Asian Journal of Applied Research for Community Development and Empowerment. Vol 6 (2022), No.2

AJARCDE
ASIAN JOURNAL OF APPLIED RESEARCH FOR COMMUNITY DEVELOPMENT AND EMPOWERMENT

Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Production Performance and Carcass Quality of Male Bali Cattle by Feeding Fermented Pineapple Peel

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ARTICLE INFO

Article History:
Received: 12 February 2022
Final Revision: 03 April 2022
Accepted: 05 April 2022
Online Publication: 06 April 2022

KEYWORDS

Bali cattle, fermentation, production performance, pineapple peel, carcass

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A B S T R A C T

Bali cattle are local Indonesian cattle that were first developed on the island of Bali with unique properties, namely resistance to heat grip and not selective for feed. This research was conducted to assess the production performance and carcass quality of male Bali cattle by feeding fermented pineapple peel. The materials and methods used were twelve male Bali cattle with an average initial weight of 168.46 ± 11.95 kg placed in individual cages randomly based on a Completely Randomized Design with 3 treatments and 4 tails as replications. namely: T0=Native grasses +(39% milled corn+61% rice bran+0% fermented pineapple peel); T1=Native grasses +(10% milled corn+70% bran+20% fermented pineapple skin with tape yeast); and T2=Native grasses +(15% milled corn +65% bran+20% pineapple peel fermented by lactic acid bacteria). The research data consisting of production performance and carcass quality were analyzed by analysis of variance using the SPSS version 16 software program and continued with Duncan's test at the 5% confidence level. The results showed that the addition of pineapple peel fermented by lactic acid bacteria as much as 20% in the ration could provide the highest daily body weight gain of male Bali cattle (0.66 kg/head/day), low FCR (8.01), high protein consumption (630.18g/head/day), high carcass percentage (55.17%), high meat index (1.00) with large rib eye area (55.97 cm^2). Conclusion: The addition of pineapple peel fermented by lactic acid bacteria in the ration of as much as 20% can improve the production performance and carcass quality of male Bali cattle.

1. INTRODUCTION

1.1. *Research Background*

The provision of sufficient and sustainable feed is one of the obstacles to developing the beef cattle business. The availability of commercial feed is not able to overcome the problem of ruminant feed because the amount is still limited and the selling price is not affordable for rural farmers [1]. The utilization of agricultural waste such as rice straw, soybean straw, corn straw, cocoa pods, and pineapple peel is one strategy to overcome the problem of the limited availability of feed in the dry season. It is said that agricultural waste and plantation waste that can function as a source of protein include peanut straw, soybeans, pineapple peel, and cocoa bean waste [2].

Pineapple peel is an agricultural waste that is widely available throughout the year with nutritional content: crude protein 2.96%, crude fat 5.011%, crude fiber 20.665%, ash content 4.462%, dry matter 81.408%, organic matter 95.538%, neutral detergent fiber (NDF) 44.691%, and 23.04% acid detergent fiber (ADF), while the fermented pineapple peel has nutrients: crude protein 6.614%, crude fiber 10.784%, crude fat 6.583%, water content 4.674%, NDF 40.683%, ADF 20.676%, dry matter digestibility 81.312% and Organic matter digestibility 82.662% [3]. Statistical data from West Nusa Tenggara Province shows that pineapple production in West Nusa Tenggara in 2020 will reach 16,400 tons/year. The weight of pineapple peel obtained from one pineapple is on average 24% of the fruit weight so in one year there are 3.936 tons of pineapple skin available [3]. Before use, pineapple peel should be fermented to increase its nutritional value by using commercial inoculum such as lactic acid bacteria [4].

Lactic acid bacteria in the process of fermenting food and beverages can produce metabolites as antibacterial bacteria [5]. Fermentation using lactic acid bacteria can increase the nutritional value of a product. This is because lactic acid bacteria play an important role in producing antimicrobial components, such as bacteriocins [6]. Bacteriocins produced by lactic acid bacteria can be in the form of proteins that provide a bactericidal effect which is a bio-preservative in food ingredients and can extend the shelf life of feed.

1.2. *Literature Review*

Local cattle (Bali cattle and Ongole crossbreed cattle), imported cattle, and imported meat are sources to meet the

https://doi.org/ 10.29165/ajarcde.v6i2.96

demand for meat in Indonesia [7]. Bali cattle in West Nusa Tenggara have unique characteristics, namely, they are very resistant to heat and are not selective for feed [4]. The performance of cattle is influenced by genetic factors [7] and environmental factors [8]. Cows that have good genetics will show good production performance if they are supported by a good environment.

