Utilization of Coconut Pulp as Methane Inhibitor Feed on Meat Quality of Goat

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Abstract. This research was conducted to know the impact of methane reduction in ruminants using coconut pulp as feed substrate on the quality of goat meat. This study used coconut pulp as an antimetanogenic substrate and was added to ruminant feed. There were twenty goats aged ± 1 year. The feed was given with a formulation of 60: 40% forage and concentrate in dry matter with a composition according to the needs of the goats. This research was carried out by treating coconut pulp with four levels of different treatment, namely 5, 10, 15, and 20% and compared with the treatment without using coconut pulp (0%). This experiment used a completely randomized design with four replications. The average difference of treatment was continued with the Duncan Multi Range Test (DMRT) test. The goats were kept for 60 days and they were slaughtered to measure the quality of meat. The variables measured were physical and chemical quality of goat meat. The results showed that the physical quality and the chemical quality of the meat had no significant effect. The conclusion of this research is the use of coconut pulp as an antimethanogenic substrate for goat feed can maintain the physical and chemical quality of meat and reduce meat cholesterol.

Keywords: methane inhibitor feed, coconut pulp, goat, meat

Abstrak. Penelitian ini dilakukan untuk melihat dampak dari penurunan metan pada ruminansia dengan menggunakan pakan mengandung ampas kelapa terhadap kualitas daging kambing. Penelitian ini menggunakan ampas kelapa sebagai substrat antimetanogenik dan ditambahkan pada pakan ruminansia. Ternak kambing sebanyak 20 ekor berumur ± 1 tahun. Pakan diberikan dengan formulasi 60:40% hijauan dan konsentrat berdasarkan bahan kering dengan komposisi sesuai dengan kebutuhan ternak kambing. Penelitian ini dilaksanakan dengan perlakuan ampas kelapa dengan empat level perlakuan yang berbeda yakni 5, 10, 15, dan 20% dan dibandingkan dengan perlakuan tanpa menggunakan ampas kelapa 0%. Percobaan ini menggunakan rancangan acak lengkap dilakukan empat kali ulangan. Perbedaan perlakukan akan dilanjutkan dengan uji Duncan Multi Range Test (DMRT). Pemeliharaan ternak selama 60 hari dan dilanjutkan dengan pemotongan ternak untuk mengukur kualitas daging. Variabel yang diukur terdiri dari kualitas fisik dan kimia daging kambing. Hasil penelitian menunjukkan bahwa kualitas fisik daging dan kualitas kimia daging memberikan pengaruh yang berbeda tidak nyata. Kesimpulan bahwa penggunaan ampas kelapa sebagai substrat antimetanogenik pakan ternak kambing dapat mempertahankan kualitas fisik dan kimia daging serta menurunkan kolesterol daging.

Kata kunci: pakan penghambat metan, ampas kelapa, kambing, daging

Introduction

Animal husbandry has two big challenges, namely how to reduce methane emissions from livestock and how to meet the needs of animal food, which includes the need for animal protein. However, efforts to reduce methane emissions on farms will certainly not interfere with livestock productivity so that the goal of meeting and realizing meat self-sufficiency can be achieved.

Various researches are conducted to reduce methane emissions from livestock. Sondakh et al. (2017) conducted initial research using coconut pulp as a source of medium-chain fatty acids and the results showed that methane emissions can be reduced by 17.38%. The percentage of this reduction is achieved when using coconut pulp of 20% added to the concentrate, with a ratio of forage and concentrate 60%:40%. However, these researches are limited to *in vitro* research. The weakness of *in vitro* research is that the results of production performance resulting from feed consumption are not yet known. Several studies

were conducted on the reduction of methane gas through *in vitro* research, but they cannot describe the actual conditions when the livestock was applied to use antimethanogenic substrate with *in vivo*. The effect of decreasing methane gas production by 17.38% and increasing propionate by 33.8% at the level of 20% coconut pulp through *in vitro* research (Sondakh et al., 2017) is interesting to be researched further to determine the quality of the meat.

