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DETERMINATION OF IN VITRO GAS PRODUCTION KINETICS AND CHEMICAL COMPOSITIONS OF LIGUSTRUM AND JASMINE TREE LEAVES

Abdulkadir ERISEK[1]*, Unal KILIC[2], Mustafa BOGA[3]

[1]*International Center For Livestock Research and Training, 06100, Ankara, Turkey*

[2]*Ondokuz Mayis University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Turkey*

[3]*Niğde Omer Halisdemir University, Bor Vocational School, 51700, Nigde, Turkey*

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Abstract

This study was carried out to determine the feed values and in vitro gas production (IVGp) kinetics of *Ligustrum vulgare* L. (*Oleaceae*) and *Jasminum officinale* L. tree leaves. In vitro (Hohenheim) gas test was used to determine the in vitro gas productions of the leaves for 3, 6, 9, 12, 24, 48, 72 and 96 h after incubation. General Linear Modal was used to compare gas production, and gas production kinetics of samples. The findings of the present study suggested that there were differences between the tree leaves in terms of crude protein, ash, ADF, in vitro gas productions, OMD, ME and NEL values ($p<0.01$). Ligustrum and jasmine leaves had similar condensed tannin and NDF contents ($p>0.05$), but ligustrum leaves showed more IVGp, organic matter digestibilities and energy values than jasmine leaves ($p<0.01$). In conclusion, it was determined that the leaves used in the study have low in vitro gas production and can be utilized as additives for alternative roughage feed in ruminant nutrition. However, it is recommended that the results obtained from this research should be combine with other forages and tested in in vivo studies.

Keywords: Ligustrum, Jasmine, Leaves, In vitro gas production, Energy values

***Corresponding author:** International Center for Livestock Research and Training, 06100, Ankara, Turkey
E mail: abdulkadirerisek@gmail.com (A. ERISEK)
Abdulkadir ERISEK https://orcid.org/0000-0002-4724-0031
Unal KILIC https://orcid.org/0000-0003-3909-799X
Mustafa BOGA https://orcid.org/0000-0002-2845-4528
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1. Introduction

Leaves of tree are important to ruminant (goats, sheep, cattle etc.) nutrition and tree leaves can be used as an alternative forages or additives (Boga, 2014; Olfaz et al., 2018; Karabıyık et al., 2018). It is also known that the leaves of some trees are meeting the requirements of ruminant in semi-arid areas like as Mediterranean region (Kamalak et al., 2005; Atalay et al., 2017). Jasmine and ligustrum leaves are abundantly found in Turkey. It is known that these leaves can be used as a low quality roughage feed or additives in ruminant nutrition. The aim of this study was to determine chemical compositions, relative feed value, in vitro gas productions, energy values (metabolizable energy and net energy lactation) and organic matter digestibility of the leaves of ligustrum and jasmine trees growing in Southern Turkey (Adana province).

2. Material and Method

The leaves of tree were harvested in mid-August from Adana province in the south of Turkey. In this study, three different tree leaves, *Ligustrum vulgare* L. (*Oleaceae*) and *Jasminum officinale* L., were used. Dry matter (DM) was determined by drying samples at 105 °C for 4 hours. Ash content was determined by ashing in a muffle furnace at 550 ºC for 8 hours. Nitrogen (N) contents were analysed using the Kjeldahl method according to AOAC (1998) procedure. Crude protein was calculated as N × 6.25. The ether extracts (EE) content was determined by using Ankom XT15 analyser (AOCS, 2005). The analyses of neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents of the leaves were based on the method of Van Soest et al. (1991) using Ankom fibre analyser. Condensed tannin contents of the leaves were determined according to Makkar et al. (1995).

2.1. In vitro gas (Hohenheim) production technique: Approximately 200 mg dry weight of samples were weighed in triplicate into 100 ml calibrated glass syringes following the procedures of Menke and Steingass (1988). Gas volumes were recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96 hours of incubations. Five replications of each leaf were used for in vitro study. The data were fitted to the model of Ørskov and McDonald (1979) by NEWAY computer package programme. Organic matter digestibility (OMD), metabolizable energy (ME) and net energy lactation (NEL) contents of the leaves were estimated according to the equations given at below used for forages.

