Effect of level of concentrate feeding and addition of sodium bicarbonate on blood parameters of Awassi lambs

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Abstract

This study was conducted at Barkat Aby Alfadhl Alabbas station- Holly Abbas shrine- Karbala Province to investigate the effect of feeding two levels of concentrate, 2.5 and 3% of body weight and addition of sodium bicarbonate at rate of 20 kg/ton on blood parameters. Ground wheat straw was offered to lambs *ad libitum*. Sixteen male Awassi lambs with average weight of 27.84 kg and 4-6 months of age were randomly distributed into 4 treatments with individual pens, 4 lambs per each. The study was lasted for 70 days initiated with 14 days as preliminary period. Results showed that increasing concentrate levels significantly ($P<0.01$) increased blood concentration of total protein from 7.47 to 8.14 g/100 ml, urea nitrogen from 27.89 to 35.43 mg/100 ml and triglycerides from 27.90 to 30.70 mg/100 ml. Concentration of theses parameters were also increased ($P<0.01$) due to addition of sodium bicarbonate. All blood parameters with exception of glucose were affected ($P<0.01$) by the interaction between level of concentrate feeding and addition of sodium bicarbonate.

Key word: Lambs, sodium bicarbonate, blood parameters

تأثير مستوى تغذية العلف المركز واضافة بيكربونات الصوديوم على معايير الدم للحملان العواسية

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الملخص

اجريت هذه الدراسة في محطة بركات ابي الفضل العباس التابعة للعتبة العباسية المقدسة في محافظة كربلاء للتحري عن تأثير تغذية مستويين من العلف المركز,2.5 و3% من وزن الجسم مع اضافة بيكربونات الصوديوم بمعدل 20 كغم/طن على معايير الدم. اما تبن الحنطة المجروش فقد قدم الى الحملان بصورة حرة. تم استخدام 16 حمل عواسي ذكري بلغ متوسط اوزانها 27.84 كغم وتراوحت أعمارها بين 6-4 شهر, وزعت عشوائيا على اربعة معاملات في الحظائر الفردية بواقع اربعة حملان لكل معاملة. امتدت التجربة التغذية الى 70يوم سبقتها فترة تمهيدية بلغت 14يوم. اظهرت النتائج ان زيادة مستوى العلف المركز الى حصول زيادة معنوية ($P<0.01$) في تركيز البروتين الكلي في الدم من 7.47الى 8.14 غم/100 مل وكل من نيتروجين اليوريا 27.89 الى 35.43 والكليسريدات الثلاثية 27.90الى 30.70 ملغم/100 مل. وارتفع تركيز ($P<0.01$)تلك المعايير بطريقة مماثلة نتيجة لأضافه بيكربونات الصوديوم. كما تأثر تركيز جميع معايير الدم معنويا ($P<0.01$) باستثناء الكلوكوز بالتداخل بين مستوى تغذية العلف المركز واضافة بيكربونات الصوديوم.

كلمات مفتاحية: حملان, بيكربونات الصوديوم, معايير الدم

Introduction

It is expected that the local demand for meat and animal protein will increase due to the relative improvement in the living conditions together with the development of food and health awareness and the means of communication. In Iraq, as is the case with most developing countries, the rapid increase in population with limited available natural resources are major challenge for the future of agriculture in supplying animal protein. Good quality feeds are considered the main source of ruminant diets. These animals are expected to become more dependent on roughages due to the rapid expansion of human activities and increased competition on concentrates. Improving animal production in line with the market needs of high-quality meat requires intensive systems using high levels of concentrate and feed additives (35). carbohydrate feedstuffs are an important ingredients used in the composition of concentrate diets. McDonald, et. al., (27) assumed that diets rich in grains such as barley have an important place in systems designed to enhance the rapid growth rates of sheep and cattle. Lambs are usually fattened with diets containing more than 800 g of

