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Addition of vitamin C and vitamin E to the diets of Awassi lambs exposed to heat stress and the effect on some of their productive characteristics.

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Abstract

The study was conducted in Al-Hamdaniya District / Nineveh Governorate. Abaut effect of using vitamins E and C in hot weather on the productive performance of lambs. (20) Awassi lambs were used, it were aged about (4-5) months, and their live weight is about (25 kg), the duration of the study was (90) days. The study aimed to find out the effect of adding vitamin C and vitamin E to the diet of lambs were exposed to heat stress and its effect on some of their productive characteristics. Lambs were randomly distributed into three groups in addition to the control group. Each group were included (5) lambs, one group was given 40 gm vitamin C, while another group was given 60 gm vitamin E, while the last group was given each of 40 gm vitamin C and 60 gm vitamin E. The group that was given 40 gm vitamin C and 60 gm vitamin E in the weight of the hot carcass was significantly superior, followed by the group that was given vitamin C, while the rest of the differences were non-significant. As for body dimensions, the group that was given vitamin C 40 gm as well as 60 gm vitamin E excelled in all body length and chest circumference, while the group that was given vitamin E excelled in chest circumference only, while the rest of the differences were non-significant.

Keywords: body weight; carcass weight; body dimensions; lambs; sheep; heat stress

Introduction

Environmental induced heat stress is a significant financial burden to sheep livestock worldwide. It jeopardizes their production, reproduction, growth and welfare (Belhadj Slimen et al., 2016). Studies into global warming and increased climate variability show the potential threat for food security in the coming decades (FAO; 2018). The thermoneutral zone of sheep is approximately between 5 and 25°C but depends on a range of environmental and individual factors (Schutz 2022) however, there are adapted breeds that begin to experience HS above 30 °C. The effects of heat stress on the health and biological functioning in sheep are well documented. Heat stress results in decreased growth, reproduction, milk quantity and quality, and natural immunity (Al-Dawood 2017) and changes in blood components and biological/biochemical pathways (Abdelnour et al. 2019). There is a well-known reduction in feed intake by ruminants in warm conditions (West 1999). Reductions in feed intake, and subsequent body weight and daily gain has been reported in sheep in several studies and several breeds (Kandemir et al. 2013).. Body temperature is good measure of heat tolerance in animals , as it represents the result of all heat gain or heat loss process in the body. However , genetic selection for low body temperature as strategy to reduce the magnitude of heat of heat stress effects in dairy cattle may be limited due to adverse association with economic indicators(Henry et al 2018). The exposure of sheep to high ambient temperature negatively affects the biological functions, which is reflected on the poor traits of productive traits (Marai,2002), Slimen et al (2019) explained that the environmental-induced heat stress exacerbates not only sheep physiological responses, but also their energy and oxidative metabolism. The reduced feed intake accounts partly in the declined energy metabolism.

Ruminants can synthesize vitamin C from carbohydrate precursors, including glucose. Glucose is the primary nutrient for embryo growth and milk synthesis, whereby nutritional requirements are increased during pregnancy, especially if there is more than one foetus (Bell & Bauman, 1997). Domestic animals, including ruminants, are able to synthesize ascorbic acid in the liver from glucose through the enzyme gulonolactone oxidase. Therefore, in general ruminants do not require dietary vitamin C (Combs, 2008). Although ruminants synthesize vitamin C, this lower concentration may be due to a greater demand for, or a decrease in the synthesis of this vitamin in the body. However, during vitamin C deficiency, successful supplementation is difficult because the vitamin is easily degraded in the rumen (MacLeod *et al*., 1999). Because of this, various alternatives have been evaluated to ensure that vitamin C is absorbed and utilized by the animal, for example vitamin C coated with hydrogenated soybean oil (Padilla *et al*., 2007). Pliego-Pliego *et al*., 2019 gave oral supplementation of 3 g and 6 g of coated vitamin C in ewes during oestrous synchronization, breeding and early gestation they showed that increased plasma vitamin C concentrations and improved antioxidant capacity without affecting the reproductive variables, progesterone and insulin concentrations.

