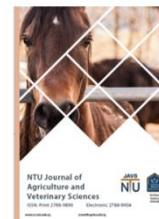




P-ISSN: 2788-9890 E-ISSN: 2788-9904

NTU Journal of Agricultural and Veterinary Sciences

Available online at: <https://journals.ntu.edu.iq/index.php/NTU-JAVS/index>



Investigation of the impact of incorporating vitamin E and rosemary leaf powder into the feed on the carcass characteristics and growth performance of Awassi sheep.

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Article Informations

Received: 09-04- 2025,
Accepted: 20-07-2025,
Published online: 28-03-2026

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Keywords:
Awassi,
Carcass traits.
Rosemary
vitamin E

ABSTRACT

This research was conducted in the fields of the College of Agriculture and Forestry/University of Mosul to study the effect of adding rosemary leaf powder and vitamin E to the feed on growth performance and carcass traits. 24 Awassi lambs were used at the age of 3-4 months and with an average weight of 21.75 kg. The lambs were fed throughout the experimental period on a standard feed consisting of concentrated feed and hay for a period of 90 days. After the preliminary period (14 days), the lambs were divided into four homogeneous treatments by weight. The first treatment was treated without adding any vitamin E, the second treatment was treated with 10 g/kg feed of rosemary leaf powder, the third treatment was treated with 300 mg/animal/day of vitamin E, and the fourth treatment was treated with 10 g/kg feed of rosemary leaf powder and 300 mg/animal/day of vitamin E for the duration of the experiment. The results showed that the best feed conversion efficiency was for the second and third treatments, and significant differences ($p \geq 0.05$) were observed in body weight at the sixth, tenth and twelfth weeks and final weight in favor of the second and third treatments. As for carcass traits, the third treatment was significantly superior ($p \geq 0.005$) in carcass width at the shoulders, kidney fat and heart fat, while no significant differences were observed in the remaining traits.



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How to Cite: Investigation of the impact of incorporating vitamin E and rosemary leaf powder into the feed on the carcass characteristics and growth performance of Awassi sheep. (n.d.). *NTU Journal of Agriculture and Veterinary Science*, 6(1).

Introduction

The growing demand for food, particularly red meat, along with rising feed prices in recent years, has led to a focus in recent studies on reducing feed costs and enhancing feed quality. This is accomplished by incorporating specific nutritional additives to create balanced feeds that fulfill the needs of animals [28]. Recent scientific research has increasingly explored the use of medicinal plants and herbs as nutritional additives in animal feed, given their significant benefits. These include boosting immunity [33], mitigating the toxic effects of aflatoxins [9], improving palatability, enhancing digestion and enzyme effectiveness in the bloodstream, and lowering cholesterol level [35]. Reducing the occurrence of digestive issues like diarrhea and bloating, as well as enhancing feed conversion efficiency [30], enhancing the rumen fluid environment and promoting daily weight gain in growing animals [9], and enhancing carcass quality [27] are all benefits of using medicinal plants in animal nutrition. Additionally, these plants are safe, palatable, and cost-effective. [12].

Rosemary (*Rosmarinus officinalis*) is an aromatic herb used in food as well as in medicine because it contains many active phenolic compounds [23], the most important of which are rosmanol, carnosal epirosmanol, isorasmanol, rosmaridiphenol, rosmaridiquinone, and phenolic acids such as rosmarinic acid and carnolic acid [29-23] Rosemary also has strong antioxidant properties, in addition to their anti-cancer, anti-inflammatory, and antibacterial properties [19]. Previous studies have indicated that adding rosemary to lamb diets had a positive effect on improving the quantitative and qualitative characteristics of lamb carcasses, leading to improved growth rates and feed conversion efficiency [25-21].

Vitamin E functions as an antioxidant by neutralizing free hydroxyl radicals, which helps prevent oxidation and serves as the primary defense against lipid peroxides [24]. It also protects unsaturated fatty acids in cell membranes from oxidation, thereby shielding cells and tissues from potential harm [22]. In addition to its role in growth, Vitamin E affects various bodily systems, immune function, and overall animal health [32].

