Evaluation of Chemical Composition and Lipid Components in Maize Straw based Complete Feed Diets Supplemented by Conden Tannin and Myristic Acid

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Abstract. Although maize straw as an agricultural by products could be used as an alternative feed ingredient for ruminants, its low nutritional value and palatability require an early processing. Supplementation of feed additive that functions as a methane inhibitor. The study was to examine the chemical composition in maize straw based complete feed diets supplemented by conden tannin and myristic acid. The experimental method used a group-randomized trials by ANOVA with 4 dietary treatments and 3 replications. The treatments are T1: Maize Straw Based Complete Rations (Control Diet), T2: Control diet +Mimosa powder (MP) 1,5% /kgDM + Myristic acid (MA)2% /kgDM, T3: Control diet + MP 1,5% /kg DM + MA 3% /kg DM, and T4: Control diet + MP 1,5% /kg DM + MA 4% /kg DM. Proximate and van soest analysis was analysed in the Feed and Nutrition Laboratory, animal Science faculty, Brawijaya University, Malang. The result showed that the maize straw complete feed without supplemented has not different with a chemical compositions Maize straw with 3 level of Conden tannin and myristic acid supplementation. Besides higher EE components contained on T4 which supplemented by CT 1,5 %/kg DM and MA 40 g/kg DM. It can be concluded that CT and MA in Maize Straw based complete feed diets can be used as rumen modifier without effected on chemical component.

1. Introduction
The major constraint in improving ruminant production in Indonesia is discontinuous availability of forage feed throughout the year, particularly in a dry season when the forage sources are limited. Utilization of agricultural by-products is usually practiced to overcome this problem. Agroindustry residues resulting from the processing of plant products, such as meals, seeds, pulps and peels, are generated in large quantities and have the potential to be used to feed animals of zootechnical interest [16]. Alternative sources of energy for livestock, of low commercial value and that do not impair animal performance, such as agroindustry co-products, may represent an increase in competitiveness in the zootechnical activity. However, the level of substitution of such foods has to be assessed, since each ingredient has intrinsic positive and/or negative characteristics. Feed is an absolute necessity that should always be considered in the maintenance of ruminants i.e. cattle, buffaloes, goats and sheep. However, availability feed always be a constraint, especially in the dry season, feed fresh forage difficult to obtain, there are only the remains of plants such as straw. One of them is the maize straw that has excellent potential as a food source, it’s just low quality. To improving the quality and benefits of maize straw will require technology that is easy and simple to do farmer.
Previous studies showed that the use of maize straw as a source of crude fibre can be combined with other feed ingredients with high protein and energy content so that a good nutritional content is obtained or can be called a complete feed. The provision of complete feed is expected to be able to meet the nutritional needs of livestock and can improve business efficiency [5]. Although it is palatable, the fibre content of corn cob silage was high [23], which is potential in producing methane during fermentation in the rumen. Methane emission by ruminants has negative effects on the animal and causes greenhouse effect to the environment. Methane which is an end product of fermentation process of feed is formed through methanogenesis. Methanogenesis cause 2–12% energy loss of the digested energy depending on diet type [10]. Methane emission from enteric fermentation contributes 25% to the total global greenhouse gases from agriculture [15].

These conditions make researchers interested in conducting research to increase the nutritional value of maize-based complete feed as ruminant animal feed and add natural compounds found in plants as feed additives to increase livestock productivity [24], including in reducing methane production [20]. One effort to reduce methane gas production in ruminants is by manipulating feed without disturbing livestock productivity. One method for the process of reducing methane gas in livestock is the addition of compounds into feed such as tannins, saponins, fat administration, organic acids, and inhibitors [8]. Reduction methane emissions have been observed through adding feed additive. Ruminant nutritionists have studied essential oils [3] and dietary lipids [2] as rumen manipulators to improve ruminal fermentation characteristics as well as potential anti-methanogenic feed additives.

