

IMPACT OF GARLIC, LEMONGRASS, PEEPERMINT AND ROSEMARY AS FEED ADDITIVES ON PERFORMANCE OF GROWING BARKI LAMBS

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SUMMARY

The present study was carried out to study the impact of using some medicinal herbs (0.3gm Garlic / kg LBW/ day (R2), 0.2 gm Lemongrass / kg LBW/ day (R3), 0.5 gm Peppermint/ kg LBW/ day (R4) ,0.2gm Rosemary / kg LBW/ day (R5) versus an supplemented ration (R1 – control ration which consists of 70% concentrate and 30% hay without any additives) on growth performance , some rumen and blood parameters of twenty five growing Barki lambs. The animals averaged 5 - 6 months old and weighed on average 26 kg. Animals were randomly divided into five similar groups (five animals each) for 120 days growth trial. The economic efficiency values were calculated. The Results could be summarized as follows: Feeding herbs improved all nutrients digestibility (DM, OM, CP, CF, EE and NFE) and nutritive values as TDN, DCP compared with control ration. Medicinal herbs decreased total lipids and cholesterol .Also, increased total plasma protein and globulin significantly ($p < 0.05$) compared to the control group. Feed efficiency (gm gain / gm DM or TDN) was enhanced in all supplemented groups compared with the control ration. It could be recommended to use 0.3 gm Garlic or 0.2gm Lemongrass or 0.5 gm Peppermint or 0.2gm Rosemary / kg LBW/ day to enhance growth and improve economic efficiency of production and to decrease plasma cholesterol and total lipids in lambs blood .

Keywords: *Medicinal herbs, garlic, peppermint, lemon grass, rosemary, performance, economic efficiency, carcass and lambs.*

INTRODUCTION

Use of herbal feed additives is gaining importance in animal production due to ban on use of certain antibiotics, harmful residual effects and cost effectiveness. Several medical herbs have many properties to improve digestibility, antimicrobial, anti- inflammatory, anti- oxidant and immune – stimulant activity.

Garlic contains numerous active metabolites such as sulfur compounds (allyl sulfides, glutamyl cysteines , allicin), enzymes, free amino acids , sterols, steroids , glycosides, flavonoids, phenols and are also rich in vitamins (specially vitamins of B complex and vitamin C). (Martins *et al.*, 2016).

Lemongrass contains several important bioactive compounds which are useful in control of several health issues. Olorunnisola *et al.*(2014). The fresh Lemongrass (*Cymbopogon citrates*), contains linalool, 10 – 25 % myrcene, 0.3 – 0.6 % volatile oils , which consisted of citral 65 – 90 % . El- Bordeny *et al.*, (2005) found that Lemongrass improved feed conversion, economic efficiency and had no undesirable effects on general health of buffalo calves.

Peppermint contains flavonoids, tannins and volatile oils (menthol, menthone, iso- menthone and limonene). Fleming, 1998 and El-Elaiame (2007) found that Peppermint, at the rate of 0.5 gm / kg LBW/ day in goat ration improved milk yield, weight gain of kids, digestibility and bacteriological quality of milk and its manufacturing properties.

Hassanein (1982) found that Egyptian Rosemary contained 0.97% essential oil (on DM basis), which is consisted of limonene, phellandrene, thymol, linalool.

Therefore, present study aimed to investigate the effects of Garlic, Lemongrass, Rosemary and Peppermint as feed additives on nutrient digestibility, feeding values, blood parameters and lambs growth performance. Also, the economic efficiency of the diets was calculated.

MATERIALS AND METHODS

Feeding Trials:

Experimental animals:

Twenty five growing Barki lambs (average 5 - 6 months old and weighed in average 26 kg) were randomly divided into five similar groups (five animals each) according to their weight, age and parity for 120 days growth trial. (from December to March). Lambs were weighed every two weeks right before morning feeding through the experimental period to record any change in body weight and to adjust their feed intake according to their changed nutrients requirements (NRC, 2007).

