The Effect of Feeding *Punicum Mombasa* on The Production of Total Gas, Methane and Digestion Factor in Vitro

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Abstract

This study was conducted in the Animal Production Department of the College of Agriculture - Baghdad University. This study included the addition of *Ponicom Mombasa* as a form of green roughage to the ration of concentrated ratio of 25, 50 and 75% of coarse fodder to study it is effect on the total gas production, methane gas and digestibility. The results indicated a significant decrease in the production of total gas and methane gas by 75% of coarse fodder and the rates during the period of 12, 24 and 48 hours. It also gave the best effect in the characteristic of the dry matter digestibility, the digestion of organic matter and the energy exchanged.

Keywords*: Gas production, methane production, Punicum Mombasa, digestibility*

Introduction

Different types of gases are produced inside the animal rumen as a result of fermentation process of different organic materials, which include hydrogen gas, hydrogen sulfide, methane and carbon dioxide. The formation of methane gas is an effective mechanism to reduce the amount of carbon dioxide and to get rid of hydrogen gas formed in the rumen, and the amount of gas produced in ruminants varies depending on several factors, including: animal type, breed, rumen pH, the percentage of acetic acid, propionic, the composition of the feed, the amount of concentrated feed provided to the animal [6]. The production of methane gas in ruminants is similar to that of compost [12], and methane is 23 times hotter than carbon dioxide [6].

The laboratory gas production gives an indication of the quality of rumen fermentation, and it is one of the quick and inexpensive methods for estimating the nutritional value of the feed [5]. Therefore, it was important to conserve the feed energy by reducing the formation of methane gas [7]. In addition, the microbial fermentation inside the rumen is a major source for the production of methane gas, which is called greenhouse gas [10]. Therefore, reducing the high emissions of these gases from the digestive system of ruminants is related to determining the quantities of these gases produced in the animal rumen when feeding on concentrated and coarse feed [12,7]. The aim of this study is to investigate the effect of feeding green fodder from the punicum plant on the total gas production and methane in Vitro and to measure the digestibility after different incubation periods.

Materials and Methods

Experimental Design and Treatments

This study was conducted in the Nutrition Laboratory in the Faculty of Agriculture of Baghdad University, to determine the effect of feeding *Punicum Mombasa* with concentrated feed on total gas production and methane in Vitro and digestibility of dry matter, organic matter and metabolized energy (Tables 1 and 2).

Table (1): components of the concentrated diet used in the experiment

ingredient	Barley	corn	Wheat bran	Soybean meal	limestone	Mineral salts	Total
%	35	35	20	8	1	1	100%

Table (2): Chemical composition of the concentrated and coarse diet components included in the composition of the diets used in the study.

Items Ingredient	DM %	OM %	ASH %	CP %	CF %	EE %	NFE %	ME
Concentrate	90.45	86.01	4.44	11.53	7.38	2.09	64.82	10.47
Straw	91.83	84.98	6.85	9.98	2.83	4.87	67.30	11.27
Punicum	39.65	88.20	10.15	16.95	18.80	2.35	51.75	10.11

Table (3): Chemical composition and metabolized energy of experimental diets

(MJ / kg dry substance).

Items Ingredient	DM %	OM %	ASH %	CP %	CF %	EE %	NFE %	ME
T1	92.94	82.81	10.13	12.37	20.56	1.65	48.23	9.78
T2	91.12	81.65	9.47	11.06	19.41	1.81	49.37	9.76
T3	92.15	82.71	9.44	11.31	20.02	1.22	50.16	9.74
T4	91.16	81.58	9.58	10.25	20.10	1.62	49.61	9.68

T1:Control

T2: Concentrated fodder with coarse feed (P. Mombasa 25% + 75% straw)

T3: Concentrated fodder with coarse feed (P. Mombasa 50% + 50% straw)

T4: Concentrated fodder with coarse feed (P. Mombasa 75% + 25% straw)