2. Materials and Methods

2.1. Collection and Preparation Sample
Maize straw ware procured from research farm laboratory of Faculty of Animal Science, Brawijaya University. This area is located in East Java island Indonesia at an altitude of 506 m above sea level with an average annual rainfall and temperature of 369 mm and 22.7 – 25.1°C, respectively. Myristic acid (99% purity) and Conden tannin ware bought from CV. Sumber Berlian Kimia, Jakarta (Indonesia). Agriculture and agro-industrial by-products for composition of total mixed rations were purchased from a feedstuff supplier in Malang city. The samples were oven dried at 50°C for 48 h then ground to pass through a 2.0 mm sieve. The dry samples were further ground to pass through a 1.0 mm sieve for the in vitro gas production experiments and chemical analysis. DM of feed component was determined by drying at 100 °C, organic matter by ashing at 550°C for 4h and crude protein by the Kjeldahl technique [1]. The acid detergent fibre (ADF) and neutral detergent fibre (NDF) content were determined according to [22]. All chemical analyses were carried out in triplicate. The experimental method used a group-randomized trials by ANOVA with 4 dietary treatments and 3 replications. The experimental diets were:
• T1: Maize Straw Based Complete Rations (Control Diet)
• T2: Control diet + Mimosa powder (MP) 1.5% /kgDM + Myristic acid (MA) 2% /kgDM
• T3: Control diet + MP 1.5% /kg DM + MA 3% /kg DM
• T4: Control diet + MP 1.5% /kg DM + MA 4% /kg DM

2.2. Chemical Analysis

Chemical analysis used in this research was a proximate analysis, consisting of analysis of proteins, fats, water and ash. The all of methods of proximate analysis used in this study are according to the procedure of Association of Analytical Communities [1]. The Carbohydrate content was analysis using calculations: 100 - (protein + fat + ash content). Gross energy was analysis using calculation: Gross energy (Kcal/100g) = (protein% x 4) + (fat% x 9) + (carbohydrate% x 4) [11].

3. Results

Based on the results of the research on the chemical maize straw based complete feed diets supplemented by conden tannin and myristic acid were obtained the following data on table 1.

| No | Component                                      | DM    | OM*   | CP*   | CF*   | EE*   | NFE* |
|----|------------------------------------------------|-------|-------|-------|-------|-------|------|
| 1  | Maize straw (Zea mays)                         | 60.31 | 89.83 | 5.13  | 36.43 | 0.63  | 47.64|
| 3  | Coffee waste (Coffea arabica)                  | 94.14 | 89.42 | 10.11 | 34.00 | 1.49  | 43.82|
| 4  | Rice bran (Oryza sativa L)                     | 90.63 | 87.40 | 10.15 | 16.20 | 13.00 | 48.05|
| 5  | Tapioca by-Product (Manihot esculenta)         | 92.59 | 82.87 | 1.76  | 25.39 | 0.44  | 55.28|
| 6  | Soybean Meal (Glycine max)                     | 93.53 | 91.62 | 47.53 | 4.04  | 2.57  | 37.48|
| 7  | Palm kernel meal (Elaeis guineensis Jacq.)     | 95.39 | 94.97 | 14.24 | 20.91 | 10.01 | 49.81|
| 8  | Copra Meal (Cocos nucifera L.)                 | 95.69 | 92.23 | 22.12 | 21.78 | 2.45  | 45.88|
| 9  | Urea                                           | 99.88 | 99.93 | 244.60| -     | -     | -    |
| 10 | Molasse                                        | 78.47 | 84.56 | 4.54  | -     | -     | -    |

**Table 1.** Chemical composition of the feeds used during the experiment.

Chemical composition of chemical treated and untreated - maize straw

|     | T1    | T2    | T3    | T4    |
|-----|-------|-------|-------|-------|
| DM  | 93.44 | 93.82 | 93.53 | 93.78 |
| OM  | 90.09 | 90.38 | 90.57 | 90.55 |
| CP  | 16.18 | 15.59 | 13.79 | 14.09 |
| EE  | 24.00 | 24.53 | 24.60 | 24.90 |
| NFE | 46.97 | 46.19 | 46.74 | 44.44 |

