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EFFECT OF ACASIA AND DRY OLIVE PULP ON ALLEVIATION HEAT STRESS IN AWASSI FEMALE LAMB IN IRAQ

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ABSTRACT

Effect of acacia saligna and dry olive pulp (dop) on alleviating heat stress and the changes in hormonal status of growing lambs were studied. Two trials were carried out in Tigris farm animal in kut on 2011. In the first trial 18 Awassi growing lambs aged 5 months old and weighing about 31±4.5 Kg. for 2 months during spring season and subjected to mild climate. In the second trial the same growing lambs were classified to three equal groups. First group was fed the basal diet plus *ad libitum* rice straw and the second group was fed basal diet plus green acacia (Acacia saligna) leaves and soft twigs *ad libitum*, while the third group was fed basal diet plus 310 gm dry olive pulp. The second trial lasted for 3 months of summer season and subjected to heat stress. Temprteture was 25.6-32.5 in spring and 40-46 in summer season and consequently the animals were suffered from heat stress during summer season. Blood samples were taken at the end of the experimental period.

Each of absolute and relative growth rate, total lipids, cholesterol, lactate dehydrogenase, sodium, potassium, calcium, Inorganic phosphorus, zinc, serum T3 and T4 hormones, progesterone and cortisol hormones showed a highly significant ($p<0.01$) decrease in hot climate (summer season) than in mild climate (spring season).

Acacia shrubs and dry olive pulp treatments during hot summer season resulted in significant ($p<0.05$) improvements in absolute growth and relative rate, total lipids, cholesterol, lactate dehydrogenase and all measured minerals and hormones. In conclusion: in Iraq, we need the high beneficial plant for feed the animals by cheap coast. since hundreds rather thousands of years, the iraqi condition, environment a lot of adverse conditions affect on sheep especially or nutrition, harsh climate, housing and management condition, pollution under Iraqi environment condition are found side by side.

INTRODUCTION

In Iraq, in general, and the new reclaimed desert lands, particularly, there is a great shortage in animal feedstuffs particularly during summer season. Using non traditional feeds in animal feeding substantially participates in solving this problem, decreases the cost of feeding and improves the animal productivity. Many attempts were made to introduce some forage which suit the weather and soil conditions of the new reclaimed lands Al-Khatib (7).

Acacia is a leguminous plant of the pea family characterized by its resistance to heat, drought salinity and alkalinity, in addition to its effects on soil stability and fertility through nitrogen fixation (15). Because acacia contains up to 13% CP. it can potentially be used as a forage plant in arid and semi-arid areas, much like other leguminous plants (17). However, its value is diminished by poor utilization of nutrients due to its high content tannins with the consequent decrease in intake and digestibility (28). Recently, El-Sayed et al. (2) reported that Acacia saligna contains high concentration of molybdenum which

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interferes with copper, reducing its availability for absorption and tissue utilization (30). Olive pulp is produced in Iraq as waste product from olive squeezing, these wastes are good resources for sheep feeding.

On the other side, heat stress resulted in drastic changes in biological functions of the ram lamb body and, consequently, lower productivity (4). Metabolism of carbohydrate, protein, fat, minerals and vitamins are affected under heat stress conditions due to depression in appetite and feed consumption. Hormonal profiles, especially, anabolic hormones such as insulin, GH, cortisol, T3 and T4 are also disturbed (3). The mechanisms by which animals face elevated environmental temperature vary greatly. These include the development of structural and functional modifications, mechanisms concerns with heat storage, evaporative cooling and behavioral responses. Alleviation of the heat load by providing suitable feeding, housing and management could help heat stressed animals to express their genetic potentialities (2). The present study aimed to investigate the effects feeding acacia or olive pulp on growth and hormonal status of sheep maintained under kut conditions.

MATERIALS AND METHODS

The present study was carried out in Tigris farm animal in kut on 2011. The average minimum and maximum ambient temperatures were 25.6°C and 32.5°C in spring (mild climate) and 40°C and 46.0°C in summer (hot climate).).