The performance of cattle is considered good if it experiences perfect growth, produces carcasses with optimal quality, and has a meat index of more than 1 [8]. The meat index determines how much of the proportion of meat to the length of the carcass. Furthermore, it is said that male Bali cattle at the age of 2-3.5 years with extensive rearing systems have a meat index of 1.13. while female Bali cattle at the same age had a meat index of 1.09. The eye area of the ribs is influenced by several factors, including genetics [9], nutritional status of feed [10], carcass weight, and length of fattening [3]. Male Bali cattle aged 1.5-2 years fed 70% corn straw and 30% commercial concentrate have an area of rib eye area of 61.79 cm2 with a carcass percentage of 54.76%, while by feeding 70% corn straw +15% fermented cocoa husk +15% commercial concentrate has an area of rib eye area of 61.01cm2 with a carcass percentage of 53.77% [11].

The performance and carcass quality of Bali cattle can be improved by improving the quality of the feed given to livestock by providing additional feed in the form of concentrate made from fermented pineapple skin with lactic acid bacteria, rice bran, and ground corn with a protein concentrate content of 12%.

1.3. Research Objectives

This research was conducted to assess the performance and carcass quality of male Bali cattle by feeding fermented pineapple peel.

2. MATERIALS AND METHODS

2.1. Materials

In this study, 12 male Bali cattle with an initial weight range of 168.46 ± 11.95 kg were used. The feed used in the study was native grasses and concentrate that consisted of fermented pineapple peel with yeast culture, fermented pineapple peel with lactic acid bacteria, milled corn, rice bran, and molasses. The animals were housed in 1.5 x 2 M^2 individual pens equipped with feed and drinking water throughs.

2.2. Research methods

2.2.1. Pineapple peel fermentation

Pineapple peel fermentation was carried out by facultative anaerobic method using 2 types of inoculums, namely yeast culture (*Saccharomyces cerevisiae*) and lactic acid bacteria [2]. Fermentation is done by the following procedure:1) Pineapple peel is dried in the sun for 2-3 days and after drying, it is continued with the grinding process; 2) Pineapple peel in powder form is steamed at a temperature below 60^0C for 30 minutes to obtain a sterile pineapple peel powder from fungi and other bacteria [2]; 3) Pineapple peel powder that has been steamed is added with 1% yeast culture or 10% lactic acid bacteria and a 25% concentration of molasses solution to form a whole bunch of pineapple peel powder; 4) Clumps of pineapple peel powder were put in a loosely closed container to obtain facultative anaerobic conditions, and incubated at room temperature for 3-4 days; 5) The results of the fermentation were carried out by laboratory tests to determine the nutritional content of fermented pineapple peel.

2.2.2. Male Bali cattle fattening

Twelve male Bali cattle were placed in individual pens at random based on a Completely Randomized Design in one way pattern with 3 feeding treatments and each treatment used 4 heads of male Bali cattle as replicates. The dietary treatments were:

T0= Native grasses +(39% Milled corn +61% Rice bran +0% fermented pineapple peel).

T1= Native grasses +(10% Milled corn +70% Rice bran +20% fermented pineapple peel with yeast culture).

T2= Native grasses +(15% Milled corn +65% Rice bran +20% pineapple peel fermented with lactic acid bacteria).

The formula and nutritional content of concentrates for each treatment are presented in Table 1.

Table 1. The nutritional content of concentrates for each treatment

Material Composition	Treatment		
	RT0[1]	RT1[1]	RT2[1]
Milled corn (%)	39	10	15
Rice bran (%)	61	70	65
Fermented pineapple peel with yeast culture) (%)	0	20	0
Pineapple peel fermented lactic acid bacteria (%)	0	0	20
Nutrient content of the ration[2]			
Crude protein (%)	12.01	12.00	12.09
Crude Fiber (%)	4.52	6.58	7.18
Crude Fat (%)	9.12	10.40	9.10
Nitrogen- Free Extract (NFE) (%)	62.50	61.17	61.19
Total Digestible Nutrient (TDN (%)	78.76	82.20	83.46
Calcium (Ca) (%)	0.04	0.05	0.04
Phosphor (%)	0.99	1.13	1.11

[1]RT0=Control ration, RT1= First treatment ration, RT2= Second treatment ration

[2]The nutritional value of the rations of each treatment is calculated based on the nutritional value of the ingredients that make up the ration.