Estimate total gas and methane production in the laboratory

The total gas production in the laboratory was estimated according to the method [13] by taking 4 replicates for each sample, as 200 mg of experimental feed materials were weighed and 20 ml of industrial saliva and 10 ml of filtered rumen liquid were added and placed in 100 ml glass syringes, then gas was added. Carbon dioxide was added to each syringe and the syringes were closed with the plunger while pushing the piston to completely remove the air. Planck work for each period of cuddling (4 replications). The injection was withdrawn to calculate the total gas production and then 4 ml of 4% NaOH was added to only 2 samples to calculate the methane gas production

according to the method [9]. Then, the metabolized energy (ME) (mJ / kg dry matter) and the laboratory digestibility factor of the organic matter% (IVOMD) were calculated using the following equations:

Eq1:ME (MJ/ kgDM) = 1.06 + 0.157GV + 0.084CP + 0.22CF −0.081A(Ash)

Eq2:

IVOMD(%)= 14.88 +0.889 GV + 0.45CP +0.651 x A(ASH)

A= Ash, ME= Metabolized Energy, GV= Total gas production (ml), CP= Crude protein%, CF= Crude fiber%, IVDMD= digestibility of Dry matter. IVOMD= digestibility of organic matter

Measurement of digestibility of dry matter and organic matter (%)

Both the digestibility of dry matter and the digestibility of organic matter were estimated according to the method (14).

Chemical Analysis

The forage samples were analyzed for dry matter, organic matter, ash, ether extract, crude protein, and crude fiber according to A.O.A.C [1].

Data Analysis

The data were analysed using analysis of variance (ANOVA), and means were separated by Duncan test at significant level $p < 0.05$ using (SAS 9.4, Cary, NC, USA, 2009). Correlation analysis was carried out to indicate the strength of relationship among the parameters when the first-order interaction was found to be significant.

Results and Discussion

The effect of adding *Punicum Mombasa* on total gas and methane production in the laboratory

The results (Table 3) indicated that there was a significant decrease ($p<0.05$) in total gas production and methane gas at T4 (75% Punicum + 25% straw) which the total gas amount reached 25.55 ml / 200 mg dry matter and methane amount 2.03 ml / 200 mg dry material. While, the total gas production recorded 27.12, 30.20 and 35.70 ml / 200 mg dry substance, and 2.20, 2.14 and 3.55 ml / 200 mg dry material of methane gas produced for the treatments T3, T2 and T1, respectively, after 12 hours. The same response was observed after 24 hours of treatments, that the total gas volume reached 27.42, 29.24, 32.22, 37.87 ml / 200 mg dry substance, and 2.47, 3.25, 3.28 and 3.75 ml / 200 mg dry material of methane gas at treatments T4, T3, T2 and T1 respectively. This result was in agreement with [14, 16] who indicated that the increase the amount of green fodder in the transactions led to a decrease the total production of gas and methane gas due to the fact that the green fodder (*Punicum Mombasa*) which led to the provision of digested energy in the animal's rumen, which result in reducing the energy spent for the production of total gas and methane gas by reducing the time of fermentation of foodstuffs.

Whereas, the same significant difference was observed in the total gas and methane production which recorded 31.50, 35.53, 36.42, 39.05 ml / 200 mg dry matter, 3.78, 3.90, 4.72 and 4.99 ml / 200 mg dry matter at treatments T4, T3, T2, and T1, respectively, after 24 hours. The significant increase in the total amount of gas and methane produced is related to the fermentation processes that occur in the rumen of the animal after this period which in agreement with [16, 17, 18]. On the other hand, there was no significant differences appear after 72 hours on total production of gas and methane gas which recorded 35.65, 37.31, 39.57, 40.10 ml / 200 mg dry matter, 4.55, 4.67, 4.95 and 4.92 ml / 200 mg dry material at T4, T3, T2 and T1, respectively. This results may be due to the reduction in the fermentation obtained in the treated feed after more than two days according to [17, 18].

