EFITA WCCA CIGR
2013 Conference
June 23-27, 2013
TORINO, ITALY
Sustainable Agriculture through ICT innovation

Effect of a broiler diet containing probiotic and exogenous enzymes on the manure used for biogas production**

Poster presentation
Environmental information systems/Environmental management systems
Maria Fernanda Ferreira Menegucci Praes[1], Jorge de Lucas Junior[1]*, Rafael Hermes[2], José Otávio Berti Sorbara[2], Lívia Maria Soares Ferreira[1], Paulo Barbosa da Cunha Simões Cardoso[1].
[1]Department of Agricultural Engineering, School of Agricultural and Veterinary Sciences, São Paulo State University, UNESP, Brazil
[2]DSM Nutritional Products, São Paulo, Brazil
*Corresponding author. E-mail: jlucas@fcav.unesp.br
**Supported by FAPESP (2010/05263-1; 2010/11329-5) and DSM Nutritional Products, São Paulo, Brazil.

ABSTRACT

The objective was to assess the accumulated volume and potential of biogas production in batch biodigesters from total and volatile solids added and reduced in manure of broilers that were fed a diet with probiotic and exogenous enzymes. In a completely randomized design, the study with the manure from broilers included 4 treatments (Cobb®), ages between 43 and 48 days, raised in cages, and fed different diets: a negative control (NC, a control diet without feed additives); probiotic (PRO, the NC diet + 500 ppm of a product containing *Bacillus subtilis*); exogenous enzyme blend (ENZ, the NC diet + 20 ppm of phytase, 200 ppm of protease and 200 ppm of xylanase); and a treatment combining both feed additives in the NC diet (P+E). Each treatment had 4 replicates in the batch biodigester. The manure was collected, identified and prepared (4% total solids). The volume per batch was the same (1.8 kg) for all biodigesters, with manure (0.301 kg) + water (1.499 kg). The vertical displacement of the gasometers was measured daily and the values were multiplied by their internal transversal section (0.00785 m^2) to determine the biogas volume accumulated in 142 days. The gasometers were reset after each reading using the discharge valve. The biogas volume was corrected for 1 atm and 20°C. The potential of biogas production was calculated using the accumulated biogas volume and amount of total and volatile solids added and reduced in the biodigesters during the anaerobic biodigestion. The values were expressed as m^3 biogas /kg total and volatile solids added and reduced. The data underwent variance analysis employing the *General Linear Model* procedure using the SAS® software. Averages were then compared based on Tukey test with a significance level of 5%. Analyses of the total accumulated biogas volume during 142 days showed that there was no statistical difference ($P<0.05$) between the treatments. However, when the potential of biogas production was evaluated, a statistical difference ($P<0.05$) was found for all evaluated characteristics. When treated in the batch

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biodigester, manure from the birds fed the P+E diet had a higher potential for biogas production per kg of total and volatile solids added and reduced, being different from those solids added to the NC treatment. In relation to the reduced solids, it was different from the ENZ and NC treatments. The use of P+E increases the potential for biogas production.

Keywords: Digester, biogas, *Bacillus subtilis*, manure.

1. INTRODUCTION

In Brazil, there is a mass agricultural livestock production, which leads to a huge residues production. The national poultry production became the most industrialized activity in livestock production.

Related to that activity there are some important environmental issues, due to a productive development with environmental and nutritional quality demands by various actors on this chain, in particular, the final consumers.

Nowadays, the environmental aspect becomes an important part of the daily handling on the poultry sector. There are some demands that should be addressed in order to the breeding process not to become a source of pollution.

Anaerobic digestion of the organic matter is a sector important alternative, representing a worldwide widely used renewable energy source.

Biodigestion leads to a generation of products, with the aim of making the breeding process environmentally viable. Those products are the biofertilizer, used as nutrient source for the cultures and the biogas, used as thermal energy source for lighting, heating and as a fuel for machines and equipments.

The higher cost in birds breeding process is food, so in order to increase diets efficiency, is absolutely necessary the use of better quality raw materials with modern manufacture techniques as the use of additives.

Nowadays, on poultry sector there is a huge variety of diets, with direct interference on birds excreted residues, that may have a negative influence in poultry residues processing by the anaerobic treatment and the biogas production.

