Effect of Adding Ginger Roots Powder and Vitamin E and their Synergistic Interaction between them to Ingredients of the Pellet Concentrated Rations on Productive Performance and Some Characteristics of Carcass of Awassi Lambs

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Abstract

To find out effects of adding ginger roots powder and vitamin E and mutual synergy between them on productive performance and some carcass features of Awassi lambs. An experimement was conducted at animal farm designated for raising sheep of the Department of Animal Production/College of Agriculture and Forestry, University of Mosul. Twenty-four of Awassi lambs (males) were selected homogeneously with average of initial weight (27.250-27.525 kg) and close in age (5.5-6 months) at the beginning of experiment. The fattening diet was prepared as a peleted ration free of feed additives (control diet).While ginger roots powder was added at a rate of 20 gm/kg dry matter to the second ration and vitamin E was added at a rate of 200 mg/kg to the third diet's components.As for fourth treatment a mixture of 20 gm of ginger roots powder and 200 mg of vitamin E was added to concentrate pelleted. The lovable concentrated diets of Awassi lambs were provided with uniform protein level (15.59%) and metabolize energy level (2750 Kcal) during fattening period (90 day). The current study found that lambs treated with the experimental treatments had significantly higher rates of final weight, daily gains, and total weight than lambs treated with the control treatments. The rates of final weight were 45.475, 48.167, 49.410, 51.512 kg, daily weight gain was 199, 232, 244, 268 gm/day and total weight gain was 17.983, 20.917, 21.978, 24,205 kg/head for four treatments respectively. In terms of carcass features, the results demonstrated a highly significant improvement (P≤0.01) on an averages of hot and cold carcasses weights was in favor of lambs treated with ginger, vitamin E, and a synergistic treatment between them as compared to lambs given with a control treatment. The averages of hot carcass weights were 20.983, 24.545, 25,711, 27.580 kg, and cold carcass weights were 20.515, 24.177, 25.325, 26,994 kg for four treatments respectively.While the current study found a substantial superiority (P≤0.05) on rates of ocular muscle area and significant decrease on fat under skin thickness which was comparison to the control group.

Key Words: Ginger Roots Powder, Vitamin E, Productive Performance, Carcass Traits, Awassi Lambs.

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As for dressing percentage that calculated by two methods, there were significant differences between control treatment than combined treatment between ginger roots powder and vitamin E. In addition, adding ginger root powder and vitamin E to the diet had moral (P≤0.05) effect on average weights of legs, ribs, and shoulders as main cuts and neck, chest weights as secondary cuts of Awassi lamb sacrifices. We conclude from this study that inclusion of ginger roots powder and vitamin E in the diets for growth and fattening of Awassi lambs resulted in a significant superiority on growth and daily and total weight gain, as well as a significant improvement on hot and cold carcass weights, Carcass cutting weights, and eye muscle area, despite a significant decrease in subcutaneous thickness.

Key Words: Ginger Roots Powder, Vitamin E, Productive Performance, Carcass Traits, Awassi Lambs.