Methods and Materials

Design and Subjects Used in Experiments

This study was conducted at the University of Mosul in the fields of the Animal Production Department, College of Agriculture and Forestry, from June 9, 2024, to December 14, 2024. It involved 24 Awassi

of vitamin E.

lamb, each averaging 3 to 4 months in age and weighing approximately 21.75 kg. The lambs were randomly divided into four equal treatment groups according to their weight, with six lambs in each group. The experimental treatments included a control group that did not receive any supplementation., second treatment included the addition of 10 g/kg feed of rosemary leaf powder, third treatment included the addition of 300 mg/lamb/day of vitamin E (TOCOMIX 500), and the fourth treatment included the addition of 10 g/kg feed of rosemary leaf powder and 300 mg/load/day

Lamb Nutrition

All lambs were fed a standard diet consisting of 68% barley, 18% wheat bran, 7.5% soybean meal, 4% wheat straw, 0.75% soda, 0.75% limestone, 0.5% urea, and 0.5% table salt. Additionally, each lamb was given a hay supplement of 150 grams per day. At the beginning of the experiment, concentrated feed was provided at a rate of 500 grams per lamb per day, which was gradually increased to 1500 grams per lamb per day by the end of the experiment, served in two meals—morning and evening, with water and mineral salts provided continuously throughout the study period. Lambs were weighed at the start of the experiment English-made (ELTER) scale using 150 kg capacity, and weighing continued every two weeks until slaughter, 100 days after the start of the experiment.

Carcass Measurements

Three lambs from each treatment group were slaughtered. The measurements taken included the hot carcass weight, external carcass length, internal carcass length of the left half after splitting the carcass, thigh length, and carcass width at both the shoulders and thighs, as well as carcass depth at the chest and the weight of the five ribs (9, 10, 11, 12, and 13) were recorded. The main and secondary carcass weights were also recorded which included weight fat tail weight kidneys weight spleen weight liver weight, heart weight, kidneys fat, pelvis fat, heart fat the weights of both the full and empty digestive systems were recorded. The dressing percentage was then calculated using both the live weight and the empty weight.

Analysis of Statistical Data

The statistical analysis was performed using a one-way completely randomized design. (C.R.D.) analysis of variance, employing the SAS statistical software (2003). This analysis aimed to assess the impact of treatments on the productive traits and carcass characteristics of lambs, following the specified mathematical model:

Where:

Y_{ij} = value of observations

μ = overall mean of observations

t_i = effect of treatment and i (control, rosemary leaf powder, vitamin E, rosemary leaf powder + vitamin E)

e_{ij} = effect of experimental error

Duncan's multiple range test was employed to assess significant differences between means [35].

Findings and Analysis

Consumption of alternative feed:

Table 1 presents the daily feed consumption rates of lambs. The data were not analyzed statistically due to group feeding. The results indicate that the third treatment had the lowest daily feed consumption compared to the other treatments, with daily consumption reaching (1.446, 1.438, 1.370, and 1.432) kg for the four treatments (control, rosemary, vitamin E, rosemary + vitamin E,) respectively. The total feed consumption rate for these treatments was 130,200, 129,475, 123,300, and 128,000 kg, respectively. The lower feed consumption in the third treatment may be attributed to the improved rumen fluid environment [9], Vitamin E is also an antioxidant, preventing the oxidation of unsaturated fatty acids found in cell membranes, thereby safeguarding cells and tissues from [22]. In addition to its impact on growth and many body systems. [12-11-16] noted that adding rosemary did not significantly affect the daily feed intake of lambs. [26] it was observed that incorporating vitamin E into the feed did not notably affect the daily feed intake of lambs. In contrast, [18] reported that adding 500 mg/kg of rosemary resulted in a significant reduction in the daily feed intake of lambs.

