Dept. of Animal Production,
Fac. of Agriculture, Assiut University.

SUGAR CANE TOPS SILAGE AS RUMINANTS FEEDSTUFF:
4- LAMBS' CARCASS TRAITS, GASTROINTESTINAL TRACT MEASUREMENTS AND HISTOPATHOLOGICAL EXAMINATION

(With 7 Tables and 10 Plates)

By

S.M. MOUSA; I.A. SOLIMAN; G.A. ABD EL-HAFEZ;

M. MUBARAK* and M.M. FARGHLY

*: Dept. of Pathology, Fac. Vet. Med., Assiut University.

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سيلاج قمم نباتات قصب السكر كغذاء للمجترات
٤- خصائص ذبائح الحملان وقياسات القناة الهضمية والفحص الهستوباثولوجي.

سليمان مصيلحي موسى ، ابراهيم عبدالله سليمان ،

جلال عبد المطلب عبد الحافظ ، محمد مبارك ، محسن محمد فرغلي

أجريت هذه الدراسة لتقييم خصائص ذبائح الحملان النامية المغذاة على تبن القمح وسيلاج قمم قصب السكر غير المعامل وسيلاج قمم قصب السكر المعامل بـ ١% يوريا و ٣% مولاس و السيلاج المعامل بالإضافة لخميرة البيرة في المخلوط المركز. تم ذبح اثنين من الكباش من كل مجموعة في نهاية مدة التجربة لتقييم صفات الذبيحة وعمل دراسة تشريحية للقناة الهضمية وأخذت عينات من كل من الكبد والكلى لفحصها باثولوجيا. أظهرت الحملان المغذاة على تبن القمح والسيلاج غير المعامل زيادة في وزن الذبيحة وفى كل من الجانب الأيسر والأيمن من الذبيحة عن تلك المغذاة على السيلاج المعامل والمعامل مع الخميرة. كذلك تحسنت نسبة التصافى في ذبائح الحملان المغذاة على تبن القمح او السيلاج الغير معامل مقارنة بالمغذاة على السيلاج المعامل او السيلاج المعامل مع الخميرة. وأدت تغذية الحملان على تبن القمح أو السيلاج غير المعامل إلى زيادة في وزن الجانب الأيسر للذبيحة وفي مكوناته عن المغذاة على السيلاج المعامل أو السيلاج المعامل مع الخميرة. كما أدت تغذية الحملان على كل من السيلاج غير المعامل و السيلاج المعامل او السيلاج المعامل مع الخميرة إلى نقص وزن كل من الشبكية والقولون والمستقيم والوزن الكلى للأمعاء عند مقارنتها بالحملان التي غذيت على تبن القمح ، بينما لم تكن هناك اختلافات معنوية بين المغذاة على تبن القمح وجميع المعاملات الأخرى فى وزن كل من الكرش والورقية والانفحة

والوزن الكلى للمعدة ، والأعور والوزن الكلى للقناة الهضمية. لم يكن للتغذية على العلائق المختلفة أي تأثير معنوي واضح على الحجم الفسيولوجى(مل) للأجزاء المختلفة للقناة الهضمية. أيضا لم يكن للتغذية على العلائق المختلفة أي تأثير معنوي على طول ومحيط أجزاء الأمعاء والحجم التشريحي للأمعاء باستثناء القولون-مستقيم حيث زاد معنويا (عند مستوى ٥%) في مجموعة السيلاج غير المعامل عن مجموعات تبن القمح والسيلاج المعامل والسيلاج المعامل مع الخميرة. أظهرت جميع الحملان التى تم تغذيتها على السيلاج المعامل باليوريا والمولاس أعراض تسمم فى الشهر الأخير من الدراسة تمثلت في عدم الاتزان أثناء السير وزيادة معدل التنفس وارتخاء الأربطة العضلية وزيادة في إفراز اللعاب وحدوث النفاخ. وأوضح الفحص الهستوباثولوجى وجود تغيرات واضحة في كل من كبد وكلى الحملان المغذاة على السيلاج المعامل والسيلاج المعامل مع الخميرة. وكانت التغيرات الهستولوجية في الكبد عبارة عن إستحالات وتنكرز فى الخلايا الكبدية بالإضافة إلى تكاثر في الخلايا الطلائية المبطنة للقنوات المرارية وأيضا تغيرات فى الأوعية الدموية البابية. أما التغيرات الكلوية فكانت في صورة استحالات فى الخلايا المبطنة للأنابيب الكلوية وتكاثر في خلايا الكبيبات. وتُعزى كل من التغيرات الكبدية والكلوية إلى زيادة نسبة اليوريا والأمونيا في دم الحيوانات التي تم تغذيتها على علائق السيلاج المعامل والسيلاج المعامل مع الخميرة. وتخلص هذه الدراسة إلى التوصية بتغذية الحملان النامية على السيلاج غير المعامل ولا ينصح بتغذية الحملان النامية على السيلاج المعامل باليوريا لفترة طويلة.

