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Research Article

PERFORMANCE AND MEAT QUALITY OF MALE BALI CATTLE FED WITH FERMENTED COCOA POD (*Theobroma cacao* L) HUSK-BASED CONCENTRATE

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ABSTRACT

The aim of this study was to evaluate performance and meat quality of male Bali cattle fed with fermented cocoa pod husk-based concentrate which fermented with Bioplus (CPHCFBio). The research was conducted for 2 months at the Teaching Farm Laboratory, Faculty of Animal Husbandry, University of Mataram. The material used was 9 male Bali cattle aged 2-2.5 years with initial weight of 142-172 kg which randomly divided into 3 treatments and 3 replications. The treatments were P1=30% CPHCFBio+70% Corn Straw; P2 =40% CPHCFBio+60% Corn Straw and P3 = 50% CPHCFBio + 50% Corn Straw. The variables observed were: Average Daily Gain (ADG), feed consumption, feed efficiency and meat quality of male Bali cattle which statistically analyzed by analysis of variance based on Complete Randomized Pattern Design using Statistical Analysis System (SAS) program, followed by Duncan New Multiple Range Test at a confidence level of 5%. Result showed that the percentage of CPHCFBio had no significant effect ($P>0.05$) on ADG, feed consumption, feed efficiency, tenderness, pH, fat content and ash content of meat of male Bali cattle, while water holding capacity (WHC), cooking loss, water content and meat protein of male Bali cattle were significantly effected ($P<0.05$) by the treatment. The percentage of CPHCFBio feed additives plus corn straw can provide male ADG of Bali cattle approximately 0.568-0.594 kg/day. The use of CPHCFBio up to 40% mixed with corn straw as male Bali cattle feed can produce good meat quality of male Bali cattle, which has high WHC (48.213 ± 1.976%), low cooking loss (36.514 ± 2.978%), and high protein content (19.723 ± 0.739%).

INTRODUCTION

Cocoa Pod husk (CPH) is the main waste from cocoa industry which promising to be used as alternative feed for large ruminants (cattle) as well as small ruminants (sheep and goat)[13] and[21]. West Nusa Tenggara Province Statistical Data show that cocoa production achieved 8,387.82 tons in 2018 with approximately 70 % of those are the cocoa pod husks, thus there would be 5,871.5 tons of CPH available in the year [2]. The incorporation of CPH for cattle feed may up to 30-40% of feed requirements, hence the utilization of CPH can be a solution for the problem of animal feed shortage and lack of labor in providing the forage feed [3] and [19]. The application of fresh CPH waste as animal feed can decrease livestock body weight because of low protein content and high levels of lignin and cellulose [4]. CPH holds a considerable amount of lignin and theobromelin, crude fiber (40.03%) and a small proportion of protein (9.71%)[14] and [7]. CPH also contains cellulose 36.23%, hemicellulose 1.14% as well as 20% - 27.95% [1]. Such elevated levels of lignin and low protein content of CPH can be improved by fermentation.

The CPH waste fermentation process can eliminates the negative effects of its use as well as increase the nutritional value, especially crude protein content and decrease crude fiber (Sun & Cheng, 002) in [21]. Through fermentation process, addition of cocoa pod husk in Bali cattle feed resulting in better growth response of the cattle [11] without altering the carcass quality [24]. Various models of fermentors have been used with varying results as follows: Mixture of EM4 with Urea [3], biofit [13], *Aspergillus oryzae* [16], *P.chrysosporium* which can lower lignin content by 18.36% [15],[17], while *Aspergillus Niger* [21], and *Trichoderma* sp, can enhance protein levels by 24% and 7.52% ash content, Levels of *lysine* amino acid can be increased up to 3.46%, *histidine* 0.94% and

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levels of *methionine* up to 0.69% by using *Koruria rosea* [16]. Utilization of the *Neurospora crassa* mold [17] may enhance protein from 4.56% to 21.20% on 60% mixed substrate of sago pulp with 40% pulp out.