Introduction

Most medical studies have confirmed need to return to medical plants and attention as a safe source as an alternative medical treatment without side effects on public health (Ali et al., 2008). Why do some herbs or vegetarian parts are highly urgent in therapeutic uses both for man and for women (WHO, 1999). Most of studies (Al-Zubaidi, 1996, Roiha, 1999 and Shofali, 2003) have found good results in farm animals by using some medicinal plants as feed additives because of their positive effects in raising productive efficiency of farm animals and supporting national income in indirect ways (Al-Rawi, 2008, Al-Moussawi, 2009, Al-Saady, 2010, Al-Jobory, 2011, and Ramzi, 2010). In addition to being growth stimulants (Antaki, 2006). It using of medicinal herbs as feed additives is one of methods that can be used to increase production and raise the immune resistance of field animals (Al-Rawi, 2008, Al-Moussawi, 2009, Hadi, 2009 and Dakhil, 2010). Appetite and improve the efficiency of food conversion (Vatyavanich et al., 2001). Moreover it has an anti-inflammatory effect and joint pain (Rebild, 2002) and improve digestion that leads to an increase in body weight (Al-Fityan, 2009), ginger rhizomes contain 10% moisture, 8.5% CP(crude protein), 36% EE (ether extract), 7.8%ash, 2.4% CF(crude fiber) (Mabey, 1988 and Shams El-Din et al., 2018). Also, ginger contains some fatty and amino acids and volatile oils that give it a pungent taste. Where it was found that ginger stimulates digestive system to increase digestion and absorption and stimulates the enzymes lipase, sucrase and maltase (Erust and Peter, 2000). Asker et al., 2021 noted that adding ginger roots to feeding rations of Awassi ewes leads to activating the body's immune system, eliminating pathogens, and improving the animal's health status, as it reduces cholesterol in blood because it contains oleoresin, which reduces level of cholesterol in intestines and increases its excretion as a result of secretion. In addition, ginger was used as feed additives in sheep and goat diets, resulting in weight increases in animals used, as it has an effect in increasing appetite and improving daily intake (Al-Moussawi, 2009) which is positively reflected to increase in animal weights and thus leads to improving productive and physiological characteristics of Awassi sheep (Al-Rawi, 2008). In this regard, Shams El-Din et al., (2018) found that adding ginger roots powder to the fattening ration of lambs resulted a significant increase on daily and total weight, as well as led to improve feed conversion efficiency for the ginger roots powder-treated lambs compared to the control group. Another study, Asker et al., (2020) found that adding ginger to Awassi sheep's growth rations at levels of 10, 20, 30 gm resulted a substantial decrease on levels of AST and ALT enzymes of lambs blood which treated with ginger roots to compared with control treatment.As for vitamin E, it is one of the most antioxidants for fats in tissues and plasma, as it traps free hydroxyl radicals and thus provides first line of protection from lipid peroxides (McDowell et al., 1996). This vitamin do make protects unsaturated fatty acids, especially those found in cell membranes and tissues against oxidation of free radicals (Morrissey et al.1998). It was found that this vitamin prevents the hemolysis and breakdown of red blood cells. Therefore, the need for vitamin E is proportional to amount of unsaturated fatty acids present in feed intake, especially unsaturated linoleic acid, which is one of the essential acids for body (Al-Zuhairy, 2000). Grundy (1999) has shown that giving vitamin E in animal ration contributes to improving the animal's immunity, productive and reproductive performance, and addition, it helps in formation, growth and development of fetuses during the stages of females pregnancy. Therefore, ginger and vitamin E under current study are considered nutritional additives necessary for growth and fattening of sheep, as ginger stimulates digestive enzymes such as lipase enzymes, sucrase and maltase (Erust and Peter, 2000) to activate the

processes of digestion, absorption and immune defense system of body and eliminate pathogens and thus improve situation Animal health (Asker et al., 2020). Thus, it achieves high weight increases of animals used, because it has an effect in increasing appetite and improving daily intake (Al-Moussawi, 2009). Vitamin E is found in the composition of enzymes that contribute to red blood cell production and prevents red blood cell breakdown and destruction in cell and tissue membranes. Also it participates in protecting vital membranes and enzymes from danger of free radicals, oxidation, cholesterol and triglycerides (Choct et al., 2004). Whereas, common synergy between them (ginger and vitamin E) leads to achieving high weight gain in animals and improving their productivity through improving productive and physiological characteristics of sheep (Al-Rawi, 2008). Therefore, it is necessary to add ginger and vitamin E to the diet in order to improve productive performance of lambs. Where lack of addition of ginger or vitamin E in sheep's diet leads to changes in animal behavior as well as in blood components (Ebrahim et al., 2016).

The goal of this study is to see effects of adding ginger root powder and vitamin E to the diet on productive performance and carcass features of Awassi lambs.