However, the present study was made with the aim to evaluate the treatment of residues excreted by cage breeding poultry, who received different diets containing additives (exogenous enzymes and probiotics), over its biogas potential production.

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2. MATERIAL AND METHODS

In a completely randomized design, the study with the manure from broilers included 4 treatments (Cobb®), ages between 43 and 48 days, raised in cages.

The treatments consisted of different diets for broiler chickens containing exogenous enzymes and *Bacillus subtillis*, whose formulation was based on corn and soy mash, supplemented with minerals, vitamins and amino acids, in order to meet the nutritional requirements according to Rostagno et al. (2005) recommendations. A nutritional matrix of each enzyme was used to ensure the proper diet formulation. The added *Bacillus subtillis* is present in a commercial product currently tested in birds. Treatments were as follow: a negative control (NC, a control diet without feed additives); probiotic (PRO, the NC diet + 500 ppm of a product containing *Bacillus subtilis*); exogenous enzyme blend (ENZ, the NC diet + 20 ppm of phytase, 200 ppm of protease and 200 ppm of xylanase); and a treatment combining both feed additives in the NC diet (P+E). Each treatment had 4 replicates in the batch biodigester.

The manure was collected, identified and prepared (4% total solids). The volume per batch was the same (1.8 kg) for all biodigesters, with manure (0.301 kg) + water (1.499 kg). The vertical displacement of the gasometers was measured daily and the values were multiplied by their internal transversal section (0.00785 m^2) to determine the biogas volume accumulated in 142 days. The gasometers were reset after each reading using the discharge valve. The biogas volume was corrected for 1 atm and 20°C (Caetano, 1985). The potential of biogas production was calculated using the accumulated biogas volume and amount of total and volatile solids added and reduced in the biodigesters during the anaerobic biodigestion. The values were expressed as m^3 biogas /kg total and volatile solids added and reduced.

The data underwent variance analysis employing the *General Linear Model* procedure using the SAS® software. Averages were then compared based on Tukey test with a significance level of 5%.

3. RESULTS AND DISCUSSION

Analyses of the total accumulated biogas volume during 142 days showed that there was no statistical difference ($P<0.05$) between the treatments. However, when the potential of biogas production was evaluated, a statistical difference ($P<0.05$) was found for all evaluated characteristics. When treated in the batch biodigester, manure from the birds fed the P+E diet had a higher potential for biogas production per kg of total and volatile solids added and reduced, being different from those solids added to the NC treatment. In relation to the reduced solids, it was different from the ENZ and NC treatments (Table 1).

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Birds diet additive provides a high biogas production, with possible benefits for the process of biodigestion, which may cause an inducted artificial environment for the process. It would be like a pre-treatment stage, doing the hydrolysis of substances present on the excreta, allowing to the microbiotic population a better performance on a following step of the biological treatment.

Caetano (1991), working with broilers excreta, verified a energetic yield of 0,28 m³/kg of added TS, 0,42m³/kg of added VS and 0,52 m³/kg of reduced VS when the batch biodigesteres treatment was made. Steil (2001) found biogas potential production in m³ per kg of added TS, obtained from broilers excreta without the use of an inoculums, 0,3828 m³/kg of TS. At the same assay, the author verified a biogás potential production of 0,5495 m³/kg of added VS, 0,0243 m³/kg of substratum and 0,9087 m³/ kg of reduced VS.

Biogas potential production found by Primiano (2002), in biodigesters supplied with broilers excreta, with or without inoculum, was, respectively, 0,019 m³ and 0,024 m³/kg of substratum, 0,315 m³ and 0,377 m³/kg of added TS, 0,460m³ and 0,560m³/kg of added VS, 0,590m³ and 1,060m³/kg of reduced VS and 0,12m³ and 0,10m³/kg of residue.

Figure 1 shows data from biogas production in 142 days on different treatments, for batch biodigestors with broilers excreta. With the analysis of the graphic, we can view that the bigger biogás production occurred at the control treatment, followed by the treatment with enzymes and posteriorly the treatment just containing probiotic and enzymes plus probiotic.

