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Effect of replacing urea-treated sugarcane bagasse with different proportions of barley on some blood biochemical traits of Arabian sheep

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Abstract

This study aimed to investigate the effect of substituting barley with urea-treated sugarcane bagasse at different ratios (0, 10, 20 and 30%) on blood biochemical parameters in the serum of Arabian lambs. The study included 16 Arabian lambs, purchased from local markets in Basra Governorate, at the age of 5-6 months, with an average weight of 25 ± 0.75 kg. Lambs were divided into four treatments (4 lambs per treatment). The treatments were: T1 the control (0% sugarcane bagasse treated with urea), T2 (10% sugarcane bagasse treated with urea), T3 (20% sugarcane bagasse treated with urea) and T4 (30% sugarcane bagasse treated with urea). The feeding period was 90 days including 14 days of adaptation. The results showed significant differences (P≤0.05) in total protein concentration (g/L) in favor of the treatments fed urea-treated sugarcane bagasse compared to the control treatment throughout the study period. There were significant differences (P≤0.05) in albumin concentration during the second month of the study in the treatments fed urea-treated sugarcane bagasse compared to the control treatment, while the differences were not significant in the first and third months of the study. There were significant differences (P≤0.05) in globulin concentration during the first and second months in favor of the treatments fed urea-treated sugarcane bagasse compared to the control treatment, while the differences were not significant in the third month. There was a significant increase (P≤0.05) in urea concentration (mmol/L) in the treatments fed urea-treated sugarcane bagasse compared to the control treatment. There was a significant increase (P≤0.05) in creatinine concentration (mmol/L) in the treatments fed urea-treated sugarcane bagasse compared to the control treatment. There was a significant increase (P≤0.05) in the concentration of liver enzymes AST and ALT (IU/L) in the treatments fed urea-treated sugarcane bagasse compared to the control treatment, but these levels remained within the normal range. It is concluded that replacing urea-treated sugarcane bagasse in lamb rations has no negative effect on the health status of lambs.

Keywords: Sugarcane bagasse, Arabian lambs, Urea treatment, biochemical profile

I. Introduction:

Improving livestock has become essential due to the increasing population growth and the high demand for animal protein. This will not be possible without providing feed in appropriate quantities and qualities, livestock is a key factor in achieving food security (Davis and White, 2020). Nutrition plays an important role in livestock production by improving production performance and quality. This is achieved through efficient nutrition programs to achieve the desired outcomes, while also considering the health aspect of the consumer (Beigh *et al*., 2017).

Sheep play an important role in providing food security for millions of people, particularly in developing and underdeveloped countries, due to their vital role in providing high-quality nutritional resources. Their economic importance lies in their ability to convert roughages into high-value protein, thereby helping to reduce malnutrition and promote a sustainable dietary system (Broderick, 2018).

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Sheep are primarily raised for meat, wool, and hides, and the success of their production systems is highly dependent on the availability and quality of feed, especially during dry seasons, which pose significant challenges in pastoral environments (Lamidi and Ologbose, 2014). Notably, feeding costs constitute approximately 70% of the total operating expenses in ruminant farming systems, making efficient feed management a critical factor in determining the economic viability of such operations (da Costa *et al*., 2015).

Sugarcane is one of the most important economic crops in the world and is primarily used as a raw material for the manufacture of sugar. The by-product of the sugar industry is bagasse, which refers to the fibrous residue of the sugarcane stalk after crushing and extraction of the juice. Bagasse is characterized as low-quality feed for ruminants due to its high content of ligno-cellulose, low crude protein and poor palatability (Gunun *et al*., 2016). On average, about 300 kg of sugarcane bagasse is produced per ton of sugarcane crushed annually (Begna *et al*., 2019). Therefore, urea ammoniation is considered the method of choice for improving the feeding value of straws and enhancing the nutritive value of poor-quality roughages (Chellapandian *et al*., 2024).

Therefore, the aim of this study was to determine the effect of replacing barley with urea-treated sugarcane bagasse at different levels on some blood chemistry parameters of Arabian lambs.

II. Materials and Methods:

The study was conducted at the Animal Field of the College of Agriculture/ University of Basrah, during the period from 24/12/2023 to 24/3/2024 (90 days) following a 14-day adaptation period. The experiment involved 16 Arabian lambs, aged between 5-6 months, with an average body weight of 25 ± 0.75 kg, purchased from local markets in Basrah Governorate. The lambs were randomly assigned to four equal treatments (four lambs per treatment) based on their average live body weight and were housed in a semi-enclosed barn. The experimental treatments were as follows: T1 the control (0% urea-treated sugarcane bagasse), T2 (10% urea-treated sugarcane bagasse), T3 (20% urea-treated sugarcane bagasse) and T4 (30% urea-treated sugarcane bagasse). Feed was provided in two meals at 8:00 AM and 3:00 PM, at 3% of body weight, as shown in (Table 1). The animals were treated by a veterinarian before the start of the experiment and were administered an anthelmintic, followed by an injection of a drug to prevent internal parasites.

