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Combination Effect of Nutritech Feed Additive Containing Saponin, Tanin and Eugenol Essential Oils on *in Vivo* Rumen Methane Production in Dairy Cattle Using Open Circuit Respiration Chamber Technique

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Abstract

Diet manipulation containing feed additive for reducing enteric methane emission of ruminant had been an interesting focus since the GHG's emission of livestock was reported increasing. Saponin, tannin and eugenol had been selected when they have a good effect for rumen methane gas reduction. There is no more information for combination between saponin, tannin and eugenol which was tested for rumen methane reduction, especially in vivo dairy cattle methane gas production assessment. Therefore, this study was carried out to evaluate the effect of combination of saponin-containing *H. Rosa sinensis* leaf, tannin-containing tea waste and eugenol-containing clove oil on in vivo rumen methane production assessment in dairy cattle using open circuit respiration chamber technique. The combination was mixed in one feed additive, Nutritech-BPPT. The treatments were R1: control ration (60% forage + 40% concentrate), R2: R1 + nutritech 100 mg/kg of body weight, R3: R1 + nutritech 150 mg/kg of body weight and R4: R1 + nutritech 200 mg/kg of body weight, which were assigned and analyzed in latin square design (4x4). Four dairy cows and four heifers Fries Holland (PFH) were used for in vivo rumen methane production assessment using open respiration chamber technique (MARS-Sable System International). The results indicated that supplementation of nutritech-BPPT reduce methane production from dairy cattle 14.96%, 25.41% and 34.92% after supplementation 200 mg/Kg BW, 100 mg/Kg BW and 150 mg/Kg BW of nutritech, respectively. The combination between saponin, tannin and eugenol essential oil in Nutritech was formulated as an optimum composition after in vitro test and their effect revealed that saponin, tannin and clove oils were no effect on in vitro rumen digestibility. Clove essential oil also may have strong microbial activity from their active component (eugenol). Eugenol is main component of clove oil which its composition was very high more than 90% in clove oil for this study. In conclusion, Nutritech containing saponin, tannin and eugenol essential oil could be used as feed additive for rumen methane reduction in dairy cattle.

Keyword: dairy, eugenol, methane, saponin, tannin

Introduction

Diet manipulation containing feed additive for reducing enteric methane emission of ruminant had been an interesting focus since the GHG's emission of livestock was reported increasing. Saponin, tannin and eugenol had been selected when they have a good effect for rumen methane gas reduction. There is no more information for combination between saponin, tannin and eugenol which was tested for rumen methane reduction, especially in vivo dairy cattle methane gas production assessment. Therefore, this study was carried out to evaluate the effect of combination of saponin-containing *H. Rosa sinensis* leaf, tannin-containing tea waste and eugenol-containing clove oil on in vivo rumen methane production assessment in dairy cattle using open circuit respiration chamber technique

Open circuit respiration chamber technique is one method for determine methane emission from ruminant. In the open-circuit respirometry chamber, outside air is supplied to the chamber continuously and chamber air is removed (Soliva and Hess, 2007). Measuring CH₄ emission from enteric fermentation using open-circuit respirometry chamber was reported has similar values Dry matter intake (DMI) and Methane production by grazing cattle to those obtained using a micrometeorological dispersion model (Tomkins et al., 2011). Rumen modification strategies by diet manipulation using supplementation oils and plant secondary active compound also has been assessed by some researcher (Patra, et al., 2011; calsamiglia et al., 2007 and Gorgulu et al., 2010). Their report was variation between animal, plant bioactive compounds, measurement technique and doses.

Eugenol is a member of the [phenylpropanoids](#) class of chemical compounds as a major component of clove oils. Tannins is major component of tea and saponin is a major component of *Hibiscus rosasinensis* leaf plant. They are abundant available in Indonesia and could be effectively is used as feed additive ingredient for ruminant. Their capacity in reducing methane from ruminant was reported well. Combination strategies between some plant bioactive may result in additive and/or synergistic effects that may enhance efficiency of rumen microbial fermentation and nutrient utilization in ruminants. There was antagonistic effect of combination between clove oil and orange peel oil 1.8 g/d on in vivo and in vitro rumen methane production (ml/gDM and g/DMI) (Rofiq et al., 2014) but synergic effect of combination between clove oil and cinnamaldehyde. Hence, their doses for combination is required in rumen methane reduction and feed efficiency. There is no more information for combination between saponin, tannin and eugenol which was tested for rumen methane reduction, especially in vivo dairy cattle methane gas production assessment. Therefore, this study was carried out to evaluate the effect of combination of saponin-containing *H. Rosa sinensis* leaf, tannin-containing tea waste and eugenol-containing clove oil on in vivo rumen methane production assessment in dairy cattle using open circuit respiration chamber technique. Nutritech-BPPT is a feed additive containing saponin, tannin and eugenol feed Additive containing saponin, tannin and eugenol.

