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Conversion of Local Feed into Functional Feed using Lactic Acid Bacteria (Lactobacillus casei) in Wafer Form for Goat Farming

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Abstract
The aimed of this research is to determine the nutritional quality of bioconversion feed and productivity performance female kacang goats. This research used method a completely randomized design with 3 treatments and 5 replications. The treatments tried were P0 = Feed without the use of Lactobacillus casei (Lc); P1 = Use of 1 ml Lactobacillus casei (Lc)/kg feed; and P2 = Use of 1.5 ml Lactobacillus casei (Lc)/kg feed. The parameters observed included the quality of bio converted feed and goat productivity, including body weight gain, dry matter consumption, feed use efficiency, cutting weight, carcass weight, and carcass percentage. The composition of feed bio converted with Lactobacillus case is 15% corn cobs, 32% rice bran, 9% ground soybeans, 19% ground corn, 15% coconut meal, 4% cassava flour, 0.5% salt, 0.5% mineral mix, and 5% molasses. Based on the results of the analysis of variance, it was found that the treatment showed no significant effect (P > 0.05) on dry matter content (DM), feed organic matter, feed dry matter consumption, slaughter weight, and carcass weight, but had a significant effect (P <0.05) on crude fiber content, extract material without nitrogen, ash content, and efficiency of ration use; however, it had a very significant effect (P<0.01) on crude protein, crude fat, body weight gain, and carcass percentage. It can be concluded that feed bioconversion using Lactobacillus casei up to a level of 1.5 ml/kg feed can improve the feed quality and productivity performance female kacang goats.

Keywords: Conversion, Local Feed, Functional Feed, Lactic Acid Bacteria.

Introduction

There is a shortage of feed ingredients in each region caused, among other things, by the increasing price of feed raw materials due to the shrinking of land for forage production development due to use for food purposes, residential areas, and industrial development. Therefore, it is necessary to look for new resources that are able to replace some or all of the forage and can reduce dependence on the use of concentrate materials that are commonly used [1, 2].

One of the remaining plantation crops that has quite a lot of potential is corn cobs. The area of corn harvested in the Central Sulawesi Province in 2018 was 115,300 ha, with a total production of 540,404 metric tons. If it is assumed that each corn will produce cob waste equal to 50% of the weight of the corn, you will get approximately 270,202 metric tons of corn cobs [3, 4]. Corn cobs are low-quality agricultural residues characterized by high crude fiber content, low protein content, and low digestibility. The nutritional composition of corn cobs consists of 90% DM, 2.8% PK, 0.7% LK, 1.5% ash, 32.7% SK, 80% cell wall, 25% cellulose, 6% lignin, and 32% ADF [5]. Therefore, in its use as a feed ingredient, the quality of corn cobs needs to be improved, including with fermentation processing technology [6]. Furthermore, the fermentation process can utilize lactic acid bacteria, which contain microorganisms that can be useful and improve livestock health. Their function is to make feed containing probiotics. Probiotics is a term used for live microorganisms that can have a good or health effect on other organisms or their hosts, and the probiotics that are widely used are the Yakult brand, which contains lactic acid bacteria (Lactobacillus casei) [7]. L. casei is also a lactic acid-producing bacterium, obtained by fermenting glucose and forming lactate, which is homofermentative to form almost 85% pure lactate. This bacterium is also able to ferment ribose into acetic acid and lactic acid [8]. Apart from producing lactic acid, the fermentation process can also produce alcohol. When glucose is oxidized to produce ethanol and CO_2, the reaction changes pyruvic acid to acetal aldehyde, and the reaction reduces acetal aldehyde to alcohol [9].

To reduce the selective nature of livestock, this can be done by making feed in the form of wafers. Wafers are a form of animal feed that is a modified cube shape. In the manufacturing process, it undergoes a mixing process (homogenization), compaction with pressure, and heating to a certain temperature. Ration wafers are a form of feed that has a compact and concise physical form, so it is hoped that it will make handling and transportation easier, in addition to having complete nutritional content and using relatively simple technology so that it is easy to apply [10]. It is hoped that the compact and fairly compact wafer shape will: (1) make it easier to handle, preserve, store, transport, and handle other forages; (2) provide added value by utilizing agricultural and plantation waste; (3) use simple technology with relatively low energy; and (4) save production costs [11]. The aimed of this research is to determine the nutritional quality of bioconversion feed and productivity performance female kacang goats.

Materials and Methods

Place and Time of Research

Research to determine the conversion of local feed into functional feed using lactic acid bacteria (lactobacillus case) in the form of wafers for ruminant livestock was carried out in two places, namely making wafers after fermentation of local feed ingredients, which was carried out at the Feed Nutrition Laboratory, Faculty of Animal Husbandry and Fisheries, Tadulako University, for one month, while to see the performance of the Kacang goats, it was carried out in the experimental pen owned by CV. Prima BREED, Tondo Village, Palu City, Central Sulawesi Province, which is conducted from April to November 2021.