The availability of sufficient propionic acid influences the increase of unsaturated fatty acids and the decrease of saturated fatty acids in ruminant meat. This propionic acid can obstruct stearic acid in the rumen (Sondakh et al., 2012a; Sondakh et al., 2017). The formation of saturated fatty acids requires the biohydrogenation mechanism. The hydrogenation process is a change in saturated fatty acids into unsaturated fatty acids (Goiri et al., 2010; Buccioni et al., 2012). Obstacles to the biohydrogenation process in the rumen provide many benefits for ruminants' meat production. Health considerations are always the main focus in consuming meat (Cross et al., 2010; Aulawi, 2013). Optimizing livestock feed coconut dregs-based in producing quality meat products, both physical and chemical qualities, is the target of this research.

Materials and Methods

Research Material

The materials were 20 bucks of goat aged 1 year, weighing about 15 kg. The ration consisted of elephant grass and concentrates with a ratio of 60:40, plus coconut dregs. The treatments of this research were as follows.

Research Methods

This experiment employed coconut pulp supplementation with the following treatments: (R0): 0% coconut pulp; (R1): 5% coconut pulp; (R2): 10% coconut pulp; (R3): 15% coconut pulp and (R4): 20% pulp. Coconut pulp were utilized to partially replace the concentrate. Each treatment was repeated 4 times. For more details, see Table 1.

This research utilized 20 goats with five treatments and three replications. Feed and drinking water were given *ad libitum*. The variables were feed consumption, daily body weight gain, and feed conversion. Observations were made for 2 months. After observing the appearance, the goats were slaughtered and the meat was taken. The parameters were meat quality, a chemical composition consisting of water, protein, fat, and ash content, analyzed proximate (AOAC, 2005); and physical natures, namely pH (AOAC, 2005), water holding capacity (WHC), and cooking losses (Swatland, 1994).

Table 1. Composition of experimental feed ingredients

Variable	Treatment (%)				
	R0	R1	R2	R3	R4
Feed Ingredients (%)					
Forage	60	60	60	60	60
Concentrate	40	35	30	25	20
Coconut pulp	0	5	10	15	20
Nutrient Composition (%)					
Crude protein	17.08	17.65	17. 46	17.28	17.01
Crude fat	5.93	5.07	5.12	5.07	5.27
Crude Fiber	23.27	23.34	23.36	23.29	23.41
Nitrogen free extract	42.34	42.64	43.05	42.35	43.28
Ash	10.46	10.04	10.24	9.84	9.96

Source: Sondakh et al. (2017)

Data Analysis

The data were analyzed using a completely randomized design with five treatments, four times replications subjected to analysis of variance followed by an orthogonal contrast test to see the best treatment Steel and Torrie (1995) with the credibility level of 0.95.

Results and Discussion

Physical Quality of Meat

The physical quality of meat consisting of pH, the WHC, and cooking losses of meat which can be seen in Table 2.

pH Value

The average pH value resulting from the treatment of coconut pulp showed the pH magnitude between 5.82 – 5.94 (Table 2). The analysis of variance revealed that the treatment showed no significant difference (P>0,05). Treatment of coconut pulp up to 20% in feed did not show a change in the pH value of goat meat yet. Arshad et al. (2018) stated that the pH value of meat is more dominantly influenced by meat glycogen. The more meat glycogen, the more lactic acid is formed and result in a low pH. In this research, the feed given to livestock as in Table 1 had almost the same nutrient composition. The balanced composition of the feed between treatments resulted in no significant change in the pH value of the meat. The pH value in this research was relatively the same as stated by Setyaningrum et al. (2015) that the normal pH of meat ranges from 5.51 to 5.78.

Water Holding Capacity (WHC)

The average water holding capacity resulting from the treatment of coconut pulp showed a pH value between 44.68 - 45.66 which can be seen in Table 2. Analysis of variance revealed that the treatment showed no significant difference (P>0, 05). Treatment of coconut pulp up to 20% in feed did not show a change in the WHC of goat meat.