At this graphic, it can be evaluated the production peak from different excretas of birds who received different diets. For the control treatment, the peak occurred at the 33º day of production (0,00097 m³), on the treatment with probiotic the peak occurred on 26° (0,000779 m³), on the treatment with enzymes was on 27° day (0,000964 m³) and on treatment with probiotic plus enzyme it occurred on 33 º day (0,000776 m³).

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Table 1. Average, values of F and P and the variation coefficient for total volume of biogás produced and biogas potential production for ST and SV added and reduced from the residues excreted by birds who received a diet containing probiotic and exogenous enzymes.

Treatment Characteristics		POTENTIAL			
		ST		SV	
	Total Volume (m^3)	Added (m^3/kg)	Reduced (m^3/kg)	Added (m^3/kg)	Reduced (m^3/kg)
NC	0,022	0,33 B	0,50 C	0,40 B	0,51 C
PRO	0,024	0,45 A	0,72 AB	0,54 A	0,72 AB
ENZ	0,023	0,40 AB	0,64 BC	0,47 AB	0,63 B
P+E	0,023	0,45 A	0,82 A	0,54 A	0,78 A
F Values	0,42	6,74	15,83	6,76	19,42
P Values	0,74	0,0065	0,0002	0,0064	<0,0001
CV[1]	10,44	10,35	10,22	10,37	7,94

[1]variation coefficient; Average with different letters at the same column are statistically different; NC= control diet without additives; PRO= NC + 500 ppm of the product containing *Bacillus subtilis*); ENZ= NC + 20 ppm of phytases enzyme, 200 ppm of protease and xylanase); P+E=NC+PRO+ENZ.

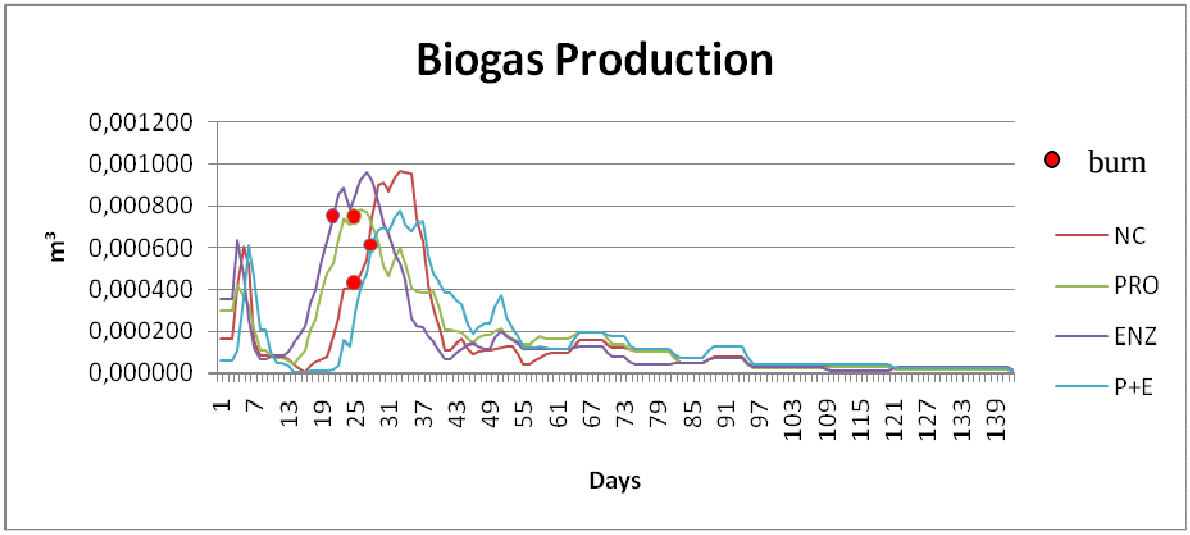

Figure 1. Biogas production (m^3) in 142 days, obtained on the biodigestion of the excreta from birds fed with diets containing probiotic and exogenous enzymes.

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4. CONCLUSION

The use of P+E increases the potential for biogas production.

5. ACKNOWLEDGEMENTS

DSM for the donation of probiotic and exogenous enzymes. To FAPESP for the scholarship and financial support to the project.

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