SUMMARY

The objective of this study was to evaluate the carcass traits of growing lambs fed wheat straw (WS), sugar cane tops silage (SCTS), sugar cane tops silage treated with 1% urea and 3% molasses (TSCTS) and TSCTS plus brewers yeast in concentrate mixture (TSCTSY). Two animals from each group were slaughtered at the end of the experimental period. Carcass characteristics were evaluated. The digestive tract was used for anatomical study while liver and kidneys were sampled for pathological examination. Lambs fed WS or SCTS had heavier hot carcass, right and left sides than those fed TSCTS or TSCTSY. Dressing percentages were improved in lambs fed on WS or SCTS than TSCTS or TSCTSY. Lambs fed WS or SCTS had heavier carcass left side with its components than those fed TSCTS or TSCTSY. Feeding SCTS, TSCTS or TSCTSY to lambs decreased the reticulum, colon-rectum and total intestine weights as compared with WS while no significant differences were observed between WS and all treatments in the rumen, omasum, abomasum, stomach compartments, cecum and total gastrointestinal tract (GIT) weight. No significant differences were observed in the physiological volume (ml) of different parts of the gastrointestinal tract for lambs receiving the different experimental rations. Also, no significant differences were recorded between all groups fed the experimental rations in length and circumference of intestines and anatomical volume except the anatomical volume of colon-rectum for lambs fed SCTS which were higher (P<0.05) than those fed WS, TSCT and TSCTSY. All lambs fed TSCTS manifested the following signs of toxicity at the last month of feeding; unsteady gait (incoordination), increased respiration rate, fibrillar muscular twitchings, excessive salivation and bloat. Histopathological examination revealed outstanding changes in liver and kidney of lambs fed either TSCTS or TSCTSY. Hepatic histological changes were manifested as degenerative and necrotic changes of heptocytes in addition to hyperplasia of bile duct epithelium and vascular changes in portal blood vessels. Renal histological changes were in form of tubular degenerative and glomerular proliferative changes. Both hepatic and renal histological changes were ascribed to a state of urea and subsequently ammonia overload. It could be concluded that feeding the growing lambs on sugar cane tops silage (SCTS) is highly recommended while feeding the growing lambs on TSCTS for a long period is not recommended.

Keywords: *SCT, silage, lambs, carcass, GIT, liver, kidney, histopathology.*

INTRODUCTION

Sugar cane tops silage has proved potential characteristics as source of forage for growing lambs (Soliman *et al.*, 2002a,b). It improves digestibility and performance of lambs without any physiological disorders (Abd El-Hafez *et al.*, 2003).

Reddy and Prasad (1982) found that the dressing percentage either on live weight or on empty body weight basis was higher in lambs fed SCT silage treated with 1.5% urea or poultry waste than those fed untreated SCT silage. In addition, the same authors found that the percentage of separable lean were higher (p<0.01) in lambs fed treated SCT silage than untreated one. On the other hand, increasing dietary N as urea from 1.93 to 2.24% decreased the hot carcass weights by 3% and dressing percentage by 1.7% (Milton *et al.*, 1997). Similarly, El-Koussy *et al.* (1991) found that the average dressing percentages based on fasting live weight were 66.09, 62.81 and 60.74%, respectively. However, the differences between groups were not significant. Talha (1990) fed calves on untreated corn stalk or treated either with spraying urea and ensiling or just spraying urea and found significant differences (p<0.01) in the dressing percentages between control and treatments.

However, he did not find any difference in the weights of heart, lung, liver, kidney, spleen, and caudal fat among groups.

Wardrop (1960) reported that the type and plane of nutrition are the most important factors determining the growth rates of the fore stomachs of lambs. He added that plant food is necessary for the normal development of these organs. It would appear that the end products (or a specific end-product) of rumen microbial digestion of plant food is responsible for normal development of the fore-stomachs rather than the physical nature of the plant food (Flatt *et al.,* 1958). Krosata (1968) showed that feeding roughage increased the small and large intestines length in cattle and hence increased the volume of secreted gastric juice. Also, Kobeisy (1990) reported that grazing lambs and kids showed the heaviest weight of the total digestive tract as well as longer colon-rectum with larger circumference compared with groups given 60% or 40% concentrate with wheat straw ***ad libitum.*** Purser and Moir (1966) reported that the weight of the rumen is related to the weight of the animal, and the physical capacity of the rumen is related to its weight while the physiological volume is related to the physical capacity. They also found a significant ($P<0.01$) positive correlation between ***ad libitum*** intakes of material low in nitrogen and the physiological volume of the rumen.

Campling *et al.* (1962) showed that addition of urea increased the total amount of digesta in the reticulo-rumen by about 7%. Minor *et al.* (1977) found a relatively high proportion of the total digesta in the fore stomachs, while the amount of digesta in the hind tract and caecum was low for Zebu bulls fed on chopped whole sugar cane and urea. Also, Owens *et al.* (1973) showed a post-ruminal improvement in digestibility for lambs fed ration-containing urea. However, the lower regions of the digestive tract might be more important in cattle fed sugar cane because of the high content of soluble sugars in sugar cane as well as a considerable amount of digestible fiber may leave the rumen to the lower tract.

