Effect of Green Cardamom Powder on Growth Performance of Karadi Male Lambs

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Abstract

The purpose of this study was to examine the effects of supplementing male Karadi lambs with green cardamom powder on growth performance. This study was carried out at farm in Animal Science Department, College of Agricultural Engineering Sciences, University of Sulaimani. There were twenty-four lambs divided into four equal groups. The control group only received the basic diet , while the other three groups were supplemented with green cardamom at doses of 40 mg (T1), 80 mg (T2), or 120 mg (T3) per kg of body weight. The growth performance of Karadi male lambs was evaluated over a 12-week experimental period. Our results showed that the mean values of initial body weight (week 0) averaged 25.29 ± 3.06 kg across all lambs, the final body weight (week 12) was 39.830 ± 4.457 kg, Total weight gain of 14.539± 2.997 kg. The average daily gain (ADG) was calculated as 0.173 ± 0.036 g/day ,feed conversion ratio (FCR) was 3.634 ± 0.687 and feed efficiency (FE) was 0.284 ±0.051. Over a period of 12 weeks, lambs grew steadily, and their final weights ranged from 37.800 ±1.948 to 42.440 ±1.907kg kg, indicating that all groups performed effectively overall. Cardamom supplementation enhanced growth performance and feed utilization in Karadi male lambs, T2 and T3 had significantly higher total weight gain, ADG, and FE, and significantly lower FCR compared to the control and T1 ($p < 0.05$).

Keyword: Green cardamom , Feed conversion ratio, Feed efficiency ,Karadi lambs

Introduction

The amount of feed consumed is one element that is very important to support the basic needs of life, growth, production and reproduction of livestock [1] .The distinct scent and potential applications of cardamom as a functional food, medication, and nutraceutical are attributed to the essential oil and other bioactive metabolites that accumulate in the capsules [2].The FCR

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is defined as the ratio between dry matter intake (DMI) and average daily gain (ADG), where animals with a higher FCR are considered less efficient[3] . Body weight gain is a result of an enlarged and increased of the body tissue as well as an improved ability to convert the nutrient content contained in the feed into meat which influenced by the quality and quantity of the feed [4,5,6,7,8].Feed conversion ratio (FCR) is one of the indices used to evaluate feed efficiency; it was proposed by Crampton et al. in 1946 and is widely used to evaluate the utilization rate of animal feed [9]. Feed efficiency is a complex multifaceted trait that is controlled by many biological processes [10].

The present study aimed to investigate the effect of dietary supplementation with green cardamom (*Elettaria cardamomum*) powder as a natural feed additive on growth performance and feed efficiency in Karadi male lambs.

Material and method

1. **Study location:** This study was carried out at farm in Animal Science Department, College of Agricultural Engineering Sciences, University of Sulaimani.
2. **Experimental animals:** A total of twenty-four healthy Karadi male lambs were used in this experiment. The lambs were approximately 90 ± 4 days old, with an average body weight of 22 ± 1 kg. They were randomly divided into four groups, with six animals in each group. The first group was kept as a control (C) and fed only the basal diet. The other three groups were treated with green cardamom powder at different levels.
3. **Diet and feeding:** Feed(concentrate diet) was offered ad libitum twice daily, wheat straw and clean drinking water was available at all times. The composition of the basal diet used in this study is presented in Table1.Dried green cardamom pods were obtained from the local market and ground into powder using a small laboratory grinder. Green cardamom powder was used as a dietary additive according to the experimental treatments. Cardamom contains many active compounds, including 1,8-cineole and α-terpinyl acetate, which may have biological effects, as reported in previous studies[11,12]. The compounds listed represent the major bioactive constituents naturally present in green cardamom seeds. This study used seed powder, which contains these compounds. The chemical composition of green cardamom used in this study is presented in Table 2.