Experimental rations:

Animals were fed on ration that consisted of 70% concentrate feed mixture (CFM) and 30% alfalfa hay, respectively, to cover their nutrients requirements, according to their live body weight NRC (2007). Water was available all time. The chemical analysis of the experimental rations was carried out according to the AOAC (1996) at the laboratories of Animal Nutrition, Animal Production Department, Faculty of Agriculture, Cairo University.

Chemical compositions of feed ingredients used in the experimental rations are shown in Table (1). And the constituents of rations and herbs supplements used in the experiment are illustrates in Table (2).

Table (1): Chemical composition of feed ingredient used in the experimental rations.

Item	Chemical composition% (DM basis)						
	DM	OM	CP	CF	EE	NFE	Ash
Hay	90.0	89.4	16	25	2.6	46.2	10.6
Yellow corn	90.5	90.8	8.1	2.8	4.2	75.7	9.2
Soya bean	91.6	92.8	42.8	4.0	1.5	44.5	8.2
Wheat bran	89.6	93.8	14	10.2	2.9	66.7	6.2
Ration	90.0	89.2	14.5	11.2	3.2	60.3	10.8

Table (2): Constituents of rations and herbs supplements used in the experiment.

Ration	Contents	%
R1 (control ration)	Clover hay	30
	Yellow corn	35
	Wheat bran	22
	Soya bean	10
	Lime stone	2
	Salt	0.5
	Mineral and vitamins	0.5
	control + 0.3gm garlic / kg LBW/day	
R2	control + 0.3gm garlic / kg LBW/day	
R3	control + 0.2gm lemongrass / kg LBW/day	
R4	control + 0.5gm peppermint / kg LBW/day	
R5	control + 0.2gm rosemary/ kg LBW/day	

Mineral and vitamins mixture provided (per kg of premix) ; 185 g of di calcium phosphate , 54 g of potassium sulfate , 24.8 g of manganese sulfate , 10 g of zinc oxide, 21 g of sulphur , 43.5 g of magnesium sulfate , 50.2 g of ferrous sulfate , 11.9 g of copper sulfate , 50 mg of molasses , 8 mg of pantothenic acid , 7 mg of vitamin B₁ , 3 mg of vitamin B₆ , 53 mg of vitamin B₂ , 6400 IU of vitamin A , 64 IU of vitamin E , 6000 IU of vitamin D₃ and sodium chloride up to 1.

Determination of essential oils in herbs:

From sample of 400 gm, triplicates, each of the air dried lemon grass, rosemary, garlic and peppermint were separated by water distillation for 5 – 6 hr. according to the method of Guenther (1961). Analysis of the oil was carried out using GLC chromatography.

Digestibility Trials:

Feeds and feces sampling and analysis:

Fifteen adult sheep (weighed 45 kg) were used in 21-days digestion trials (3 for each group), consisting of 14 days as preliminary period, and 7- days as collection period. Animals were kept in metabolic cage and fed 90% of their rations, which provide their maintenance requirements. Rations were received twice daily in equal parts, at 8.00 and 17.00 hr. and water was freely available to all animals. During the collection period feces. Feces samples were dried at 60 °C/24 hrs in a hot air oven. At the end of the collection period, dried samples of feed and feces were finely grounded to pass through 1- mm sieve and kept in tight plastic containers for chemical analysis according to the methods of the AOAC (1996).

Rumen liquor sampling and analysis:

Rumen fluid samples were taken individually from animals at the end of digestibility trials before feeding (zero time), then at 3 and 6 hrs. post feeding using a stomach tube. Samples were filtered through four layers of surgical gauze, to determined ruminal pH immediately using digital pH meter. Then, the samples were kept frozen for other ruminal parameters determination. Ruminal ammonia-N concentration was determined according to Conway (1963) method, while the total VFA s concentration was determined according to Warner (1964).

Blood sampling and analysis:

Blood samples were collected from the jugular vein of the animal at the end of the growth trials. The blood samples were centrifuged at 3000 r. p. m. for 15 minutes, and blood plasma was separated into polypropylene tube and stored at –18 °C until analysis for total proteins and albumin according to Doumas *et al.* (1971), respectively. Globulin value was calculated by the difference between total protein and corresponding value of albumin. . Plasma cholesterol was determined according to the method described by Richmond (1973). Plasma total lipids mg/dl determined according to the method described by Zollner and Kirsch (1962). Plasma uric acid determined according to the method described by Barham and Trinder (1972). Plasma alanine amino transaminase (ALT) and aspartate transaminase (AST) were determined according to the method described by Retiman and Frankel (1957).