Materials and Work Methods

The current experiment was implementedt on (24) Awassi lambs (males) at sheep hall of the animal production field linked with the Department of Animal Production,College of Agriculture and Forestry/University of Mosul, The lambs were placed under veterinary care from first day under the supervision of veterinarian, as they were examined at beginning of experiment to ensure that they were free of diseases. An integrated preventive program was allocated to them to ensure the safety of animals throughout the experiment period. The lambs were homogeneous in age and close in rates of initial weight for four treatments: 27,492, 27,250, 27,442 and 27,442 kg, respectively. The lambs were then randomly divided into four groups as follows:

Control treatment (first group): Awassi lambs ate basal diet every day, manufactured in form of pelleted feed, free of feed additives and vitamin E.

The second treatment: Awassi lambs ate basal ration to which ginger roots powder was added at an amount of (20 gm/kg dry matter) manufactured in form of pelleted feed on a daily basis.

The third treatment: Awassi lambs ate standard diet, which was added vitamin E in amount of (200 mg/kg dry matter) manufactured in form of pelleted feed on a daily basis.

The fourth treatment: Awassi lambs ate standard ration to which a mixture was added (20 gm of ginger roots powder + 200 mg of vitamin E) manufactured in form of pelleted feed on a daily basis.

As a result, each group will receive its individual treatment. The initial weights were statistically analyzed to confirm that there were no significant disparities in averages of initial weights'.The process of measuring initial weights of lambs was carried out at beginning of the experiment by using a disc scale with a capacity of 150 kg equipped with an iron cage and this initial weight was counted and weighing process continued periodically every (14) days until the end of experiment period. In the form of pelleted feed during experiment period of 90 days preceded by preliminary period of two weeks to gradually adapt rumen neighborhoods to new food.The experimental treatments included feeding ofAwassi groups on a concentrated standard ration made in form of pelleted ration at Kosar Company for feed industry was called control group. In the second treatment, ginger roots powder was added at an amount of 20 gm/kg of dry matter in basal ration in form of pelleted feed to lambs feed of second group on a daily basis, as well as third treatment, 200 mg of vitamin E/kg dry matter was added in standard diet to be used in feeding of the third group lambs. The fourth treatment, was containing mixture was added (20 gm ginger roots powder + 200 mg vitamin E/kg dry matter with same time periods mentioned above. The feeding was continued on four diets for fattening period (90 days) The feed was served on a daily twice, the first at 8 o'c.a.m. and the second at 4 o'c.p.m to ensure that animals consumed allocated quantity of four rations and the next day before serving the morning meal remaining fodder was collected from each grouped separately and weighed with a feed scale to calculate the amount of feed consumed.

All lambs fasted for 12 hours before slaughter at the end of the trial and their live weight before slaughter was recorded to reflect the final weight after which the lambs were slaughtered. The weights of the hot and cold sacrifices were recorded according to was mentioned in Al-Mahdawi (2002) and Netto et al., (2013). The

buttocks were then removed, the weight of tail was recorded and the carcasses were cuts into main parts (thigh, cotton, ribs, and shoulder) and minor parts (neck, chest, flank, and forearm) as indicated by Abdul Rahman et al.,(2013).The dressing ratio was computed using with two methods: the first was based on living weight, and the second was based on empty body weight (Al-Jalili et al. 1985, Gardner et al., 2015) according to Rouse et al.,(1970) and Yacoub et al.(1987). The area of ocular muscle at the eleventh rib was measured on a cut between the tenth and eleventh ribs and thickness of subcutaneous fat of the three ribs area was measured an average of three readings with a small transparent ruler.

The Experiment Design and Statistical Analysis

The data was analyzed using a Completed Randomized Design (C.R.D.) according to Al-Zubaidy and Al-Falahy, (2016) in order to determine the effects of adding ginger roots powder and vitamin E, as well as their mixture, to a regular concentrate ration in the form of pelleted feed.The Duncan test (1955) polynomial was used to find out the significant differences between the averages of the studied traits, which was done using a computer system and a statistical program (SAS, 2012).