Materials and Methods

Four heifers Fries Holland (PFH) were used for in vivo rumen methane production assessment using open respiration chamber technique (MARS-Sable System International). They fed total mixed ration as a control ration (60% forage + 40% concentrate) with Nutritech-BPPT feed additive as a treatment for this experiment. Nutritech-BPPT is a feed additive containing 6% saponin, 40% tannin and 0.8 % eugenol of nutritech. The treatments were R1: control ration (60% forage + 40% concentrate), R2: R1 + nutritech 100 mg/kg of body weight, R3: R1 + nutritech 150 mg/kg of body weight and R4: R1+ nutritech 200 mg/kg of body weight, which were assigned and analyzed in latin square design (4x4).

Rumen methane production from heifers were measured by open respiration chamber technique. After treatments with Nutritech supplementation, animals were located in open circuit respiratory chamber for 5 days (3 days for chamber adaptation and 2 days respiration measurements). Respiration measurements using MARS Sable System USA^(R), an open circuit respiratory system for measuring gas containing in gas respiration, pressure and flow. Chamber with close head animal keep gas respiration near animals head that would took by pump flow meter via plumbing. The gas from flow meter is filtered into the scrubber and gas dryer before entre to gas analyser. There are 2 chambers for 2 treatments which were automatically arranged by Intelligent Multiplexer (RM8) for changing measurements between chamber and baseline measurement. The gas analyser reads gas contains (CH₄, O₂, and CO₂) as percentage gas composition. It would be read by computer with acquisition program Expedata Software and the result of gas contains could be reported with graph and data sheet.

Results and Discussion

Result showed that supplementation of nutritech-BPPT reduce methane production from dairy cattle 25.41%, 34.92% and 14.96% after supplementation 100 mg/Kg BW, 150 mg/Kg BW and 200 mg/Kg BW of nutritech, respectively (Table 1). Combination effect between tannin, eugenol and saponine was effective at 150 mg doses of Nutritech.

Supplementation 100 mg of Nutritech Combination effect might give specific function of tannin, eugenol and saponine. Tannin and saponin are reported could reduce rumen protozoa and reduce methanogen bacteria, indirectly. Eugenol has strong antimicrobial could reduce some microbes inside rumen. Eugenol reduced rumen pH and Methane production (Patra, 2009), N-NH₃ (Bach et al., 2005), increased propionic acid (Kung et al., 2008) and reduced butyric and acetic acid. Eugenol also reported that methane reducing 60-70% by feeding with clove oils (Patra, 2009). Its capability for decreasing methane is still need further research with some doses.

Table 1. Methane production of dairy cattle with Nutritech supplementation

Parameters	R1	R2	R3	R4
Dry matter intake				
DMI (Kg/d)	4.20 ± 0.26	4.12 ± 0.36	4.12 ± 0.15	4.07 ± 0.41
DMI (g/Kg BW)	182.19 ± 35.90	243.53 ± 53.59	279.92 ± 68.71	212.15 ± 51.09
Methan as measured				
CH ₄ (L/d/head)	155.02 ± 24.51 ^c	114.06 ± 31.38 ^b	99.17 ± 24.97 ^a	128.03 ± 33.97 ^b
CH ₄ (g/d/head)	99.37 ± 15.71 ^c	73.11 ± 21.12 ^b	63.57 ± 16.01 ^a	82.07 ± 21.77 ^b
CH ₄ (g/kg DMI)	23.68 ± 45.08 ^c	17.66 ± 4.49 ^b	15.41 ± 3.77 ^a	20.13 ± 5.27 ^b
Methane predicted				
CH ₄ (g/d) ¹	114.57 ± 1.60	113.52 ± 2.25	113.44 ± 0.94	112.85 ± 2.55
CH ₄ (g/d) ²	116.01 ± 4.21	113.24 ± 5.92	113.02 ± 2.48	111.47 ± 6.71

R1 = Control Feed (60% Grass 40% concentrated Feed), R2 = R1+100 mg/Kg BW, R3 = R1+150 mg Nutritech/kg BW, R4 = R1+400 mg Nutritech/Kg BW, DMI = dry matter intake, CH₄(g/d)¹ =Ellis et al (2007), CH₄(g/d)² =Kurihara (1999)

Compare value of methane production between methane as measured with methane prediction was not similar. Methane production estimation was higher than methane production as open respirometry chamber measurement. The estimation used dry matter intake of ruminant with combine database of beef and dairy database (Ellis, 2007) was over estimation for open respirometry chamber technique.