Fermented Cocoa Pod husk (FCPH) as Bali cattle feed can give body weight gain of 0.9 kg/day [18]. FCPH can be given up to 4 kg/day as feed for cattle and can produce Bali catle average daily weight gain (ADG) of 1.21 kg/day [3]. Bali cattle fed with FCPH flour have ADG of 0.52 kg/day [11], while if it fed with FCPH as much as 3 kg/day can give ADG of 0.86 kg/day [3]. Bali cattle with high ADG tend to have higher carcass percentage and better meat quality [8].

Meat quality can be determined chemically, microbiologically, organoleptically, and physically. The physical quality of meat can be indicated by water holding capacity (WHC), cooking loss, tenderness and pH. The chemical quality of meat will affect the quality of processed meat. Meat with good physical and chemical qualities will certainly provide good processed products. The physical and chemical characteristics of meat of male Bali cattle based on muscle type which were extensively raised in Bima Regency and slaughtered at 2 years of age, namely Bicef Femoris (BF) muscle and Longisimus Dorsi (LD) muscle at 2 years of slaughter age had tenderness of 1.362 kg/cm^2 and 1.249 kg/cm^2 respectively, with protein content: of 18.36% and 21.98% [8]. Male Bali cattle that are extensiely maintained in Bima Regency at a slaughtered age of 2.1-2.5 years can provide better meat quality in terms of cooking loss (42.121%), tenderness (1.506 kg/cm^2) and protein content (18.156%) [9]. Data on the meat quality of male Bali cattle that maintained intensively in terms of physical characteristics and chemical composition still need to be reproduced as a strategic step to improve meat quality, therefore the study is needed to be done with the title: Performance and Meat Quality Of Male Bali Cattle Fed With Fermented Cocoa Pod (*Theobroma cacao* L) husk-based Concentrate.

MATERIAL AND METHODS

The research materials used were 9 male Bali catle aged 2-2.5 years with a body weight of 142-172 kg and cocoa pod husk which fermented with Bioplus (CPHCFBio). Cattle fattening was carried out at the Teaching Farm Laboratory, Faculty of Animal Husbandry, University of Mataram for 2 months. Cattle are randomly divided into 3 treatments with 3 replications, namely: P1 = 30% CPHCFBio + 70% Corn Strw, P2 = 40% CPHCFBio + 60% Corn Straw and P3 = 50% CPHCFBio + 50% Corn Straw. The process of slaughtering cattle was carried out in the Slaughterhouse Majeluk Kota Mataram at body weight of 186.5-189.5 kg. The method of slaughter applied was recommnded by the Majelis Ulama Indonesia (Board of Indonesian Moslem Scholars). The variables observed in the form of cattle performance were measured by direct weighing method, while the physical quality of meat was measured by the *Warner-Bratzler* method and *Hamm's* method [20] and the chemistry of meat was measured by the AOAC method [6]. The data analysis was carried out by the Analysis of Variance (ANOVA) based on the Completely Randomized Design of Unidirectional patterns with the SAS program, and continued with the Duncan Multiple Range Test at a confidence level of 5%.

RESULTS AND DISCUSSION

Bali Cattle Performance

The performance of male Bali cattle fed with fermented cocoa pod husk based concentrate was reflected by Average Daily Gain (ADG), feed consumption and feed efficiency. Average Daily Gain is one parameter that can be used as a benchmark for livestock productivity, especially beef cattle. The Average Daily Gain (ADG), feed consumption and feed use efficiency during the study are presented in Table 1.

Table 1 Average Daily Gain (ADG), feed consumption and feed efficiency

Variables	Treatments			P
	CPHCFBio (30%)	CPHCFBio (40%)	CPHCFBio (50%)	
Final body weight (kg)	186.500±11.533^b	189.500±9.656^a	186.667±13.041^b	*
ADG (kg/day)	0.568±0.016	0.571±0.021	0.594±0.087	NS
Feed consumption (% BW)	7.934±0.236	7.415±0.265	6.508±0.296	NS
Feed consumption (% DM)	5.019±0.767	4.928±0.280	4.713±0.523	NS
Feed efficiency (%)	0.117±0.007	0.114±0.004	0.129±0.026	NS

Note: DM =Dry Matter; BW= body weight; NS = Non Significant; * = Significant (P<0.05).