Table (1). Proportions of feed components included in the study %

Ingredients	Treatments			
	T1	T2	T3	T4
Barley	45	35	25	15
Wheat bran	43	43	43	43
U-SCB	0	10	20	30
Soya bean meal	10	10	10	10
Minerals & Vitamins	2	2	2	2

U-SCB= urea-treated sugarcane bagasse; T1= 0% u-scb; T2 = 10% u-scb; T3 = 20% u-scb; T4 = 30% u-scb

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Table (2). Chemical composition of the feeds used in the study %

Ingredients	Treatments			
	T1	T2	T3	T4
DM %	88.79	88.71	88.63	88.55
CP %	15.82	15.41	15.31	15.22
EE %	4.93	4.20	3.81	3.61
CF %	12.64	15.90	16.96	18.76
Ash	4.75	5.66	6.99	7.58
NFE %	61.86	58.83	56.93	54.83

DM= dry mater; CP= crude protein; EE= ether extract; CF= crude fiber; NFE= nitrogen free extract; T1= 0% u-scb; T2 = 10% u-scb; T3 = 20% u-scb; T4 = 30% u-scb

Blood Sample Collection:

Blood samples were collected monthly throughout the study period from the jugular vein in the neck region using a 10 ml medical syringe. The blood was transferred into sterile glass tubes containing gel but no anticoagulant. Samples were then transported to the laboratory, where serum was separated by centrifugation at 4000 rpm for 5 minutes. Serum was transferred into sterile tubes and stored at (−20°C) until biochemical analyses were performed. Biochemical parameters of the blood serum were measured using a spectrophotometer, following the specific analytical kits provided by the French company BioLabo for each parameter, and in accordance with the procedures recommended by the manufacturer.

Statistical analysis:

Data were analyzed by using statistical package SPSS (version26, 2019). The study was designed as complete randomized design (CRD) described as, $Yij = \mu + Ti + eij$, where Yij is the studied observation j in a treatment i, μ is the common mean, Ti is the effect of ith treatment and eij is the error effect associated with each observation.

III. Results and discussion:

Total Protein, Albumin and Globulin:

Table (3) shows the effect of replacing urea-treated sugarcane bagasse on blood protein concentrations. A significant increase ($P \leq 0.05$) in total protein concentration was observed in the first month in favor of the treatments fed urea-treated bagasse T2, T3 and T4 (62.65, 68.93, 66.36 g/L, respectively), compared to T1 which recorded (55.65 g/L). Similarly, the same treatments showed a significant superiority ($P \leq 0.05$) in the second month (79.80, 88.50, 80.52 g/L, respectively) compared to T1 (62.22 g/L). In the third month, these treatments again showed significantly higher values ($P \leq 0.05$) (67.25, 71.10, 69.05 g/L, respectively) compared to T1 (64.12 g/L). Table (3) showed that there were no significant differences in albumin concentration during the first and third months. However, a significant difference ($P \leq 0.05$) was observed in the second month in favor of the treatments that received urea-treated sugarcane bagasse T2, T3 and T4 (39.12, 40.32, 36.30 g/L, respectively) compared to T1 (31.22 g/L). Table (3) showed a significant increase ($P \leq 0.05$) in globulin concentration during the first month of the study for treatments fed urea-treated sugarcane bagasse T2, T3 and T4 (31. 85, 35.53, 34.73 g/L, respectively) compared to T1 (25. 60 g/L). Similarly, a significant improvement ($P \leq 0.05$) was observed in the second month for the same treatments (40.67, 48.17, 44.22 g/L, respectively) compared to T1 (31.00 g/L). However, no significant differences were observed in the third month. The

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reason may be attributed to the enhanced health status of the lambs, as well as the increased population of ruminal microorganisms and microbial protein fermentation products (Guedes *et al*., 2008). The elevated levels of amino acids entering the bloodstream consequently lead to an increase in blood protein concentrations. Furthermore, the addition of urea to the diet as a nitrogen source for the rumen microbiota contributes to the synthesis of essential amino acids involved in blood protein formation. This finding is consistent with the results reported by Singer and Marwan (2019), who observed similar outcomes when replacing barley hay with urea-treated sugarcane bagasse in the calf feeding. Additionally, Singer (2024) reported significant differences (P≤0.05) in blood protein concentrations when calves were fed straw treated with 2.5% and 5% urea compared to untreated straw.

