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Evaluating Fermentation of Cacao Seed Waste (*Theobroma cacao* L.) in Feed Toward Consumption of Dry Matter, Crude Protein and Average Daily Gain of Local Sheep Rams

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ABSTRACT

Research on the use of fermented cacao seed skin waste (FCS) was carried out to determine dry matter, crude protein consumption and daily weight gain of local rams. Fifteen local rams aged 1.5 years with an initial body weight ranging from 14-20 kg were used for analyses. The local rams were grouped according to their initial body weight: K1 = 14-16 kg, K2 = 16-18 kg, K3 = 18-20 kg. Variables measured were dry matter and protein consumption, daily weight gain and feed conversion. The research method used a randomized block design. The treatments involved five levels of fermented cocoa FCS. Data analysis involved ANOVA and Duncan's test. The results demonstrated a significant effect on dry matter and crude protein consumption (P <0.01) and of daily weight gain (P<0.05) but no significant effect with respect to feed conversion (P> 0.05). The highest consumption of dry matter and protein in the P1 treatment and the highest daily weight gain for local rams was obtained in the P3 treatment. Hence, it was concluded that fermented cocoa seeds can replace up to 75% of field grass for sheep feed purposes.

Key words: Local rams, Fermented cocoa seeds, Performance of production.

INTRODUCTION

The cocoa plant (*Theobroma cacao* L.), or what we call cocoa, is a plant that is commonly found growing in the tropics. Cocoa (*Theobroma cacao* L.) is a plantation plant that is quite widely developed in Indonesia. Indonesia has a very large plantation area (Umela, 2016). The total area of cocoa plantations in Indonesia reaches 959,000 ha. Cocoa bean skin has not been used optimally and its economic value is low. So far, cocoa bean shells have only been used as animal feed and compost. Cocoa bean bark is a thin, soft and rather slimy skin that surrounds the cocoa bean chip, the percentage ranges from 10-16% of the whole dry cocoa bean (Kamelia and Fathurohman, 2017). Cocoa pod husk is the main waste as a result of cocoa fruit processing which is very potential to be used, including as a source of ruminant animal feed, including for fattening sheep (Fridarti *et al*, 2017).

The main problem in the sheep and goat livestock business is the availability of forage feed which is difficult in the dry season. To reduce the use of forage, alternatives need to be found as a substitution of forage with one of the abundant agricultural wastes, namely the cocoa bean shells. Fresh cocoa bean skin has high protein, lipid, polyphenol and antioxidant content (Lecumberri *et al*, 2007). Some polyphenols have a good effect on health (Ramiro-Puig and Castell, 2009). Report of the Indonesian Institute of Agricultural Technology Assessment (2010) consists of dry matter 88%, crude protein 8%, crude fiber 40.1% and TDN 50.8% (Institute of Agricultural Technology, 2010). Cocoa bean skin as animal feed contains several limiting compounds. Some of these limiting compounds include tannin levels that inhibit glucose absorption, theobromin content of 1.80-2.10%, lignin which is difficult to digest (Nelson and Suparjo, 2011). The results of the research by Sujono *et al* (2019) that the content of antinutrient compounds in the skin of fresh cocoa beans include tannin (0.36%), ADF (35.77%), NDF (71.61%), lignin (15.38%), silica (0.98%) and theobromine (0.589%). The antinutrient content in the skin of tannin fermented cocoa skin was 0.26%, 45.7% ADF levels, 51.72% NDF, 23.74% lignin, 0.67% silica and 0.606% theobromine (Sujono *et al*, 2019). The limit on the use of fresh cocoa skin in livestock can reach 50% of the feed requirements, if over-feeding can disrupt the appearance of livestock production including sheep (Fridarti *et al*, 2017). One way to reduce antinutrients in the skin of cocoa beans is by fermentation using several types of bacterial microbes (Cempaka *et al*, 2014). Fermentation of cocoa bean shells is an important step carried out on the quality of cocoa bean shells that will be produced, because the benefits of fermentation are