2.3. Research variables

2.3.1. Production performance:

a. Initial body weight (kg). Initial body weight was obtained by weighing at the beginning of the study (before feeding treatment) [12].
b. Final Weight (kg). The final body weight was obtained by weighing the cattle at the end of the study [12].
c. The increase in the bodyweight of cattle was obtained by subtracting the final bodyweight of the study from the initial body weight.

Daily body weight gain was obtained by dividing the overall body weight gain by the length of the study [13], with the formula:

$$\textbf{Daily weight gain} = \frac{\textbf{Final weight – Initial Weight}}{\textbf{Length of research}}$$

 https://doi.org/ 10.29165/ajarcde.v6i2.96

d. Feed Conversion Ratio (FCR) is the result of dividing ration consumption by weight gain [14];[15], with the formula:

$$\mathbf{FCR} = \frac{\textbf{Consumption of ration}}{\textbf{Body weight gain}}$$

e. Consumption of dry matter. The dry matter consumption of the ration is the ration consumption based on the dry matter multiplied by the percentage of the dry matter of the ration[16].

f. Consumption of protein. The high and low consumption of protein is influenced by the amount of protein content in the ration [17]. Consumption of protein can be calculated by the formula:

Consumption of protein =
Consumption of dry matter x (% ration protein)

2.4. Carcass quality:

Carcass Weight. Carcass weight is the weight of meat along with bones and fat after separating the four legs, head, skin, and all contents in the abdominal cavity except the kidneys.

Carcass Percentage. Carcass percentage is the ratio of carcass weight to slaughter weight x 100%.

Carcass length. Carcass length was obtained by measuring the length of the carcass from the first rib to the front end of the base of the coccyx using an ordinary tape measure [18].

Flesh index (meat index). The flesh index is the ratio between carcass weight and carcass length [8].

Ribs eye area. Measurement of the eye area of the ribs can be measured by drawing a cross-sectional area of the longissimus Dorsi muscle between the 10th and 11th ribs, then calculated using block millimeters [19].

2.5. Data Analysis

The research data were analyzed using one-way ANOVA based on a Completely Randomized Design with a one-way pattern [25]. Data analysis was continued with the Duncan Multiple Range Test at a 5% confidence level using the SPSS version 16 software program.

3. RESULT AND DISCUSSION

3.1. Production Performance

Production performance is one of the parameters that can be used to measure livestock productivity, especially beef cattle. The performance of livestock production can be seen in body weight gain, dry matter consumption, feed conversion ratio (FCR), and protein consumption. Average body weight gain, dry matter consumption, FCR, and protein consumption are presented in Table 2.

The results of One way ANOVA analysis showed that the addition of fermented pineapple peel in Bali cattle ration did not have a significant effect (P>0.05) on body weight gain, protein consumption, dry matter consumption, and FCR. Duncan test results showed that Bali cattle rations containing 20% pineapple peel fermented by lactic acid bacteria could produce the highest body weight gain (0.66 kg/head/day) compared to control (T0) of 0.61 kg/head/day and T2 treatment. The results of this study are lower compared to the results of previous studies, namely Bali cattle were reared for 4 months with feed consisting of king grass + 1.5% concentrate of body weight and 1 kg of corn flour had a bodyweight gain of 0.89 kg/head/day [21].

Table 2. Average Body Weight Gain, Dry Matter Consumption, FCR, and Protein Consumption of Male Bali Cattle

Variable[1]	Treatment			Significance
	T0 (Control)[2]	T1 (FCY)[2]	T2 (FBAL)[2]	
Initial weight (kg)	167.50±7.51[a]	168±10.42[a]	169.88±18.83[a]	0.965
Final weight (kg)	204±6.78[a]	202.5±9,15[a]	209.25±18.48[a]	0.734
Weight gain (kg/head/day)	0.61±0.13[a]	0.58±0.13[a]	0.66±0.07[a]	0.601
Dry matter consumption (kg/head/day)	5.09±0,16[a]	5.16±0.07[a]	5.22±0.04[a]	0.269
FCR	8.63±1.69[a]	9.30±1.98[a]	8.01±0.78[a]	0.530
Consumption of protein (g/ head/day)	611.52±18.67[a]	619.87±8.72[a]	630.18±4.560[a]	0.150

[1] The values are mean from four replication.
FCY= Yeast Culture Fermentation; FBAL= Lactic Acid Bacteria Fermentation; T0=control, T1= first treatment, T2= second treatment. Different superscripts (a, b, c, etc.) in the same line showed significant differences (P<0.05).