Two experiments were carried out in this study (Table1), In the first experiment, eighteen growing lambs were maintained under spring condition to study the effect of mild climate on growth and hormonal status, all sheep were housed, as one group (S) which considered as control group for the first group of summer season, in an open pen under shade and were fed on balanced ration (a pelleted concentrate diet) plus free available rice straw and natural water. In the second experiment the same growing lambs of experiment one were divided randomly to three similar and equal groups. The first group was considered as control group, while the second and third groups were maintained under heat stress during the summer season. The animals in the three groups were provided with the same basal ration consisting of pelleted concentrates according to live body weight and daily gain (29), beside the basal diet the first group (R) was offered freely available rice straw, the second group (A) was fed basal diet (75% of their TDN requirements) plus green acacia (Acacia saligna) leaves and

soft twigs *ad libitum*, while the third group was fed basal diet (75% of their TDN requirements) plus 310 gm dry olive pulp.

The animals were weighed every 2 weeks before morning feeding and watering. Growth rate (live body weight increase %) was determined during spring and summer months by fitting the data to the linear equation y = a + bx then deducing growth rate using the equation

$$\frac{W_2 - W_1}{W_1} \times 100$$

, which was undertaken by (23).

Then relative growth rate was calculated using the following equation

$$R.G.R. = \frac{\text{Growth rate.}}{\text{Initial weight}} \times 100$$

(21).

Table 1: Experimental design of the study

Items	Sheep group	Number of sheep	Season	Treatments	
				Acacia	Olive pulp
Experiment,1: (60 days) Effect of mild climate on growth performance of female Awassi sheep in kut	Spring (S)	18	Spring	-	-
Experiment, 2: (90 days) a- Effect of hot climate on growth performance of female Awassi sheep.	Control G1	6	Summer	-	-
b- Amelioration of heat stress using acacia to improve growth traits.	G2	6	Summer	+	-
c- Amelioration of heat stress using olive pulp to improve growth traits.	G3	6	Summer	-	+

Blood samples were obtained 6 hrs post morning feeding from jugular vein from each animal at the end of each experimental period treatment in 10 ml heparinized vacutainer tubes. Samples were kept on ice untill centrifuged at 6000 rpm for 20 minutes at 40°C. Plasma was transferred to 5 ml vials and frozen at -20°c untill assayed. Triiodothyronine (T3), thyroxine (T4), progesterone and cortisol were determined using Radioimmunoassay (RIA) technique Tawfeek et al (2010). Concentration of total lipids, cholesterol, lactate dehydrogenase were estimated in plasma according to Tietz (39) and Haleem et al., (19). Determination of some essential mineral elements were carried out using Flame Emission Spectrophotometer for sodium, potassium, calcium and inorganic phosphorus and using atomic absorption spectrophotometer for zinc.

Data of the present study were examined statistically by least squares analysis of variance using the general linear model (GLM) procedure of SAS (32) according to Steel and Torrie (35).

RESULT AND DISCUSSION

Effect of high environmental temperature on growth rate, some biochemical constituents and hormonal status of heat stressed lambs

High environmental temperature during summer generally in iraq and specially in kut resulted adverse effects on farm animals performance (Table 2). These adverse efforts includes highly significant decrease ($p<0.01$) during summer than spring in each of daily gain 33.89% and relative growth rate 34.95%. Similarly, highly significant decreases in levels of blood total lipids, cholesterol and lactate dehydrogenase by 30.1, 31.6 and 25.3%, respectively.

Table 2: Effect of acacia and olive pulp feeding on growth and some biochemical parameters of heat stressed lambs in relation to the control.

Items		Spring group (S)	Summer groups		
			Rice straw (R)	Acacia (A)	Olive pulp (O)
Growth traits	Daily body gain Change %	112.4 ± 19.8	74.5 ± 10.5 -33.89**	86.7 ± 16.6 +15.51*	93.2 ± 16.8 + 22.85**
	Relative growth rate Change %	3.51 ± 0.38	2.23 ±1.14 34.95**	2.52 ± 1.21 16.02*	2.78 ± 0.92 22.5**
Blood metabolites	Total lipids (mg/dl) Change %	495 ± 18.6	350 ±24.8 30.1**	403 ± 28.8 15.9*	422 ± 30.6 20.3**
	Cholesterol (mg/dl) Change %	120 ± 7.51	82.2 ± 7.86 31.6**	94.2 ± 12.4 14.3*	90.8 ±11.2 11.2*
	L.dehydrog. (U/L) Change %	402 ± 48.5	331 ± 60.2 25.3**	347 ± 61.5 15.1*	346 ± 61.2 18.2*

Change % :[(Treatment – Control) / Control] X 100
*** P<0.05 and ** P<0.01**

The electrolytes and some essential mineral element concetration in heat stressed growing lambs showed high significant (p<0.01) decrease in comparison with the spring value (Table 3). Sodium, potassium, calcium, inorganic phosphorus and zinc levels decreased by 29.8, 25.1, 30.1, 20.2, and 34.9% respectively, in summer than in spring. Heat stress also decreased (p<0.01) T3, T4, progesterone and cortisol by 25.5, 36.8, 31.1 and 15.8 % respectively in relation to control group.