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improving the texture of the ingredients and taste (Fridarti, 2013), enhancing digestibility, reducing lignin content, increasing protein content (Fridarti, 2011), suppress the adverse effects of theobromine toxins and increase livestock productivity (Institute of Agricultural Technology, 2010). Fermented cocoa shells have a higher chemical composition than the composition of unfermented cocoa beans. Suparjo *et al*., (2011) stated that fermentation increased the crude protein content of cocoa bean shells to 13.84% or increased by 59.31%, reducing the content of crude fiber (34.36%). The decrease in FCS crude fiber content is caused by the degradation of cell wall components, namely lignin and hemicellulose (Suparjo *et al*, 2011). Rafidah (2016) the content of theobromin compounds in the skins of cocoa can be reduced by milling, drying or fermenting (Rafidah, 2016). This study aims to evaluate the use of fermented cocoa skins (FCS) on the appearance of rams as an effort to substitute forage.

MATERIALS AND METHODS

Material and Tools

Fifteen local sheep rams aged on average 1.5 years were divided into three groups based on the initial body weight:
K1 = 14-16 kg
K2 = 16-18 kg
K3 = 18-20 kg

Each animal was placed in individual cages (1.5 x 0.55 m) equipped with a place to feed and drink water. Randomization was based on grouping body weight from the lightest to the heaviest in each treatment. Maintenance was carried out for 48 days, with feed and environmental adaptation periods prior to treatment to allow sheep to become used to the new feed.

After the adaptation period was complete, the sheep were given feed according to the treatment and drinking water in the morning, afternoon and evening. Fresh feed was given at a level of 10% of body weight. According to Budiman (2006), sheep often require feed as much as 10% of body weight and sometimes up to 2 kg (Budiman, 2006). Feed was given at 08.00 and 15.00 WIB according to the treatment. The remaining feed was weighed after 24 hours the next day prior to feeding was returned and recorded. Sheep body weight was measured once every 14 days during maintenance to avoid stress for sheep.

Feedstuff used in this study consisted of field grass and skin of fermented cocoa seed waste. The nutritional content of fermented cocoa seeds and field grass (%DM) is presented in Table 1.

The research was based on a randomized block design (RBD), with five levels of FCS, namely:
P0 = 100% field grass,
P1 = 75% field grass + 25% (FCS),
P2 = 50% field grass + 50% (FCS),
P3 = 25% field grass + 75% of (FCS),
P4 = 100% of (FCS).
Data analysis: Data were analysed using ANOVA, followed by observed changes in terms of smallest significant differences (LSDs).

RESULTS AND DISCUSSION

Effect of Treatment of Dry Material Consumption

Dry matter intake influences sheep production performance and can be used as an indicator of feed quality (Wijaya *et al*, 2016). Data regarding average consumption of dry ingredients are presented in Fig 1.

The results of variance analysis demonstrated that the treatment had a significant effect (P <0.01) with respect to dry matter consumption. Sheep which were only given field grass (P0) consumed the lowest dry matter of 0.576 kg/ head / day and the highest dry matter consumption was achieved in the P1 treatment of 1.115 kg/head/ day. The dry matter content of field grass is lower than that of fermented cocoa beans. Feed with good composition in terms of nutrition and good palability can increase consumption of

Table 1: Chemical composition of Fermented Cocoa Beans (FCS) and Field Grass (FG) (% DM).

Chemical composition	DM%	CP%	EE%	CF%
FCS[1]	96.57	10.52	4.39	16.31
FCS waste	97.25	10.16	4.24	15.75
FG[2]	24.4	8.2	1.44	31.70

[1]Animal science and nutrition laboratory analysis, [2]IPB PAU laboratory (2015) in Handarini *et al.* (2016).