**Keterangan:** - Analysis results at the Laboratory of Nutrition and Animal Feed Faculty of Animal Science, Brawijaya University (2019)

- *100% DM Basis

Data in table 1. showed that DM of treatment feed content of ranged from 93.44% to 93.82%, whilst DM content of complete feed component ranged from 60.31% to 99.88%. Regarding the crude protein content of maize straw, the relatively low protein content can be corrected by a combination of protein and mineral feed ingredients. However, the selection of protein sources must pay attention to the characteristics of the protein source to be used in addition to considering the price of feed ingredients to be easily affordable [14]. The use of maize straw as ruminant animal feed requires supplementation of energy and protein feed sources, because of its low quality [21]. Nutrient supplementation both energy and protein together is intended for optimization of microbial growth so that the utilization of fibrous feed can be optimized.
The crude protein content (CP) in the complete treatment of maize straw-based feed can be seen in the tables in P1, P2, P3, and P4 respectively 16.18%, 15.59%, 13.79%, and 14.09%. Crude protein in complete feed is adjusted by NRC [13], which is the feed for beef cattle fattening in 13%. Maize straw has a low PK which can be seen in the table that is equal to 5.13% so that in this study corn grain is treated as complete feed. The processing of maize straw as a complete feed is intended as a feed that is sufficient nutrition for certain animals in a certain physiological level. Complete feed is formed or mixed to be given as sole food and is capable of caring for the basic life or production (or both) of livestock without the addition of other substances except water [23].

In this study, maize straw is a source of fibre feed ingredients with additional other feed ingredients as a supplement to the lack of nutrients. The largest group of methane gas-producing feedstuffs is the forage of fibre sources, then followed by the forage of protein sources and the constituent feed ingredients. Selection of feed ingredients with various types can also be done in the activity of formulating complete feed in an effort to reduce methane emissions from livestock [22]. The crude fat content of CF in each treatment also showed a quite noticeable difference (table 1) with the highest value at P4 7.12% and the lowest at P1 2.94%. This difference in crude fat content correlates with the addition of myristic acid levels in the treatment. Myristic acid (myristic acid) or tetra decanoic acid is a saturated fatty acid composed of 14 atoms of C. In the study of Soliva Supplementation of Mystic acid in dairy cattle feed can increase fat in milk [20].

4. Conclusion

Based on the results of the study, it can be concluded that the higher fat components contained on T4 which supplemented by CT 1.5 %/kg DM and MA 40 g/kg DM. It can be concluded that CT and MA in Maize Straw based complete feed diets can be used as rumen modifier without effected on chemical component.

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References

[1] AOAC 2012 Official Methods of Analysis of AOAC International. 19th Ed., Latimer G. W. (edit). Gaithersburg, Md Publisher.
[2] Beauchemin K A, S M McGinn and H V Petit 2007 Methane abatement strategies for cattle: lipid supplementation of diets Canadian Journal Anim. Sci.
[3] Calsamiglia S, M Busquet, P W Cardozo, L Castillejos and A Ferret 2007 Invited review: Essential oils as modifiers of rumen microbial fermentation Journal Dairy Science.
[4] Dohme F, Machmüller A, Wasserfallen A, Kreuzer M. Comparative efficiency of various fats rich in medium-chain fatty acids to suppress ruminal methanogenesis as measured with RUSITEC. Canadian Journal of Animal Science. 2000;80(3):473–482.
[5] Gustiani E, dan Permadi K 2015 Study on Productivity of PO Cattle Provided by Complete Feed Containing Fermented Corn-Cobs in Majalengka District, West Java.Jurnal Peternakan Indonesia, Februari 2015 Vol 17 (1) ISSN 1907-1760
[6] Henderson, C 1973 The effect of fatty acids on pure cultures of rumen bacteria. Journal of Agricultural Science 81, 107–112.
[7] Hess BW, Moss GE, Rule DC 2008 A decade of developments in the area of fat supplementation research with beef cattle and sheep. J Anim Sci. 86:E188-E204.
[8] Hook S E, Wright A D G, McBride B W 2010 Methanogens: methane producers of the rumen and mitigation strategies, Archaea 1-11.
[9] Jayanegara A, Sofyan A 2008 Determination of biological tannin activity in some forages in vitro using the 'Hohenheim Gas Test' with polyethylene glycol as a determinant, *Med. Pet.* 31(1) 44-52.