Economical efficiency:

The economic efficiency in the present study was calculated from input–output analysis based on the total feed cost and price of the final gain in body weight. The values of economics efficiency was calculated as the net revenue per unit of total costs.

Statistical Analysis:

The obtained data were analyzed using the general linear model procedure of SAS (2001), using the following model:

$$Y_{ij} = \mu + T_i + E_{ij}$$

Where:

Y_{ij} = Observed value of a given dependent variable.

T_i = The effect of treatments.

E_{ij} = The experimental random error.

μ = Overall adjusted mean.

Significant differences between means were separated by Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

The analysis of essential oils in medicinal herbs:

The analysis of the essential oil of the tested medicinal herbs is presented in Tables (3, 4, 5 and 6). Garlic, rosemary, peppermint and lemongrass contain numerous active metabolites such as allicin, linalool, myrcene, menthol, menthone, carvacrol and thymol. Results showed that the constituents of the essential oils are differed among the herbs, so different effects on the consumers (human and animals are expected). These results are harmony with Firmino *et al.* (2020) who reported that garlic, rosemary and peppermint are used in animal nutrition because they rich in carvacrol and thymol and many compounds which have a wide range of properties such as antimicrobial, immune-stimulant and anti-oxidative activities, and the ability to enhance intestinal absorption, to improve growth and even to reduce cumulative mortality.

In contrast, lemongrass contains several important bioactive compounds which are useful in control of several health issues. The fresh lemongrass (*Cymbopogon citrates*), contains linalool, 10–25 % myrcene, 0.3–0.6 % volatile oils, which consisted of citral 65 – 90 % El-Elaime (2007) and Olorunnisola *et al.* (2014)

Peppermint contains flavonoids, tannins and volatile oils (menthol, menthone, iso- menthone and limonene) (El-Elaime, 2007).

Table (3): The constituents of essential oils in Rosemary.

No.	Components	% in Rosemary
1	Borneol	28.23
2	α – pinene	14.82
3	α – caryophyllene	11.95
4	Ledol	7.43
5	Eucalyptol	6.0
6	Camphor	5.9
7	γ -Terpinen	5.77
8	D- Verbenone	4.30
9	Limonene	4.21
10	α –Muolene	3.1
11	Myrecene	2.93
12	β -Pinene	2.40
13	phellendrene	2.27
14	Thymol	0.69

Table (4): The constituents of essential oils in Peppermint.

No.	Components	% in Peppermint
1	P- cymene	22.27
2	α – pinene	1.973
3	Nerol	1.639
4	Borneol	2.004
5	Thymoquinone	43.699
6	Linalool	4.503
7	γ -Terpinen	3.304
8	Cineole	1.589
9	D- Limonene	7.108
10	Eugenol	3.800
11	Myrecene	2.264
12	β -Pinene	2.40
13	Phellendrene	4.447
14	Thymol	0.900

Table (5): The constituents of essential oils in Garlic.

No	Components	% in Garlic
1	Diallyl sulfide	8.45
2	Diallyl disulfide	25.19
3	Methylallyl disulfide	2.50
4	Methylallyl trisulfide	26.00
5	dialallyl trisulfide	23.00
6	dialallyl tertasulfide	13.00
7	1,3,5 trithiane	0.81
8	2- vinyl – 1,3- dithiane	0.80
9	Hexamethylenesulfoxide	0.25

Table (6): The constituents of essential oils in Lemongrass.