The value of WHC didn't give an effect on goat meat from livestock fed with coconut pulp up to 20% because the pH content was relatively the same. The WHC value is influenced by the pH value of the meat. According to Li et al. (2017), pH and denatured protein affect WHC in meat. Shija et al. (2013), post mortem pH can reduce WHC. The WHC in this research was higher than the WHC of goat meat reported by Aksoy et al. (2019), namely 32.4 - 33.25%.

Cooking Loss

The average cooking loss resulting from the treatment of coconut pulp indicated a value between 44.68 – 45.66 (Table 2). Analysis of variance revealed that the treatment showed no significant difference (P>0,05). Treatment of coconut pulp up to 20% in feed did not show changes in cooking loss of goat meat yet. The cooking loss value obtained in this research was higher as reported by Setyaningrum et al. (2015) that is between 34.18 and 38.05% in goats given fatty acid supplementation with different NaOH content.

Table 2. Average physical quality of the meat in goats given feed containing coconut dregs with different level

Parameter	Treatment				
	R0	R1	R2	R3	R4
pH	5.82	5.80	5.72	5.7	5.74
WHC (%)	45.66	44.68	45.23	44.86	45.18
Cooking losses (%)	31.52	30.84	30.56	31.24	30.53

Information: (R0): 0% coconut pulp; (R1): 5% coconut pulp; (R2): 10% coconut pulp; (R3): 15% coconut pulp and (R4): 20% pulp

Chemical Quality of Meat

The Chemical quality of meat which consisted of water content, meat crude protein, meat crude fat, and meat cholesterol content can be seen in Table 3.

Moisture

The results indicated that the feed treatment using coconut pulp provided the same effect on the water content of the meat. The moisture of goat meat by giving feed containing 0-20% coconut dregs ranged from 72.53 – 73.68%. This moisture was appropriate with the moisture of the meat according to Soeparno (2005) which stated that the moisture of meat ranges from 68 - 75%. Meanwhile, according to Lawrie and Ledward (2014), the moisture of meat ranges from 68 - 80%. Several researchers reported that the moisture of the meat was higher than that in this research, including the research of Aqsa *et al*. (2011) which reported that the moisture of Kacang goat *(C.aegagrus. hircus)* meat was 77.2%, Imam et al. (2016) reported that the moisture of the meat ranged from 75.83-76.40%. According to Berg and Butterfield (1976), differences in moisture in meat can be influenced by environmental factors, age, and genetic conditions. In young goats, the moisture was higher than that in old ones. In this research, there was no real difference in moisture because the livestock used in this research had relatively the same age. Several authors stated that moisture was inversely related to fat content. The high moisture can be affected by the fat content (Lee et al., 2008; Santos et al., 2008; Sondakh et al., 2012a).

Meat Protein

The results showed that the feed treatment using coconut pulp provides the same effect on the crude protein of the meat. Goat meat crude protein with the feed contains 0-20% coconut pulp ranging from 19.36 – 20.75%. This meat protein content was confirmed those according to Soeparno (2005) that the protein content of meat ranges from 16-22%. Likewise, Geay et al. (2001) explained that the protein content of ruminant meat ranged from 17-22%. In more detail, Gama et al. (2020) reported that the protein composition of goat meat was 19.7%, while mutton was 19.4%. In this research, there was no difference in meat composition because the feed given to livestock contains almost the same composition (Table 1) based on the nutrient balance in the treatment.

Crude Fat

The results showed that the feed treatment using coconut pulp provided the same effect (P>0,05) on the crude fat content of the meat. Goat meat crude fat by feeding coconut pulp contains 0-20% is 4.97 – 5.30%. The results of this research were still in the range of meat fat content according to Aberle (2001), i.e., 1,5 - 13%. There was no difference in the fat content of meat originating from livestock fed by coconut pulp because the nutrient content contained in each treatment was relatively the same (Table 1).