Research Materials

The research material used in this experiment was agricultural waste fermented using lactic acid bacteria (Lactobacillus case) and 12 female Kacang goats aged +10 months with a body weight range of 10.57–16.63 kg. All treatments will use Panicum sacramentum grass as an ad-libitum forage source, while the composition of the concentrate fermented with lactic acid bacteria (Lactobacillus casei) is listed in Table 1.

Table 1: Concentrate Composition

No	Feed Ingredients	Composition (%) Dry weight
1.	Corncob *	15,1
2.	Rice Bran *	32
3.	Ground Soybeans *	9
4	Ground Corn *	19
5.	Coconut Meal **	15
6.	Cassava Flour	4
7.	Salt	0.5
8.	Mineral Mix	0.5
9.	Molasses	5,9
Total		100

Pen

The cage used is a stilt cage with a tin roof, plank floor, and board walls measuring 7 x 20 m. The cage was divided into 15 plots, each measuring 1.0 x 1.75 meters, occupied by a local female experimental goat, equipped with a feed trough made of boards and a basin for drinking. Before use, it must first be cleaned and sprayed with Rodalon at a dilution rate of 15 cc per 10 liters, so that the cage is free from germs.

Treatment

The treatments tried were:

P0 = Wafer without Lc usage; P1 = Use of 1 ml Lc/kg wafer; P2 = Use of 1.5 ml Lc/kg wafer

Data Analysis

Data obtained from observations during the research were analyzed for variance using the MS Excel 2013 data analysis program based on a completely randomized design (CRD). If there was a real effect, then proceed with the BNJ test (Steel and Torrie, 1995).

Results and Discussion

Nutrient Composition of Local Feed Resulting from Bioconversion using Lactic Acid Bacteria (Lactobacillus Case)

The percentage change in the nutrient composition of local feed resulting from bioconversion using lactic acid bacteria inoculum is presented in Table 2. Research on the utilization of local feed resulting from bioconversion using lactic acid bacteria (Lactobacillus casei) has been carried out, as have the results of the feed nutrition laboratory analysis at the Faculty of Animal Husbandry and Fisheries at Tadulako University in 2021. The results of the analysis of the nutrient composition of local feed after fermentation with lactic acid bacteria (Lactobacillus casei) are presented in Table 2.

Table 2: Effect of Treatment on Feed Nutrient Components

Nutrient Composition	Treatment		
	P0	P1	P2
Dry Ingredients	86.34±3.94[a]	89.29±2.83[a]	86.19±6.47[a]
Organic Ingredients	79.27±3.99[a]	82.85±2.79[a]	81.03±5.93[a]
Crude protein	13.37±0.29[a]	16.83±0.01[b]	17.58±1.14[b]
Crude Fiber	13.32±0.15[a]	14.24±0.79[b]	15.79±0.11[c]
Crude Fat	9.66±0.03[a]	8.61±0.01[b]	7.85±0.46[c]
Ash Content	7.07±0.36[a]	6.44±0.19[b]	5.16±0.64[c]
EMWN	56.58±0.17[a]	53.88±0.86[b]	53.62±0.89[b]

Note: Numbers followed by different letters in the row indicate significant differences.

- P0 = local feed without the use of Lactobacillus casei
- P1 = bioconversion results using 1.0 ml Lactobacillus casei/kg local feed
- P2 = bioconversion results using 1.5 ml Lactobacillus casei/kg local feed

Based on the results of the analysis of variance, it was found that the treatment showed no significant effect (P>0.05) on the dry matter (DM) and organic matter content of the feed, but showed a very significant effect (P<0.01) on the crude protein content. and crude fat, and had a significant effect (P<0.05) on crude fiber content, extract material without nitrogen (EMWN), and ash content. Based on Table 2, it can be seen that the dry matter content increased between treatments P0 and P1, but between P0 and P2, there was actually a decrease of 0.16. Organic matter increased from P0 to P1 and P2. The decrease in dry matter was caused by the large amount of water released during the fermentation process, which resulted in a decrease in the dry matter content of the substrate. The longer the fermentation time, the lower the dry matter content, so the fermentation time must be a concern.

The effect of treatment on crude protein content increased from P0 (13.37%) to 16.83% (P1) and 17.58% (P2). This increase is due to the ability of lactic acid bacteria. The function of this yeast is to aid in the fermentation process of concentrate feed and as an additional source of protein, especially amino acids needed by livestock.

