Proc. 41st Conf. Nig. Soc. for Ani. Prod. 20-24 March, 2016. Federal University of Agriculture, Abeokuta, Ogun State, Nigeria

EFFECT OF AMMONIUM SULPHATE SUPPLEMENTATION ON METHANE PRODUCTION USING AN IN-VITRO GAS PRODUCTION TECHNIQUE

***Akinlade, A.T. and Ososanya, T.O.**
*Department of Animal Science, University of Ibadan, Ibadan, Nigeria*Corresponding e-mail: topes1725@yahoo.com, Tel.:+234 08034425735*

Abstract
The effect of ammonium sulphate on methane production was evaluated using an in-vitro gas production technique. A total of sixteen (16) West African Dwarf (WAD) rams weighing 12.8±0.12kg were assigned to diets containing 0.00, 0.25, 0.50 and 0.75 % levels of ammonium sulphate and defined as T1, T2, T3 and T4 respectively. In a completely randomized design, each ram was fed 5 % body weight of the diet and wilted guinea grass in a 60:40 ratio for 105 days. At the end of the feeding trial, rumen liquor was collected from the sheep. The rumen liquor collected from rams within the same treatment was mixed together. During the incubation, the gas production was recorded at 0, 2, 4, 6, 8, 10, 12, 18 and 24hr. The results revealed that increased levels of ammonium sulphate decreased methane production and increase gas production. Although, the sum of ammonium sulphate did not differ among treatments, incubation at 24hr was greatly appreciated by 0.75% $(NH_4)_2SO_4$ (4.50ml). In addition, $(NH_4)_2SO_4$ led to the highest IVDMD. Therefore, this study suggested that, $(NH_4)_2SO_4$ at 0.75% in the diet have the potential to reduce methane emission.

Keywords: Ammonium sulphate, in-vitro gas production, methane production, rumen liqour, WADsheep

Introduction
Methane (CH_4) is a greenhouse gas that has been implicated in contributing to global warming 14.3% of total anthropogenic CH_4 in 2005 to global warming (IPCC, 2007). Globally, ruminant livestock produces approximately 80 million tones of CH_4 annually, accounting for approximately 28% of anthropogenic emissions of CH_4 (Beauchemin *et al.*, 2008). Ruminant nutritionists have been looking for several alternative methods to reduce CH_4 production in the rumen.

Methanogenesis can be reversed by using sulfate as the terminal electron acceptor. Moreover, sulfate reducing bacteria compete with methanogenic archaeafor H_2 when sulfate is presented. According to the report by Raskin *et al.*, (1996) who found that CH_4 production decreased immediately following the addition of sulfate. However, the most important thing to be aware of regarding sulfate-containing compound is optimum levels in the diet. Low ruminal sulfur concentration can also depress microbial growth (Baland Ozturk, 2006). Despite this, there have been a lot of investigations on using various sulfate-containing compounds for improving performance and health of ruminants.

Methane production in the rumen is a nutritionally wasteful process which represents 2 to 15% feed energy loss (Moss, 1993). Therefore, the objective of this research was to investigate the effect of ammonium sulfate supplementation in ruminant diet on methane (CH_4) production by using an in-vitro gas production technique.

Materials And Methods
The study was conducted in sheep unit of the Teaching and Research Farm, University of Ibadan, Nigeria. The plastic syringes containing the substrates were placed inside the incubator at 38°-39°C an hour before incubation started. The gas produced was read by measuring the space formed between the top of piston and the liquid in the syringe. Data collected were subjected to Analysis of Variance (ANOVA) using Statistical Analysis SystemSAS(1999).

Results And Discussion
The results showed that significant ($P<0.05$) increases were observed in gas production at all incubation hours except at 4 hour. The 0.25% $(NH_4)_2SO_4$diet had the lowest value while those containing 0.75% $(NH_4)_2SO_4$ recorded thehighest value of gas production. The gas production at 24 hoursranged between 2.60 mL for 0.25% $(NH_4)_2SO_4$ and 4.50mLfor 0.75% $(NH_4)_2SO_4$. Gas production emanates of all the nutrients fermented, soluble as well as insoluble; and non fermentable fractions contribute to gas production. The in-vitro gas production system helps to better qualify nutrients utilization, and its accuracy in describing digestibility in animals has been validated in numerous experiments (Getachew *et al.*, 2004).

Table 1: Gross compostion of experimental diet (% DM)

Ingredients	T1	T2	T3	T4
Ammonium Sulphate $(NH_4)_2SO_4$	0.00	0.25	0.50	0.75
Urea $(NH_2)_2CO$	1.00	1.00	1.00	1.00
Dry Cassava Peel	60.00	60.00	60.00	60.00
Brewers Dry Grain (BDG)	23.00	23.00	23.00	23.00
Palm Kernel Cake (PKC)	10.00	10.00	1.00	10.00
Dicalcium Phosphate (DCP)	1.00	1.00	1.00	1.00
Oyster Shell (OS)	2.00	2.00	2.00	2.00
Salt (Nacl)	2.00	2.00	2.00	2.00
Premix (Growers)	10.00	1.00	1.00	1.00
Total	**100.00**	**100.25**	**100.50**	**100.75**

T1: 0.00% $(NH_4)_2SO_4$, T2: 0.25% $(NH_4)_2SO_4$, T3: 0.50% $(NH_4)_2SO_4$, T4: 0.75% $(NH_4)_2SO_4$

Significant ($P<0.05$) differences were observed in in-vitro dry matter degradability (IVDMD) and methane production. The methane production was higher in feed containing **0.00% $(NH_4)_2SO_4$** (4.50mL/200g DM) and lowest ($P<0.05$) in feed containing **0.75% $(NH_4)_2SO_4$** (2.60mL/200g DM). The lowest ($P<0.05$) short chain fatty acid (0.12