The results of this study prove that the nutritional balance in the ration provides a significant contribution to the appearance of Bali cattle production [7]. The achievement of better growth in livestock groups that received rations containing pineapple peel fermented by lactic acid bacteria (T2) was caused by the achievement of an ecosystem balance in the rumen, namely the harmony of nutrients that make up the ration that supports a synergistic relationship between microbes in the rumen. This has implications for higher feed digestibility so that livestock receive sufficient nutrients to support optimal growth of livestock. The low growth of male Bali cattle with the provision of rations containing pineapple peel fermented yeast culture (T1), is caused by too much ammonia (NH_3) that is formed in the rumen so that the rumen ecosystem is disturbed which causes livestock growth to be not optimal.

Giving fermented pineapple peel in the ration had no significant effect (P>0.05) on the dry matter consumption of the ration and protein consumption. The results of this study reflect that fermentation of pineapple peel using yeast culture or using lactic acid bacteria in the ration is not to a level that interferes with the appetite of Bali cattle, so feed consumption is based on the dry matter was relatively the same among all treatments. Consumption of rations in livestock serves to meet energy needs, and livestock will stop eating when the livestock feel their energy needs are met. Table 1 shows that the dry matter consumption values obtained in this study ranged from 5.09–5.23 kg/head/day and had met the standards set by the National Research Council (NRC) of 1.4-3% [21]. The results of this study were lower than the dry matter consumption value of Bali cattle fed king grass+1.5% concentrate of body weight with a dry matter consumption value of 5.48-7.66 kg/head/day [21].

The results (Table 1) showed that the addition of pineapple peel fermented by lactic acid bacteria in the diet provided higher protein consumption (630,183 ± 4,560 g/head/day) compared to the addition of fermented pineapple peel with yeast culture (619.87±8.72 g/head/day) and with control (611.52±18.67g/head/day). This is because the Bali cattle ration with the addition of pineapple peel fermented by lactic acid bacteria can increase the palatability of the ration.

The value of efficiency of the use of rations indicated by the FCR value has an important meaning in the livestock production process and is often used as a basis for making decisions. The obtained FCR is 8.01±0.78 (T2); 8.63±1.69 (T0), and 9.30±1.98 (T1) and not significantly different (P>0.05) between treatments. The results of this study indicate that the addition of fermented pineapple peel with lactic acid bacteria (T2) in the ration can increase the efficiency of using higher feed compared to T0 and T1. This was because the T2 treatment had a bodyweight gain that was proportional to the increase in dry matter consumption of feed so that it could provide a smaller FCR value (8.021±0.78) compared to the FCR at T0 (8.631±1.69) and FCR at T1 (9.30). The FRC value obtained in this study was relatively the same as the FRC value of Bali cattle fed king grass +1.5% concentrate of body weight and 1 kg of cornflour, which was 7.48-9.07 [21].

3.2. Carcass Quality

Carcass quality can be seen from carcass weight, carcass percentage, meat index, and rib eye area. The results of the study on carcass quality (carcass weight, carcass percentage, meat index, and rib eye area) of male Bali cattle fed with fermented pineapple skin were presented in Table 2.

Table 2. Carcass Quality of Male Bali Cattle with Fermented Pineapple Peel Feed

Variable[1]	Treatment			Significance
	T0 (Control)[2]	T1 (FCY)[2]	T2 (FBAL)[2]	
Slaughter weight (kg)	204±6.78^a	202.5±9.15^a	209.25±18.48^a	0.734
Carcass weight (kg)	109±6.75^a	111.75±5.91^a	115.5±11.12^a	0.702
Carcass Percentage (%)	54.252±1.57^a	55.173±0.73^a	55.168±0.55^a	0.397
Carcass Length (cm)	128.5±0.58^a	129.5±0.58^a	129.25±0.96^a	0.184
Meat index	0.85^a	0.87^a	1.00^b	0.034
Ribs Eye Area (cm^2)	49.86±3,12^a	55.56±1.03^b	55.97±2.01^b	0.008

[1] The values are mean from four replication.
[2]FCY= Yeast Culture Fermentation; FBAL= Lactic Acid Bacteria Fermentation; T0=control, T1= first treatment, T2= second treatment. Different superscripts (a, b, c, etc.) in the same line showed significant differences (P<0.05).