The results also indicated that adding rosemary, vitamin E, or their mixture had no significant effect on the total weight gain of lambs, which amounted to (17.35, 18.85, 18.83, and 16.02) kg for the four treatments, respectively. These results were consistent with the findings of [16], One study indicated that adding rosemary did not significantly impact the total weight gain of lambs. In contrast, [12-8-11-13] reported that rosemary supplementation had a notable effect on lamb weight gain. These findings align with those of [5-6-26], who also found that vitamin E did not significantly influence the total weight gain of lambs. According to the results presented in Table 1 The rosemary and vitamin E treatments showed the highest feed conversion efficiency, achieving rates of 6.987 and 6.695 kg of feed per kg of weight gain, respectively, compared to the control and mixture addition treatments, which reached (7.618 and 8.157), respectively [12-8-34-11] noted that adding rosemary led to a significant improvement in feed conversion efficiency. [15] confirmed Adding a combination of selenium and vitamin E improved the efficiency of feed conversion in lambs, which

had a positive role in the significant improvement in body weight rates before slaughter, and may also be attributed to the fact that rosemary contains active compounds Tannin plays a crucial role in promoting fermentation processes in the rumen and aiding in the digestion of nutrients, particularly protein. This enhances the amount of digestible protein available in the stomach or intestine [36]. However, studies by [16-6-5] found no significant impact of rosemary or vitamin E on feed conversion efficiency.

Body weight and weight gain:

The results of Table (2) showed that there was no significant effect of adding rosemary or vitamin E or their mixture on the weight of lambs at the second, fourth and eighth weeks of the study the results showed that the third treatment was significantly more effective ($P < 0.05$) than the fourth treatment regarding body weight at the sixth week, with weights of 31.20 kg and 27.90 kg, respectively. By the tenth week, both the second and third treatments also showed significant superiority. ($P < 0.05$) It reached 36.70 and 36.94 kg, respectively, compared to the control treatment and the fourth treatment, in which the body weight reached 35.40 and 35.04 kg, respectively. The significant superiority of the third treatment continued in the twelfth week compared to the control treatment and the fourth treatment, and the body weight reached 39.54, 37.20 and 37.00 kg, respectively. In the final weight, the second and third treatments recorded the highest weight of lambs, which reached 41.20 and 41.08 kg, respectively, while the lowest reached 39.90 and 38.42 kg for control and fourth treatments, respectively, but the differences were not significant. The increased weight gain observed in lambs during the second and third treatments may be due to Rosemary's strong antioxidant properties, as well as its anti-inflammatory and antibacterial effects. [19]. Its addition to the feed improved feed conversion efficiency and consequently improved lamb growth rates [21]. The superior body weight of the third treatment may also be due to the role of vitamin E in increasing appetite and feed consumption efficiency [38-11-13-4] found that incorporating rosemary as a nutritional additive in lamb feed significantly increased their weights. In contrast, [34-18] did not observe any significant effects of rosemary on lamb weights. On the other hand [33-15] reported that the combination of vitamin E and selenium led to a notable improvement in lamb weights. [7-6] found no significant impact of adding vitamin E to the feed on lamb weights.

Carcass measurements:

The results of the study indicated that the third treatment (vitamin E) There was a significant superiority ($P < 0.05$) of the control treatment regarding the width of the carcass at the thighs, reaching 23.00 and 21.77 cm, respectively (Table 3). This superiority may be attributed to vitamin E

ability to improve animal production performance [5-24]. confirmed that adding vitamin E to the feed improves the quality of the carcass. Similar results were obtained by [37], who noted that adding vitamin E to the feed led to an improvement or increase in carcass dimensions. On the other hand, the results of the study showed that adding rosemary, vitamin E, or their mixture to lamb rations did not significantly affect the length of the external carcass, the length of the internal carcass, the width of the carcass at the shoulders, the length of the thigh, and the depth of the carcass at the chest, and rib weight. This study agreed with the findings of [31-26-12-34-18-5-6], who found no significant differences in carcass dimensions when rosemary or vitamin E were added to lamb rations.

Carcass characteristics:

Table 4 indicates that the third treatment yielded the following results. (adding vitamin E) significantly ($P < 0.05$) superiority in kidney fat and heart fat, which amounted to 283.67 and 73.33 g. respectively compared to the rest of the treatments in which kidney fat amounted to 135.00, 99.00, and 119.67 g. for the control, rosemary, and mixture (rosemary + vitamin E) treatments, respectively. While [7] noted that adding 500 IU/head/day of Adding Vitamin E to the diet of lambs resulted in a notable reduction in kidney fat compared to the control group. The second and third treatments also significantly ($P < 0.05$) The liver weights for the treatments were 107.33 g and 105.33 g, respectively, outperforming the fourth and control treatments, which recorded weights of 96.00 g and 70.33 g. However, the study found no significant impact from adding rosemary, vitamin E, or their combination on various parameters, including the weight of the hot carcass, tail, kidneys, spleen, heart, pelvic fat, as well as the full and empty digestive systems. Additionally, there was no effect on the dressing percentage based on live weight or the dressing percentage based on the empty weight of the lambs. These results are consistent with the findings of [31-26-8-18-5] and Pinto et al. (2011), who found no significant impact from the addition of rosemary or vitamin E on these traits.