The results of variance analysis showed that the treatment of feed based on the percentage of CPHCFBio had a significant effect (P <0.05) on the final body weight of male Bali cattle fattened with feedloting method, but did not have a significant effect (P> 0.05) on ADG (kg/day), feed consumption (% BW), feed consumption (% DM) and feed efficiency. The results of this study indicate that the nutritional balance in the ration contributed significantly to the appearance of Bali cattle production. Bali cattle are very responsive to efforts related to feed improvements [19]. The highest ADG of Bali cattle (0.594 ± 0.087 kg/day) was achieved by giving 50% CPHCFBio feed, followed by CPHCFBio 40% treatment (0.571 ± 0.021 kg/day), and CPHCFBio 30% treatment (0.568 ± 0.016 kg/day). The results of this study are higher than the results of the study [20], namely ADG of Bali cattle ranging from 0.372-0.552 kg/day. Male Bali cattle which are maintained by the feedlot system have ADG ranging from 0.34 - 0.49 kg/day [10]. The results of this study were lower than the report [5] which reported that Bali cattle fed with HQFS supplements reached ADG of 0.62 kg/day. Likewise it was reported [15] that Bali cattle weight gain could still be increased to 760 grams/day with 40% elephant grass feed + 60% concentrate (20.7% CP, and 77% TDN). Giving cocoa pod husk in the form of fermentation as cattle feed can reach 4 kg/day and can produce Bali cattle body weight gain 1.21 kg/day [3].

The high level of ADG in livestock groups that received feed containing 50% of CPHFBio was caused by the achievement of ecosystem balance in the rumen caused by the harmony of nutrient-making feed which support a synergistic relationship between microbes in the rumen. This has implications for higher feed digestibility so that livestock receive a higher nutrient supply and ultimately enhance the growth of livestock. Feed treatment did not give significant difference (P>0.05) on feed consumption based on body weight percentage. This reflects that the provision of CPHCFBio at the level of 50%, level 40% and level 30% in the feed does not reach the level

that alters the appetite of animals, so consumption is not disturbed. Basically, feed consumption is intended to meet the energy needs of livestock, so that livestock will stop eating if their energy needs are fulfilled by the feed. However, if the feed is not energy intensive (high in fiber), the digestive capacity, especially the fermentative digestive organs, will be the main limiting factor for feed consumption, although the animals are still need additional energy. In Table 1 it can be seen that, the value of feed consumption based on dry matter ranges from 4.713 ± 0.523–5.019 ± 0.767 kg/day or an average of 4.887 ± 0.157 kg/day. This figure is relatively the same as the results of the study [11] which reported that the dry matter consumption of Bali bovine fed with ammoniated rice straw + corn oil + hydroxy methionine analogue was 5.358 kg/day. If the consumption of dry matter is expressed in percent body weight, the average consumption is 7.252 ± 0.715% of the body weight. This result is higher when compared with the NRC (1984) recommendation that consumption of dry matter for beef cattle between 1.4 - 3 percent of body weight. This is because the body weight of male Bali cattle fattened for 60 days has an average weight below 200 kg, which means that the growth rate of fattened male Bali cattle has not achieved the optimum level.

The feed efficiency value has important role in livestock production, and is often used as a basis for decision making. The results of variance analysis showed that the treatment of feed based on the percentage of CPHCFBio had no significant effect (P>0.05) on the feed efficiency of male Bali cattle which raised using feedlot fattening. The results showed that the use of CPHCFBio gave a relatively similar level of feed efficiency between treatments, which ranged from 0.114 ± 0.004-0.129 ± 0.026.

Meat Quality of Bali Cattle

The quality of meat and its processed products in general can be seen from the physical characteristic and chemical composition. The average physical characteristic meat of Bali cattle with fermented cocoa pod husk based concentrate are presented in Table 2.