Hart *et al.* (1939) found a kidney damage in heifers fed urea at 2.8 % of ration dry matter and they reported that feeding higher levels of urea for long periods might result in tissue damage. They also described liver necrosis and kidney degeneration in calves fed urea at 4.3% of the ration dry matter. Harris and Mitchell (1941) noted kidney hypertrophy when urea was fed at 3.15% of ration dry matter. Kim *et al.* (1982) reported hepatic microscopical changes such as vacuolar degeneration, fatty change, focal of necrosis and partial proliferation of the interlobular connective tissue in chronic urea toxicity of goats. These chronically intoxicated animals also showed vacuolar degeneration and necrosis of renal tubular epithelium with the presence of hyaline casts in the renal tubular lumens. In contrast, Muller *et al.* (1971) found that, fattening steers fed ration containing 2.8% urea for approximately two years had no pathological abnormalities. This study was carried out to investigate the effect of feeding treated or untreated sugar cane tops silage on carcass traits of growing lambs and gastrointestinal tract anatomical characteristics as well as liver and kidney histopathology.

MATERIALS and METHODS

Feeding trial:

A feeding trial was conducted to study the effect of feeding treated or untreated sugar cane tops silage on carcass traits and gastrointestinal tract characteristics as well as liver and kidney histopathology of growing lambs.

Experimental animals:

Twelve healthy Ossimi males (six month's old) were divided into four groups (three males each) according to their average live body weight. The average initial weights were similar in all groups (31.75 ± 0.16 kg). Lambs were kept in individual pens. The experimental period lasted for 270 days and consisted of two periods, *i.e.* 30-days adjustment period followed by 240 days experimental period.

Experimental rations:

The experimental rations were wheat straw (Control), untreated sugar cane tops silage (SCTS), sugar cane tops silage treated with 1% urea and 3% molasses (TSCTS) and sugar cane tops silage treated with 1% urea and 3% molasses plus concentrate mixture containing brewers yeast at the rate of 5kg /ton (TSCTSY). All animals of these groups were fed 60% of their requirements according to NRC (1985) as concentrate mixture while roughage was given *ad libitum.* The composition of concentrate mixture was; yellow corn 37%, wheat bran 17%, rice bran 13%, undecorticated cotton seed meal 30%, limestone 2% and sodium chloride 1%. The quantity of concentrate mixture was adjusted every two weeks according to change in body weight. Licks of vitamins and minerals and fresh water were available free of choice.

Slaughtering:

At the end of the feeding trial, two animals from each group were chosen randomly. At the day of slaughtering, fasting body weight was recorded, then animals were fed their diets two hours before slaughter to fill the digestive tract for physiological volume measurement.

Carcass traits:

Immediately after slaughtering, weight of head, pelt, liver, lungs, heart, spleen, kidneys, kidney fat, cual fat, omental fat, sex organs, and heart fat were recorded. Dressing percentage to fasting body weight were calculated. The carcass was split longitudinally into two sides and weighed. The left side was cut according to Brown and Williams (1979). Weights of tail, leg, loin, rack breast,1-6 ribs, and 7-12 ribs were recorded too.

Gastrointestinal tract anatomical characteristics:

After slaughtering, the alimentary tract was ligated from the esophagus up to anus to prevent loss of digesta and then the parts of the digestive tract, reticulo-rumen, omaso-abomasum, small intestine, cecum and colon-rectum were isolated by tying. The gastrointestinal tract was evaluated utilizing the following criteria:

Physiological volume:

The physiological volume of stomach compartments (reticulo-rumen and omaso-abomasum) and the intestinal segments (small intestine, cecum and colon-rectum) were measured by the difference between the volume of each part when filled with its contents and its volume after emptying the contents using volume subtracted water method. This means that physiological volume of each part equals the volume of its contents as described by Abd El-Khalek (1986).

Anatomical volume:

The anatomical volumes of the small intestine, cecum and colon-rectum were estimated mathematically from the length and the average diameter of the intestinal segments. The average diameter was obtained by measuring the circumference at five loci avoiding any stretching during measuring.

The anatomical volume was calculated using the following formula as described by Abd El-Khalek (1986).

$$AV = \pi . r^2 . l$$

Where, AV= anatomical volume
π = constant = 22/7
r = radius
l = the length

The radius (r) was calculated from the circumference (c) using the formula, $c = 2\pi r$

Fresh tissue weight:

Fresh tissue weights of the stomach compartments (rumen, reticulum, omasum and abomasum) and the intestinal segments (small intestine, cecum and colon) were recorded.

Histopathology:

Representative samples of the liver and kidneys from the slaughtered animals of all groups were fixed in 10% neutral buffered formalin. The fixed tissues were processed routinely for paraffin embedding technique. Firstly, the fixed tissue samples were washed thoroughly in running tap water and then dehydrated in ascending grades of ethyl alcohol (70, 80, 90 and 100%). The dehydrated tissue samples were cleared in methyl benzoate and then infiltrated with hard paraffin wax (melting point 56 °C). The infiltrated tissue samples were embedded in soft paraffin wax (melting point 52 °C). Embedded tissues were sectioned at 3 microns and stained with hematoxylin and eosin (H. & E.) according to the method described by Bancroft and Stevens (1982). The stained tissue sections were examined by light microscope.