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Table 1. Formulation and chemical composition of experimental diets

Ingredient	DM basis (%)	Wheat straw
Barley grain	20	
Wheat grain	15	
Soybean meal	17	
Corn grain	35	
Wheat bran	10	
Salt	0.5	
Vitamin–mineral mixture	1.5	
limestone	1	
Total	100	
Chemical composition % [1]		
Dry Matter	87.7	91
Ether extract	2.93	1.8
Organic matter	94.5	92
Crude protein	16.8	3
Metabolizable energy (MJ/DM)[2]	10	6.3
Neutral Detergent Fiber	12	81
Acid Detergent Fiber	3.5	58
Ash	5.4	8

[1 and 2] Chemical composition of experimental diets Metabolizable energy (MJ/DM) were calculated according to the NRC(2007)

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Table 2: Chemical composition of green cardamom *(Elettaria cardamomum)* seeds used in the study

Compound	Approx. %	Chemical Class
1,8-Cineole (Eucalyptol)[11,12]	25–55 [11,12]	Oxygenated monoterpene
α-Terpinyl acetate)[11,12]	28–35[11,12]	Ester (monoterpenoid)
Linalool acetate[12,13]	~8 [12,13]	Oxygenated monoterpenoid
Sabinene[14,12]	1.5–5 [14,12]	Monoterpene hydrocarbon
Linalool[11,12]	0.9–4[11,12]	Monoterpene alcohol
α-Pinene[14,12]	0.7–1.8[14,12]	Monoterpene hydrocarbon
β-Pinene[14,12]	0.2–0.4[14,12]	Monoterpene hydrocarbon
Limonene[14,12]	2–3[14,12]	Monoterpene hydrocarbon
α-Terpineol[11,12]	2–3[11,12]	Monoterpene alcohol

Details of dietary treatments : green cardamom powder per (1kg) body weight.

In control group (C) , lambs are fed basal diet , during the experiment.

T1 : basal diet with (40 mg) green cardamom powder/ kg body weight

T2 : basal diet with (80 mg) green cardamom powder/ kg body weight

T3 : basal diet with (120 mg) green cardamom powder/ kg body weight

4. **Growth performance measurement :**

At the start of the experiment , the initial body weight of the male Karadi lambs was recorded. Throughout the duration of the 12-week study, lambs were weighed every week at the end of each week using a digital scale. The final body weight was the weight measured at the end of week 12. The following parameters were measured:

1. Body weight gain (kg): The difference between the final and initial body weights of the Karadi male lambs was used to compute their total weight increase (kg), according to the following formula:
   Body weight gain = Final body weight - Initial body weight
2. Average daily gain (g/day):The average daily gain (ADG; g/day) was determined by dividing the total body weight gain by (number of experimental days, the duration

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of the study period, according to the following formula:

Average daily gain (g/day) = Body weight gain / number of experimental days.

3. Feed conversion ratio: The feed conversion ratio (FCR) was determined by the ratio of dry matter intake to body weight gain during the study duration, according to the following formula:

Feed conversion ratio = Dry matter intake (DMI) (Kg)/ Body weight gain (Kg)

4. Feed efficiency (FE) :Feed efficiency (FE) was determined as the ratio of body weight gain to dry matter intake(DMI) , according to the following formula:

Feed efficiency (FE) = Body weight gain (Kg)/ Dry matter intake(DMI) (Kg)

5. **Statistical analysis:** Data were analyzed using one-way ANOVA to assess the effects of green cardamom on growth performance. When significant differences were detected, means were compared using Duncan's multiple range test. Differences were considered statistically significant at $P<0.05$.

Result and discussion

In our study, the initial body weight, final weight, total gain, average daily gain, feed conversion ratio, and feed efficiency of Karadi male lambs treated with green cardamom powder were measured. The effects of green cardamom on their growth performance are presented. The effective selection of feed efficiency significantly contributes to improving the sustainability and economic viability of ruminant production [15]. The selection of feed efficiency (FE) in ruminants has been the subject of substantial research over the past century[16] .

Mean± SD values of Initial body weight (IBW) , Final body weight(FBW) , Total weight gain(TWG) , Average daily gain (ADG), Feed conversion ratio (FCR) , Feed efficiency(FE) of Karadi male lambs treated with green cardamom powder are shown in table 3.