Table 2 Physical Characteristics of Meat of Male Bali Cattle Based on Treatment of Feeding with CPHCFBio

Variables	Treatment			P
	CPHCFBio (30%)	**CPHCFBio (40%)**	**CPHCFBio (50%)**	
WHC (%)	44.583±15.218^{c}	48.213±1.976^{a}	46.189±14.227^{b}	*
Cooking Loss (%)	37.381±1.817^{ab}	36.514±2.978^{b}	38.613±0.866^{a}	*
Tenderness (Kg/cm^2)	3.667±0.577	3.512±0.443	3.992±0.020	NS
pH	5.8±0.058	5.7±0.351	5.4±0.351	NS

Note: * = significant (P<0.05)
NS = Non significant (P>0.05)

The results of variance analysis showed that the percentage of CPHCFBio had significant effect (P<0.05) on WHC and the cooking loss of meat male Bali cattle and non significant (P>0.05) on tenderness and pH of meat. The Duncan's test showed that WHC and cooking loss of male Bali cattle given CPHFBio feed were significant (P<0.05) between treatments. From Table 2, it can be seen that on average WHC of male Bali cattle based on feed treatment ranges from 44.583 ± 15.218-48.213 ± 1.976%, cooking loss 36.514 ± 2.978-38.613 ± 0.866%, pH 5.4 ± 0.351-5.8 ± 0.058 and meat tenderness 3.667 ± 0.577-5.000 ± 1.000 kg/cm^2. The results of the study as seen in Table 2 are in accordance with Shanks *et al*. (2002) in [23] and [20] which states that the percentage of cooking loss is closely related to the WHC. If the WHC is high, the cooking loss will be low, as seen in the 40% CPHFBio treatment which has high WHC (48.213 ± 1.976%), and low cooking loss (36.514 ± 2.978%). Meat with low WHC will release a lot of water when the meat is cooked due to cellular membrane damage and protein degradation [19]. It was also said that the percentage of cooking losses in cattle and buffaloes was also influenced by the relatively young age, so that the content of collagen in meat was still relatively low when compared with older animals. The high and low DIA is closely related to intermuscular fat content, intramuscular fat and thickness of back fat. The results of this study indicate that an increase in intermuscular fat levels, intramuscular fat and back fat was followed by an increase in WHC in Bali cattle, from 44.583 ± 15.218% to 48.213 ± 1.976 %, while back fat thickness increased from 2.600 ± 0.078 mm to 2.633 ± 0.0567 mm.

Meat tenderness is one of the physical properties of meat that determines the level of palatability of meat. The more tender the meat the more preferred by consumers. Meat tenderness is determined by several factors including age of slaughter, sex, nutrient content of feed, breed and treatment before slaughter. The results of tenderness analysis of male Bali cattle aged 2 – 2.5 years fed with CPHF Bio ranged from 3.512 ± 0.443-3.992 ± 0.020 kg/cm^2. Standard of meat tenderness said that: 1-2 kg/cm^2 is classified as very tender, 3-5 kg/cm^2 is classified as tender and more than 5 kg/cm^2 is classified as tough meat (Wheeler *et al*. 2003) in [8]. Referred to this standard guide, the tenderness of Bali cattle based on this study can be classified as tender meat. The results showed that the CPHF Bio feed was able to produce meat with the same tenderness as Bali cattle meat fed with commercial concentrate.

The range of pH of meat (Table 2) shows that pH value is in accordance with isoelectric points which indicates that the regormortis process has ended in the range of pH 5.4 ± 0.351 – 5.8 ± 0.058. There were no significant difference (P> 0.05) of meat pH between treatments. This is probably due to the age of slaughter and the sex of Bali cattle were the same as well as the treatments of livestock before the slaughter were the same, which were fasted for 12 hours so that the cattle are not stressed, and glycogen reserves post mortem are still available and the regormortis process was completely finished. The pH values of the meat from the results of this study are in accordance with the results of the study by [22], namely 5.45 and research by [13] which was 5.6.

The chemical composition of meat is influenced by several factors, such as breed, age, sex and nutritional value of feed. The average chemical composition meat of Bali cattle fed with fermented cocoa pod husk concentrate are presented in Table 3.