Statistical Analysis:

The experimental design was the complete randomized design (CRD). The data were statistically analyzed using general linear model (GLM) procedure of SAS (1998). The significant differences between treatment means were tested using Duncan Multiple Range Test (Steel and Torrie, 1982).

RESULTS and DISCUSSIONS

Carcass characteristics:

Results presented in Table 1 showed that the differences in hot carcass, dressing percentage and carcass components of lambs fed diets based on wheat straw (control), SCTS, TSCTS or TSCTSY were not significant (P<0.05). However, lambs fed wheat straw and SCTS had heavier hot carcass, right and left sides than lambs fed TSCTS or TSCTSY. Hot carcass weight for lambs fed wheat straw and SCTS were higher by about 24.7, 13.72 and 29.4, 17.99 % than those fed either TSCTS or TSCTSY, respectively. High weight of hot carcass and both left and right sides in wheat straw and SCTS groups may be related to the significant (P<0.05) high slaughter weight. To prove the effect of the slaughter weight on the hot carcass weight, the later was calculated as a percentage of the slaughter weight which were 56.41, 54.17, 49.58 and 51.70% for wheat straw, SCTS, TSCTS and TSCTSY, respectively. Results indicated that the hot carcass affected by the slaughter weight. These results are conformed by Cameron and Drury (1985) who found a highly significant (P<0.01) effect of slaughter weight on hot carcass in lambs.

Dressing percentages were numerically higher in lambs fed wheat straw or SCTS than those fed TSCTS or TSCTSY. Such increase may be related to the high body weight of both control and SCTS lambs (Abd El-Hafez et al., 2003). Dahmen et al. (1985) found a positive relationship between dressing percentage and live body weight. In this field, El-Koussy et al. (1991) found that supplementation of urea to chopped corn stalk decreased dressing percentage of Friesian calves.

The overall mean weight of head, feet, spleen, heart, liver, kidney, kidney fat, caudal fat and sex organs tended to be heavier in lambs fed wheat straw or SCTS than those fed TSCTS or TSCTSY. These results may be due to the higher dry matter intake of lambs fed wheat straw and SCTS than those fed TSCTS and TSCTSY. Murray and Slezacek (1980) illustrated that lambs fed a high plane of nutrition had greater weight of liver, kidney, head and sex organs than similar animals fed a low plane of nutrition. However, the pelt tended to be heavier in TSCTS while lungs weight tended to be higher in TSCTSY as compared with those fed the control and SCTS. These results are in agreement with that of Talha (1990) who found no significant difference in weight of heart, lungs, liver, kidney, spleen and caudal fat when calves were fed untreated corn stalk, corn stlak treated with NH_3 ,urea sprayed and ensiling and urea sprayed rations.

Table 1: Effect of feeding untreated and treated sugar cane tops silage to lambs on hot carcass and edible and non-edible parts.

Items*	Control	SCTS	TSCTS	TSCTSY	SEM	Prob.
Slaughter weight, kg	59.30	56.30	53.80	50.00	2.13	0.132
Hot carcass, kg	33.45	30.50	26.82	25.85	2.83	0.337
Right side, kg	13.25	13.10	11.65	11.10	0.92	0.379
Left side, kg	14.20	13.10	12.10	12.10	0.88	0.390
Dressing percentage, %	58.35	55.97	51.36	53.67	3.30	0.545
Head, kg	4.10	4.10	3.35	3.60	0.17	0.077
Feet, kg	1.35	1.15	1.25	1.25	0.11	0.684
Pelt, kg	6.30	6.20	8.10	6.40	0.98	0.535
Spleen, kg	0.090	0.072	0.058	0.085	0.01	0.388
Liver, kg	0.746	0.734	0.729	0.647	0.07	0.782
Heart, kg	0.190	0.175	0.162	0.140	0.02	0.309
Kidney fat, kg	0.258	0.288	0.178	0.178	0.05	0.345
Kidney, kg	0.122	0.107	0.114	0.113	0.01	0.823
Caudal fat, kg	0.434	0.379	0.095	0.116	0.11	0.204
Sex Organs, kg	0.459	0.639	0.428	0.479	0.07	0.253
Lungs, kg	0.669	0.624	0.563	0.743	0.06	0.290

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control : Wheat straw. SCTS : Sugar cane tops silage.
TSCTS : Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY : Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM : Standard error of least-squares means.

Table 2 showed that the carcass left side of lambs fed wheat straw was about 14.79 % heavier weight than TSCTS or TSCTSY. Also these lambs were about 32.87,12.30, 30.68, 24.55, 8.43 and 49 % higher in 1-6 ribs, 7-12 ribs, rack breast, lion, leg and tail, respectively than those fed TSCTS. Similarly, lambs fed SCTS tended to be heavier in left side and its components than those fed TSCTS or TSCTSY. Such improvement in carcass components may be due to the increase of both daily gain and body weight of lambs fed wheat straw and SCTS (Abd El-Hafez et al., 2003). Gravet and Rosenhahn (1965) found a positive correlation between daily gain and the percentages of muscular tissues and fat.

Table 2: Effect of feeding untreated and treated sugar cane tops silage on carcass left side and its components of lambs.