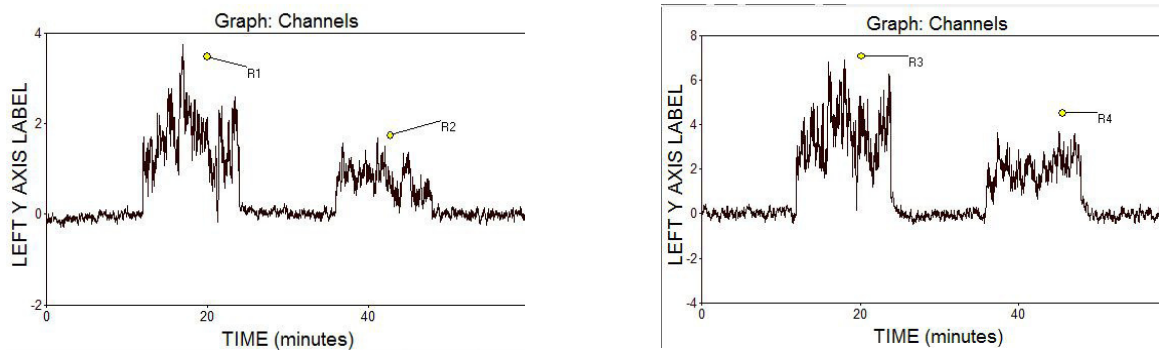


Figure 1. Methane production graph using Sable system MARS respiration measurement

Conclusion

Supplementation of Nutritech containing saponin, tannin and eugenol could reduce methane by dairy cattle. Encapsulation of Nutritech as supplement for reduce methane by dairy goat could be used in future experiments.

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References

- Animut G, R Puchala, AL Goetsch, AK Patra, T Sahlu, VH Varel, J Wells. 2008. Methane emission by goats consuming diets with different levels of condensed tannins from lespedeza. *Anim. Feed Sci. and Tech.* 144, 212–227
- Bach A, S Calsamiglia, MD Stern. 2005. Nitrogen metabolism in the rumen. *J. Dairy Sc.* 88(E. Suppl.):9-21.
- Bodas R, N Prieto, R Garcia-Gonzales, S Andres, FJ Giraldes, S Lopez. 2012. Manipulation of rumen fermentation and methane production with plant secondary metabolites. *Anim. Feed Sci. and tech.* 176 : 78-93
- Calsamiglia S, M Busquet, PW Cardozo, L Castillejos, Ferret. 2007. Essential Oils for modifying rumen fermentation : A review, *J. Dairy Sci.* 90:2580-2595
- Ellis JL, Kebreab E, Ddongo NE, McBride BW, Okine EK, France J. 2007. Prediction of methane production from dairy and beef cattle. *J. dairy. Sci.* 90. 3456-3467

- Gorgulu M, F Özogul, E Yildiz. 2010. Bazı Bitki Uçucu Yağlarının Enerji, Protein ve Lif Kaynağı Yemlerde in vitro Gerçek Kuru Madde, Ham Protein ve NDF Sindirilebilirliğine ve Yüksek Verimli Süt Sığırlarında Süt Verimi ve Süt Kompozisyonlarına Etkileri. Final Report Project No. 1070822. TUBITAK.
- Kung L, Williams P, Schmidt RJ, Hu W. 2008. A Blend of Essentials Oils Used an Additive to Alter Silage Fermentation or Used as a feed Additive for Lactating Dairy Cows. J. Dairy Sci., 91:4793-4800
- Kurihara M, Magner T, Hunter R, McCrabb G. 1999. Methane production and energy partition of cattle in the tropics. Br. J. Nutr. 81. 227-234
- Pandima DK, SA Nisha, R Sakthivel, SK Pandian. 2010. Eugenol (an essential oil of clove) acts as an antibacterial agent against *Salmonella typhi* by disrupting the cellular membrane. J. of Ethnopharmacology. 130 : 107-115.
- Patra AK, J Saxena. 2009. Dietary phytochemicals as rumen modifiers : a rview of the effects on microbial population. J. Antonie van Leewenhock. 96:363-375. Springer.
- Patra AK. 2011. Effects of Essential Oils on Rumen Fermentation, Microbial
- SABLE SYSTEM INTERNATIONAL CO. 2007. Respirometry System Measurements. <http://www.sablesys.com/index.php>. Las Vegas.
- Soliva CR, HD Hess. 2007. Measuring methane emission of ruminants by in vitro and in vivo techniques. H.P. Makkar and P.E. Veorcoe (eds.) Measuring methane production from ruminants, 15-31. IAEA
- Tomkins NW, SM McGinn, DA Turner, E Charmley. 2011. Comparison of open-circuit respiration chambers with a micrometeorological method for determining methane emissions from beef cattle grazing a tropical pasture. Anim. Feed. Sci. tech. 167 : 240 - 247