Effect of acacia and olive pulp on growth performance, biochemical and hormonal changes

The data presented in Tables (3) and (4) show the role of acacia and olive pulp in alleviating the heat load in heat stressed growing lambs in order to improve the productivity. In addition the disturbance in thyroid and adrenal functions and biochemical constituents were partially corrected by these two technique.

Table 3: Effect of acacia and olive pulp feeding on some blood electrolytes and hormones of heat stressed lambs

Items		Spring group (S)	Summer group		
			Rice straw (R)	Acacia (A)	Olive pulp (O)
Blood minerals	Sodium(mg/dl) Change %	130±7.12	91.6±8.02 29.8**	100±9.11 10.2*	107±8.11 18.2**
	Potassium (mg/dl) Change %	7.05±1.12	5.29±1.12 25.1**	5.78±1.31 10.9*	6.13±1.12 15.4**
	Calcium(mg/dl) Change %	10.6±1.75	7.36±2.13 30.1**	8.38±2.11 14.3*	8.55±1.89 16.5**
	Inorganic phosphorus (mg/d) Change %	5.32±0.89	4.25±1.33 20.2**	4.56±1.12 8.21	4.68±0.88 10.3*
	mg/dl Change %	79.5±1.21	51.7±2.13 34.9**	58.7±3.12 11.7*	62.1±3.11 19.2**
Hormonal profile	T3 (ng/ml) Change %	61.4±12.4	45.6±14.8 25.5**	52.8±17.8 16.9**	51.5±15.6 14.8*
	T4 (ng/ml) Change %	49.1±2.98	31.4±4.11 36.8**	34.5±4.91 8.9*	36.5±4.96 15.3**
	Progesterone, ng/ml Change %	2.31±0.21	1.78±0.31 31.1**	2.13±0.32 20.2**	2.01±0.29 15.5**
	Cortisol (µg/ml) Change %	12.5±1.16	10.5±3.11 15.8**	11.9±2.87 10.4	12.1±2.11 11.8

Change % :[(Treatment – Control) / Control] X 100
***Significant p < 0.05 **Highly significant p < 0.01**

Using acacia saligna in growing lambs feeding improved productivity of heat stressed growing lambs during the summer season. Daily body gain and relative growth rate increased (p<0.05) by 15.51 and 16.02% respectively. Total lipids, cholesterol and lactate dehydrogenase increased significantly (p<0.05) by 15.9 14.3 and 15.1 respectively. Na, K, Ca, and Zn increased significantly (p<0.05) by 10.2, 10.9, 14.3 and 11.7% respectively. However inorganic phosphorus showed non significant increase in relation to the control group. T3 and progesterone increased (p<0.01) by 16.9 and 20.2%, T4 and cortisol increased (p<0.05) by 8.9 and 10.4% respectively.

Using olive pulp in feeding of heat stressed growing lambs increased (p<0.05) daily body gain, relative growth rate, total lipids, cholesterol and lactate dehydrogenase by 22.85, 22.5, 20.3, 11.2 and 18.2% respectively. Na, K, Ca and Zn showed highly significant increase (p<0.01) by 18.2, 15.4, 16.5 and 19.2% respectively but inorganic phosphorus increased significantly (p<0.05) by 10.3%.

The hormonal profile in olive pulp treatment showed somewhat improvement and this was obvious from the significant increase in T3 (14.8%), T4 (15.3%), progesterone (15.5%) and cortisol (11.8%).

Effect of high environmental temperature

Growth performance

Previous research has shown that daily body gain and relative growth rate decreased in heat stressed growing lambs in summer than in spring. These findings are in agreement with those of Abdel-Samee (5) and Marai et al. (27) who reported that carbohydrate, protein, fat, mineral and vitamin metabolism are disturbed under heat stress conditions due to depression in both appetite and consequently feed intake. Anabolic hormones such as insulin, T3 and T4 are decreased by exposure to heat stress (11). This leads to negative balance in nitrogen, minerals and energy resulting in low growth rate. The decrease in the daily body gain as a function of heat stressed may be due to the activity of the metabolic enzymes, since their concentration decreased in an attempt by animals to diminish heat production to counteract the increase in heat load (16).