Table(3): Growth performance parameters of Karadi male lambs supplementation with green cardamom powder (Mean± SD)

Growth parameters	**Mean± SD**
Initial BW(Kg)	25.291 ±3.057
Final BW(Kg)	39.830 ± 4.457

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TWG (Kg)	14.539 ± 2.997
ADG (Kg/day)	0.173 ± 0.036
FCR	3.634 ± 0.687
FE	0.284 ±0.051

The growth parameters (Mean± SD) of Karadi male lambs under different dietary treatments are presented in Table 3. Initial body weight (BW) averaged 25.29 ± 3.057 kg across all lambs. At the end of the feeding period, the final BW was 39.830 ± 4.457 kg, corresponding to a total weight gain of 14.539± 2.997 kg. The average daily gain (ADG) was calculated as 0.173 ± 0.036 g/day. Feed conversion ratio (FCR) was 3.634 ± 0.687 and feed efficiency (FE) was 0.284 ±0.051 reflecting the overall feed utilization during the experiment. The findings demonstrate that lambs demonstrated normal growth throughout the study duration, with a rise in body weight from initial to final measurements. Variations were seen in weight increase, average daily gain (ADG), feed conversion ratio (FCR), and feed efficiency (FE) between the treatment groups. The body weights of Karadi male lambs recorded at thirteen time points are presented in Table 4.

Table (4) : Weekly body weight (kg) of Karadi male lambs fed diets supplemented with green cardamom powder.

Weeks	**C(Kg)**	**T1(Kg)**	**T2(Kg)**	**T3(Kg)**
0	25.400±1.011	25.233 ±1.586	25.200 ±1.212	25.340±1.661
1	24.800±1.018	25.483 ±1.730	25.750 ±1.147	25.940 ±1.865
2	26.233 ±1.230	26.933 ±1.939	26.400 ±1.675	28.220 ±2.201
3	26.383 ±1.449	27.383 ±1.596	27.267 ±1.361	28.540 ±1.829
4	28.700 ±1.295	28.250 ±1.778	29.867 ±1.743	30.280 ±1.868
5	28.742 ±1.730	28.483 ±1.907	30.417 ±1.285	30.880 ±1.860

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6	29.500 ±1.346	29.250 ±2.049	31.350 ±1.216	32.080 ±2.397
7	31.333 ±1.403	31.250 ±1.977	33.367 ±1.298	34.200 ±2.039
8	32.483 ±1.591	32.567 ±1.966	34.550 ±1.406	34.940 ±1.865
9	33.700 ±1.493	33.833 ±1.892	36.467 ±1.280	37.560 ±1.812
10	34.750 ±1.489	35.183 ±1.920	38.167 ±1.592	38.480 ±1.771
11	36.567 ±1.609	36.467 ±2.118	39.850 ±1.519	40.820 ±1.806
12	37.933 ±1.648	37.800 ±1.948	41.583 ±1.529	42.440 ±1.907

There is no significant difference (p>0.05) among treatments for that parameter.

Initial body weights(week 0) were similar across all treatment groups, ranging from(25.200 ±1.212 to 25.400±1.011) kg, with no significant differences ($p > 0.05$), demonstrating consistency at the start of the experiment. Body weights increased gradually in all groups over the thirteen measurement points, reflecting typical development in response to the dietary requirements. Final weights (week 12) were (37.933 ±1.648) kg for the control group (C), 37.800 ±1.948kg for T1, 41.583 ±1.529kg for T2, and 42.440 ±1.907kg for T3. Statistical analysis showed that there were no significant differences among the treatment groups at any measurement point ($p > 0.05$), indicating that all groups exhibited consistent responses throughout the experiment. Although T2 and T3 showed numerically higher weights than C and T1, these differences were not statistically significant. Overall, the data demonstrate normal growth of lambs under the experimental conditions, with no measurable impact of cardamom supplementation on body weight. The current investigation indicates that lambs receiving cardamom supplementation tended to have higher body weights, however these changes were not statistically significant, indicating potential species-specific responses, while some previous studies [17,18] reported no significant effects of herbal feed additives on growth in birds.

