EFFECT OF UREA SUPPLEMENTATION AND UREA TREATED STRAW ON THE REPRODUCTION PERFORMANCE OF GROWING AWASSI RAM LAMBS

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ABSTRACT

Two different urea supplementation methods were tested in feeding rations of 12 Awassi rams lambs. Lambs were divided randomly into three groups of four lambs each. A basic concentrate ration was supplemented with adequate amounts of untreated straw (WhS), urea treated straw (UTS) and urea grains (UG) at feeding. The basic diet of UTS and UG groups consisted of a concentrate mix having 8% soybean meal and that of WhS having 20% soybean meal. All diets had similar feeding values. The experiment included two reproductive periods, growth (17-25 weeks) and pubertal periods (26-35 weeks). Growth and reproductive characteristics studied included body weight, daily weight gain, daily feed intake, testicular and penile development, puberty and fertility.

Organic matter digestibility (OMD) of UTS was 5% higher than other groups ($P<0.05$). UTS animals consumed more (778.5 g) than UG and WhS animals (679 and 658 g, respectively) ($P<0.05$). Daily weight gain was higher ($P<0.05$) in UTS (94.2±13) in comparison with UG and WhS (73.9±1 and 59.0±8 g, respectively). Body measurements in all groups were not affected by feeding ($P>0.05$). Differences ($P<0.05$) in testicular growth and penile development were detected in phase I of the pubertal period among animals of all groups. Testes volume, scrotal circumference, prepucial and urethral scores were higher ($P<0.05$) in WhS than UTS and UG groups. Animals of WhS followed by UTS and UG groups achieved puberty at an earlier stage of development (28, 29 and 31 weeks of age, respectively). Mean values obtained of semen volume, sperm viability and concentration for phase I and II were higher ($P<0.05$) in WhS followed by UTS and UG groups. Utilization of urea in Awassi sheep feeding as a source of crude protein promoted an increase in voluntary feed consumption, daily weight gain and OMD. The results also suggest that the use of urea might retard puberty age and fertility in young growing ram lambs.

Key words*:* Awassi sheep, urea, weight gain, digestibility, puberty, fertility

INTRODUCTION

Awassi sheep, originated from Turkey, Syria and Iraq, is the predominant breed of Mediterranean West Asia. The breed is highly adapted to the climatic conditions that determine feed and water shortage. This breed is the main supplier of meat in the Middle East, particularly in Lebanon (Coomb and Trib, 1963; Asghar, 1974). However the population of 380,000 heads in Lebanon (FAO, 2000) is still below the increasing demand for meat in the country.

Efforts were made to replace traditional sources of protein in animal rations with some synthetic nitrogenous compounds to benefit from the rumen microorganisms' ability of converting the non-protein nitrogen (NPN) compounds, like urea, into biologically valuable protein (Ensminger, 1979; Sundstol and Owen, 1984). The addition of urea to ration improves the productive and reproductive characteristics of the breed (Owen, 1976). For a considerable part of the year, poor quality roughage comprises the diet of ruminants in most Middle East countries. Animals on such diets are on a negative energy balance and supplementary feeding is required to supply the physiological demands. It has been shown that urea supplementation can play an important role in this regard (Hadjipanayiotou *et al.,* 1993 and 1997; Fox *et al*., 1971).

The objective of this study was to assess the effect of urea on growth and reproductive performance of growing Awassi ram lambs, using either urea treated straw or urea directly added to rations.

MATERIALS AND METHODS

Animals

The experiments were carried out at the facilities of the Faculty of Agricultural Sciences of the Lebanese University. Twelve Awassi ram lambs of approximately seventeen weeks of age, collected from different flocks were used in the trial. The lambs' average body weight was 23 ± 1.5 kg. The animals were kept at the farm for two weeks between 10 and 25 July to adapt to the new environmental conditions. The pens were cleaned and insecticide dust was powdered weekly on the floor to prevent infestation of endo and ecto parasites. The animals were dipped in an acaricide solution and then vaccinated against enterotoxaemia, anthrax, foot and mouth disease and medicated against GI parasites. Additionally, the animals received an injection of multivitamins (A, D_3, E).