No.	Components	% in Lemongrass
1	Myrcene	16.6
2	E,E – consmene	11.56
3	Z β-Ocimene	0.21
4	E- β-Ocimene	0.18
5	α –Terpinolene	1.08
6	Citronellal	2.03
7	Cis- Carveol	1.45
8	Cis- Verbenol	0.17
9	Linalool	2.04
10	Nerol	0.22
11	Neral	30.25
12	Geranyl acetate	0.57
13	Caryophellene	0.26
14	Carveol	0.40
15	Geranial	33.00

Nutrients digestibility and nutritive value of the experimental rations:

Result in Table (7) showed that the digestion coefficients of dry matter and organic matter showed significant differences ($P < 0.05$) compared to the control group. Feeding herbs improved all nutrients digestibility than control by (70.24–74.23) for CP, (52.83–58.42) for CF, (80–86.4) for NFE. These results are in harmony with those observed by El-Elaime (2007) who found that the addition of peppermint at level 0.5 gm / kg LBW /day improved organic matter, crude protein, crude fiber and nitrogen free extract digestibility. The TDN value for control ration was significantly ($P < 0.05$) lower than others, while R2, R4, R3 and R5 showed the highest values, respectively. The DCP values ranged between 10.27 to 10.76 for tested rations while it was decreased to 10.18 % for control group.

These results were in agreement with Hanafy *et al.*, (2009) who noticed that medicinal plants addition in diets showed higher value of DM, OM, CF, NFE and EE digestibility than the control.

Table (7): Nutrient digestibility and nutritive value (% DM basis) of the experiment rations.

Item	Experimental rations					SEM
	R1	R2	R3	R4	R5	
DM	74.60 ^c	76.20 ^{ab}	76.12 ^{ab}	77.40 ^a	75.43 ^{ab}	1.21
OM	76.13 ^{ab}	78.42 ^a	76.90 ^{ab}	77.80 ^a	75.90 ^b	1.32
CP	70.24 ^c	74.23 ^a	72.15 ^b	72.67 ^b	70.80 ^c	1.15
EE	79.89 ^a	78.24 ^b	77.13 ^{ab}	77.24 ^{ab}	79.65 ^a	1.34
CF	52.83 ^c	58.42 ^a	56.67 ^b	57.42 ^{ab}	54.10 ^c	1.67
NFE	80.00 ^b	86.40 ^a	84.32 ^a	84.60 ^a	82.64 ^{ab}	1.70
TDN	66.24 ^c	74.41 ^a	72.60 ^{ab}	72.9 ^{ab}	71.26 ^b	0.92
DCP	10.18 ^c	10.76 ^a	10.46 ^{ab}	10.54 ^{ab}	10.27 ^b	0.23

a,b,c,... means on the same row with different superscript are significantly different ($p < 0.05$).

Rumen parameters:

Results in Table (8) showed that the mean values of ruminal pH value and Ammonia – N concentration for animals showed no significant difference. Addition of medicinal herbs to the ration didn't affect Ammonia – N and pH value. Regarding the effect of sampling time on NH₃-N concentration it may be noticed that the ruminal NH₃-N concentration was increased at 3 hrs post feeding , but it decreased at 6 hrs post feeding for all treatments .

The decrease of NH₃-N concentration at 6 hrs post feeding was sharp with control group but it was gradual with treatments. This may be attributed to the regulatory action of Garlic, Peppermint, Lemon grass and Rosemary as buffers on regulators in absorbing and releasing NH₃-N in the rumen. These results are in contrast with El -Bordeny *et al.* (2008) and Hanafy *et al.* (2009) who reported that pH value of rumen liquor was not significantly by affected by medicinal plants supplementation. The volatile fatty acids concentrations (meq/ 100 ml) of rumen fluid were significantly (p <0.0 5) higher for R2, R4, R3, R5, respectively than the control group. This increase in volatile fatty acids concentration with experimental rations compared with control group may be due to the increase in OM digestibility in the experimental groups.

Table (8): Effect of adding medicinal herbs to rations on some rumen parameters.