Items*	**Weight (kg)**				**SEM**	**Prob.**
	Control	**SCTS**	**TSCTS**	**TSCTSY**		
Left side	14.20	13.10	12.10	12.10	0.87	0.386
Neck	1.53	1.63	1.46	1.43	0.11	0.620
Shoulder	2.45	2.43	2.34	2.25	0.14	0.748
1-6 ribs	1.43	1.23	0.96	1.04	.014	0.238
7-12 ribs	1.22	1.07	1.07	1.12	0.09	0.674
Rack breast	1.76[a]	1.34[b]	1.22[b]	1.27[b]	0.07	0.017
Lion	1.67	1.50	1.26	1.30	0.20	0.499
Leg	4.15	3.90	3.80	3.70	0.35	0.826
Tail	6.00	4.30	3.06	2.65	1.07	0.263

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control : Wheat straw. SCTS : Sugar cane tops silage.
TSCTS : Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY : Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM : Standard error of least-squares means.
[a, b] Means of the same row with different superscripts are significantly different (P<0.05).

Gastrointestinal tract characteristics:

Absolute fresh tissue weight:

Table 3 shows the absolute fresh tissue weights (g) of different parts of gastrointestinal tract. Feeding SCTS, TSCTS or TSCTSY to lambs decreased significantly the weights of reticulum, colon-rectum and total intestine than control. Such decrease represent about 20.6, 27.2 and 13.2% of reticulum, 2.5, 24.2 and 32.6% of colon-rectum, 0.8, 9.3 and 24.4% of total intestine weight, respectively. No significant differences were observed between control and the rest of treatments in the rumen, omasum, abomasum, stomach compartments, cecum and total gastrointestinal tract (GIT) weight. However, total GIT had numerical higher weight for lambs fed wheat straw and SCTS than those fed TSCT and TSCTSY. This increase may be due to the increase in weight of total stomach and intestine. Purser and Moir (1966) reported that there is a correlation between rumen weight and body weight.

Table 3: Effect of feeding untreated and treated sugar cane tops silage on fresh tissue weights (g) of different parts of gastrointestinal tract (GIT) in lambs.

Items*	Fresh tissue weight (g)				SEM	Prob.
	Control	SCTS	TSCTS	TSCTSY		
Rumen	897.50	727.50	760.00	698.00	80.99	0.421
Reticulum	136.00	108.00	99.00	118.00	7.89	0.105
Omasum	92.50	87.00	92.00	66.50	15.86	0.650
Abomasum	216.00	228.50	211.00	155.00	36.47	0.556
Total Stomach compartments	1342.00	1151.00	1165.00	1037.50	125.84	0.479
Small intestine	769.00	786.00	796.50	630.00	82.65	0.521
Cecum	58.00	45.00	48.00	46.00	6.15	0.510
Colon-rectum	636.00^a	620.50^a	482.00^b	429.00^b	23.67	0.008
Total intestine	1463.00	1451.50	1326.50	1105.50	81.14	0.101
Total G.I.T.	2805.00	2602.50	2491.50	2143.00	193.42	0.249

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control : Wheat straw. SCTS : Sugar cane tops silage.
TSCTS : Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY : Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM : Standard error of least-squares means.
a, b Means of the same row with different superscripts are significantly different ($P<0.05$).

Physiological volume:

No significant differences were observed in the physiological volume (ml) of different parts of the gastrointestinal tract for rams fed the different experimental rations as shown in Table 4. The physiological volume of reticulo- rumen tended to be higher for lambs fed TSCTS and TSCTSY than those fed SCTS. These results may be due to the addition of urea at ensiling time. Campling *et al.* (1962) and Minor *et al.* (1977) observed that the addition of urea to the ration increased the total amount of digesta at the reticulo-rumen by about 7%. The opposite is recorded in this study as the physiological volume of total gastrointestinal tract (GIT) was lower for rams fed SCTS than those fed the control, TSCTS and TSCTSY. These differences are mainly related to the decrease in reticulo-rumen and omaso-abomasum volume (Table 4). Lower mean retention time of digesta for rams fed SCTS than those fed the other diets (Soliman et al., 2002b) may result in a decrease in physiological volume of the total gastrointestinal tract.

Table 4: Effect of feeding untreated and treated sugar cane tops silage on physiological volume (ml) in lambs.

Items*	Physiological volume (ml)				SEM	Prob.
	Control	SCTS	TSCTS	TSCTSY		
Reticulo-rumen	6965.00	5550.00	6735.00	7080.00	1216.40	0.803
Omaso-abomasum	470.00	365.00	1020.00	775.00	306.04	0.498
Total stomach compartment	7435.00	5915.00	7755.00	7855.00	1499.43	0.786
Small intestine	530.00	362.00	445.00	340.00	172.21	0.857
Cecum	305.00	470.00	372.00	300.00	121.53	0.746
Colon-rectum	872.50	1183.00	875.00	550.00	311.60	0.605
Total intestine	1707.50	2015.50	1692.50	1190.00	434.24	0.639
Total G.I.T.	9142.50	7930.50	9447.50	9045.00	1708.46	0.924

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control: Wheat straw. SCTS : Sugar cane tops silage.
TSCTS: Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY: Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM: Standard error of least-squares means.