Conclusions

This study concludes that adding rosemary leaf powder or vitamin E to lamb rations improves lamb weight and feed conversion efficiency. Rosemary leaves are safe, palatable, and inexpensive to feed to lambs. Adding vitamin E improves some carcass traits, and the inclusion of these ingredients did not adversely affect the health of Awassi lambs.

Acknowledgments

The researchers would like to thank the College of Agriculture and Forestry and the University of Mosul for their assistance and support in completing this study.

References

- [1] Al-Saigh, M. N. (2012). Effect of Using Zingiber officinale and Vitamin E on some Reproductive traits of Awassi Male Lamb: Mudhaffar NR Al-Saigh1 and Saad Th. J. Al-Rawi2. *The Iraqi Journal of Veterinary Medicine*, 36(0A), 134-141.
- [2] Al-Fityin, M. H. S. (2009). Effect of adding Eruca Sativa Seeds and Vit. E. on the diet of mal Awassi lambs on same production traits: Manhal Habib Salman Al-Fityin; Mudhaffer Nafic ALSaig. *The Iraqi Journal of Veterinary Medicine*, 33(2), 50-61.
- [3] Al-Saadi, Y. M., Al-Samarace, W. H., Al-Waeli, S. N., & Al-Tamemmy, M. J. H. (2020). Effect Of Different Levels Of Black Seed (*Nigella Sativa*) And Rosemary (*Rosmarinus Officinalis*) Supplementation On: Some Characteristics Of Awassi Lambs Meat. *Iraq Journal Of Agricultural Research*, 25(1).
- [4] Al-Shibawi, J. A. A., Al-Yaseri, A. J., Al-Dhalimi, H. M. K., & Al-Gharawi, J. K. M. (2022). Effect of rosemary and licorice powder in the diet on some carcass traits of local goats. *Revis Bionatura*, 8 (1) 72.
- [5] Atay, O. K. A. N., Gökdal, Ö. Z. D. A. L., Eren, V. A. D. U. L. L. A. H., Çetiner, Ş. E. V. K. İ., & Yikilmaz, H. (2009). Effects of dietary vitamin E supplementation on fattening performance, carcass characteristics and meat quality traits of Karya male lambs. *Archives Animal Breeding*, 52(6), 618-626.
- [6] Pinto, A. P. P., Furusho-Garcia, I. F., Leopoldino Júnior, I., Olalquiaga Pérez, J. R., Alves, N. G., & Pereira, I. G. (2011). Performance and carcass characteristics of lambs fed diets with fat and vitamin E. *Revista brasileira de zootecnia*, 40, 2911-2921.
- [7] Sami, A. S., & Shehata, M. F. (2006). Effect of dietary vitamin E supplementation on meat production related traits of Barki lambs. *Egyptian Journal of Animal Production*, 43(1), 49-56.
- [8] Yagoubi, Y., Hajji, H., Smeti, S., Mahouachi, M., Kamoun, M., & Atti, N. (2018). Growth performance, carcass and noncarcass traits and meat quality of Barbarine lambs fed rosemary distillation residues. *Animal*, 12(11), 2407-2414.
- [9] Abdalhamid, A.M.; A.E. Sallam; G.A. Abd Allah and S.H. El-Samra (2002). Effect of feeding male rates on aflatoxic diets without or with medicinal herbs (thyme, safflower, ginger, black cumin and/or garlic). *Proc. 2nd Conf. Food born Contamination and Egyptian's Health*, 23-24 April, El-Mansoura, Egypt, p: 99-121.
- [10] Abdullah, M. N., Mohammed, O. D., Abbo, N. Y., & Yousef, S. I. (2019). Effect of partial replacement of barley grain with wheat bran in the ration and some feed additive on growth and some carcass traits of Awassi lambs. In *Journal of Physics: Conference Series* (Vol. 1294, No. 9, p. 092027). IOP Publishing.
- [11] Allam, S., & El-Elaim, R. R. (2020). Impact of garlic, lemongrass, pepermint and rosemary as feed additives on performance of growing Barki lambs. *Egyptian Journal of Nutrition and Feeds*, 23(3), 359-367.
- [12] Al-Samarace, W. H., Al-Tamemmy, M. J. H., Al-Waeli, S. N., & Al-Saadi, Y. M. (2017). Effect of different levels of black seed (*nigella sativa*) and rosemary (*rosmarinus officinalis*) supplementation on