Item	Experimental rations						SEM
	Time	R1	R2	R3	R4	R5	
pH values	0	6.60 ^b	7.20 ^a	7.02 ^a	7.10 ^a	7.10 ^a	0.29
	3	5.70 ^b	6.30 ^a	5.60 ^b	6.20 ^a	6.30 ^a	
	6	6.80	6.40	6.60	6.60	6.70	
	Mean	6.37	6.63	6.40	6.63	6.70	
Ammonia–N (mg/100ml)	0	25.8 ^a	22.8 ^c	24.3 ^b	22.3 ^c	22.4 ^c	3.11
	3	38.7 ^a	36.5 ^b	36.4 ^b	35.1 ^c	35.2 ^c	
	6	30 ^a	30.8 ^a	30 ^a	28.3 ^b	28.6 ^b	
	Mean	31.5	30.03	30.23	28.6	28.73	
Total VFAs (meq/100ml)	0	6.8 ^b	8.5 ^a	8.5 ^a	8.2 ^a	7.7 ^a	1.73
	3	10.6	11.5	10.8	10.8	10.9	
	6	8.0 ^b	10 ^a	9.2 ^a	10 ^a	8.2 ^{ab}	
	Mean	8.47	10.00	9.50	9.70	8.90	

a,b,c,.. means on the same row with different superscript are significantly different (P < 0.05)

Blood parameters:

Data in Table (9) showed no significant difference detected for uric acid, ALT and AST. But medicinal herbs decreased cholesterol, with the highest effect (160 mg / dl) for R2 followed by R3, R4 and R5 compared to control group. Also, Garlic and lemon grass decreased total lipid and all herbs increase total protein and albumin with significant differences (P < 0.05) compared to control group. Also, globulin level increased significantly (P < 0.05) compared to control group. The highest value was for R3 followed by R2, R4 and R5. This increase in globulin due to these medicinal herbs, contained steroidal flavonoid terpens which stimulate the normal secretion of cortisone. Seventy percent from this cortisone bind with globulin El-Elaime (2007).

Table (9): Mean values of some blood constituents recorded for lambs fed the experimental rations.

Item	Total Protein	Albumin	Globulin	Total lipid	Cholesterol	Uric acid	ALT	AST
R1	7.3 ^c	3.6 ^b	3.7 ^b	330 ^a	188 ^a	1.82	22.0	40.0
R2	8.2 ^a	3.6 ^b	4.2 ^a	300 ^c	160 ^c	1.72	18.9	38.0
R3	8.2 ^a	3.9 ^a	4.3 ^a	310 ^b	170 ^b	1.74	19.4	38.0
R4	8.1 ^a	3.9 ^a	4.2 ^a	322 ^a	175 ^{ab}	1.78	18.6	39.0
R5	7.8 ^b	3.8 ^a	4.0 ^a	322 ^a	180 ^a	1.78	20.0	38.2
SEM	0.120	0.219	0.108	0.0879	1.56	0.118	0.341	0.320

a,b,c,.. means on the same row with different superscript are significantly different (p < 0.05)

Live weight gain and feed efficiency of lambs fed the experimental rations:

Data in Table (10) illustrate the live weight gain and feed conversion of lambs fed the experimental rations. All treated groups showed better weight gain with the significant difference ($P < 0.05$) compared with control group. The highest for R2 followed by R3, R4 and R5.

Feed efficiency was enhanced in all treated groups in all treated groups than control group. These results support the idea that medicinal herbs supplements improved weight gain and decreased feed efficiency.

Table (10): Dry matter intake, live weight gain and feed efficiency of lambs fed the experimental rations.

Item	Exprinemtal ration					SEM
	R1	R2	R3	R4	R5	
Initial wt. (kg)	26.20	26.30	26.25	26.40	26.20	0.61
Final wt. (kg)	43.8 ^c	49.75 ^a	47.2 ^b	47.2 ^b	46.9 ^b	0.62
Total gain (kg)	17.6 ^c	23.45 ^a	20.95 ^b	20.8 ^b	20.8 ^b	0.17
Daily gain (g)	146.7 ^c	195.4 ^a	174.6 ^b	173.3 ^b	172.5 ^b	1.46
Feed intake /h/d						
DMI, kg	0.980	0.960	0.960	0.980	0.975	-
TDN, kg	0.649	0.714	0.697	0.714	0.695	-
DCP, g	0.695	103.30	100.40	103.30	100.13	-
Feed conversion						
DM/gain, kg/kg	6.68 ^a	4.91 ^c	5.76 ^b	5.50 ^b	5.65 ^b	-
TDN/gain, kg/kg	4.42 ^a	3.65 ^c	3.99 ^b	4.12 ^b	4.03 ^b	-
DCP/gain, kg/kg	0.680 ^a	0.529 ^c	0.575 ^b	0.596 ^b	0.580 ^b	-

a, b, c, ... means on the same row with different superscript are significantly different ($P < 0.05$)

Economical evaluation:

Data of the Economic evaluation of feeding growing lambs on the tested rations in Table (11) showed that medicinal herbs supplements significantly ($P < 0.05$) increased the economic efficiency for growing lambs. The effect was the highest for R2 followed by R4, R3 and R5, compared with control group.