Length, circumference and anatomical volume of intestinal segments:

Length and circumference of intestines presented in Table 5 showed no significant differences among all the experimental groups fed on the experimental rations. Also, the differences among the anatomical volume of different intestinal segments (Table 6) were not significant except that of colon-rectum for SCTS which was increased ($P<0.05$) by about 57.16, 50.74 and 63.32 over control, TSCT and TSCTSY, respectively. These increases in anatomical volume of colon-rectum as a result of the increase of both length and circumference of the colon–rectum (Table 5), may be attributed to the increase in body weight of rams fed SCTS than other treated groups or due to increased feed intake of this group as recorded by Abd El-Hafez *et al.* (2003). Parra (1978) reported that the gastrointestinal tract size, length and circumference, of the intestine is directly proportional to body weight. This larger proportional volume of the colon-rectum of SCTS group may have a role in explaining the higher efficiency of roughages utilization by this group which reported by Abd El-Hafez *et al.* (2003). In future investigation, attention should be paid to quantify the contribution of the lower gut to the digestion of roughages.

Table 5: Length and circumference (cm) of intestinal segments as influenced by feeding on untreated and treated sugar cane tops silage to lambs.

Items*	Length and circumference (cm)				SEM	Prob.
	Control	SCTS	TSCTS	TSCTSY		
Small ntestine:						
Length	2702.00	2336.00	2521.00	2360.00	180.35	0.522
Circumference	2.75	3.22	3.63	2.74	0.24	0.140
Cecum:						
Length	38.50	41.50	38.50	33.50	3.71	0.555
Circumference	8.83	10.39	9.62	10.10	1.32	0.846
Colon-rectum:						
Length	655.50	738.50	675.00	608.50	34.35	0.202
Circumference	5.30	7.63	5.49	5.09	0.64	0.132

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control: Wheat straw. SCTS : Sugar cane tops silage.
TSCTS: Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY: Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM: Standard error of least-squares means.

Table 6: Effect of feeding untreated and treated sugar cane tops silage on anatomical volume (ml) of lambs.

Items*	Anatomical volume (ml)				SEM	Prob.
	Control	SCTS	TSCTS	TSCTSY		
Small intestine	1638.99	1960.74	2634.54	1416.85	313.90	0.168
Cecum	241.35	392.29	285.46	271.88	108.46	0.782
Colon-rectum	1466.34^{b}	3423.15^{a}	1686.23^{b}	1255.56^{b}	363.99	0.041

* Values are least- squares means (L.S.M.) of 2 rams/treatment.
Control: Wheat straw. SCTS : Sugar cane tops silage.
TSCTS: Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY: Treated sugar cane tops silage + brewers yeast in concentrate mixture.
SEM : Standard error of least-squares means.
[a, b] Means of the same row in each trial with different superscripts are significantly different (P<0.05).

Pathological study:

Clinical signs of toxicity:

Ataxia was noticed during the experimental period for lambs fed TSCTS or TSCTSY and this was expressed as inability of the treated animal to stand on the hind limbs. Apparent signs of toxicity were detected from the sixth month of feeding and the health condition of the treated animals was deteriorated at the last month of feeding. Signs of toxicity were easily detected on lambs fed TSCTS while lambs fed TSCTSY manifested less severe signs. All lambs fed TSCTS manifested the following signs of toxicity; unsteady gait (incoordination), increased respiration rate, fibrillar muscular twitchings, excessive salivation and bloat. Detection of the severe signs of toxicity coincided with the time where the blood urea level reached its peak.

Gross pathology:

Noticeable gross pathological lesions were noticed in animals which were fed on TSCTS. There was diffuse congestion in all visceral organs including liver, kidneys, lungs, heart and spleen. Liver was swollen, friable and occasionally mottled. Pulmonary edema was marked. Excess mucus was seen on the intestinal mucosa.

Histopathology:

The most noticeable histological changes were that of the two groups which were fed on TSCTS and TSCTSY. However, the group of lambs which received 1% urea plus brewers yeast in TSCTSY ration showed less severe changes. In lambs fed TSCTS, the most significant histological changes were observed in the liver and kidneys. Table 7 summarizes the main histological changes noticed in liver and kidneys of lambs fed untreated and treated sugar cane tops silage.

Liver:

All the examined liver tissues showed widespread cellular degenerative changes including cell swelling (Plate 1). The swollen hepatic cells had cytoplasm of ground glass appearance and their cytoplasmic membranes were irregular. Edema obviously separated and dissociated the degenerated hepatic cells (Plate 2). In some areas, the degenerative changes progressed to necrotic ones where the necrosed cells lost their outlines and their nuclei were either pyknotic (small and condensed) or lysed (Plate 3). Cytoplasm of many necrosed cells appeared as coagulated hyperacidophilic mass. Portal areas in most of the examined liver samples showed chronic inflammatory cell infiltration (mainly lymphoid cells), which was associated with atrophic changes of the bile ductules (Plate 4). Bile ducts in some portal areas had hyperplastic epithelial lining, which was characterized by the presence of tall columnar cells. The portal connective tissue was increased, portal veins were distended and portal arterial branches had thickened tunica media and proliferated endothelial lining cells (Plate 5).