- growth and some carcasses characteristics of awassi lambs. Iraq Journal of Agricultural Research, 22(4).
- [13] Bıyık, F., Biricik, H. A. K. A. N., Ürkmez, E., Kara, C., Cetin, I., & Udum, D. U. Y. G. U. (2023). Effects of rosemary essential oil as a feed additive on performance, rumen fermentation, and blood parameters in preweaning Holstein calves.
- [14] Choct, M., & Naylor, A. J. (2004). The effect of dietary selenium source and vitamin E levels on performance of male broilers. Asian-Australasian journal of animal sciences, 17(7), 1000-1006.
- [15] Dhari, E. A., & Kassim, W. Y. (2019). Effect of Adding Selenium with or Without Vitamin E and Combination of them on some of Productive and Physiological Characteristics of Awassi Lambs. Basrah Journal of Agricultural Sciences, 32(2), 115-125.
- [16] Farghaly, M. M., & Abdullah, M. A. M. (2021). Effect of dietary oregano, rosemary and peppermint as feed additives on nutrients digestibility, rumen fermentation and performance of fattening sheep. Egyptian Journal of Nutrition and Feeds, 24(3), 365-376.
- [17] Gabryszuk, M., & Klewicz, J. (2002). Effect of injecting 2-and 3-year-old ewes with selenium and selenium-vitamin E on reproduction and rearing of lambs. Small Ruminant Research, 43(2), 127-132.
- [18] Güney, M., Karaca, S., Erdogan, S., Kor, A., Kale, C., Onalan, S., ... & Bingol, N. T. (2021). Effects of dietary supplementation with rosemary oil on methanogenic bacteria density, blood and rumen parameters and meat quality of fattening lambs. Italian Journal of Animal Science, 20(1), 794-805.
- [19] Habtemariam, S. (2016). The therapeutic potential of rosemary (*Rosmarinus officinalis*) diterpenes for Alzheimer's disease. Evid. Based Complement. Altern. Med., , p. 14 Article ID 2680409 (pages).
- [20] Hashem, A. L. S; Shakir, Y. M; Abdel-Fataah, M. S; Hanan, Z. and Ashgan, M E. (2013). Effect of weaning age on growth performance and carcass traits of Barki lambs in Siwa Qasis. Egypt. World Applied Sci. J., 21:975-982.
- [21] Hassan, S. A. (2008). Effect of some medicinal plants supplementation on daily intake, live weight gain and carcass characteristics of Awassi lambs. accepted for publication in Egyption J.Nutr.and Feed.
- [22] Lewis, E. D., Meydani, S. N., & Wu, D. (2019). Regulatory role of vitamin E in the immune system and inflammation. IUBMB life, 71(4), 487-494.
- [23] McCarthy, T. L.; J. P. Kerry; J. F. Kerry; P. B Lynch and D. J. Buckley (2001). Evaluation of the antioxidant potential of natural food /plant extracts compared with synthetic antioxidants and vitamin E in raw and cooked pork patties. Meat Sci., 57:45-52.
- [24] McDowell, L. R., Williams, S. N., Hidiroglou, N., Njeru, C. A., Hill, G. M., Ochoa, L., & Wilkinson, N. S. (1996). Vitamin E supplementation for the ruminant. Animal Feed Science and Technology, 60(3-4), 273-296.