Table 1. Components of oncentrated pellet ration and chemical analysis

Respect	Components (%)	Percentage
1	Barley grains.	30
2	Yellow corn,	23
3	Wheat bran	23
4	Soybean meal.	13
5	Wheat flour	06
6	Wheat straw	03
7	Calcium carbonate.	01
8	Salts.	01
Total		100%
Chemical analysis*		
1	Dried matter (%)	90.33
2	Crude protein (%)	15.59
3	Crude fat (%)	1.99
4	Crude fiber (%)	8.37
5	Ash (%)	5.31
6	Nitrogen Free Extract (%)	59.07
7	Metabolize Energy (Kcal/kg)	2750

*Laboratory analysis of feed according to feed manufacturer (Kosar Agriculture and Poultry Company).

Results and Discussion

The results of the studied traits data were tabulated as follows

Performance and Growth of Awassi Lambs

From results observed in table (2) shows that the rates of initial weight of Awassi lambs were completely homogeneous at the start of the experiment. An averages of primary weight were 27,492, 27,250, 27,432, and 27.525 kg. The weights of lambs at the start of the trial were the same in terms of weight, size, and age. In terms of final weight rates and daily total weight gain in Awassi lambs, the statistical analysis presented in table (2) revealed that experimental treatments (ginger roots powder, vitamin E, and a combination of the two) were superior in averages of final weight, daily and total weight gain and were in favor of the experimental treatments (ginger roots powder, vitamin E, and a mixture of the two) when compared to the control treatment of lambs was fed a diet free of feed additives (ginger roots and vitamin E). The statistical analysis revealed that there were highly significant differences (P≤0.01) between the joint synergy treatment (ginger roots and vitamin E) and the control treatment, but no significant differences on average of final weight, daily and total weight gain between first three treatments and the last three treatments.The rates of final weight of lambs were 45.475, 48.167, 49.410, 51.512 kg and daily weight gain was 199, 232, 244 and 268 gm, and total weight gain was 17.983, 20.917, 21.978, and 24.205 kg for four treatments.The results in table (2) shows that experimental treatments (second, third, and fourth) were significantly (P≤0.05) on rates of final weight, daily, and total weight increases for lambs receiving ginger root powder, vitamin E, or a combination of the two, when compared to the control group.The addition of ginger roots in diet of the second treatment was improving the appetite from lambs by increasing feed intake because ginger roots contain some ingredients called (Aryl akanes) which was one of the active ingredients of ginger which gives a pungent taste which increases appetite of lambs by increasing amount of feed consumption.Tilgner (1999) and Shams El-Din et al. (2018) both found that increasing of feed intake which leads to improve daily weight gain and final weight of lambs. On the other hand, the presence of vitamin E in the third treatment may have played a key role activating a processes of nutrient

absorption into body tissues, leading to an increase protein tissue deposition of animal's body, as evidenced by improvement in daily and total weight gain of lambs treated with vitamin E. (Abdi, 2006, Koyuncn and Yerlikaya, 2007). Also, The combination of (ginger roots + vitamin E) by lambs that to improve animals appetite, leading to an increase of feed intake, which in turn leads to strengthening of protein tissues of body tissues which resulting a significant increase on final weight, total weight gain of Awassi lambs (Al-Rawi et al 2004). The statistical analysis revealed that there were no significant changes between the four treatments on empty body (table 2) for the four treatments. The average empty body weight was 43.378, 45,703, 46.457 and 46.608 kg, respectively. Due to the group feeding of lambs during the trial period, the features of amount of feed intake and efficiency of feed conversion for four treatments were not statistically examined. The results of feed intake were 1.467, 1.525, 1.540, and 1.665 kg/day/lamb, respectively. The feed conversion efficiency for the four treatments was 7.35, 6.56, 6.31, and 6.19 kg feed/kg weight gain, respectively. The findings of this study are consistent with other (Al-Moussawi, (2009) and Shams El-Din et al., (2018), who found significant differences in the rates of daily and total weight increase for lambs fed a ginger root powder diet compared to the control group. Also, Abdi (2006), Thamer et al. (2020), and Al Joulaq (2020) found significant differences on rates of daily and overall weight increase for lambs dosed with vitamin E compared to the control group. The findings contradict Noaman and Shujaa (2016) and Noaman, (2018), who found no significant effect of adding ginger powder to the diet on rates of daily and total weight gain for Awassi lambs, and then contradict Al-Mallah et al., (2011) and Mohammed et al., (2015), who found no significant effect of adding vitamin E to the diet on rates of total daily weight gain compared to the control group.