Table (3). Effect of replacing urea-treated sugarcane bagasse with different proportions of barley on blood protein concentrations (g/ L) in blood serum

Item	Time	Treatment				Significant
		T1	T2	T3	T4	
Total protein	30 day	d55.65 ± 0.70	c62.65 ± 0.59	a68.93 ± 0.55	b66.63 ± 0.33	*
	60 day	c62.22 ± 1.14	b79.80 ± 0.87	a88.50 ± 0.81	b80.52 ± 0.99	*
	90 day	c64.12 ± 0.71	b67.25 ± 0.93	a71.10 ± 0.64	ab69.05 ± 0.55	*
Albumin	30 day	30.05 ± 0.61	30.80 ± 0.84	33.40 ± 0.67	31.63 ± 1.61	ns
	60 day	31.22 b ± 0.43	39.12 a ± 1.28	40.32 a ± 3.07	36.30 ab ± 1.75	*
	90 day	31.80 ± 0.92	33.97 ± 0.57	35.20 ± 0.64	33.72 ± 1.76	ns
Globulin	30 day	34.73 a ± 1.91	35.53 a ± 0.88	31.85 a ± 1.42	25.60 b ± 0.35	*
	60 day	44.22 ab ± 2.74	48.17 a ± 2.75	40.67 b ± 0.77	31.00 c ± 0.81	*
	90 day	35.32 ± 2.19	35.90 ± 0.62	33.27 ± 1.20	32.32 ± 1.64	ns

Different litters in same column means significant differences; NS= non-significant differences; * Significant differences at level 0.05; T1= 0% u-scb; T2 = 10% u-scb; T3 = 20% u-scb; T4 = 30% u-scb

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Urea and creatinine:

Table (4) shows the effect of replacing urea-treated sugarcane bagasse with barley on urea and creatinine concentrations (mmol/L) in blood serum. The table indicates a significant increase (P≤0.05) in urea concentration during the first month in favour of treatments fed urea-treated sugarcane bagasse T2, T3 and T4 (6.22, 6.37, 7.12 mmol/L, respectively) compared to T1 (5.51 mmol/L). In the second month, the differences were not statistically significant. However, in the third month, a significant increase (P≤0.05) was observed again in the same treatments (8.59, 8.64, 8.83 mmol/L, respectively) compared to T1 (7.19 mmol/L). This increase may be attributed to the rapid release and absorption of ammonia resulting from the dietary urea, leading to a significant elevation in serum urea concentrations. This finding is consistent with the results reported by Adelusi and Oja (2018), who observed a significant (P≤0.05) increase in urea concentration when feeding urea-treated sugarcane bagasse compared to untreated bagasse (140.65, 70.90 mg/L, respectively). Similarly, Devidas (2023) reported a significant (P≤0.05) increase in urea concentration in cows fed urea-treated rice straw compared to those fed untreated straw (9.22, 7.74 mg/dL, respectively). Table (4) showed a significant increase (P≤0.05) in creatinine concentration in the treatments fed urea-treated sugarcane bagasse T2, T3 and T4 in the first month (75.50, 79.25, 91.00 mmol/L, respectively) compared to T1 (72.50 mmol/L). Similar trends were noted in the second month (86.50, 81.66, 95.00 mmol/L, respectively) compared to T2 (75.25 mmol/L). In the third month, creatinine concentrations remained significantly higher in the same treatments (73.75, 70.00, 85.75 mmol/L, respectively) compared to T1 (63.25 mmol/L). The reason may be due to the presence of urea in the diet, which potentially impaired kidney function, possibly through disruption of the glomerular filtration rate, or it may be due to the increased level of rumen-undegraded protein, which may have elevated both urea and creatinine levels due to the influx of proteins and amino acids into the bloodstream. These findings align with El-Hafez *et al*. (2003) when feeding urea-treated sugarcane bagasse compared to barley hay (0.51, 0.38 mg/dL, respectively). Similarly, Singer (2024) reported a significant increase (P≤0.05) in creatinine concentration in sheep fed urea-treated straw compared to untreated (1.08, 0.9 mg/dL, respectively).