Urea administration

Urea treated straw. A bulk of 100 kg of chopped wheat straw (dried for 24 hours) was thoroughly mixed with five kg of urea (46% nitrogen) dissolved in 100 liters of water and packed in plastic bags, following modifications of O'Donovan (1968), Hadjipanayiotou (1984) and Dolberg (1992), then covered with polyethylene film (0.2 mm thickness) for a period of less than three weeks. The borders of the film were fixed with soil to maintain a good seal.

Direct mixing of urea. Two percent of urea (46% nitrogen) was added to concentrate rations as described by Karr *et al*. (1965).

Feeding, management and recording

Animals were randomly divided into three groups of 4 lambs each. Table 1 shows ingredients and chemical composition of the three rations. The untreated wheat straw (WhS) animal group was fed with a concentrate ration based on 20% soybean meal as protein source and untreated wheat straw. Animals of the urea treated straw (UTS) group were fed a concentrate mix containing 8% soybean meal and urea treated straw. Urea grain (UG) group was fed the same concentrate ration as the UTS mixed directly with 2% of urea and untreated straw. All experimental rations were adjusted using different quantities of corn, barley, and wheat bran to be nutritionally similar according to sheep requirement described by Ensminger (1979). Samples of rations collected routinely were dried and analyzed for crude protein (CP), crude fiber (CF) and ether extract (EE) content. Nitrogen free extract (NFE) and metabolizable energy were calculated mathematically. Salt blocks and water were provided *ad lib*. The ram lambs were kept in pens for seventeen weeks from July till December and fed twice a day at 6 a.m. and 4 p.m. The animals were offered when available, some green corn leaves. In addition, organic matter digestibility (OMD) was determined twice after the first and 2nd months of the experiment by moving the lambs of each group, individually, to metabolic boxes for 3 consecutive days for feces collection.

TABLE 1
Ingredient and Chemical Composition of the Three Diets Fed to the Experimental Animals (%)

Animal-groups / Ingredients	Untreated wheat straw (WhS)	Urea treated straw (UTS)	Urea grain added directly to concentrates (UG)
Wheat straw	40	-	40
Urea treated wheat straw	-	40	-
Soybean meal	20	8	8
Urea grains	-	-	2
Corn	19	23	22
Barley	20	23	22
Wheat bran	-	5	5
NaCl	1	1	1
Chemical composition:			
*Metabolizable energy, Mcal/kg**	*2.3*	*2.2*	*2.2*
Crude Protein	*15.3*	*15.5*	*15.1*
Nitrogen- free Extract	*46.5*	*49.5*	*48.7*
Crude fiber	*16.6*	*20.9*	*16.7*
Ether Extract	*3.4*	*2.8*	*3.1*

*NRC (1985)

Air temperature

Air temperature was measured daily in midday in the meteorological station by standard meteorological procedures and recalculated as weekly average.

Body measurements and consumption

Weight and body measurements were recorded weekly, and feed intakes daily by group.

Reproductive performance

The physiological development of the ram lambs was divided into two periods depending on testes measurements of animals:

- Growth period (0-8 weeks)
- Pubertal period:

a- Phase I (8-12 weeks) - based on the appearance of first spermatozoa under microscopic observations.
b- Phase II (12-16 weeks) - where animals showed a concentration of 0.8 x 10^9/ml spermatozoa.

Testicular measurements

Testicular volume was measured by water displacement as described by Oldham *et al*. (1978), using a graduated beaker filled with water where testes were submerged.

Scrotal circumference was measured weekly at the point of greatest testicular circumference (Foote, 1984).

Penile measurements

The penile development was studied by categorizing the prepuce and urethral process into five scores: 1 (prepuce closed) to 5 (head free) and 1 (urethral filament completely adhered) to 5 (urethral filament completely detached), respectively as proposed by Wiggins and Terill (1953) and Abi Saab *et al*. (1994 and 1997).