Table 2. Effect of addition ginger roots powder and vitamin E and their mixture on productive performance of Awassi lambs

The studied traits	1st treatment (control)	2nd treatment (ginger roots powder)	3rd treatment (vitamin E)	4th treatment (ginger roots powder + vitaminE)
1. Number of lambs:	6	6	6	6
2. Initial weight^{NS} (kg).	27.492 ± 1.16A	27.250 ± 0.40 A	27.432 ± 0.40 A	27.525 ± 0.66 A
3. Final weight (kg).**	45.475 ± 1.56 B	48.167 ± 1.28 AB	49.410 ± 0.87 AB	51.512 ± 1.30 A
4.Empty body weight (kg)^{NS}	43.378 ± 3.35 A	45.703 ± 1.48 A	46.457 ± 0.53 A	48.608 ± 0.98 A
5.Daily weight gain (gm/day)**	199 ± 27.29 B	232 ± 16.15 AB	244 ± 12.20 AB	268 ± 11.34 A
6.Total weight gain (kg)**	17.983 ± 2.46 B	20.917 ± 1.46 AB	21.978 ± 1.10 AB	24.205 ± 1.57 A
7.Feed consumption: (Kg/day).	1.467	1.525	1.540	1.665
8.Efficiency of Feed conversion: (kg feed/ kg overweight)	7.35	6.56	6.31	6.19

Significant. * significant at probability level of 0.05. ** high significant at a probability level of 0.01.

Returning to study's findings in table (3) shows that first three treatments (control), second (ginger roots powder), and fourth (ginger root powder Plus vitamin E) had very high significant differences (P≤0.01) on hot and cold carcass weights. There were no significant changes in average weights of hot and cold carcasses between the second and third treatments and no significant differences in average weights of hot and cold carcasses between the third and fourth treatments.The average weight of hot corpses was 20,983, 24.545, 25,711, and 27.580 kg, while the average weight of cold carcasses was 20,515, 24.177, 25.325, and 26,994 kg (table 3). According to the above findings, the second, third, and fourth treatments are significantly superior than control treatment in terms of average weights of hot and cold carcasses.This is due to the fact that addition of ginger roots powder in diet led to an increase in appetite of animals (WHO, 1999) by increasing absorption of fats and proteins during digestion, which was positively reflected an improvement on weight gain of animals and thus to an increase in weights of hot and cold carcasses (Huang et al.,