Table (4). Effect of replacing urea-treated sugarcane bagasse with different proportions of barley on urea and creatinine concentrations (mmol/L) in blood serum

Item	Time	Treatment				Significant
		T1	T2	T3	T4	
Urea	30 day	5.51 c ± 0.28	6.22 ab ± 0.43	6.37 ab ± 0.51	7.12 a ± 0.17	*
	60 day	6.47 ± 0.20	8.04 ± 0.64	8.07 ± 0.54	8.18 ± 0.68	ns
	90 day	7.19 b ± 0.22	8.59 ab ± 0.42	8.64 ab ± 0.55	8.83 a ± 0.66	*
Creatinine	30 day	72.50 b ± 3.66	75.50 b ± 5.86	79.25 ab ± 5.99	91.00 a ± 2.04	*
	60 day	75.25 c ± 2.17	86.50 ab ± 3.61	81.66 bc ± 3.96	95.00 a ± 1.87	*
	90 day	63.25 c ± 3.19	73.75 b ± 2.86	70.00 bc ± 1.95	85.75 a ± 2.01	*

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AST and ALT:

Table (5) shows the effect of substitution urea-treated sugarcane bagasse on the level of liver enzymes AST and ALT (IU/L) in blood serum. The table indicates that there was no significant increase (P≤0.05) in the level of AST during the first month for T4 (109 IU/L) compared to T1, T2 and T3 (80, 79, 91 IU/L, respectively). However, in the second month, a significant increase (P≤0.05) in AST levels was observed in T2, T3, and T4 fed urea-treated bagasse (139.66, 121.75, 156 IU/L, respectively), while T1 showed a significantly lower value (89 IU/L). A similar trend was noted in the third month, where the T1 again recorded a significantly lower AST level (95.50 IU/L) compared to T2, T3, and T4 (109.75, 108, 110 IU/L, respectively). Table (5) indicates that there was a significant increase (P≤0.05) in ALT level during the first month in T4 (18 IU/L) compared to T1, T2 and T3 (13.66, 13.25, 14.25 IU/L, respectively). In the second month, there was a significant increase (P≤0.05) in T4 (22.33 IU/L) compared to T1, T2 and T3 (14.66, 19.25 and 18 IU/L, respectively). A similar trend was observed in the third month, where there was a significant increase (P≤0.05) in T4 (22.75 IU/L) compared to T1, T2 and T3 (14.75, 20.50, 19.75 IU/L, respectively). This may be due to the presence of urea in the diet, which may have exerted stress on hepatic cells, thereby elevating enzyme levels as a result of liver strain. However, it is noteworthy that all recorded values remained within the normal physiological range. These findings are consistent with Kobeisy *et al*. (2016), who observed elevated ALT levels in lambs fed urea-treated sugarcane bagasse compared to untreated bagasse. Similarly, Singer and Marwan (2019) reported a significant increase in AST and ALT levels in calves fed urea-treated sugarcane bagasse compared to untreated bagasse.

Table (5). Effect of replacing urea-treated sugarcane bagasse with different proportions of barley on the level of liver enzymes AST and ALT (IU/L) in blood serum

Item	Time	Treatment				Significant
		T1	T2	T3	T4	
AST	30 day	80.00 b ± 4.30	79.00 b ± 3.67	91.25 ab ± 3.49	109.00 a ± 13.86	*
	60 day	89.00 b ± 8.33	139.66 a ± 21.44	121.75 ab ± 13.85	156.00 a ± 16.19	*
	90 day	95.50 b ± 2.39	109.75 a ± 3.66	108.00 a ± 3.34	110.00 a ± 3.51	*
ALT	30 day	13.66 b ± 0.62	13.25 b ± 0.75	14.25 b ± 1.31	18.00 a ± 1.68	*
	60 day	14.66 b ± 1.31	19.25 ab ± 2.09	18.00 ab ± 1.08	22.33 a ± 2.24	*
	90 day	14.75 b ± 1.03	20.50 ab ± 2.75	19.75 ab ± 1.03	22.75 a ± 1.88	*

Different litters in same column means significant differences; * Significant differences at level 0.05; T1= 0% u-scb; T2 = 10% u-scb; T3 = 20% u-scb; T4 = 30% u-scb

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IV. Conclusions:

Urea-treated sugarcane bagasse can be utilized as a feed resource for lambs, given its availability and low cost, which contributes to reducing feeding expenses and addressing forage scarcity. The inclusion of sugarcane bagasse in the diet did not exert any adverse effects on the health status of the lambs. Therefore, it is recommended to incorporate urea-treated sugarcane bagasse at appropriate inclusion levels as a sustainable alternative feed source in lamb fattening programs, particularly under conditions of feed shortage and rising input costs.

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