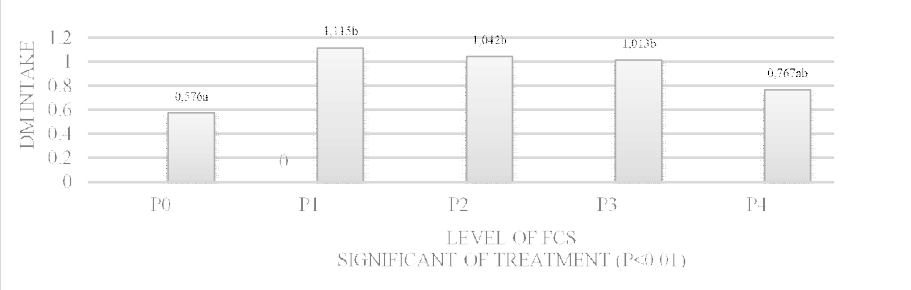

Fig 1: Data regarding average consumption of dry ingredients (kg day^{-1} head^{-1}).

dry feed ingredients (Wijaya *et al*, 2016). Feed is sufficient in protein content and has a fine size structure that can increase the amount of feed consumption (Handarini *et al*, 2016). The physical properties and chemical composition of feed can affect consumption in ruminants. Other factors regarding palatability of feed affecting the level of feed consumption are odour, taste, texture and temperature (Paramita *et al*, 2008). The average consumption of dry matter that consists only of FCB was 100% higher than Suparjo and colleagues' (2011) study with treatment of fermented cocoa pods, concentrates and elephant grass with a dry material consumption of only 434-560 g/head/ day (Suparjo *et al*, 2011). The results of this study are in accordance with the standard daily nutritional requirements for sheep according to the NRC (1985) in Hardianto (2006), stating the daily nutritional requirements for sheep with a body weight of 10-20 kg comprised dry ingredients of 0.5-1 kg or 5% of live weight based on the NRC (1985) in Suparjo *et al*. (2011), with sheep of a body weight of 10-20 kg requiring dry matter of 0.24–0.53 kg / head / day (Hardianto, 2006). According in Wijaya *et al*. (2016), dry matter consumption is influenced by body weight, sex and age of livestock - the higher the body weight, the more feed consumption (Wijaya *et al*, 2016). Male cattle consume more dry ingredients than females and older sheep can consume more feed than young sheep.

Effect of Treatment into Crude Protein Consumption

Protein consumption is closely related to animal body weight gain. Protein is used to fulfil basic life, production and reproduction. The proportion of digested high proteins in the rumen reaches 70-80%, while high and easily digested feed will produce high NH3 concentrations in the rumen (Handarini *et al*, 2016). The average consumption of feed protein during the study is presented in Fig 2.

The results of variance demonstrated that the treatment given had a highly significant effect (P <0.01) on consumption of crude protein. The highest protein consumption was achieved in sheep with treatment P1 (75% FG and 25% FCS) of 228 grams/head/ day and the lowest was in treatment P4 (100% FCS) of 84 grams / head / day). Low protein consumption is caused by low consumption of dry matter and organic matter and lower feed protein content which affects the consumption of less crude protein (Suparjo *et al*, 2011). According in Hardianto (2006), daily nutrition needs for sheep with body weight of 15–20 kg is 127-167 grams CP / head / day (Hardianto, 2006).

The results of the treatment of P0-P3 exceeded the daily requirements: 194-228 grams / head / day. This result can be explained because the treatment given uses two types of field grass feed ingredients and fermented cocoa seed skin, resulting in high quantity, quality and palatability compared to those treatments using single feed (P4). This result is in accordance with the opinion of Wijaya *et al*. (2016) that the quantity and quality of feed consumed by livestock can influence the level of feed nutrient consumption - the higher the quantity and quality of feed, the better nutrient content so that consumption of crude protein is high (Wijaya *et al*, 2016).