Table 3. Average nutrient composition of meat in goats given feed containing coconut dregs with different levels

Parameter	Treatment				
	R0	R1	R2	R3	R4
Moisture (%)	73.21	72.79	72.53	73.68	73.34
Protein (%)	20.42	19.85	20.12	20.75	19.36
Lipid (%)	5.04	5.26	5.11	4.97	5.30
Cholesterol (mg/100g)	78.43^{a}	78.26^{a}	77.36^{ab}	77.63^{a}	76.12^{b}

Information: (R0): 0% coconut pulp; (R1): 5% coconut pulp; (R2): 10% coconut pulp; (R3): 15% coconut pulp and R(4): 20% pulp;The superscript on the same line shows a significant (P<0.05)

In general, muscle activity can increase fat deposition in muscle tissue, while intramuscular fat was largely influenced by heritability factors (Aberle, 2001). Imam et al. (2016) stated that it is suspected that the Kacang goat (C. aegagrus hircus) was unable to store excess consumption of energy and feed protein to be converted into meat fat/marbling. That is why the fat content in this research was relatively low.

Cholesterol Meat

The results revealed that the feed treatment using coconut pulp provided the same effect (P>0,05) on the cholesterol content of the meat. Goat meat cholesterol by feeding coconut pulp contains 0-20% ranging from 76.12 – 78.26 mg / 100 g. There was a decrease in the value of meat cholesterol in livestock that was given feed containing 20% coconut pulp. The decrease in the value of meat cholesterol was suspected because coconut pulp contains a lot of medium-chain fatty acids. According to Machmüller (2006), the medium-chain fatty acids content played an important role in suppressing methane production and increasing propionic acid. This opinion was reinforced by Sondakh et al. (2017) stated that the use of 20% coconut pulp in feed can reduce methane production by 17.38% and increase propionic acid by 33.8% in rumen fermentation *in vitro*. The content of propionic acid in *in vitro* digestibility can describe on digestibility of *in vivo*. Sondakh et al. (2012b) have investigated that the propionic in rumen fermentation given coconut meal as substrate in *in vitro* increased from 3.28 µmol to 4, 08 µmol (increasing of 24%). Likewise, Sondakh et al. (2012a) also continued their *in vivo* research with the composition of feed using coconut meal resulting in an increase in propionic acid from 2.7 µmol to 3.24 µmol, an increase of 20%. Thus, the results of *in vitro* digestibility studies can represent the results of *in vivo* digestibility studies of propionic acid.

Furthermore, Sondakh et al. (2012a) reported that an increase in propionate in rumen fermentation can result in the chemical composition of meat, especially a decrease in saturated fatty acids and an increase in unsaturated fatty acids in meat, and a decrease in meat cholesterol.

Conclusions

The use of coconut pulp as an antimethanogenic substrate for goat feed can maintain the physical and chemical quality of meat and reduce meat cholesterol.

References

AOAC (Association of the Official Analytical Chemist). 2005. Official Methods of Analysis. Ed ke-13. Washington DC.

Aksoy Y, Ü Çiçek, U Şen, E Şirin, M Uğurlu, A Önenç, M Kuran and Z Ulutaş. 2019. Meat production characteristics of Turkish native breeds: II. meat quality, fatty acid, and cholesterol profile of lambs. Arch. Anim. Breed. 62:41–48.

Aqsha GE, E Purbowati and AN Al-Baari. 2011. Komposisi Kimia Daging Kambing Kacang, In: Prosiding Workshop Nasional Diversifikasi Pangan Daging Ruminansia Kecil, Jakarta. Pp:104-109

Arshad MS, M Sohaib, RS Ahmad, MT Nadeem, A Imran, MU Arshad, JH Kwon and Z Amjad. 2018. Ruminant meat flavor influenced by different factors with special reference to fatty acids. Lipids in Health and Disease. 17(1):1-13

Aulawi T. 2013. Hubungan konsumsi daging merah dan gaya hidup terhadap risiko kanker kolon. Kutubkhanah. 16(1): 37-45

Berg RT and RM Butterfield. 1976. New Conceps of Cattle Growth. Stdney University Press. Sydney

Cross AJ, LM Ferrucci, A Risch, BI Graubard, MH Ward, Y Park, AR Hollenbeck, A Schatzkin and R Sinha. 2011. A large prospective study of meat consumption and colorectal cancer risk: an investigation of potential mechanisms underlying this association. Cancer Res. 70(6):2406-2414.