The observed decrease of some blood metabolites such as, total lipids, cholesterol and lactate dehydrogenase in heat stressed lambs may be attributed to the depression in appetite the decrease in anabolic hormones and the increase in blood components utilization to produce more energy for greater muscular expenditure required for high respiratory activity and the haemodilution (water retention) which occurs in heat stressed animal (24) on the other hand, catabolism increases mainly in fat depots and lean body mass due to the increase in catabolic hormones and endogenous DNA and RNA catabolism (12). Disturbance in enzymes activity may be also due to the fact that enzymes reaction simply are affected by high temperature, consumption and quality of food and respiratory activity (33) as well as amino acid levels and protein supplementation to heat stressed animals (9).

Blood minerals

The observed decline in blood minerals i.e. Na, K, Ca, P and Zn in growing lambs which exposed to high ambient temperature (Table 3) agree with the findings of Srikanda Kumar et al. (34), who found that heat stress decreased plasma K in Omani sheep and plasma Ca in Omani and Merino sheep. Total plasma Ca is affected by total plasma protein concentration as approximately 45-50% of the total plasma Ca is bound to plasma proteins. Accordingly, plasma Ca concentration will be decreased with hypoproteinemia as a consequence of the possible reduced feed intake associated with heat stress.

Blood hormonal levels

Some blood components and hormonal levels of thyroid and adrenal glands which are related to productive performance in growing female sheep Table (3). The observed decrease in T3 level during the summer season may help the animal to decrease its endogenous heat production in order to tolerate heat (11). In addition, the synergism between the thyroid response to temperature and catecholamines in animal may contribute to such mechanism (10). Similarly, Thompson (38) found that the decrease in heat production during heat exposure is closely correlated with changes of blood concentrations of the calorigenic hormones as thyroid hormones, GH, catecholamines and glucocorticoids. Therefore, it is likely that the decrease in the concentration of T3 relates to the decrease in heat production during heat exposure (31). Moreover, during heat stress, plasma T3 was depressed, apparently because of decreases in each of TSH

biosynthesis and excretion of T3 and T4 and energy metabolism of animals fed on high fiber diets reflected greater energy turnover in low fiber diets treatment (26).

Plasma cortisol which considered as indicator of adrenal function decreased in heat stressed sheep. The present results are in agreement with Abdel-Samee (1) and Kamal et al. (24) who found that cortisol level decreased significantly as a function of heat stress. However, some investigators claimed that plasma cortisol did not change significantly in cattle as a function of heat stress (18). Contradictory results are available (40), who found that cortisol level increased significantly under heat stress conditions. such contradiction might be attributed to the duration of exposure to high environmental temperature. Short duration would result in increased levels. Significant decrease would require at least 9 days of exposure to heat (7) or that the cortisol did not consistently change as a function of heat stress, since Jhani (21) found lower values of cortisol following initial increases in the lactating cows and sheep during exposure to the heat stress. In addition, some authors concluded that the basal cortisol concentrations vary greatly so that its values may not be reliable indicators of animal ability to adjust to short or long stressful conditions (20).

Plasma progesterone deceased in heat stressed sheep as compared with the control group. similar results were obtained by Marai et al. (27) who found that high environmental temperature or rapid and sudden fluctuations of temperature that often occur in many parts of the subtropics cause unfavorable effects on reproductive function. High ambient temperature also affects uterine environment either directly by reducing blood supply (36) or indirectly due to an imbalance of hormones such as progesterone, thyroid and glucocorticoid hormones. Lublin et al. (25) clarified that during hyperthermia, there was significant reduction in blood flow in the ovaries (23%) and in the undifferentiated uterine wall of non-pregnant or early-pregnant animals. Such results verify that the low reproductive performance during periods of thermal stress to be functional problems in females as well as in males.

Effect of acacia and olive pulp on growth performance, biochemical and hormonal changes

Daily gain and relative growth rate were improved significantly in heat stressed lambs as a response to acacia and olive pulp feeding. This can be attributed to concomitant improvement in serum T3 level and increasing the appetite and voluntary food intake of sheep as observed in the present experiment. The present data is in accord with previously published observations that acacia and olive pulp feeding result in a significant increase in daily live weight gain and relative growth rate (3). Because acacia and olive pulp contain lower amount of crude fiber than rice straw, the relative growth rate showed a highly significant increase ($p<0.01$) in olive pulp and significant increase ($p<0.05$) in acacia group in relation to the control group. Similar results were obtained by El-Masry (13) and Abdel-Samee (2) who reported that using low fiber diet can improve the feed efficiency and live body weight in the lambs exposed to high ambient temperature.