Table (4): Effect of adding *P. Mombasa* on total gas and methane production in the laboratory (ml / 200 mg dry matter)

Studied Characters	Total gas				Volume of methan			
Treatment	**12**	**24**	**48**	**72**	**12**	**24**	**48**	**72**
T1	0.24 ±35.70 a	0.30 ±37.87 a	0.20 ±39.05 a	0.42 ±40.10 a	0.84 ±3.55 a	0.08 ±3.75 a	0.40 ±4.99 a	0.07 ±4.92 a
T2	0.34 ±30.20 b	0.44 ±32.22 b	0.46 ±36.92 b	0.56 ±39.57 b	0.04 ±2.14 c	0.17 ±3.28 a	0.17 ±4.72 a	0.13 ±4.95 a
T3	0.41 ±27.12 c	0.54 ±29.24 c	0.37 ±35.53 b	0.12 ±37.33 a	0.09 ±2.20 b	0.13 ±3.25 b	0.04 ±3.90 b	0.04 ±4.67 a
T4	0.41 ±25.55 d	0.32 ±27.42 d	0.40 ±31.50 c	0.47 ±35.65 a	0.15 ±2.03 c	0.40 ±2.47 c	0.13 ±3.78 b	0.06 ±4.55 a
	*	*	*	N.S	*	*	*	N.S

T1:Control

T2: Concentrated fodder with coarse feed (P. Mombasa 25% + 75% straw)

T3: Concentrated fodder with coarse feed (P. Mombasa 50% + 50% straw)

T4: Concentrated fodder with coarse feed (P. Mombasa 75% + 25% straw)

Effect of adding *P. Mombasa* on in vitro digestibility of dry matter, organic matter, and alternating energy

The result (Table. 5) showed that the treatment T4 was the best treatment in terms of the digestibility of dry matter (66.23%) as compared with (62.31, 63.41 and 60.18%) under T3, T2 and T1, respectively. Similar of the digestibility of dry matter, treatment T4 result in high value of digestibility of organic matter (64.08%) as compared with T3, T2 and T1 which recorded (63.31, .4861 and 60.07%) respectively. This results are in agreement with [3, 4], they found that using green fodder decreasing total gas and methane production.

The higher alternating energy at T4 (9.23 mJ / kg) was associated high with digestibility of dry matter and organic matter opposite the low values under T3, T2 and T1, (9.54, 9.61 and 9.82 MJ / kg) respectively. The difference in the digestibility of dry matter and organic matter were associated with the reduction in the energy exchange according to [16, 17, 18].

Table (5): Effect of adding *P. Mombasa* on in vitro digestibility of dry matter, organic matter, and alternating energy

Studied Characters Treatment	IVDMD	IVOMD	ME(MJ/kgDM)
T1	0.87 ±60.18 a	0.73 ±60.07 a	0.13 ±9.82 a
T2	0.67 ±63.41 a	0.66 ±61.48 a	0.10 ±9.61 a
T3	0.53 ±62.31 a	0.43 ±63.31 ab	0.08 ±9.54 a
T4	0.30 ±66.23 b	0.77±64.08 b	0.04 ±9.23 b
	*	*	*

T1:Control	**T2: Concentrated fodder with coarse feed (P. Mombasa 25% + 75% straw)**
T3: Concentrated fodder with coarse feed (P. Mombasa 50% + 50% straw)	**T4: Concentrated fodder with coarse feed (P. Mombasa 75% + 25% straw)**

Conclusion

Considering the high nutritional value of the *P. Mombasa* plant, its use in animal nutrition affects the productive characteristics as well as the amount of energy spent to produce the total gas and methane gas, as it leads to a reduction in the energy spent for its production and thus has a significant effect on the exchange energy that the animal benefits from in improving its productive qualities. The reduction in total gas and methane production was associated with increasing the feed level of *P. Mombasa*.

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