Table 7: Histological scoring for hepatic and renal changes observed in lambs fed untreated and treated sugar cane tops silage

Change	SCTS	TSCTS	TSCTSY
Liver:			
Hepatocellular degeneration	_	+ + +	+ +
Hepatocellular necrosis	_	+ + +	+
Inflammatory cell infiltration	_	+ +	+
Bile duct hyperplasia	_	+ +	+ +
Vascular changes	_	+ +	+ +
Kidney:			
Tubular degenerative changes	+	+ + +	+ +
Glomerular proliferative changes	_	+ +	+ +
Glomerular tuft fibrosis	_	+ +	+
Thickening of GBMs	_	+ +	+
Interstitial reaction	_	+ + +	++

-, normal ;+, mild ; + +, moderate ; + + +, severe
SCTS: Untreated sugar cane tops silage.
TSCTS: Treated sugar cane tops silage with 1% urea and 3% molasses.
TSCTSY: Treated sugar cane tops silage plus brewers yeast in concentrate mixture.

The presently described hepatic pathological changes are usually encountered in urea-intoxicated animals (Bartik and Piskac, 1981). The latter authors reported that the lesions in the liver might be due to increased ammonia in the portal blood and also in the peripheral blood to a level which exceeds the detoxification capacity of the liver. A particular level of ammonia in the peripheral blood will elicit clinical symptoms of poisoning. In this respect, Bartley *et al.* (1981) stated that increased ammonia into the portal blood, resulting in central nervous system derangement and subsequently clinical signs of toxicity raised. This was indicated by the higher liver function enzymes AST and ALT in the present cases as recorded by Abd El-Hafez *et al.* (2003). Moss and Butterworth (1974) stated that the use of enzyme estimation is one of the main application of enzymology for the detection of cellular damage.

Leakage of enzymes from plasma membranes into the blood provides a sensitive index of cell damage (Thomson, 1984). Histopathological changes encountered in the liver were most probably arised due to increased blood levels of urea and ammonia. Ammonia intoxicated animals are subjected to increased nitrogen intake and subsequently nitrogen overload leads to tissue degenerative changes (Chandra *et al.*, 1984b). This effect of nitrogen overload was obvious in the liver as judged by the demonstrated hepatic histological changes. These hepatic changes were mainly of necrobiotic nature and this reflects a toxic effect on the hepatocellular architecture.

Kidneys:

Also, in the examined kidneys, there were widespread degenerative changes involving the convoluted tubular cells. Many of the tubular lumina contained remnants of proteinaceous material. Most of the glomeruli had markedly proliferated mesangial cells with expansion of the glomerular tuft mass, which occupied most of the glomerular spaces (Plate 6).

The glomerular mesangio-proliferative change was associated with partial tuft fibrosis (Plate 7). Glomerular tuft fibrosis was also accompanied with thickening of the glomerular basement membranes (GBMs) (Plate 8). In the same examined kidneys, there was severe interstitial reaction which was manifested by noticeable chronic inflammatory cell infiltration and fibrosis associated with tubular atrophy and tubular cystic dilatation (Plate 9). The glomeruli in such kidneys had atrophied tufts and relatively increased glomerular spaces (Plate 10). The cortical arterial branches had swollen endotheliallining cells.

Remarkable picture of nephritis which involved all the main structural renal units including tubules, glomeruli and interstitium were noticed. It was found that increased nitrogen intake is among causes of non-infectious nephritis (Chandra *et al.*, 1984a). It is proposed that the damaging effect of the elevated urea and ammonia at the level of renal glomeruli initiated the process of nephritis.

Other tissues:

Congestion, edema and parenchymal degenerative changes were noticed in lungs, heart and all other tissues. Edema which was described in nearly all tissues was probably the result of the injurious effect of the elevated circulating urea on the vascular walls. Increased urea level was possibly the cause of the widespread degenerative changes in the various parenchymatous tissues. Similar results were reported by Kim *et al.* (1982), Chandra *et al.* (1984a,b) and Javed *et al.* (1995).

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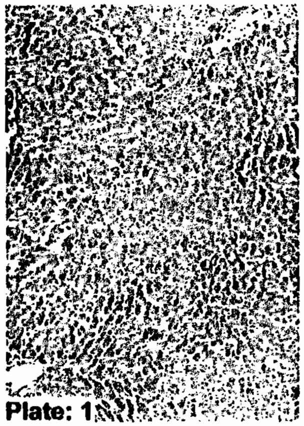