P4 treatment does not meet the daily requirements of sheep, which is 84 grams / head / day. The treatment only uses a single feed, CFS, causing low palatability and livestock consuming only a low level of feed so that consumption of crude protein is low. Rafidah (2016) reported that the skin of cocoa beans that have not been processed

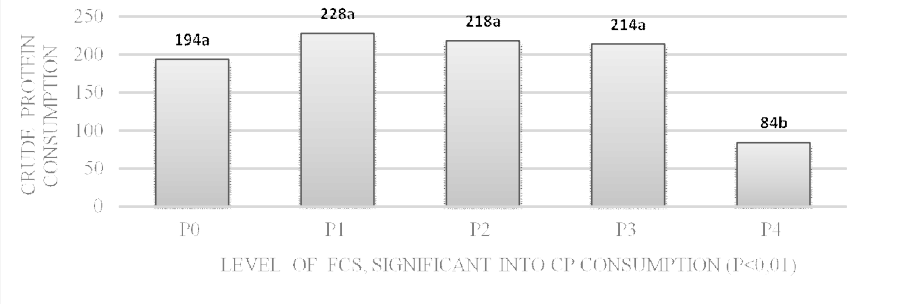

Fig 2: The average consumption of crude protein (g/head/day).

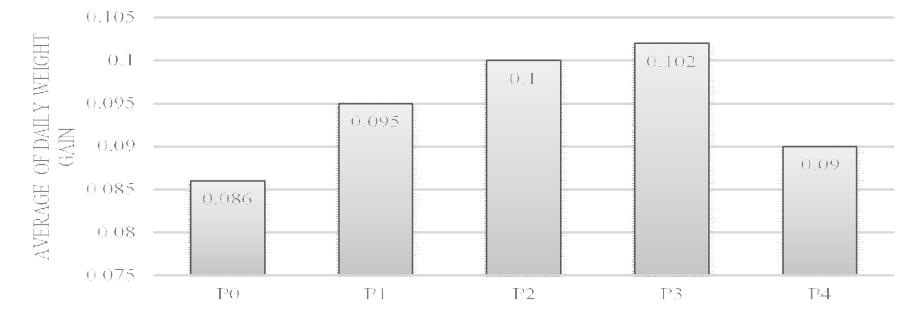

Fig 3: The average results of fat tail sheep weight gain given fermented cacao seed skin feed.

has a nutritional content of *theobromine* compounds of 1.80-2.10 (Rafidah, 2016). Hence, this factor should be restricted in order to not affect livestock production. The limit on the use of fresh cocoa fruit skin in livestock can reach 30-40% of feed requirements (National Directorate General of Plantation, 2011). The limit for giving fresh chocolate fruit skin to ruminants is 35%. The skin of cocoa beans should be fermented first prior to being used as animal feed. The content of *theobromine* compounds on the skin of cocoa seeds can be reduced by grinding and drying (Rafidah, 2016). Cocoa seed skin used in the study was drained and fermented so that feeding in the treatment had no limits. Treating P4 with 100% fermented cocoa seed skin does not have a negative effect on livestock. The skin of cocoa seeds that have been drained in this study led to a decrease in *theobromine* compounds, with an initial level of 1.80-2.10% falling to 0.606% and after fermentation it further decreased to 0.589%. This result provides evidence that processing can result in good feed ingredients, particularly due to the fermentation process. Fermentation of the skin of cocoa seeds reduces the raw fibre of feed, improves the texture of the ingredients and taste, enhances digestibility, reduces lignin content and theobromine compounds and increases protein levels and palatability (Sujono *et al*, 2019). The cocoa seed skin fermentation process in this study used *Trichoderma* fungi by anaerobic fermentation. The fermentation in this study led to changes to the nutrition of feed ingredients because the use of *Trichoderma* fungi provides good fermentation by increasing the protein content to 3% and decreasing crude fibre to 25%. The fermentation process does not have a negative impact on the animals given the treatment of up to 100% fermented cocoa bean skin.