Based on the results of the statistical analysis, it shows a very significant effect (P<0.01) on increasing crude protein levels. The increase in crude protein resulting from bioconversion with lactic acid bacteria is likely due to the presence of protease enzymes that can lyse complex proteins into simpler ones, and molds have the ability to convert starch into protein by adding inorganic nitrogen through fermentation. Another thing that causes the nutrient content to increase after fermentation is that mold can synthesize protein by taking carbon sources from carbohydrates, nitrogen sources from organic or inorganic materials, and minerals originating from the substrate. Sharma et al. stated that fermentation can cause changes in the properties of food ingredients as a result of the breakdown of food content by the activity of enzymes produced by microbes [12]. The same thing was stated by Adebo et al.: the increase in nutrient levels during the fermentation process was caused by a decrease in organic matter during the fermentation process as a result of the breakdown of several food substances, such as carbohydrates, fats, and proteins, by mold [13]. The highest increase in crude protein was seen in treatment P2, namely 1.5%/kg concentrate. This is because the population of mold growth in the P2 treatment looks more fertile than in the P0 and P1 treatments, which is indicated by the smell of a fragrant smell like tape, which is more pronounced than in the P1 treatment, so that it can contribute biomass protein to the media used. The bioconversion process, there will be an increase in protein content as a result of changing inorganic nitrogen into cell protein during microbial growth. has died and is one of the contributions of single-cell protein to the media because most mold cells are proteins.

Feed quality is determined by high or low crude fiber content (whether or not the bonds between lignocellulose, lignoceric cellulose, and silica are strong) when consumed by ruminants. This causes low digestibility of the feed ingredients. One way to increase the digestibility value is through fermentation, and now it has been discovered that there is a white root fungus that is able to change these bonds. Theoretically, with bioconversion, there will be a decrease in crude fiber due to the very complex process of stretching the cellulose and hemicellulose bonds, but in this treatment, it appears that there is an increase in crude fiber. Based on the results of the statistical analysis, it shows a significant effect (P<0.05) on crude fiber content. Furthermore, based on further tests, it was seen that treatment P0 was significantly different (P<0.05) from P1 and P2. Likewise, between P1 and P2, there was a significant difference (P<0.05). In this research, it can be seen that there is an increase in the crude fiber component. This is due to the role of enzymes produced by molds that occur in the fermentation process, so that these enzymes can break down or reduce the tightness of the bonds that occur between feed tissue fibers. However, the fertile growth of fermented feed will decompose the fiber fraction, but the mycelium walls of the mold itself contain high amounts of crude fiber, so it is a contribution of crude fiber to the medium itself. The fermentation process shows fertile mold growth, and apart from being able to decompose, it can also increase the crude fiber content. This is due to the development of mold biomass during the fermentation process, where the cell walls also contain a lot of silica.

Production Performance of Goats that Receive Local Feed Resulting from Bioconversion using Lactic Acid Bacteria (Lactobacillus case)

The results of weighing and measuring the production performance of Kacang goats are shown in Table 3.

Table 3: Effect of Treatment on Goat Production Performance

Production Performance	Treatment		
	P0	P1	P2
Body Weight Gain (g/head/day)	34.14±0.51[a]	35.57±0.26[b]	36.64±0.34[c]
Feed Dry Matter Consumption (g/head/day)	596.65±6.75[a]	585.34±20.35[a]	573.66±10.58[a]
Feed Use Efficiency	0.057±0.0009[a]	0.061±0.0021[b]	0.064±0.0012[c]
Slaughter Weight (kg/head)	14.58±1.09[a]	16.59±1.57[a]	14.00±1.41[a]
Carcass Weight (kg/head)	6.40±0.48[a]	7.40±0.68[a]	6.42±0.64[a]
Carcass Percentage (%)	43.89±0.32[a]	44.63±0.29[b]	45.84±0.26[c]

Note: Numbers followed by different letters in the row indicate significant differences.

- P0 = local feed without the use of Lactobacillus casei
- P1 = bioconversion results using 1.0 ml Lactobacillus casei/kg local feed
- P2 = bioconversion results using 1.5 ml Lactobacillus casei/kg local feed

Based on the results of the analysis of variance, it was found that the treatment showed no significant effect ($P>0.05$) on dry matter consumption, slaughter weight and carcass weight of female Kacang goats, had a significant effect ($P<0.05$) on the efficiency of ration use and had a very significant effect. significant ($P<0.01$) on the increase in body weight and carcass percentage of female Kacang goats.