Bouton PE, PV Haris and WR Shorthose. 1976. Factor influencing cooking losses from meat. J. Food Sci. 41:1092 – 1095.

Forest JC, EB Aberle, HB Hedrick, MD Judge and RA Merkel. 1975. Principles of Meat Science. W.H. Freeman and Co. San Fransisco.

Gama KVMF, JM Pereira Filho, RF Soares, MA Cordão, MF Cézar, ASM Batista, AMA Silva, M Madruga, RL Oliveira and LR Bezerra. 2020. Fatty acid, chemical, and tissue composition of meat comparing Santa Inês breed sheep and Boer crossbreed goats submitted to different

supplementation strategies. Tropical animal health and production. 52(2):601-610.

Geay Y, D Bauchart, JF Hocquette and J Culioli. 2001. Effect of nutritional factors on biochemical, structural and metabolic characteristics of muscles in ruminant, consequences on dietetic value and sensorical qualities of meat. Reprod. Nutr. Dev. 41:1-26

Imam K, E Purbowati and R. Adiwinarti. 2016. Komposisi kimia daging kambing kacang jantan yang diberi pakan dengan kualitas berbeda. Animal Agriculture Journal 2(4):23-30

Lawrie RA. 1979. Meat Science 3rd Ed. Perganion Press. Oxford.

Lee JH, B Kouakou and G Kaanan. 2008. Chemical composition and quality characteristics of chevon from goats fed three different post-weaning diets. Small Rumin. Res. 75:177-184

Li Y, J Li, L Zhang, F Gao and G Zhou. 2017. Effects of dietary starch types on growth performance, meat quality and myofibre type of finishing pigs. Meat Science. 131:60–67.

Machmuller A. 2006. Medium chain fatty acids and their potensial to reduce methanogenesis in domestic ruminants. Agric. Ecosyst. Environ. 112:107-114

Santos CL, JRO Perez, CAC da Cruz, JA Muniz, PA Santos and TRV Almeida. 2008. Chemical composition of carcass cuts of Santa Ines and Bergamacia Lambs. Cienc. Technol. Aliment. 28:51-59

Setyaningrum A, S Soeparno, LM Yusiati and K Koestantinah. 2015. Performance and meat quality of thin tailed sheep in supplementary feeding lemuru fish oil protected by saponification with different naoh concentration. Animal Production. 17(3): 177-185

Shija DS, LA Mtenga, AE Kimambo, GH Laswai, DE Mushi, DM Mgheni, AJ Mwilawa, EJM Shirima and JG Safari. 2013. Chemical composition and meat quality attributes of indigenous sheep and goats from traditional production system in Tanzania. Asian-Australasian Journal of Animal Sciences. 26(2):295–302.

Soeparno, 2016. Ilmu dan Teknologi Daging. 2nd edition. Gadjah Mada University Press. Yogyakarta

Sondakh EHB, JAD Kalele, and FS Ratulangi. 2017. The use of coconut pulp as a feed substrate to methanogenesis inhibitor in in vitro rumen fluid fermentation. Journal of the Indonesian Tropical Animal Agriculture. 42(3): 202-209

Sondakh EHB, LM Yusiati, H Hartadi and E Suryanto. 2012a. The effect of methanogenic inhibitor feed on propionic acid and lamb meat chemical quality. Journal of the Indonesian Tropical Animal Agriculture. 37(3): 183-188

Sondakh EHB, LM Yusiati, H Hartadi and E Suryanto. 2012b. Bungkil kelapa sumber medium chain fatty acids dalam pakan ruminansia sebagai agensia penurun gas metan pada fermentasi rumen secara in vitro. Agrinimal. 2(2): 39-43.

Steel RGD and JH Torrie. 1980. Principles and Procedures of Statistics. 1st edition. McGraw-Hill Book Co. Inc. New York.

Swatland HJ. 1984. Structure and Development of Meat Animal. Prentice-Hall Irc. Englewood Cliffs, New Jersey.