[10] Johnson K A, Johnson D E 1995 Methane emissions from cattle, *Journal Animal Sci.* 73(8) 2483-92.

[11] Jurgens M H, Bregendahl K 2007 *Animal Feeding and Nutrition.* 10th Ed Kendall/Hunt Publishing Company, Iowa, USA.

[12] Makkar H P S, Francis G, Becker K 2007 Bioactivity of phytochemicals in some lesser known plants and their effects and potential applications in livestock and aquaculture production systems, *Animal* 1 1371-91.

[13] National Research Council 1996 Nutrient requirements of beef cattle. Fifth Revised Edition. National Academy of Science. Washington DC.

[14] Natsir A 2012 Efficient Utilization of Fibre for Ruminants. Masagena Press.

[15] Olivier J G J, van Aardenne J A, Dentener F, Ganzeveld L, Peters J A H W 2005 Recent trends in global greenhouse gas emissions: Regional trends and spatial distribution of key sources, In A. van Amstel (Ed.) Non-CO2 Greenhouse Gases (NCGG-4) 325-30.

[16] Prado I N, Moreira F B 2002 Supplementation of moringa in the pasture and alternative feeds used in cattle farming PR: Eduem.

[17] Sahoo A, Singh B and Bhat T K 2010: Effect of tannins on in vitro ruminal protein degradability of various tree forages. *Livestock Research for Rural Development.* Volume 22, Article 119. Retrieved December 7, 2019, from http://www.lrrd.org/lrrd22/7/saho22119.htm.

[18] Siregar H A, Rahmadi H Y, Wening S, dan Suprianto E 2018 Composition of Fatty Acid and Carotene of Oil Palm Elaeis Oleifera, Interspecific Hybrid, and the First Pseudo-Backcross in North Sumatra INDONESIA J Pen Kelapa Sawit 26(2): 91-101.

[19] Sitoresmi P D, Mira L Y, dan Hartadi H 2009 Effects of Addition of Coconut Oil, Sunflower Seed Oil, and Palm Oil to the Decrease of Methane Production in the Rumen *In vitro*.* Buletin Peternakan* 33(2) 96-105.

[20] Soliva CR, Hindrichsen IK, Meile, L, Kreuzer M, Machmüller A 2003 Effects of mixtures of lauric and myristic acid on rumen methanogens and methanogenesis in vitro Lett Appl. Microbiol 37 35–39.

[21] Suhartanto B, Widyobroto B P, dan R Utomo 2003 Production of complete feed (complete feed) and supplementation of undegraded protein to increase production and quality of beef. Research institutions of Universitas Gadjah Mada. Yogyakarta.

[22] Van Soest P.J., Robertson J.D. and Lewis B.A. 1991 Methods for dietary fibre, neutral detergent fibre and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74, 3583-3597.

[23] Widiawati Y, Puastuti W, dan Yulistiani D 2017 Profile Of Methanic Gas From Ruminansia Raw Feed Materials. Proceedings of the Livestock Technology and Agribusiness Seminar V: Livestock Technology and Agribusiness to Support Food Security, Faculty of Animal Husbandry Universitas Jenderal Soedirman.

[24] Yulianti D L, Permata Ika Hidayati P I, dan Shodiq A 2018 Complete Feed Formulation (Complete Feed) Based on Agricultural Waste as Goat Animal Feed in Kromengan District, Malang Regency. *JPM (Journal of Community Empowerment)* 3(1).