1991, Al-Moussawi., 2009). The significant improvement of hot and cold carcass traits was in favor of lambs treated with vitamin E is due to presence of vitamin E in the ration having a fundamental and important role on stimulating processes of digestion, absorption, and nutrient metabolism of body tissues, resulting a significant increasing hot and cold carcasses weights (Towaje et al., 2018) compared to control group.The findings of this study corroborate those of Chaves (2008) and Al-Moussawi (2009), who discovered a substantial rise in weights of hot and cold carcass weights of lambs treated with ginger roots powder than for control group of lambs. Also, Al-Joulaq (2020) stated there was a considerable improvement for hot and cold carcasses weights of lambs dosed with vitamin E when compared to the control group.While did not agree with those of Orzuna et al., (2021), whom did not detect any significant variations in rates of hot and cold carcass weights of hybrid lambs when using ginger roots powder with other additives when compare to control group. Also, the results of this study did not agree with results of Turner et al., (2002), Macit et al., (2003), Maiorao et al., (2007) and Zhao, (2013) and Mohammad et al., (2015) who indicated that there were no significant differences for lambs treated with vitamin C, vitamin E on averages of weights of carcasses in their studies. As for characteristics of rib eye muscle area and thickness of subcutaneous fatty layer, the results showed in table (3) indicates were high significant differences (P≤0.01) between control treatment,third (vitamin E) and fourth (mixture) treatment in averages of ocular muscle area and on the other hand between the control treatment and the last treatment in rates of subcutaneous fat layer thickness. The average ocular muscle area was 9.00, 12.00, 11.33, and 13.33 cm^2 and thickness of subcutaneous fat layer was 5.00, 2.50, 3.00, and 2.70 mm for four treatments respectively. From above results presented in table (3), we find a significant improvement in ocular muscle area rates in the experimental treatments, offset by a significant decrease in rates of the subcutaneous fatty layer thickness compared to the control treatment.This came to the fact that using of ginger powder in experimental treatments leads to increase activity of nutrient metabolism because ginger contains some proteins, fatty acids and multiple amino acids that increasing appetite of animals and that leads to increase body weights of animals, causing a significant increase in carcasses weights and thus to a significant increase in rib eye muscle area compared to group of control lambs (Kemper, 1999, and Tilgner, 1999). The considerable increase in ocular muscle area of lambs given vitamin E is due to a significant rise in liveweight and hot,cold carcasses weights which was positively reflected an increasing in ocular muscle area (Al-Joulaq, 2020). The role of ginger and vitamin E in stimulating digestion processes, absorption, and nutrient metabolism, as well as acting as antioxidants, was attributed to the significant decrease on subcutaneous fat of second, third, and fourth groups when compared to control treatment which was resulting a significant decrease in thickness of subcutaneous fat (Zhao et al.,2013).The significant decrease on position thickness of subcutaneous fat under skin of Awassi lambs may be due to the fact that groups of lambs included in this study were a smaller ages and in stage of growth which deposition of muscle tissue increases at expense of the fat percentage of body tissues. These findings corroborated those of Al-Saigh and Al-Timimi (1986) and Al-Moussawi (2009), who found that giving ginger to groups of lambs had a significant effect when compared to the control group.The investigations (Birch et al.,1994, and Al-Joulaq,2020) found significant variations on ribs eye muscle area and subcutaneous fat from lambs was given with vitamin E compared to the control group. While the findings of this study differed with those of Orzuna-Orzuna et al., (2021), who found no significant differences on ribs eye muscle area and thickness of subcutaneous fat between ginger and other feed additives in hybrid lamb fattening regimens. The findings of this study contradicted those of Zhao et al., (2013), and Atay, (2009), who found no significant effect of vitamin E on averages of ocular muscle area and subcutaneous fat thickness of adipose layer of lambs.On the other hand, we discovered that the difference in percentage of dressing computed by the first approach on the basis of live weight and the second way on the basis of empty body weight for Awassi lambs groups was significant (P≤0.05) (combination between ginger and vitamin E). In the averages of computed dressing percentage by both approaches, there were no significant variations between the first three treatments. For four treatments, the rates of dressing percentage calculated using the first approach were 45.36, 50.32, 51.26, 52.42 percent, while the rates calculated using the second way were 47.60, 53.03,

54.52, and 55.55 percent, respectively (table 3). Through this results, we find that there were significant improvement in rates of dressing percentage calculated by two methods of the experimental treatments than compared to the control treatment. perhaps to ascribed to a major increase of total weight gain, as well as a moral increase of hot and cold weights of lambs carcasses, which was positively reflected to significant increase of dressing percentage.The findings of this study corroborate those of Mohammed et al., (2009), and Al-Moussawi, (2009), who found substantial differences on dressing percentage which estimated by using both methodologies between the ginger roots and control treatments.The results of this study was agreed with observed by Al-Joulaq (2020), which indicated that there was a significant improvement in favor of lambs treated with vitamin E over control group. These findings contradict Hassan et al., (2010), who stated that adding black seeds at various levels to fattening rations of Karadi lambs had no significant effect on dressing percentage, and this study contradicted Turner et al., (2002), Macit et al., (2003), Mairorao et al., (2007), Zhao, (2013), and Mohammed, (2015) who confirmed that vitamin E did not have any significant effect on mean of dressing percentage among sheep groups.