High body weight gain indicates that with bioconversion treatment, the ration can be optimally utilized by livestock, so compensation is in the form of higher body weight gain. This can be seen in the P2 treatment of 36.64 ± 0.34 g/head/day, compared to the P1 treatment of 35.57 ± 0.26 g/head/day and the P0 of 34.14 ± 0.51 g/head/day. This increase in body weight gain is thought to be due to the high levels of nutrients that can be utilized by goat livestock, as a result of the rations consumed in treatments P1 and P2 being the result of bioconversion, so that the nutrients required by livestock are good for basic living and biological processes, such as providing energy for activity and protein to increase and enlarge body cells, and are available and easily utilized by the livestock body. This is in line with the opinion of Liu et al. that fermented products are generally easily decomposed biologically and have a higher nutritional value than the original material [14]. Furthermore, Sharma et al., added that apart from the fermentation process, the catabolic nature of microbes, or breaking down complex components into simpler ones so that they are easier to digest, they can also synthesize several complex vitamins [15]. The benefits of fermentation include being able to change complex organic materials such as proteins, carbohydrates, and fats into molecules that are simpler and easier to digest, changing undesirable tastes and aromas into preferred ones, and synthesizing proteins. Apart from that, another benefit of fermentation is that the feed ingredients are better. can be stored and can reduce the toxic compounds it contains. The results of the Least Significant Difference (LSD) follow-up test regarding the effect of differences between treatments showed that treatment P2 was very significantly different (P0.01) from treatments P1 and P0, as well as treatments between P1 and P0 showing a very significant difference (P0.01). This indicates that treatment P2 has better quality compared to other treatments.

Dry matter consumption in goat livestock rations has no effect. It shows that giving local bioconverted feed using lactic acid bacteria (Lactobasillus casei) as concentrate feed gives the same results as giving non-bioconverted concentrate feed. Another possibility is due to the quality of the treatment ration being the same, as seen from the aspects of palatability and crude fiber and crude protein content, which are almost the same between treatments (Table 3). These results are in accordance with the opinion of Cherdthong that ration consumption in ruminant livestock depends on the fiber content of the feed. Apart from that, ration consumption is influenced by palatability, as a result of the concentrate being composed of low-quality feed [16]. Even though the ration used is the result of bioconversion, it is assumed that bioconversion of the ration can increase dry matter consumption of the ration. According to Pazla and Adrizal, one of the causes of the level of ration consumption is the quality of the feed; the lower the quality of the feed, the lower the level of palatability [17].

Feed use efficiency is the comparison between the resulting increase in body weight and the amount of feed consumed. According to Pinotti et al., the use of feed by livestock will be more efficient if the amount of feed consumed is low but results in high body weight gain. Good feed quality means livestock will grow faster and use feed more efficiently [18].

Table 3 shows that the average slaughter weight and carcass weight of peanut goats fed local feed resulting from bioconversion using lactic acid bacteria (Lactobacillus case) had no significant effect except on carcass percentage. Slaughter weight and carcass weight were no different from local feeds resulting from bioconversion using lactic acid bacteria (Lactobacillus case), indicating that carcass weight was very closely related to the slaughter weight of livestock. The carcass weight obtained in this study was almost the same as that obtained by Sodiq, namely that local male goats aged after weaning (6–18 months) with a live weight range of 10–23.5 kg (average 15.99 kg) produced a carcass weight of 4.5–10.5 kg (average 7.05 kg) and a carcass percentage of 44.68–45% (average 44.09%), but these results are lower than research by Irawan et al., namely that the carcass weight of Kacang goat was 10.30 kg (43.79% of slaughter weight). Carcass weights that were not different were probably caused by slaughter weights that were not significantly different [19, 20].

The percentage of kacang goat carcasses fed local feed resulting from bioconversion using lactic acid bacteria (Lactobasillus casei) shows a very significant difference and increases with increasing use of lactic acid bacteria. The increase in carcass percentage is closely related to the nutritional content of the feed; this can be seen from the results of the analysis of organic material components, which are increasing with the increasing use of lactic acid bacteria in local feed resulting from bioconversion, as shown in Table 2. The quality or nutrient value of the feed can influence the amount of feed produced and consumed by livestock. The quality of feed consumed by livestock can affect the carcass percentage. Sharif et al. stated that protein and energy are very important elements in carrying out the growth process, so a ration containing high protein and energy will provide high body weight gain and ultimately can affect the goat carcass percentage [21].

Goat productivity cannot be separated from the performance of livestock production, which is influenced by several factors, including heredity (genetics) and environmental factors consisting of feed, management, housing, and disease prevention [22]. A low amount of feed will not be able to provide optimal body weight gain and carcass growth in accordance with the genetic potential that exists in each animal, such as growth speed and high carcass percentage, which can only be realized if the animal can get enough food [23].

Conclusion

The average slaughter weight and carcass weight of peanut goats fed local feed resulting from bioconversion using lactic acid bacteria (Lactobacillus casei) had no significant effect except on carcass percentage. The bioconversion process, there an increase in protein content as a result of changing inorganic nitrogen into cell protein during microbial growth. The bioconversion of feed using lactic acid bacteria (Lactobacillus casei) up to a level of 1.5 ml/kg of feed can improve feed quality and show good performance in goats that receive the treated feed.

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