3.3. The results of One way

ANOVA analysis showed that the addition of fermented pineapple peel in Bali cattle beef ration had a significant effect (P>0.05) on meat index and rib eye area, while slaughter weight, carcass weight, carcass percentage, and carcass length had no significant effect (P<0.05). The addition of fermented pineapple peel with yeast culture and lactic acid bacteria in the diet resulted in the carcass percentage of male Bali cattle in treatment T1 (55.17%) and T2 (55.17%) which was higher than the carcass percentage in control T0 (54.252). The carcass percentage of Bali cattle at T1 and T2 was higher than the percentage of male Bali cattle carcass fed with fermented cocoa husk, which was 54.76% [11], carcass percentage of male Bali cattle reared extensively in East Nusa Tenggara (53.38%) [22] and also higher with the percentage of male Bali cattle carcass slaughtered at the Manado Slaughterhouse, North Sulawesi (50.17%) [23].

Carcass length obtained in this study (Table 2) ranged from 128.50 to129.50 cm. The results of this study were higher than the carcass length of male Bali cattle with a slaughter weight of 300-400 kg which had a carcass length of 125 cm [24]. The factor that affects the carcass length is the permanent bone length, while the width of the carcass is determined by the growth of tendons in the area around the chest [10]. Furthermore, it was explained that male Bali cattle with an age range of 3 to 3.5 years and a fat body condition had a carcass length of 148.20 cm.

Duncan's test results showed that the male Bali beef index at T0 (0.85) was lower and significantly different (P<0.05) from the beef index at T2 (1.00) and not significantly different (P>0, 05) with beef index treatment T1(0.87). This is because the treatment of rations containing pineapple peel fermented by lactic acid bacteria has a higher carcass weight compared to other treatments. The size of the meat index is very dependent on the weight of the carcass [25]. The meat index obtained in this study ranged from 0.85 to 1.00 lower than the male Bali cattle meat index on the island of Bali, which was 1.23 [25]. This is because the age of the male Bali cattle used as research material is still relatively young, namely 1.5-2 years, so it has not provided maximum growth of the carcass constituent components.

The rib eye area of the male Bali cattle obtained in this study ranged from 49.86 to 55.56 cm^2, lower than the rib eye area of male Ongole cattle with high energy feeding (TDN=69.67%) which is 83.64 cm^2 [10]. The results of Duncan's test showed that the eye area of rib eye area of the male Bali cattle at T0 (49.86

 https://doi.org/ 10.29165/ajarcde.v6i2.96

cm^2) was lower and significantly different (P<0.05) from the eye area of the male Bali cattle rib at T1 (55.56 cm2) and T2 (55,97cm^2). The results of this study indicate that there is a positive correlation between carcass weight, slaughter weight, and rib eye area as shown in Figure 1.

Figure 1 shows that an increase in slaughter weight and carcass weight will cause an increase in the eye area of the ribs. It is proven that there is a positive correlation between carcass weight and rib eye area which has a regression correlation value (r) of 0.851 and the regression equation: Y=68.32+69.98x (x=Carcass weight; Y= Ribs eye area).

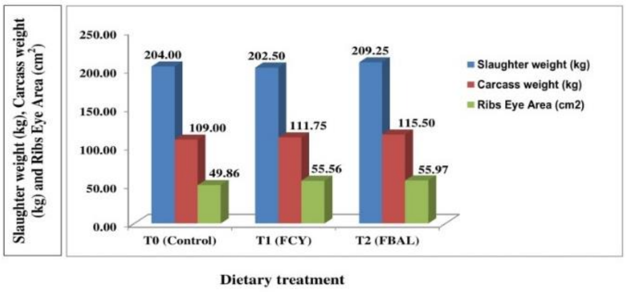

Figure 1. Graph of the relationship between the weight of the slaughter, the weight of the carcass and the eye rib area. The values are mean from four replication. FCY=Yeast Culture Fermentation; FBAL=Lactic Acid Bacteria Fermentation, T0=control, T1=first treatment, T2=second treatment, WHC=water holding capacity.

A larger ribs eye area produces higher amounts of meat compared to livestock with a smaller rib eye area [9]. It is said that the factors that affect the eye area of the ribs are live weight and carcass weight [11].

4. CONCLUSION

The addition of pineapple peel fermented by lactic acid bacteria in the ration of as much as 20% can improve the production performance and carcass quality of male Bali cattle.

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