- [25] Mohamed, A. H.; M. Nadia; Abd El-Bar and K. Ibrahim (2005). Influence of some medicinal plants supplementation:2- Lamb performance, carcass properties and mutton meat quality. Egyptian J. Nutrition and Feeds 8(1) Special Issue:445-460.
- [26] Mohammad, A. M., Abdullah, D. S., & Al-Saige, M. N. (2015). Effect of The Shearing Use and Vitamin E to Reduce The Impact of Stress on The Measurements and Carcass Characteristics in Lambs Awassie. Tikrit Journal for Agricultural Sciences, 15(3).
- [27] Morteza, K.; A. Abd-Razak; Y. Goh; Q.S. Awis and M. Ivan (2010). Effects of dietary herbal antioxidant supplemented on feedlot growth performance and carcass composition of male goats. Amer. J. Anim. & Vet. Sci., 5 : 33.
- [28] Rodrigo, B. C., D. R., S., GA., A., J.V., R., S.L., C., B., A. and G.P., (2021). Effect of Feeding Frequency on Intake, Digestibility, Ingestive Behavior, Performance, Carcass Characteristics, and Meat Quality of Male Feedlot Lambs, Agriculture.
- [29] Senorans, F. J., Ibanez, E., Cavero, S., Tabera, J., & Reglero, G. (2000). Liquid chromatographic-mass spectrometric analysis of supercritical-fluid extracts of rosemary plants. Journal of Chromatography A, 870(1-2), 491-499.
- [30] Shehata, E.I., F.H. Abd El-Rasoul, Egyptian Zaraibi does and their new born kids. Egypt. J. sheep and goats Sci., 2: 111.
- [31] Smeti, S., Atti, N., & Mahouachi, M. (2013). Effects of rosemary extracts incorporation on Barbarine lamb's growth and carcass characteristics. Options Méd A, 107, 219-222.
- [32] Soliman, E. (2015). Dose-response of vitamin E and selenium injection on growth performance, physiological and immune responses of Ossimi lambs. Egypt. J. Sheep Goats Sci.; 10(1): 27-40.
- [33] Tawfik, S.A.; M.E. Ahmed; E.I. Shehata and O.B. El-Gazzar (2005). Effect of adding chamomile flowers to aflatoxins containing diet on growth performance, rumen parameters and some blood components of growing lambs 4th Inter. Sci. Conf. Mansoura.
- [34] Yagoubi, Y., Smeti, S., Ben Saïd, S., Srihi, H., Mekki, I., Mahouachi, M., & Atti, N. (2021). Carcass traits and meat quality of fat-tailed lambs fed rosemary residues as a part of concentrate. Animals, 11(3), 655.
- [35] Steel, R. G. D. and J. H. Torrie, (1984). Principles and procedures of statistics. 2nd Ed., McGraw-Hill Co., New York, USA.
- [36] Al-Fayyadh, D. Z., Hasson, A. A., Hussein, A. K., & Hassan, R. K. (2020). Effect of humic acid spray on growth characteristics of wheat varieties. Journal of Life Science and Applied Research, 1(1), 13-24.
- [37] Zayed, Z., & Estuty, N. (2022). Effects of dietary vitamin e on growth performance, carcass characteristics, lipid oxidation and vitamin E content in meat and liver of Mahali goat in Libya. Assiut Veterinary Medical Journal, 68(174), 1-9.
- [38] Shetawi, M. M., H. A. Daghash and T. S. Abd El-All. 1992. Growth performance, hematology and serum profiles of coarse-wool lambs as influenced by supplemental vitamin E. Assiut Vet. Med. J.