Semen collection and evaluation

Puberty detection. All animals were electroejaculated on weekly basis. Ejaculates were collected in a glass collecting tube and were directly examined under the microscope for the presence or absence of spermatozoa. Animals were assumed to have reached puberty when a first spermatozoon was seen under the microscope.

Sperm evaluation. At the pubertal period the rams were subjected to sperm evaluation. The semen volume was measured by the means of a graduated tube. Semen motility was assessed through a scale from zero to 100%. The concentration of semen was determined under the microscope using a haemocytometer. Semen abnormalities were checked according to Evans and Maxwell (1987).

Statistical analysis

The collected data was analyzed by analysis of variance by the Duncan's multiple range Test (DMRT) at 95 % level. The relationship between feed intake and air temperature was measured using regression analysis.

RESULTS AND DISCUSSION

Efficiency of straw treatment

Treatment of straw with urea increased its crude protein content (N x 6.25) from 4.9% (untreated straw) to 16.3% (treated straw). These results were in agreement with those findings obtained by Sundstol *et al*. (1978), and Dolberg (1992). Dry matter content decreased from 88% in the untreated straw to 80% in the treated straw because the urea solution added increased moisture content. There was no mold development and the treated straw had a dark brown color and typical ammonia smell.

Feed Intake

Feedlot performance data are shown in Figure 1. The average daily feed intake under the WhS, UTS and UG rations did not differ (P>0.05) and averaged 658.5±253.4, 778.5±355.9 and 679.2±263.1 g/day, respectively. Similar findings by Karr *et al*. (1965) and Joy *et al.* (1991) were reported for lambs fed mixtures containing urea or biuret. Asghar (1974) also obtained comparable results by feeding Awassi lambs with 2.5% urea as a substitute of soybean meal. The urea treated straw treatment recorded the highest voluntary feed intake.

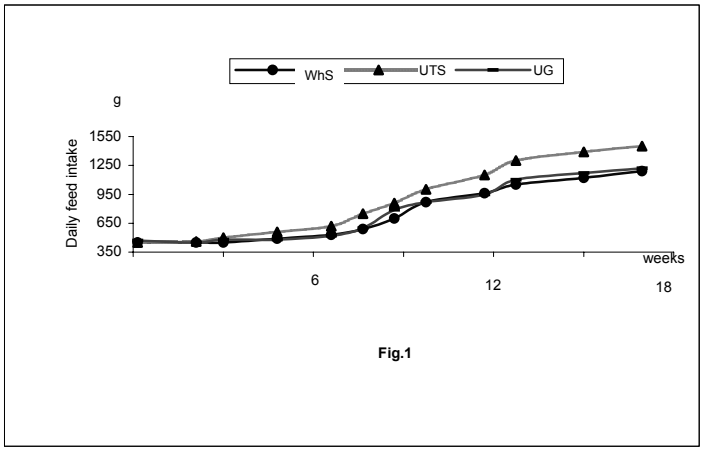

Figure 1. Changes in voluntary feed intake for 18 weeks of the experiment.

Organic matter digestibility (OMD)

Results of OMD were plotted in Figure 2. The average values in UTS, UG and WhS were 47.9 ± 4%, 42.5 ± 3% and 41.3 ± 3%, respectively after one month of the experiment and similar to those recorded in the second month. The highest OMD's of UTS was different ($P<0.05$) than the other groups, which is in agreement with Shaker and Goodchild (1993) and Joy *et al*. (1991).