The most important naturally occurring antioxidant is vitamin E, which protects fat by preferential acceptance of free radicals. The possible effects of fat oxidation in diets in which vitamin E levels are marginal are of considerable importance (McDonald, et al 2010). Vitamin E

functions in the animal mainly as a biological antioxidant; in association with the selenium-containing enzyme glutathione peroxidase and other vitamins(McDonald, et al 2010). It was previously considered that a proportion of dietary vitamin E was destroyed in the rumen, but more recent evidence has revealed that virtually all flows to the small intestine for absorption(McDonald, et al 2010). The importance of vitamin E lies that it is an antioxidant (Martin and Jenkins, 2002), Heat stress amelioration strategies can be broadly grouped into three categories: modifying the environment, management including nutritional modifications (Schütz, 2022). During exposure to high environmental temperatures, sheep trigger a series of physiological compensatory mechanisms that allow the body to adapt to extreme environmental conditions, including increases in rectal temperature, respiration rate, and heart rate (McManus, et al 2020). Ghanem et al (2008) found that vitamin C and vitamin E supplementation decreased rectal temperature and rate of respiration.

The aim of this study is to know the effect of addition vitamin C and vitamin E to diet of lambs that exposed to heat stress and its effects on some of their productive characteristics

Material And Methods

This study was conducted at a private farm in Al-Hamdaniya District / Nineveh Governorate. On the effect of using E and C vitamins in hot weather on productive performance in lambs. (20) Awassi lambs was used , their ages ranged between 4-5 months, and their live weight was about (25 kg). The lambs underwent a veterinary care program during the study period.

The study included four experiment groups, lambs in each group were 5 lambs , The animals were randomly distributed among the treatments and ate the same type of diet (table 1). The vitamins were added to the treatments as shown in this table

Table (1) The experiment groups

Matters	T1(control)	T2	T3	T4
Barley	%60	%60	%60	%60
bran	%21	%21	%21	%21
Ground wheat	%8	%8	%8	%8
Soybean meal	%10	%10	%10	%10
salt	%1	%1	%1	%1
Vitamins	No vitamins	Vit. C 40gm	Vit. E 60gm	Vit. C40 & E60
Crude Protein	15.34%	15.34%	15.34%	15.34%
Ether Extract	2.12%	2.12%	2.12%	2.12%
Crude Fiber	7.10%	7.10%	7.10%	7.10%
Ash	4.66%	4.66%	4.66%	4.66%
Metabolism Energy (Mcal/kg feed)	2.592	2.592	2.592	2.592

T : Treatment Vit. : Vitamin

Lambs were housed in semi-open barns divided into four cages, depending on the number of experimental groups. The height of the cage was 1.5 meters, and the area of each cage was

$(2.6\ x\ 4)m^2$. Each cage contained fixed feeders and drinking water fountains. The lambs were distributed randomly to the cages, and the feed was given at the rate of two meals every day (at eight o'clock in the morning and five o'clock in the afternoon). Drinking water was replaced daily with clean water. All the lambs were out for grazing daily at a rate of 3 hours in the morning and 3 hours in the evening during this study period. All lambs were weighed on a 10g electronic floor scale. This represented the initial weight of the lambs. During this study period rectal temperature, pulse rate and respiratory rate were calculated.

Statistical analysis : complete randomly design (CRD) to study the effect of mentioned treatments in productive characteristics. Statistical analysis of the data were carried out using the SAS statistical analysis system (SAS 2001) and the significance was tested using the Duncan's multiple range test (Duncan (1955) and effects were considered to be significant at a value of ($p \leq 0.05$).