Table 1. Effect of vitamin E and rosemary on body weight, weight gain and conversion efficiency in lambs (kg).

Traits/ Treatment	Daily feed consumption rate	Total feed consumption rate	Total gain	Food conversion efficiency
Control	1.446	130.200	17.35 a	7.618
Rosemary	1.438	129.475	18.85 a	6.987
Vitamin E	1.370	123.300	18.83 a	6.695
Rosemary + vitamin E	1.422	128.000	16.02 a	8.157

Letters that are vertically aligned suggest that there are no significant differences between the treatments.

Table 2. The effect of adding vitamin E and rosemary on the total and daily weight gain of Awassi lambs (kg).

Traits- Treatment	Control	Rosemary	Vitamin E	Rosemary vitamin E
Initial BW	22.55±1.04a	22.35±0.69 a	22.25±1.33 a	22.40±1.33 a
Week 2	24.40±0.76a	24.50±0.55 a	24.60±0.81 a	24.60±1.08 a
Week 4	26.60±0.58 a	27.90±0.91 a	28.08±1.01 a	26.30±1.30 a
Week 6	29.10±0.71ab	29.80±1.18 ab	31.20±0.82 a	27.90±1.18 b
Week 8	31.70±0.66 a	33.20±1.10 a	33.60±0.76 a	32.24±1.22 a
Week 10	35.40±0.48 b	36.70±0.22 a	36.94±0.50 a	35.04±0.34 b
Week 12	37.20±0.73 b	38.40±0.73 ab	39.54±0.49 a	37.00±0.32 b
Final BW	39.90±0.56ab	41.20±0.86 a	41.08±0.59 a	38.42±0.51 b
Overall gain	17.35±1.11 a	18.85±1.30 a	18.83±1.31 a	16.02±1.12 a
Daily gain	0.17±0.01 a	0.19±0.01 a	0.19±0.01 a	0.16±0.01 a

Different letters placed horizontally signify significant differences ($P < 0.05$) among the transactions.

Table 3. The impact of rosemary and vitamin E supplementation on carcass measurements (cm).

Traits- Treatment	Control	Rosemary	Vitamin E	Rosemary + vitamin E
External carcass length	73.00±0.58 a	71.00±1.45a	72.50±1.04a	71.17±1.17a
Inner carcass length	61.00±1.53 a	61.67±1.48a	61.33±0.67a	60.83±1.64a
Thigh length	30.00±0.58 a	30.33±0.67a	29.17±0.60a	28.83±0.44a
Shoulder carcass width	25.53±1.86 a	25.67±0.33a	26.50±0.29a	26.33±1.01a
Thigh carcass width	21.77±0.12 b	22.53±0.23ab	23.00±0.29a	22.33±0.33ab
Carcass chest depth	28.70±0.66 a	28.00±0.76a	28.00±0.76a	28.50±0.87a
Ribs weight (9-10 11-12-13)	853.67±15.30a	853.00±17.00a	883.33±8.41a	865.33±8.41a

Different letters placed horizontally signify significant differences ($P < 0.05$) among the transactions.

Table 4. The impact of rosemary and vitamin E supplementation on carcass characteristics.

Different letters placed horizontally signify significant differences ($P < 0.005$) among the transactions.

Traits- Treatment	Control	Rosemary	Vitamin E	Rosemary+vitamin E
Weight hot carcass(kg)	23.53±1.62a	23.42±1.01a	23.33±1.26a	22.37±0.69a
Weight Fat tail(g)	4070.33±353.1a	4030.67±638.04a	4090.00±257.03a	4052.67±438.21a
Weight Kidney(g)	114.67±6.44a	108.00±6.03a	118.00±14.15a	113.33±8.45a
Weight spleen(g)	70.33±2.60c	107.33±3.48a	105.33±1.86a	96.00±3.21b
Weight liver(g)	869.00±48.26a	949.33±45.68a	796.00±71.00a	804.33±54.89a
Weight Heart(g)	163.33±6.23a	179.00±11.02a	167.00±9.85a	165.00±8.39a
fat Kidney(g)	135.00±34.24b	99.00±9.54b	283.67±56.55a	119.67±20.02b
Pelvis fat(g)	347.67±65.09a	304.00±45.76a	359.00±10.79a	244.67±66.04a
Heart fat(g)	42.00±4.04b	43.67±6.17b	73.33±7.75a	31.33±3.48b
Digestive filled(g)	4754.00±326.15a	4769.33±522.99a	4240.33±272.22a	4162.00±490.39a
Empty digestive(g)	1847.67±87.03a	1694.33±199.68a	1762.67±147.79a	1601.00±135.66a
Dressing % (BW live)	53.39±0.87a	55.29±1.84a	54.64±0.95a	56.10±0.93a
Dressing % (BW empty)	57.16±1.12a	59.60±1.55a	57.99±1.16a	59.93±0.63a