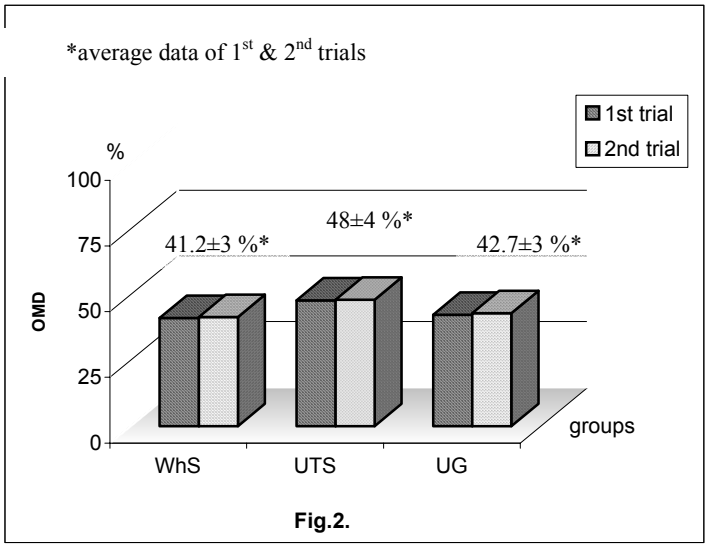

Figure 2. Changes in organic matter digestibility (OMD).

Body measurements

Changes in body weight, heart girth, body length and height at the withers (Table 2; Figure 3) showed a distinct pattern throughout the growth and pubertal periods and did not differ significantly ($P>0.05$) among groups within period, reflecting a similar performance as that reported by Abi Saab *et al*. (1994 and 1997).

The initial average weight of the lambs was 23 ± 1.5 kg and the final weight 32.9 ± 3 kg. At the beginning of the experiment a decrease in body weight was observed in all groups, which might be related to the high temperature depressing feed intake. The decrease in live body weight was more severe in UG and UTS groups than in the WhS group. This might be explained by an effect of adaptation to diets described by Caffrey *et al*. (1967 a, b).

Daily weight gain

Average daily weight gains (Figure 4) of groups UTS and UG (94.2 ± 13 and 73.9 ± 10 g/day, respectively) differed ($P<0.05$) from that of the WhS group (59 ± 8 g/day) reflecting body weight changes, during the first 3 weeks all groups lost some weight; the loss in WhS

was less severe than in UTS and UG. The high temperature (29-32 ºC) during this period of the year (Fig. 5) is the most likely cause to explain the decrease in feed intake, which led to a decrease in live body weight. The correlation between temperature and feed intake was r=0.9 (P<0.05).

TABLE 2
Changes in Live Body Weight, Heart Girth, Body Length and Height in Growing Awassi Rams Fed WhS, UTS and UG

Reproductive Periods	Group/ Diet	Body weight (kg)	Heart girth (cm)	Body length (cm)	Body height (cm)
Growth period	**WhS**	28.5	72.3	62.8	59.5
	UTS	28.1	72.3	62.0	60.3
	UG	27.9	71.8	62.4	59.5
	SEM	*0.7*	*0.9*	*0.7*	*1.0*
Pubertal period:					
Phase I	**WhS**	29.9	75.0	63.5	61.9
	UTS	30.3	75.5	63.8	60.9
	UG	29.8	72.3	63.6	60.9
	SEM	*0.7*	*0.9*	*0.8*	*0.9*
Phase II	**WhS**	32.2	75.4	63.8	62.4
	UTS	32.9	77.3	63.8	63.0
	UG	32.0	75.4	64.8	62.0
	SEM	*0.9*	*1.35*	*1.2*	*1.4*

All means in columns of the growth period and phase I and phase II are not significant (P>0.05)

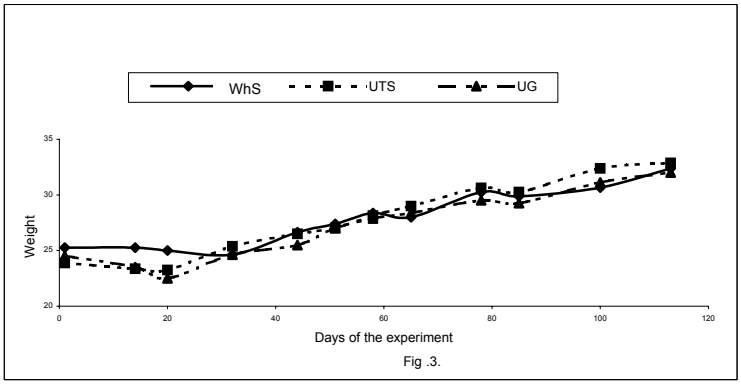

Fig. 3. Changes in body weight of the 3 groups during the experiment.