Table 2: Rumen fermentation kinetics of wad rams fed ammonium sulphate supplemented diets

Parameter	T1	T2	T3	T4	SEM
a	1.00	1.25	1.50	1.75	0.12
B	6.38	6.50	7.25	7.50	1.28
a+b	7.38^d	7.75^c	8.75^b	9.25^a	0.40
C	0.07^d	0.10^c	0.53^b	0.96^a	1.31
T	18.50^d	19.50^c	20.50^b	21.50^a	3.17
Y	3.00	3.25	3.50	3.75	0.46
24 hr GV	2.60^d	3.60^c	4.00^b	4.50^a	0.03
CH_4 (ml/200mgDM)	3.00^a	2.50^c	2.00^b	1.50^d	0.18
IVDMD (%)	30.02^d	33.34^c	38.76^b	45.00^a	1.10
SCFA (µmol)	0.05	0.08	0.09	0.10	0.03
ME (MJ/kgDM)	3.75	3.93	4.03	4.15	0.18
OMD (%)	42.45	44.27	45.56	46.94	1.14

a, b, c: Means within rows with unlike superscripts are significantly different from each other ($P<0.05$). T1: 0.00% $(NH_4)_2SO_4$, T2: 0.25% $(NH_4)_2SO_4$, T3: 0.50% $(NH_4)_2SO_4$, T4: 0.75% $(NH_4)_2SO_4$, SEM: Standard Error Mean, Y= degradability at time t, a = intercept (or initial gas produced), b = potentially degradability of b, c = rate of degradability, t = incubation time, GV· Total volume of gas produced, CH_4: Methane production, IVDMD: In-vitro dry matter degradability, SCFA: Short chain fatty acid, ME: Metabolizable energy, OMD: Organic matter degradability.

Conclusion

In conclusion, the present study found that added ammonium sulphate at 0.75% in the diet increased in-vitro gas production and decreased methane accumulation. The total methane gas production differs among treatments but was greatly reduced at 24 hr of incubation. In addition, ammonium sulphate led to the highest in-vitro organic matter degradability at 24 hr. Therefore, this study suggested that ammonium sulphate at 0.75% in the diet could modify rumen fermentation and have a potential to mitigate methane emission in ruminants.

References

Babayemi, O.J. and Bamikole, M.A. (2006). Supplementary value of *Tephrosia bracteolate, Tephrosia candida, Leucaena leucocephal and Gliricidia sepium* Hay for West African Dwarf goats kept on range. *Journal of Central European Agriculture* 7 (2): 323-328.

Bal, M.A. and D. Ozturk (2006). Effects of sulfur containing supplements on ruminal fermentation and microbial protein synthesis. Res. J. Anim. Vet. Sci., 1: 33-36.

Beauchemin, K.A., M. Kreuzer, F. O'Mara and McAllister T.A.(2008). Nutritional management for enteric methane abatement: a review. *Aust. J. Ep. Agric.*, 48: 21-27.

Beauchemin, K.A., S.M. McGinn, C. Benchaar and L. Holtshausen, (2009). Crushed sunflower, flax, or canola seeds in lactating dairy cow diets: effects on methane production, rumen fermentation and milk production. *J. Dairy Sci.*, 92: 2118-2127.

Corton, T.M., J.B. Bajita, F.S. Grospe, R.R. Pamplona, C.A. Assis Jr., R. Wassmann and Lantin R.S. (2000). Methane emission from irrigated and intensively managed rice fields in Central Luzon (Philippines). Nutr. Cycl. Agroecosyst, 58: 37-53

Getachew, G., DePeters, E.J. and Robinson, P.H. (2004). *In vitro* gas production provides effective method for assessing ruminant feeds. *California Agriculture.* 58(1): 54-58

Goel, G. and Makkar H.P.S. (2012). Methane mitigation from ruminants using tannins and saponins. Trop. Anim. Health Prod., 44: 729-739. Goering, H.K. and P.J. Van Soest, 1970. Forage Fiber Analysis (Apparatus, Reagent, Procedures and Some Application). Agric. Handbook No. 379. ARS, USDA, Washington,Pp 120-122

IPCC (2007). Climate Change: Synthesis Report; Summary for Policymakers. In underlying report, adopted section by section at IPCC Plenary XXVII Valencia: Spain.

Isah, O.A. and Kojeku, F.T.(2015). The effect of replacement of molasses with pineapple waste in multi-nutrient block on in vitro gas production and digestibility. Trop. Anim. Prod. Invest. 13 (1): 13-18.

Khazaal, K. and Orskov, E.R. (1993). Potentiality of the Gas Production technique in comparison to nylon bag for the prediction of Animal performance. *Proceeding VII World Conference on Animal Production.* University of Alberta, Edmonton, Alberta, Canada.

McAllister, T.A. and NewboldC.J. (2008). Redirecting rumen fermentation to reduce methanogenesis. Aust. J. Ep. Agric., 48: 7-13. *Pak. J. Nutr.*, 12 (8): 729, 2013 729

Minamikawa, K., N. Sakai and H. Hayashi, (2005). The effects of ammonium sulfate application on methane emission and soil carbon content of paddy ?eld in Japan. Agri. Ecosyst. Environ., 107: 371-379.

Raskin, L., B.E. Rittmann and StahlD.A. (1996). Competition and coexistence of sulphate-reducing and methanogenicpopulation in anaerobic biofilms. Appl. Environ. Microbiol., 62: 3847-3857.