Results

productive characteristics : Iraq has a climate characterized by hot summer season. However, heat stress usually begin in middle of May lasts through September. After 90 days of the study ago, the animals that were given both vitamin C and vitamin E together it excelled in their live weight (47.82 kg) compared to the control group (45.86 kg), as well as both groups that were given vitamin C and vitamin E (45.83 and 45.35 kg, respectively). However, the superiority was only arithmetic, and no significant differences were recorded. The animals also converged in their total and daily weight gain rates (Table 2).

Significant differences ($p \leq 0.05$) were observed in the weight of the hot carcass, as the animals that were given both vitamin C and vitamin E had a higher weight (28.50 kg) than the control group (24.83 kg) and the two groups that were given vitamin C and vitamin E (26.66 and 26.03). kg respectively), and the differences were not significant in feed conversion efficiency (Table 2). The results of this study were similar to results of Hot carcass weight reached by (Kasha et al 2021).

Vitamin C and vitamin E added to diets had a clear role in weight gain. Vitamin E is known to improve the antioxidant capacity of muscle and hence meat quality by avoiding/delaying the lipid peroxidation, protein oxidation and discoloration of muscle meat (Ponnampalam et al 2016),

Vitamin E in animals is mainly as a biological antioxidant and has positive effects with other vitamins and elements (McDonald, et al 2010), This may be a reason for superiority in the final weight as well as the weight of the hot carcass

جدول رقم (2) الصفات الانتاجية

Observes	Means	Control	Vit. C 40gm	Vit. E 60gm	Vit. C40 & E60
Primary Weight (Kg)	25.42 ± 0.06	25.47 ±0.03 A	25.49 ± 0.01 A	25.31 ± 0.24 A	25.41 ± 0.06 A
Final Weight (Kg)	45.86 ± 0.60	44.45 ± 1.11 A	45.83 ± 1.26 A	45.35 ± 0.91 A	47.82 ± 1.35 A
Daily weight gain	226.98 ± 6.81	249.0 ± 12.41	22.86 ± 13.97	221.7 ± 11.51	249.00 ± 14.50

(gm)		A	A	A	A
Total weight gain (Kg)	20.44 ± 0.61	18.97 ± 1.13 A	20.34 ± 1.253 A	20.04 ± 1.011 A	22.41 ± 1.31 A
Hot carcass weight (Kg)	26.50 ± 0.47	24.83 ± 0.85 B	26.66 ± 0.72 AB	26.03 ± 0.65 B	28.50 ± 0.86 A
Feed Conversion Ratio(Kg feed/ Kg weight gain	7.39 ± 0.22	7.94 ± 0.45 A	7.42 ± 0.48 A	7.48 ± 0.35 A	6.71 ± 0.38 A

Regarding body dimensions only, the effect was significant ($p \leq 0.05$), as an improvement in body length was observed for animals that were given both vitamin C and vitamin E (70.60 cm) compared to the control group only (68.20 cm) as shown in Table (3). Also, the effect was significant ($p \leq 0.05$) for the chest circumference, which reached 100.60 cm and 100.00 cm for the animals that were given both vitamin C and vitamin E, as well as the animals that were given only vitamin E, respectively, while the control group reached 93.00 cm. While the differences were not significant between the rest of the experimental groups in both measurements of height at the buttocks and abdominal circumference.

Increasing the rate of metabolism within the body tissues, as well as increasing the absorption of the monosaccharides and fatty acids, in addition increasing of the metabolism of proteins, which led to a significant effects on weight gain, which reflected positively on some dimensions such as body length and chest circumference. Vitamin C helps in growth by stimulating the functioning of the thyroid gland and increasing the secretion of the thyroxin hormone, which works to increase the rate of metabolism within body tissues , as well as increase the absorption of monosaccharides and fatty acids in addition to increasing protein metabolism and increasing the production of RNA, which works as a result to increase the growth of animals (Hopkins et al 1980)