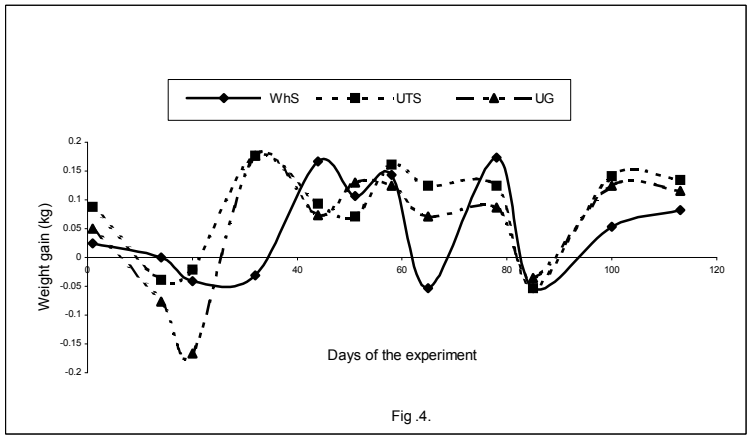

Figure 4. Changes in daily weight gain during the experiment.

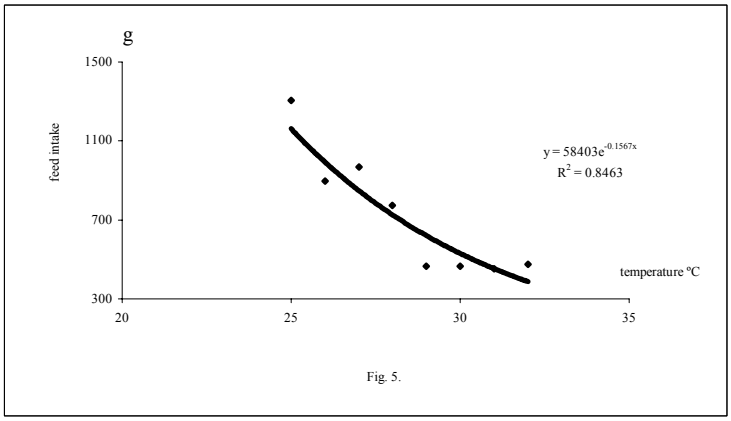

Figure 5. Regression of feed intake on air temperature.

Testicular and penile development

Table 3 shows the variation in testicular volume, scrotal circumference, prepuce and urethral processes. The scrotal circumference of ram lambs of group WhS increased by 43.7% during the growth period in comparison with the initial measurements at the beginning of the experiment, whereas the testicular volume showed much rapid increase (67.5%), attaining a growth of 1.2 ml/day at the beginning and 2.4 ml/day after 4 weeks of the experiment. This increase in testicular volume was most probably due to the increase of the volume of the seminiferous tubules, which was doubled according to Courot (1967) and Foote (1984). As

shown in Table 3 all values of testicular and penile measurements in UTS and UG groups were lower (P<0.05) than animals in the WhS group during the growth period and phase I of the pubertal period. In phase II, the lowest values different from other groups (P<0.05) were obtained in lambs of the UG group. These results confirm the findings of Skinner *et al*. (1968) and Schanbacher *et al*. (1974).

