g/e/day)</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>28.3</td>
<td>27.3</td>
<td>27.2</td>
</tr>
<tr>
<td>Fermentation (T2)</td>
<td>30.6</td>
<td>31.8</td>
<td>29.5</td>
</tr>
<tr>
<td>Ammoniation (T1)</td>
<td>33.6</td>
<td>35.1</td>
<td>30.7</td>
</tr>
<tr>
<td>Control (T0)</td>
<td>34.7</td>
<td>33.6</td>
<td>33.9</td>
</tr>
<tr>
<td>Total amount</td>
<td>126.2</td>
<td>124.2</td>
<td>121.3</td>
</tr>
</tbody>
</table>

Notes: Different superscripts in the same column shows the difference significantly (P < 0.01), respectively.

The following morning, The duration between meals with rumination does not differ much because the feed before being given cut first. Research indicated resources that the time required for ruminant to rumination the feed with short size of particles is shorter and roughly equal to mealtime.

Processed cassava peel cafeteria was given as a single feed. Wet weight ration of approximately 2 kg per head per day or approximately 0.24 kg per local goat per day in dry matter. Local goat has a very selective feeding behavior. The observations in this study (Table II) indicate that the selected local goat feed in order of preference are processed cassava peel with amofer technology, fermentation, ammoniation, and without processing. This condition is caused by the high digestibility of dry and organic matter is on cassava peel obtained by the amofer method.

Based on Table II it can be indicated that digestibility increased cassava peel’s consumption as the result of amofer processing. This is because the amofer process begins with ammoniation process, whereas urea had loosen the bonding between cellulose and lignin. It caused microbes that contained in EM4 easily degraded the fibers in the cassava peel, making it easier to improve digestibility. The higher digestibility’s level caused of the lower of feed consumption. Total digestible nutrients in the amofer treatment able to reduce the cassava peel’s consumption of the local goat.

The consumption of cassava peel on T0 is highest compare to other treatments. It is in line with digestibility experiment that indicated the fermentation processing by the EM4 as stater on the treatment of fermentation. Microbes in the EM4 can optimally digest crude fiber component contained in the cassava peel compared with T1. During the ammoniation processing, the reform process occured only in the material structure that was that only softning the lignocelluloses bonds. The content of crude fiber in the diet will lead to low grades degradation, as crude fiber in the form of cellulose and hemihemicelluloses and lignin are often bound to be difficult to be broken down by digestive enzymes.

The addition of inculcums in T2 and T3 have led to the growth of bacteria on the substrate more and more, so that enzyme activity is also increased in breaking down fiber components into simpler molecules. This addition of inculcums were further accelerate the fermentation process and the more degraded substrates. The level of reduction in crude fiber content related to the composition of crude fiber, especially lignin. High lignin will lead to the difficulty of microorganisms (bacteria) to degrade the material, so that it made the change in the decline of crude fiber content to be low.

The decreasing of feed consumption indicated the decreasing of HCN content in the processed of cassava peel. When cells of...
Table III. Effect of treatment on hydrogen cyanide of cassava peel.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hydrogen cyanide (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>580.93*</td>
</tr>
<tr>
<td>T1</td>
<td>3.10*</td>
</tr>
<tr>
<td>T2</td>
<td>1.16*</td>
</tr>
<tr>
<td>T3</td>
<td>0.34*</td>
</tr>
</tbody>
</table>

Notes: “**”Different superscripts in the same column shows the difference significantly ($P < 0.05$).

the cassava peel become damaged, cyanogen glycosides affect the enzymes lynamarynax produces cyanhydrin then causes lathryhydrin decomposition and the formation of cyanide.10 Cyanide released by evaporation, washing and cooking from the outside environment way out, soaking, fermenting and boil the water first, to become cyanogen glycosides in the cyanide.1 Furthermore, as cyanide in contact with water or air, it is removed from the food material. This explanation was being proved as shown in Table III.

Ammoniation process (T1) can significantly ($P < 0.05$) reduce the content of HCN in cassava peel compare to T0. It because of chopping was done as physical treatment before the ammoniation processing. Chopping of ±5 cm in size and the addition of water to the treatment of T1 facilitate dissolution HCN.11 HCN would easily soluble in water and then be released into the air after ammoniation processing is ended by opening the silo. The treatment of T1 has the lowest ability in reducing HCN compared with T2 and T3. It’s predicted that during the fermentation process in the T2 and T3 is not only water that can dissolve the cyanide but also the capability of producing enzymes that degrade linamarin. As HCN can be removed by the time of the chopping and dissolved in water at the treatment, the enzyme in the fermentation process also factored into the loss of HCN in cassava peel. The fermentation process produces an enzyme capable of degrading linamarin.3

HCN content decreases along with the length of time of fermentation, because of the increasing of fermentation time. It is also increasing the ability of the enzyme to degrade linamarin to compounds that do not harm.6 The content of HCN in cassava peel as the results of treatment T1, T2 and T3 has been safely consumed by goats. Goats and sheep were able to tolerate cyanide at a concentration of 2.5 to 4.5 ppm per kg of body weight.1 Furthermore, the decreasing of HCN significantly effected the cassava peel preferency of local goat. It concerning with the reducing of linamarin which have a bitter taste, causing local goat prefer to consume cassava peel processed that contains of the lowest HCN.

4. CONCLUSION

Based on the research study, ammoniation processing which was combined with fermentation processing (amofer) can reduce cassava peel’s consumption and increase the quality of proximat composition of cassava peel. Local goat prefer to consume cassava peel processed by amofer which has the lowest HCN. It can be recommended amofer processing technology should be used to increase the quality of cassava peel as feed for the livestock.

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References and Notes

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