Growth performance parameters, including initial and final body weight, total gain, average daily gain (ADG), feed conversion ratio (FCR), and feed efficiency (FE), are summarized in Table 5.

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Table (5): Effect of green cardamom powder supplementation on growth performance of Karadi male lambs .

Growth performance	**C**	**T1**	**T2**	**T3**
Initial body weight(Kg)	25.400±1.011a	25.233 ±1.586 a	25.200 ±1.212 a	25.340±1.661a
Final body weight (Kg)	37.933 ±1.648 a	37.800 ±1.948 a	41.583 ±1.529 a	42.440 ±1.907a
Total weight gain (Kg)	12.533 ±1.407 b	12.567± 0.805b	16.383±0.607 a	17.100 ±0.593a
ADG (Kg/day)	0.149 ±0.017 b	0.150±0.010 b	0.195 ±0.007a	0.204 ±0.007a
FCR	4.128± 0.324 a	3.992 ±0.230 a	3.201± 0.129b	3.130± 0.160 b
FE	0.251±0.024 b	0.225 ±0.015b	0.315±0.011 a	0.323 ±0.017a

Values are presented as means. Means in the same row with different superscripts (a, b) are significantly different ($p<0.05$) according to Duncan's multiple range test.

The growth performance of Karadi male lambs during the experimental period is presented in the table5. Initial body weights were similar across all treatment groups, ranging from 25.20 to 25.40 kg, with no significant differences ($p>0.05$), ensuring uniformity at the start of the experiment. Final body weights increased in all groups, reaching (37.933 ±1.648) kg (C), 37.800 ±1.948 kg (T1), 41.583 ±1.529 kg (T2), and 42.440 ±1.907 kg (T3). Lambs in T2 and T3 achieved higher final weights and total weight gains (16.383±0.607 kg and 17.100 ±0.593 kg, respectively) compared to the control and T1 (12.533 ±1.407 kg and 12.567± 0.805 kg), indicating that higher levels of cardamom supplementation improved growth performance. Average daily gain (ADG) followed a similar pattern, with T2 and T3 showing higher values (0.204 ±0.007 and 0.195 ±0.007 kg/day) than C and T1 (0.149 and 0.150 kg/day), reflecting enhanced growth efficiency. Average daily gain and total weight gain were numerically higher in T2 and T3, these differences were either statistically significant, these finding are consistent with [21], who reported enhanced body weight gain and feed intake in broiler chicks supplemented with cardamom. Feed conversion ratio (FCR) was significantly lower in T2 and T3 (3.130± 0.160 and 3.201±0.129) compared with C and T1(3.992 ±0.230 and4.128± 0.324),

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indicating more efficient conversion of feed into body weight. Correspondingly, feed efficiency (FE) was higher in T2 and T3 (0.323 ±0.017 and 0.323 ±0.017 and) than in C and T1 (0.251±0.024 and 0.225±0.015).These findings are consistent with previous studies that reported beneficial effects of cardamom and its derivatives on animal performance. For instance, [19] observed a significant improvement in feed conversion ratio when cardamom essential oil was included in broiler diets. The improvements in growth performance observed in this study may be mainly attributed to 1,8-cineole, a bioactive compound in cardamom, which has been shown to positively affect intestinal structure and promote nutrient absorption in broilers [22]. The observed reduction in the feed-to-gain ratio is probably associated with enhanced intestinal morphology, which increases the efficiency of nutrient utilization. In line with this, 1,8-cineole supplementation has been reported to improves intestinal structure in broilers [23].

Conclusion :

Supplementation with green cardamom (Elettaria cardamomum) powder substantially influenced growth performance and feed utilization efficiency in Karadi male lambs. The treated groups, especially T2 and T3, exhibited markedly greater total weight increase, average daily gain (ADG), and feed efficiency, with a considerably reduced feed conversion ratio (FCR) in comparison to the control and T1 groups ($p < 0.05$). These findings suggest that, under the conditions of this study, green cardamom can be regarded as a useful natural feed supplement to improve lamb productivity.

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