Table 3 Meat Composition of Male Bali Cattle Based on Treatment of Feeding CPHCF Bio

Variables	Treatment			P
	CPHCFBio (30%)	**CPHCFBio (40%)**	**CPHCFBio (50%)**	
Water content (%)	74.765±1.931^{b}	75.274±0.166^{ab}	76.834±2.397^{a}	*
Protein content (%)	17.090±1.077^{b}	19.723±0.739^{a}	19.236±1.796^{a}	*
fat content (%)	0.588±0.085	1.579±1.105	0.972±0.119	NS

Ash content (%)	1.181±0.262	1.460±0.409	1.146±0.075	NS

Note : * = Significant, NS = Non Significant

The results of variance analysis showed that the percentage of CPHFBio feed had a significant effect (P<0.05) on water content and protein content of male Bali cattle, and did not significantly (P> 0.05) affect on fat and ash content. Duncan's test results showed that the water content and protein content meat of male Bali cattle are different between the treatment of 30% CPHFBio and 50% CPHFBio. As shown in Table 3, the average of the chemical composition of male Bali cattle based on treatment, starting from water content ranges from 74.765 ± 1.931-76.834 ± 2.397, protein content 17.090 ± 1.077-19.723 ± 0.739%, ash content 1.146 ± 0.075-1.460 ± 0.409 and fat content 0.588 ± 0.085-1.579 ± 1.105%.

Water is the predominant chemical component of meat compared with other chemical components such as protein, fat and ash content. The results of the study indicate that male Bali cattle with up to 50% CPHFBio in feed produce meat with high water content which exceeds the standard of meat water content of 60-70% [24]. Meat that has water content below 80% is still suitable for consumption but must be processed immediately or stored in freezer at low temperature. The high water content of the meat is caused by the male Bali cattle slaughtered at a young age of 2-2.5 years.

The male Bali cattle protein values obtained in this study are still in the range of normal meat protein level, because meat generally has a normal protein range of 16-22% [25]. The highest meat protein (19.723 ± 0.739%) was obtained in the treatment of CPHFBio 40%, followed by the treatment of CPHFBio 50% (19.236 ± 1.796%) and the lowest in the CPHFBio treatment 30% (17.090 ± 1.077%). The level ash of Bali meat is determined by breed. Bali cattle breed Bos Taurus has higher ash content than that of Bos Inducus. Environmental factors especially feed intake and nutrient content, also determine the ash content of meat. The highest ash content of meat was obtained in the treatment of CPHFBio 40% (1.460 ± 0.409%), followed by the treatment of CPHFBio 30% (1.181 ± 0.262%), while the lowest was in the treatment of CPHFBio 50% (1.146 ± 0.075%). The normal standard of beef ash content is 1.30% for BF muscle and 1.44% for LD muscle. Based on normal standards of beef ash content, it can be said that the ash content of the results of this study is normal [20]. The highest fat content of male Bali cattle was achieved at treatment CPHFBio 40% (1.146 ± 0.075%), followed by the treatment of CPHCFBio 50% (0.972 ± 0.119%) and the lowest fat content was in the CPHFBio 30% treatment (0.588 ± 0.085%). These range of fat levels are still below the maximum standard recommended fat content of up to 13% [25]. The fat content in this study tend to be considered as low, due to male Bali cattle being slaughtered at a young age and in accordance with the results of Anjaneyulu *et al*. (2007) cited by [23] whose stated that Bali cattle slaughtered at the age range of 2.5 - 3 years have a fat content of around 1.5%. Young animals have not experienced maximum fat growth. The tissues that develop in young animals are new bone, muscle tissue and then followed by fat tissue [20].

CONCLUSION AND RECOMMENDATION

CONCLUSION

1. The percentage of CPHCFBio has non significant effect (P>0.05) on ADG, feed consumption, feed efficiency, tenderness, pH, fat content and ash content of meat in male Bali cattle, while it has significant effect (P<0.05) on WHC, cooking loss, water content and protein content.
2. The percentage of CPHCFBio plus corn straw can provide ADG of male Bali cattle approximately 0.568-0.594 kg/day.
3. The use of CPHCFBio up to 40% mixed with corn straw as male Bali cattle feed can produce good quality meat, which have high WHC (48.213±1.976%) low cooking loss (36.514 ± 2.978%) and high protein content (19.723 ± 0.739%).

Recommendation

CPHCFBio as male Bali cattle feed can be used as much as 40-50% of the feed.

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