Table (3) Body Dimensions

Observes	**Means**	**Control**	**Vit. C 40gm**	**Vit. E 60gm**	**Vit. C40 & E60**
Body length	68.20 ± 0.60	66.80 ± 0.58 B	68.00 ± 1.58 AB	67.40 ± 0.51 AB	70.60 ± 1.28 A
Height at the front	74.50 ± 0.88	72.20 ± 1.32 A	73.60 ± 1.12 A	75.00 ± 1.30 A	77.200 ± 2.61 A
Chest circumference	98.25 ± 1.23	93.00 ± 1.92 B	99.40 ± 2.16 AB	100.00 ± 1.64 A	100.60 ± 2.87 A
Height at the back	77.50 ± 0.89	75.40 ± 1.75 A	77.20 ± 1.11 A	77.20 ± 0.97 A	80.20 ± 2.65 A
Abdominal circumference	104.50 ± 1.42	99.60 ± 1.69 A	104.60 ± 2.441 A	107.20 ± 3.47 A	106.60 ± 2.91 A

The oxidative stress is responsible of these metabolic disorders, which can alter further the ovine production performances. And so it should, adequate nutritional system should be followed to meet the energy requirements of heat stressed sheep and to remedy the shortcoming of the

heat-induced oxidative stress and so , rations rich in low fermentable proteins and fats may be administrated, in combination with controlled quantities of concentrate to avoid acidosis. Fibers must have good quality. And without any doubt, mineral and antioxidant supplementation is necessary.

The reason for the differences between the experimental groups may be due to administrative and nutritional conditions, and this variation may be attributed to the difference in body weights (Raaof 2007). The difference was observed in the two characteristics of body length only and not in all dimensions, due to the presence of a phenotypic correlation between these two characteristics (Abdullah et al 2013). The reason for this is that these measurements are related to bone growth, because bones grow early and constitute the largest portion of body weight (Jimmy et al 2010). Vitamin C is a powerful antioxidant, and spares vitamin E & enhance immune responses (Chiba 2009). Vitamin E may involved in the synthesis of ascorbic acid (Chahal et al 2008), therefore the Two vitamins together may help to growth of animal body

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اضافة فيتامين C وفيتامين E الى علائق الحملان العواسية المعرضة للاجهاد الحراري وتاثير ذلك على بعض صفاتها الانتاجية

الخلاصة

أجريت الدراسة في قضاء الحمدانية / محافظة نينوى. حول تأثير استخدام فيتامينات E و C في الطقس الحار على الأداء الإنتاجي للحملان. تم استخدام (20) من حملان العواسي ، أعمارها حوالي (4-5) أشهر ، ووزنها الحي حوالي (25 كجم) ، وكانت مدة الدراسة (90) يوماً . هدفت الدراسة إلى معرفة تأثير إضافة فيتامين C وفيتامين E إلى عليقة الحملان المعرضة للإجهاد الحراري وتأثيره على بعض خصائصهما الإنتاجية. تم توزيع الحملان عشوائياً الى ثلاث مجاميع اضافة الى مجموعة السيطرة. ضمت كل مجموعة (5) حملان ، اعطيت مجموعة 40 غم فيتامين C ، فيما اعطيت مجموعة اخرى 60 غم فيتامين E ، بينما اعطيت المجموعة الاخيرة كل من فيتامين 40 غم فيتامين C وكذلك 60 غم فيتامين E .

تفوقت المجموعة التي اعطيت فيتامين 40 غم فيتامين C وكذلك 60 غم فيتامين E في وزن الذبيحة الحار معنوياً ، تلتها المجموعة التي اعطيت فيتامين C ، بينما كانت بقية الاختلافات غير معنوية. أما فيما يتعلق بأبعاد الجسم فقد تفوقت المجموعة التي اعطيت فيتامين 40 غم فيتامين C وكذلك 60 غم فيتامين E في كل طول الجسم ومحيط الصدر، فيما تفوقت المجموعة التي اعطيت فيتامين E في محيط الصدر فقط ، بينما كانت بقية الاختلافات غير معنوية.