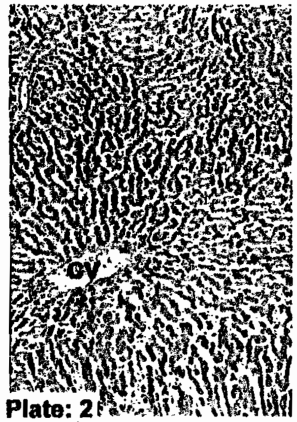

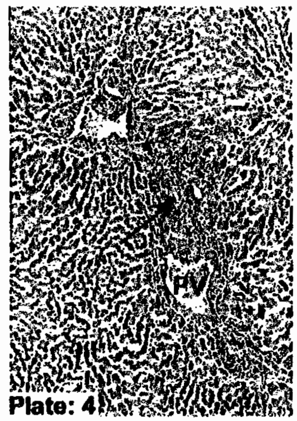

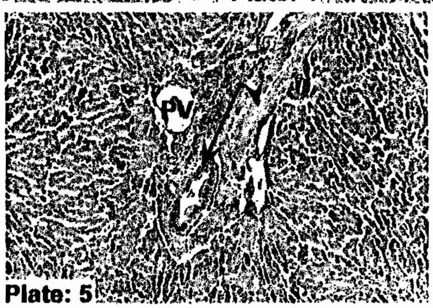

Plate1 : Liver showing widespread cellular degradative changes . The degenerated hepatcytes are swollen& vacuolated.Lambs fed TSCTS. H&E.x160.

Plate2 : Livers showing edema which obviously separates and dissocites the hepatic cords.The central vein (CV) is distended.Lambs fed TSCTS. H&E.x160.

Plate3 : Livers showing focal necrosis (*). The necrosed cells have hypereosinophilic coagulated cytoplasm and pyknotic or lysed nuclei.Lambs fed TSCTS. H&E.x280.

Plate4 : Livers showing chronic inflammatory cell infiltration in a portal area. Bile ductules (arrow) are atrophied. Portal veins (PV) are distended. Lambs fed TSCTS. H&E.x160.

Plate5 : Livers showing hyperpasia of the bile duct epithelium (arrow). The portal C.T is increased and portal veins (PV) are distended. the portal arterial branch (arrowhead) has thickned tunica media. Lambs fed TSCTS. H&E.x160.

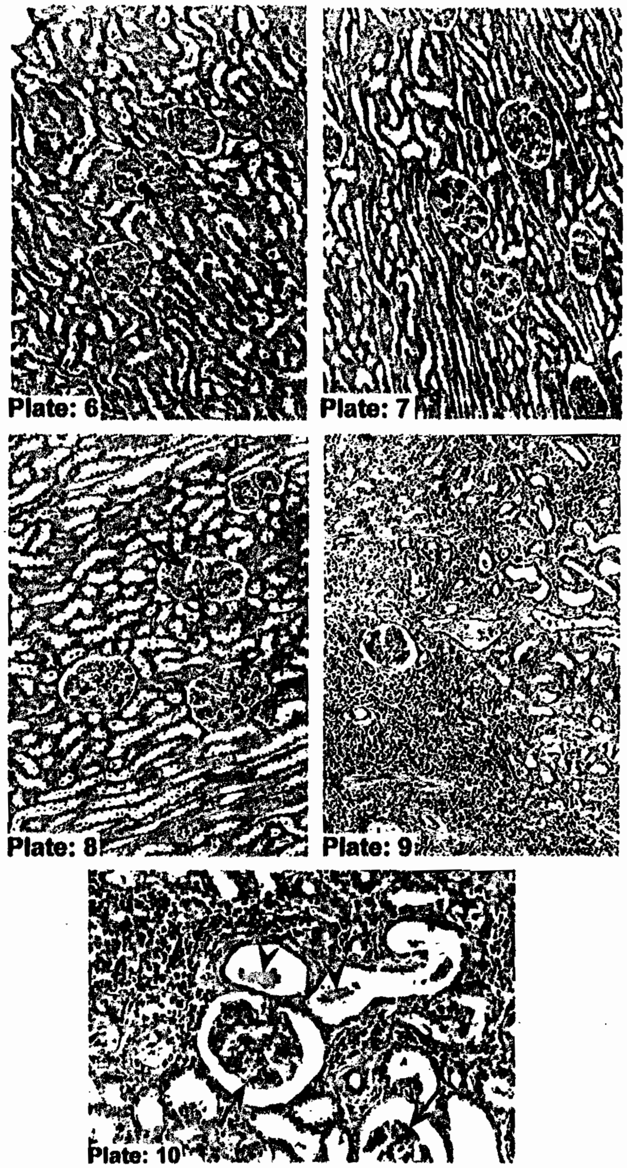

Plate 6: Kidney showing widespread degenerative change in the tubular epithelium and markedly proliferated glomerular mesangial cells (arrow). Lambs fed TSCTS. H & E.x 160.

Plate7: Kidney showing partial fibrosis of the glomerular tufts (arrow).the glomerular mesangial cells are proliferated. Lambs fed TSCTS. H & E x 160.

Plate8: Kidney showing partial fibrosis of the glomerular tufts (arrow) and thickening of the glomerular capillary basement membranes (arrowhead). Lambs fed TSCTS. H & E.x 160.

Plate9: Kidney showing diffuse interstitial chronic in flammatory cell infiliitration associated with fibrosis. Tubules are either atrophied or dilated . Lambs fed TSCTS. H & E.x 160.

Plate10: Kidney showing atrophy of the glomerular tufts (arrow).Note the periglomerular fibrosis, interstitial chronic inflammatory cell reaction and the proteinaceous material within the cystically dilated tubules (arrowhead). Lambs fed TSCTS. H & E.x 320