OMD, % = 14.88+ 0.8893Gp + 0.448Cp + 0.651 ash
(Menke et al., 1979)
ME, MJ/kg DM = 2.20+0.136Gp + 0.057Cp + 0.002859 EE^2
(Menke et al., 1979)
NEL, MJ/kg DM = 0.101Gp + 0.051Cp + 0.11EE
(Menke and Steingass, 1988)

Where; Gp: 24 h net gas production (ml/200mg DM), Cp: Crude protein (%), EE: Ether extract (%)

2.2. Statistical analysis

General Linear Modal was used to compare gas production, and gas production kinetics of samples.

3. Results

Chemical compositions of the tree leaves were given in Table 1. Besides, In vitro gas productions and gas production kinetics of the leaves were given in Table 2, Table 3 and Figure 1.

Table 1. Chemical compositions and condensed tannin contents of the leaves (as DM%)

Leaves	DM	NDF	ADF	EE	Ash	Cp	CT
Jasmine	35.610	37.914	29.487	2.983	8.220	10.798	0.692
Ligustrum	35.072	38.185	29.514	1.667	7.679	8.919	0.849
SEM	1.615	0.457	1.420	0.318	0.027	0.172	0.084
Significant	0.825	0.696	0.986	0.043	0.000	0.002	0.255

DM= Dry matter, NDF= Neutral detergent fibre, ADF= Acid detergent fibre, EE= Ether extracts, Cp= Crude protein, CT= condensed tannin, SEM= Standard error of means

Table 2. in vitro gas production of the leaves (ml/200 mg DM)

Leaves	3.h	6.h	9.h	12.h	24.h	48.h	72.h	96.h
Jasmine	3.46	6.20	9.19	10.90	19.02	21.74	27.72	28.08
Ligustrum	3.56	9.08	13.16	16.18	30.06	36.39	41.25	43.90
SEM	0.14	0.31	0.39	0.32	0.40	0.82	0.40	0.47
Significant	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SEM= Standard error of means, h= hour as incubation period

Table 3. in vitro gas production kinetics and pH values after 96.h incubation of the tree leaves

	pH*	b	c	a+b	OMD	ME	NE_L
Jasmine	6.59	27.83	0.04	28.46	37.17	5.43	2.80
Ligustrum	6.58	45.50	.05	43.34	46.13	6.80	3.67
SEM	0.01	0.45	0.00	0.41	0.35	0.05	0.04
Significant	0.47	0.00	0.05	0.00	0.00	0.00	0.00

b= potential gas production (ml), c= the gas production rate constant for the insoluble fraction (ml/h), a+b= total gas production (ml), OMD= organic matter digestibility (%), ME= metabolisable energy (MJ/kg DM), NEL= net energy lactation (MJ/kg DM), *: pH values after 96.h incubation.

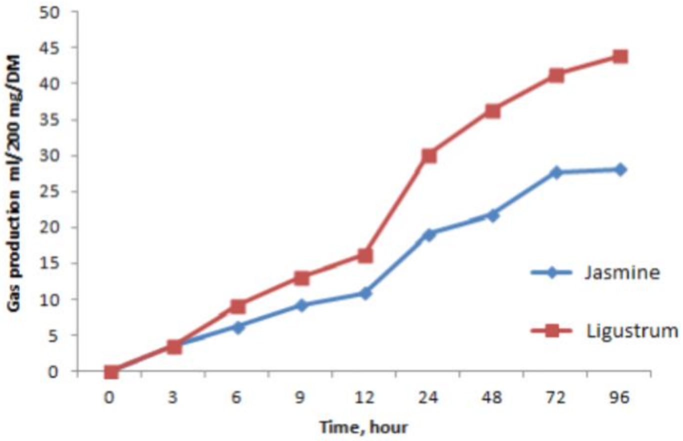

Figure 1. Gas productions of ligustrum and jasmine leaves

This results of the study indicated that the Jasmine had the highest Cp ($p<0.01$), ash ($p<0.01$) and EE ($p<0.05$). It was determined that the CT contents of the tree leaves were generally low (between 0.692-0.849 % DM). The highest CT content was found in Jasmine. There was no significance difference in DM, CT, NDF and ADF between trees leaves ($p>0.05$).