TABLE 3

Changes in Testicular Measurements and Penile Process Scores in Growing Awassi Rams Fed WhS, UTS and UG

Reproductive Periods	Group/ Diet	Testicular Volume (ml)	Scrotal circumfe-rence (cm)	Prepuce (Score)	Urethral process (Score)
Growth period	**WhS**	201[a]	19.4[a]	3.2[a]	2.6[a]
	UTS	160[b]	15.25[b]	2.4[b]	2.0[b]
	UG	143[b]	14.9[b]	2.0[b]	1.9[b]
	SEM	*17.3*	*1.2*	*0.4*	*0.3*
Pubertal period:					
Phase I	**WhS**	240[a]	23.5[a]	4.2[a]	4.4[a]
	UTS	215[c]	20.5[c]	3.8 [b]	3.5[c]
	UG	198[c]	18.5[c]	3.2[c]	3.4[c]
	SEM	*11.3*	*0.9*	*0.6*	*0.6*
Phase II	**WhS**	260[a]	25.16[a]	5.0[a]	5.0[a]
	UTS	245[a]	22.5[a]	4.8[a]	5.0[a]
	UG	223[b]	21.5[b]	4.4[b]	4.8[a]
	SEM	*14.4*	*1.4*	*0.6*	*0.4*

[abc]Means in columns of the growth period and phase I and phase II with no common superscript are significantly different (P<0.05)

The urethral process score at phase II of the pubertal period was similar (P>0.05) in the three groups. A high prepuce score (P<0.05) for WhS was noticed in comparison with UTS and UG groups. On the other hand, the slow increase in body weight of UTS and WhS groups at the beginning of the growth period delayed the development of prepuce and urethral processes, which agrees with Abi Saab *et al*. (1994).

Puberty

Puberty in groups WhS, UTS and UG was attained when animals of these groups weighed 29±2.2 kg, 30.3 ± 1.8 kg and 29.8 ± 1.6 kg, respectively, at 28, 29 and 31 weeks of age, respectively, being approximately 40-50 % of its adult body weight, in agreement with Dyrmundsson and Lees (1972). The early time to reach puberty of WhS and UTS group was attributed to higher increase in weight gain (120 g/day) at the beginning of growth period, thus confirming that sexual development was more closely associated with body growth than with chronological age.

These results agreed with the findings reported earlier by Thwaites (1994) and Abi Saab *et al*. (1997) who concluded that nutrition is a major factor in the development of body growth and early attainment of puberty. One might add that the growth period was critical for enhancing an early attainment of puberty.

Fertility measurements

Semen volume, mobility and concentration (Table 4) were significantly different ($P<0.05$) for rams of the three different groups. At puberty, sperm mobility was significantly higher ($P<0.01$) for rams of WhS group and so were semen volume and sperm concentration. This was expected since the animals of group WhS reached puberty earlier and attained their reproductive functions faster than other groups. During phase II of the pubertal period, semen characteristics in UTS and UG group lower than WhS group ($P<0.05$).

TABLE 4

Changes of Phase I and Phase II of the Pubertal Period in Semen Volume, Mobility and Concentration of Sperm in Growing Awassi Ram Lambs Fed WhS, UTS and UG

Reproductive Periods	Group/ Diet	Semen volume (ml)	Sperm mobility (%)	Sperm concentration (cells x 10^9/ml)
Pubertal period:				
Phase I	**WhS**	0.3^a	30^a	0.23^a
	UTS	0.2^b	10^c	0.11^b
	UG	0.0^c	0.0^c	0.0^c
	SEM	*0.11*	*8.5*	*250*
Phase II	**WhS**	0.6^a	65^a	1.12^a
	UTS	0.4^b	30^c	0.88^b
	UG	0.3^b	10^c	0.12^c
	SEM	*0.9*	*4.5*	*164*

^{abc}Means in columns of the growth period and phase I and phase II with no common superscript are significantly different ($P<0.05$

CONCLUSION

The quality of ingredients of which rations were composed had a direct effect on food utilization, which resulted in rapid and early productive and reproductive growth. Daily weight gains of UTS and UG groups were better than that of group WhS, which might be advantageous taking into consideration the cost of the two rations. The body weight of animals of UTS group exceeded the weight of other groups. Animals of group WhS developed their reproductive performance earlier than those of UTS and UG groups, and therefore reached puberty at an earlier age.

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