The results of this study are higher than those study by Suparjo *et al*. (2011). Average protein consumption during the study reached 45-72 g / head / day while Hardianto reported an average crude protein consumption per day of each the treatment ranging from 62.76 to 71.03 g / day - this result meets the standard estimate of the adequacy of crude protein requirements (Hardianto, 2006). Consumption of crude protein in sheep in this study is in accordance with NRC standards of 76-137 g / head / day in Wijaya *et al*. (2016) with protein consumption approximately amounting to 77-140 g / head / day. Hardianto stated that feed and crude protein consumption can be influenced by several factors, namely body weight, gender and animal (Hardianto, 2006). The bigger the animal, the more feed consumption; as noted previously, male cattle consume more dry food ingredients than females and older sheep can consume more than young sheep to meet basic life needs and reproduce. The results of each treatment demonstrated that crude protein consumption in this study meets the basic living standards and growth for local sheep rams.

Effect of Treatment on Body Weight Increase

The average results of fat tail sheep weight gain given fermented cacao seed skin feed are presented in Fig 3.

Based on ANOVA analyses, administration of FCS (P1, P2, P3, P4) significantly affected daily body weight gain of sheep. The highest average daily body weight gain was achieved for the P3 treatment of 102 grams / head / day and the lowest for the P treatment of 90 grams/head/day. According to McDonald *et al*., the provision of high-quality feed increases growth rate, while low-quality rations lead to slow growth (McDonald *et al*, 2002). Ericksen and McDonald *et al*. stated that livestock growth will be better if the number of rations consumed is in accordance with livestock requirements (Mc Donald *et al*, 2002; Ericksen, 2007). Although the existence of theobromine limits the use of cocoa seed skin, the amino acid profile of cocoa pods is better compared to oil palm waste so that it can be used as a protein source that can replace grain proteins in animal feed (Oluokun, 2005). Protein consumption is closely related to daily weight gain. Consumption of crude protein from each treatment P0-P4 produced an average daily body weight gain of 86-102 grams / head / day. This result is higher than that reported by Wijaya *et al*. (2011) - a protein consumption of only 77-140 g/head / day and giving an increase of daily body weight gain of 56-58 grams / head / day (Wijaya *et al*, 2016). This result has met the standard estimate of the adequacy of crude protein needs based on body weight to achieve a daily body weight gain of 100 grams / head / day.

CONCLUSION

Based on the results of this study, it can be concluded that:

1. The use of fermented cocoa seed skin has a significant ($P < 0.01$) effect on the consumption of dry matter and protein of local sheep rams.
2. The use of fermented cocoa seed skin has a significant ($P < 0.05$) effect on daily weight gain in local sheep rams.
4. The highest daily weight gain was achieved in treatment P3, namely the use of 75% cocoa seed skin replacing field grass.

REFERENCES

Budiman, H. (2006). Improvement of Feed Management in Sheep Fattening at Level Farmers. National Technical Meeting of Agricultural Functional Personnel. Animal Husbandry Research and Development Center: 31- 35.

Cempaka L, Aliwarga L, Purwo S, Kresnowati MT. (2014). Dynamics of Cocoa Bean Pulp Degradation during Cocoa Bean Fermentation: Effects of Yeast Starter Culture Addition. J. Math. Fund. Sci. 46(1): 14-25.

Ericksen, (2007). The Effect of Feeding on Local-Based Complete Feed Fermentation Against Consumption, Feed Conversion and Feed Cost in Bligon Male Goat. Gadjahmada University, Yogyakarta Journal of Animal Husbandry Bulletin. 39(3): 167 - 173.

Fridarti, N. Jamarun, M. Zain and R.W.S. Ningrat. (2017). The Use of Waste Cacao (*Theobroma Cacao* L) Fermentation as a Substitute for Forage to Cattle Sheep Performance. Scholars Journal of Agriculture and Veterinary Sciences. Sch J Agric Vet Sci. 4(6):230-235.