In vitro gas production of jasmine and ligustrum tree leaves were given in Table 2 and Figure 1. There is no difference in terms of in vitro gas production between the leaves for 3 hours incubation time ($p> 0.05$). But, the highest in vitro gas production values for 6, 9, 12, 24, 48, 72 and 96 hours incubation were observed in ligustrum tree leaves ($p<0.01$).

The highest values for estimated energy (ME and NEL) and organic matter digestibility (OMD) of ligustrum and jasmine tree leaves in the study determined in ligustrum tree leaves ($p<0.01$).

In the study, the similar pH values after 96 hours of incubation were observed between the tree leaves. Therefore, it can be said that the buffer solution was not consumed until the end of the incubation period and it did not affect the results.

4. Discussion

In this study, it was determined that the crude protein contents of ligustrum and jasmine tree leaves were lower than Vu et al. (2011) and Olfaz et al. (2018) reported that (respectively 20.3, 13.68 % DM) for mulberry leaves. However, the leaves crude protein contents were lower than Olfaz et al. (2018) reported that protein content of olive tree leaves. Condensed tannin (CT) values of the tree leaves determined in the study was 0.69-0.85%, which was lower for ruminant nutrition.

Yao et al. (2000) reported that the chemical compositions of the mulberry leaves harvested in the spring and autumn seasons DM (23.6-24.4; 29.6-30.45 %), Cp (20.8-21.6; 19.6-21.9 % DM) and NDF (37.5-39.5; 38.9-43.4 % DM) have changed. The nutrients in ligustrum and jasmine tree leaves may be affected by season and harvest time.

Olfaz et al. (2018) reported that total gas production (a+b), OMD and ME values in sour orange tree leaves (40.81 ml/200mg DM, 50.73% and 7.40 MJ/kg DM), mulberry tree leaves (53.13 ml/200mg DM, 55.38% and 8.11 MJ/kg DM) and olive tree leaves (30.53 ml/200mg DM, 40.41% and 6.06 MJ/kg DM) respectively. These values were determined for jasmine tree leaves and ligustrum tree leaves as respectively 28.46 ml/200mg DM, 37.17% and 5.43 MJ/kg DM and 43.34 ml/200mg DM, 43.13% and 6.80 MJ/kg DM in this study. The values of jasmine tree leaves were lower than some tree leaves which reported in the literatures. The main reason for this is that the 24 hours gas production in the equations used for the calculation was low.

However, it is thought that ligustrum tree leaves and jasmine tree leaves to be forage feed source or additives that can be used to feed ruminants. It is clear that low CT content will not affect the consumption of animals in the negative direction.

As the results the use of ligustrum tree leaves and jasmine tree leaves (both of them) reduced total gas and methane production in ruminants. This suggests that the use of jasmine tree leaves in certain ratio in the ruminant feeding will provide significant environmental benefits and that the energy of the feeds will be better utilized. Besides, it was suggested that CT contents of 5-10% may result disgust of feeds, reduces forage consumption and live weight gain, decreases digestibility and absorption, reduce performance and lead toxicity related effects (Kamalak, 2007). Since the CT contents of leaves used in this study were between 0.69-0.85%, it is believed that this will not have an adverse effect on the feed consumption.

5. Conclusions

It is concluded that there were significant differences between these leaves in terms of chemical composition and potential gas production. In conclusion, it was determined that the leaves used in the study have low in vitro gas production and can be utilized as additives for alternative roughage feed in ruminant nutrition. It is recommended that the results obtained from this research should be combine with other forages. However, these results need to be confirmed further with in vivo studying, before these products can be advanced further in animal nutrition.

Conflict of interest

The authors declare that there is no conflict of interest.

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