Table 3. Effect of addition ginger roots, vitamin E and their combinations common overlap between them on carcass traits of Awassi lambs

The studied traits	1st treatment (control)	2nd treatment (ginger roots powder)	3rd treatment (vitamin E)	4th treatment (ginger roots powder + vitamin E)
1. Hot carcass weight (kg)**	20.983 ± 0.19 C	24.545 ± 0.35 B	25.711 ± 0.18 AB	27.580 ± 0.52 A
2. Cold carcass weight (kg)**	20.515 ± 0.14 C	24.177 ± 0.34 B	25.325 ± 0.17 AB	26.994 ± 0.51 A
3.Ribeye muscle area(cm^2)**	9.00 ± 0.57 C	12.00 ± 0.58 AB	11.33 ± 0.66 B	13.33 ± 0.33 A
4. Subcutaneous fat under skin**	5.00 ± 0.58 A	2.50 ± 0.26 B	3.00 ± 0.29 B	2.70 ± 0.20 B
5. Dressing percentage according on live weight (%)*	45.36 ± 2.85 B	50.32 ± 1.96 AB	51.26 ± 0.12 AB	52.42 ± 0.89 A
6. Dressing percentage according on empty body weight (%)*	47.60 ± 3.37 B	53.03 ± 2.17 AB	54.52 ± 0.25 AB	55.55 ± 1.1 9 A

NS: not significant. * Significant at the 0.05 level of probability. ** At a 0.01 probability level, this is highly significant.

Carcass Cuts

According to the results in tables (4,5), adding ginger roots powder and vitamin E, as well as their mixture, had a significant effect (P≤0.05) on means of thighs, shoulders, and ribs weights as essential cuts and neck, chest as minor cuts in sheep carcasses among experimental treatments between three treatments (ginger roots powder, vitamin E, and mixture) when compare to control treatment without feed additives. The averages of thighs weights were 3.963, 4.563, 4.771, 5.350 kg, and shoulder weights were 2.876, 3.656, 3.383, 3.673 kg, and ribs weights 2.796, 3.567, 3.736 kg and neck weights of 1.210, 1.462, 1.983, 1.398 kg and chest weights of 2.040, 2.563, 2.303 and 2.556 kg for four treatments respectively. The average weights of the back, forearm, and flank in carcasses of Awassi sheep were not significantly altered by four experimental treatments in the other regions of the main and secondary cuts. Where the rates of back weights were 3.035, 3.688, 3.763, 3.786 kg, and forearm weights were 0.710, 0.793, 0.837, 1.020 kg and the loin weights were 0.723, 0.800, 0.820, 0.943 kg for four treatments.From this results it was noted that rates of weights of thighs, shoulders and ribs as main parts of the carcass was significant increase (P≤0.05) in favor of the groups treated with ginger, vitamin E and combination between them compared to the control group (free of feed additives). This could be due to a significant increase for weights of cold and hot carcasses, which was reflected in significant increases in the weights of main and secondary cuts of lamb carcasses (Al-Moussawi, 2009, and Al-Joulaq, 2020), or it could be due to the existence of a positive and significant correlation between live weight at slaughter and weights of the main cuts (thighs, ribs and shoulders) (Al-Moussawi, 2009, and Al-Joulaq, 2020).The correlation coefficients between lambs' live weight and their thighs, shoulders, and ribs were 0.58, 0.29, and 0.79, respectively (table 5).The moral differences in rates