Fridarti. (2011). Improved Nutrition from Fermented Cacao Porters with Mikroorganime Local Cacao Rind. Ekotrans Scientific Journal. 11(2): 61-65.

Fridarti. (2013). Increased Nutrient Content of Fermented Cacao Rind with Some Level of Inoculum *Basillus Sp*. Journal Tower. 6(39): 79-84.

Handarini. R, D. Sudrajat, A. Prasetyo. (2016). Local Sheep Perfor mance Given Agroindustrial Waste Based Concentrate During Pregnancy. National Seminar and Product Show. Hal 133-142.

Hardianto. Y. W. (2006). Fattening of sheep With Feeding Skin of Soybean waste (*Pulp Tempe*) And Field Grass. Thesis. Bogor Agricultural Institute. Bogor.

Institute of Agricultural Technology, (2010). Fermented Cocoa Skin for Feed Livestock. Institute for Agricultural Technology Assessment. West Sumatra.

Kamelia K and Fathurohman. (2017). Utilization of Fermented Cocoa Skin as Alternative Vegetable Feed Materials and Their Effects on the Growth of Entok (*Cairina muschata*). BIOSFER Journal of Biology Education Tadris. 8(1): 66-77.

Lecumberri, E., R. Mateos, M. Izquierdo-Pulido, P. Ruperez, L. Goya and L. Bravo. (2007). Dietary fibre composition, antioxi dant capacity and physico-chemical properties of a fi bre-rich product from cocoa (*Theobroma cacao* L.). Food Chem. 104:948-954.

McDonald, P., R. Edwards, J. Greenhalgh and C. Morgan. (2002). Animal Nutrition. 6th Edition. Longman Scientific and Technical, New York.

National Directorate General of Plantation. (2011). Fermented Cocoa Skin for Feed Livestock. Institute for Agricultural Technology Assessment. West Sumatra.

Nelson dan Suparjo. (2011). Penentuan Lama Fermentasi Kulit Buah Kakao dengan *Phanerochaete chrysosporium*: valuasi Kualitas Nutrisi Secara Kimiawi. Agrinak Vol 1 No.1.

Oluokun, (2005). Potential and Utilization of Cocoa Fruit Skin as Alternative Animal Feed Ruminants. Wartazoa Journal. Bogor: Vol. 24, Hal 151-159.

Paramita W. L, W. E. Susanto and A.B. Yulianto. (2008). Ingredient Consumption and Digestion Dried and Organic Ingredients at Ongole Cattle Used Haysilage. Veterinary Media. 24 (1): 59-62.

Rafidah. (2016). Nutrient Content of Fermented Cocoa Beans Waste Using Cellulolytic Bacteria with Different Drying Methods. Thesis. Faculty of Animal Husbandry. Hasanuddin University. Makassar.

Ramiro-Puig, E. and Castell M. (2009). Cocoa: Antioxidant and immunomodulator. Br. J. Nutr. 101:931-940.

Sujono, Hidayati A and Yuliati I. (2019). Evaluation of the Nutrition and Anti-Nutrition of the fermentation of Cacao Seed Skins (*Theobroma**cacao* L). International Journal of Science and Research (IJSR) ISSN: 2319-7064.

Suparjo, K. G. Wiryawan, E. B. Laconi and D. Mangunwidjaja. (2011). Goat Performance which is Fermented Cocoa Skin. Animal Husbandry Media. 34(1): 35-41.

Umela S. (2016). Fermented Cocoa (*Theobroma cacao*) Skin as Feed Material Livestock. Jtech. 4(2): 107-115.

Wijaya. G. H, M. Yamin, H. Nuraini and A. Esfandiari. (2016). Pro duction Performance and Metabolic Profile of Garut and Jonggol Sheep Blood Given Bean and Omega-3 Waste. Jurnal Veteriner. 17(2): 246-256.