Table (11): Economical evaluation of the experimental ration.

Item	Exprinemtal ration				
	R1	R2	R3	R4	R5
Total weight gain obtained (kg)	17.6	23.45	20.95	20.8	20.7
Consumed DM (kg) to produce	117	117.6	115.2	115.2	117.6
Feed cost (LE)for Total weight gain	468	497.45	487.3	475.2	497.45
Total revenue* (LE)	1056	1407	1257	1248	1242
Net revenue** (LE)	588	909.55	769.7	772.8	744.6
Economic efficiency***	1.26	1.83	1.58	1.63	1.50
Relative Economic efficiency	100	145.24	125.4	129.37	119.47

Total revenue = Total weight gain * price of kg live weight gain (60 LE)*

*Net revenue** = Total revenue – Feed cost for total weight gain.*

Market prices were as follow: concentrate was 4500LE / Ton , alfalfa hay was 3000LE /Ton , garlic and peppermint 5LE/kg , rosemary and grass lemon 30LE/kg

*Economic efficiency*** = $\frac{\text{Net revenue}}{\text{Total feed cost}}$*

Referring to the obtained results, it could be recommended using medicinal herbs (0.3gm Garlic / kg LBW/ day (R2), 0.2 gm Lemongrass / kg LBW/ day (R3), 0.5 gm Peppermint (R4), 0.2gm Rosemary / kg LBW/ day (R5) in growing lambs ration to improve weight gain , feed efficiency and economical efficiency.

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تأثير اضافة الثوم وحشيشة الليمون والنعناع واكليل الجبل كإضافات علفية على الاداء الانتاجى لحملان أغنام البرقى النامية

صباح محمود علام و رندا رفاعى السيد العليمى

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اجريت هذه الدراسة على 20 حمل من الأغنام البرقى متوسط وزنها 26 كجم و متوسط عمرها 5- 6 شهور بهدف دراسة تأثير اضافة بعض الاعشاب الطبية (الثوم - حشيشة الليمون - النعناع- اكليل الجبل) للعلائق المكونه من 30 % دريس برسيم و 70 % مركزات على الاداء الانتاجى للحملان من حيث معدلات النمو و مواصفات الدم و سائل الكرش و الكفاءة الاقتصادية. ولقد اظهرت النتائج ما يلى : ان اضافة الاعشاب الطبية للعلائق ادت الى تحسبن كل القيم الغذائية (للمادة الجافة والعضوية والبروتين الخام والالياف الخام و مستخلص الاثير والمستخلص الخالى من الازوت) مقارنة بعليقة المقارنة . كما اظهرت النتائج ان اضافة الاعشاب الطبية الى العلائق ادى الى تحسن فى القيمة الغذائية كمركبات مهضومة كلية وبروتين مهضوم كما ادت الى زيادة معنوية فى معدل النمو اليومى . كما ادت اضافة الاعشاب الطبية الى خفض كلا من كوليستيرول الدم والدهون الثلاثية و زيادة كلا من البروتين الكلى و الجلوبيولين بدرجه معنويه مقارنة بعليقة المقارنة. كما ادت اضافة (الثوم - حشيشة الليمون - النعناع - اكليل الجبل) الى تحسن فى الكفاءة الاقتصادية مقارنة بعليقة المقارنة. وعلى ذلك يمكن التوصية باضافة الاعشاب الطبية (الثوم - حشيشة الليمون - النعناع- اكليل الجبل) لعلائق الحملان لأنها تؤثر ايجابيا على ادائها الانتاجى من حيث معدلات النمو وكفاءة الاستفادة من الغذاء مواصفات الدم و سائل الكرش و الكفاءة الاقتصادية.