The blood metabolites such as total lipids, cholesterol and lactate dehydrogenase were improved significantly by acacia and olive pulp groups. However, Abdel-Samee (1) reported that the nutritional status of the cattle had no significant effect on plasma total lipids and cholesterol concentrations. Similar results were reported by Abdel-Samee et al. (3) who replaced

concentrates by roughages and fed rabbits four different diets containing 100% concentrate for the first group and the other three groups were fed 80, 60 and 40% concentrate mixture plus acacia ad-lib., respectively and found that total lipids and cholesterol did not significantly change among the four nutritional groups

The beneficial effect of acacia and olive pulp on heat stress is also indicated by the observed higher increase in plasma minerals and hormones concentration in growing lambs that were feeding acacia and olive pulp than those which were feeding rice straw during the hot summer season. This may be attributed to the role of minerals that playing in hormones, vitamins and moderating the enzymatic reactions, which are necessary for meat, bone formation and normal biological processes.

It could be concluded that up to 25% of TDN of concentrates in sheep rations could be replaced with impunity by protein rich and cheap green welting acacia and olive pulp to improve the relative growth rate, mineral and hormonal levels of growing female lambs in the new reclaimed desert lands under subtropical conditions of arid environments.

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تأثير الاكاسيا وتفل الزيتون في تخفيف الاجهاد الحراري لاناث الحملان العواسية في العراق

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الملخص

تم إجراء تجربتين في مزرعة دجلة للانتاج الحيواني في محافظة واسط سنة **2011** لدراسة تأثير الاكاسيا وتفل الزيتون في معدل النمو ومستوى الهورمونات فى الدم فى الحملان النامية المعرضة لظروف العبء الحراري في التجربة الأولى تم استخدام **18** حملاً (عواسياً) فى عمر خمسة أشهر ومتوسط وزن **31** كيلوغرام كمجموعة واحدة ثم تغذيتها على عليقة متوازنة لمدة شهرين أثناء فصل الربيع، وفى التجربة الثانية تم تقسيم الحملان إلى ثلاث مجموعات متساوية (كل مجموعة ستة حملان)، عدت المجموعة الأولى مجموعة مقارنه للمجموعتين الثانية والثالثة، وعدت مجموعة الربيع مجموعة مقارنه للمجموعة الأولى وتمت تغذية المجموعة الأولى على عليقة متوازنة بالاضافه إلى قش الأرز حتى الشبع والمجموعة الثانية على **75%** من العليقه المركزة بالإضافة إلى الاكاسيا حتى الشبع والمجموعة الثالثة على **75%** من العليقه المركزة مع **310** غرام من تفل الزيتون وذلك لمده ثلاثة أشهر أثناء فصل الصيف. وتراوحت درجات الحرارة من **25.6-32.5** أثناء فصل الربيع و**40-46** في فصل الصيف و دل ذلك على تعرض الحيوانات للاجهاد الحرارى في فصل الصيف.

وكانت النتائج كما يأتي:

1- تعرض الحملان لدرجات الحرارة العالية صيفاً أدى إلى انخفاض معنوى في معدل النمو النسبى و تركيز الدهون الكلية و الكلسترول وإنزيم اللكتات ديهيدروجينيز وبعض العناصر المعدنية مثل الصوديوم والبوتاسيوم والكالسيوم والفسفور الغير عضوي والزنك كذلك في تركيز بعض الهرمونات مثل ترای ايودوثيروتين **T3** والثيروكسين **T4** والبروجستيرون والكورتيزول وذلك بالمقارنة بمجموعة الربيع.

2- إمداد الحملان المعرضة للإجهاد الحراري بالاكاسيا وتفل الزيتون كجزء من العليقه أدى إلى تحسن معنوى فى كل المقاييس المدروسة.

من هذا البحث يمكن استنتاج أن استبدال **25%** من العليقه بالاكاسيا وتفل الزيتون في تغذية الحملان أدى إلى تحسن في معدل النمو اليومى وزيادة العائد الاقتصادى وتخفيف العبء الحرارى تحت ظروف البيئات الجافة وشبه الجافة.

كلية الزراعة- جامعة واسط- واسط- العراق.