of neck and chest weights (secondary cuts) were attributed to moral differences in rates of lambs weights at slaughter in result of this study, which led to emergence of moral differences in rates of neck and chest weights (Al-Moussawi, 2009, Al-Joulaq, 2020). There is another reason attributed to presence of a positive and significant correlation coefficient between live weight of lambs at slaughter and weights of neck and chest, which amounted to 0.27 and 0.50 in the current result of this study (table 5) respectively. The findings of this study are corroborated those of Al-Moussawi, (2009) who found a moral improvement in most weights of main and secondary carcass cuts of lambs fed ginger roots powder and a combination (ginger roots powder and ripe watercress seeds) when compared for control group.These results was resembles with what was stated by Obeidat, (2021) which noticed a significant increase in rates of thigh weights for lambs group consuming black cumin seeds than to compere of control group. Also, findings were consistent with those of Atay et al., (2009) and Al- Joulaq, (2020), who found substantial variations in weights of thighs, shoulders, neck, and thorax for lambs given vitamin E vs those given a placebo. The results did not agree with what was stated Odnaib et al., (2018) found a non-significant and arithmetic rise in weight rates of main cutting and secondary carcasses of Dorper lambs when they utilized four treatments (control, rosemary leaves, black seeds, and a mixture of rosemary leaves and black seeds) compared to the control. Also,this results was differed from what was stated contradicted those of Mohammad et al., (2015) who did not find any significant effect of adding vitamin E in the diets of fattening lambs on weights and proportions of the shoulders, thighs, ribs, neck and chest in the carcasses of Awassi lambs when comparison with the control group.

Table 4. Effect of addition of ginger roots powder, vitamin E and their combinations on weights of major and minor cuts of Awassi lambs' carcasses

The studied traits	1st treatment (control)	2nd treatment (ginger roots powder)	3rd treatment (vitamin E)	4th treatment (ginger roots powder + vitamin E)
1. Thighs weights (kg)*.	3.963 ± 0.23 B	4.563 ± 0.08 AB	4.771 ±0.50 AB	5.350 ± 0.14 A
2. Loin weights (kg)NS.	3.035 ± 0.31 A	3.688 ± 0.58 A	3.763 ± 0.36 A	3.786 ± 0.37 A
3. Shoulder weights (kg)*	2.876 ± 0.30 B	3.656 ± 0.04 A	3.383 ± 0.07 AB	3.673 ± 0.09 A
4. Rib weights (kg)**.	2.796 ± 0.29 B	3.567 ± 0.24 AB	3.736 ± 0.29 A	4.290 ± 0.12 A
5. Neck weights (kg)*.	1.210 ± 0.13 B	1.462 ± 0.04 AB	1.983 ± 0.38 A	1.398 ± 0.06 B
6. Chest weights(kg)*.	2.040 ± 0.13 A	2.563 ± 0.16 A	2.303 ± 0.12 AB	2.556 ± 0.06 A
7. Forearm weights (kg)NS.	0.710 ± 0.06 A	0.793 ± 0.02 A	0.837 ± 0.09 A	1.020 ± 0.15 A
8. Flank weights (kg)NS.	0.723 ± 0.04 A	0.800 ± 0.09 A	0.820 ± 0.06 A	0.943 ± 0.10 A

NS: not significant. * At a probability threshold of 0.05, this is significant. ** At a 0.01 probability level, this is highly significant.

Table 5. Values of correlation coefficients between the live weight of Awassi lambs at slaughter and the weights of main and secondary carcasses

The studied traits	Correlation coefficients
1. final weight × final weightNS	1.00
2. final weight × hot carcass**	0.70
3. final weight × cold carcass**	0.72
4. final weight × thighs**	0.58
5. final weight × loinNS	0.19
6. final weight × ribs**	0.79
7. final weight × shoulders*	0.29
8. final weight × neck*	0.27
9. final weight × chest*	0.50
10. final weight × forearmNS	0.48
10. final weight × flankNS	0.80

NS: not significant. * At a probability threshold of 0.05 this is significant. ** At a 0.01 probability level this is highly significant.

We deduced from this experiment results that addition of ginger roots powder and vitamin E and synergistic interaction of them together of fattening ration lambs which resulted in form of pellet ration was resulted in a significant improvement in daily, total weight gains, and final weight of Awassi lambs. Another beside, the results was observed a moral improvement on daily and total weight gain, chest, forearm, and flank) of carcasses of Awassi lambs treated with ginger roots and field crops. Because of the significant increase in live weight of lambs and weights of hot carcasses, that leads to significant increase on ocular muscle area at three ribs region (9,10,11) of Awassi lambs groups treated with ginger roots powder and vitamin E and their combination compared to the control treatment.

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