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concentrates to achieve high levels of energy intake and daily weight gain (29). Feeding concentrates reduces the molar proportion of acetic acid and increases the molar proportion of propionic acid (13), reducing methane production and enhancing energy retention (32). Increasing intake of grains may lead to imbalance in the ratio of the number of bacteria that able to utilize lactic acid, such as *Megasphaera elsdenii* and *Selenomonas ruminantum* and *Veillonella alcalescens* and increase the number of acid-producing bacteria such as *Streptococcus Bovis* and *Lactobacillus* spp.(28). This can lead to a significant and rapid decrease in the pH of the rumen liquid to less than 5 - 5.3 and the dominance of *Lactobacillus* spp. in the rumen environment, its growth is associated with a further increase in the production of lactic acid (8). The decrease in the pH of the rumen liquid can damage the mucous lining of the rumen and allow the fluids to enter from the bloodstream to the rumen, causing a state of severe dehydration (4). Sodium bicarbonate, a weak base that buffers hydrogen ions liberated from organic acids in the rumen was used to treat this case (23). The current study aimed to investigate the effect of addition of sodium bicarbonate on blood parameters in Awassi lambs fed two levels of concentrates.

Material and methods

This study was conducted in the Barakat Abi Al-Fadhl Al-Abbas station of the Abbasi Holy Shrine, Karbala province from 28/2/2019 to 7/5/2019. Sixteen Awassi lambs with average body weight (BW) of 27.84 ± 1.45 and 4 to 6 months of age were randomly distributed into four experimental treatments (T), with four lambs per each. Concentrate diet was offered at two levels, 2.5 and 3% of BW, and two meals at 8 AM and 4 PM. Sodium bicarbonate (sb) was added to concentrate diet and offered to half number of lambs at level of 20 kg /ton, other half of the lambs were fed concentrate diet at both levels without addition of sb. Experimental treatments are illustrated below:

T1: Concentrate diet was offered to 4 lambs at 2.5% of BW without sb.

T2: Concentrate diet was offered to 4 lambs at 2.5% of BW with sb at 20kg/ton.

T3: Concentrate diet was offered to 4 lambs at 3% of BW without sb.

T4: Concentrate diet was offered to 4 lambs at 3% of BW with sb at 20kg/ton.

Ground wheat straw was offered to all lambs ad libitum. Table 1 shows the chemical composition of concentrate diet, its ingredients and wheat straw.

Table (1). Chemical composition of concentrate diet*, its ingredients and wheat straw (%)

Ingredients	DM	% in DM						ME MJ/100 g
		Ash	OM	CP	CF	EE	NFE	
Wheat bran	91.75	5.48	94.52	14.27	13.96	3.77	62.52	1.23
Yellow corn	91.18	2.22	97.78	9.27	4.2	3.51	80.80	1.37
Barley	91.78	5.65	94.35	10.16	6.71	1.99	75.49	1.27
Soybean meal	91.93	7.87	92.03	45.48	3.75	1.83	39.35	1.18
Urea	-	-	-	287.5*	-	-	-	-
Concentrate	88.22	7.95	92.05	9.22	5.88	2.27	74.68	1.25**
Wheat straw	92.60	7.12	92.88	3.34	35.67	1.78	52.09	1.00**

*** 46 × 6.25**

****Level of ME in diets was estimated according to MAFF (25) equation with subsequent conversion of values from MJ/kg DM to MJ/ 100 g DM in consistence with chemical composition based on percentage determinations: MAFF (MJ/ Kg DM) = 0.012 CP + 0.013 EE + 0.005 CF + 0.014 NFE.**

Level of RDN was estimated according to previous studies in which the ruminal effective degradability of protein fraction in the different ingredients of concentrate diet had been determined as follows: 80 and 60% for barley and yellow corn respectively (17), 70% for soybean meal (1) and 67% for wheat bran (30).

NaCl and mineral-vitamin mix manufactured by Turkish Profeed Company were added to concentrate at rate of 1% for each. Urea was added at rate of 0.62% to ensure existence of a standard ratio of 1.34 g RDN/MJ of ME (3).

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Blood samples were collected from the jugular vein of all experimental animals in one day and at three times, before feeding of morning meal, three and six hours thereafter using a 10 ml syringe, then blood samples were transferred to sterile, dry tubes free of anticoagulants. Blood serum was separated using a centrifuge at 6000 rpm/min for 5 minutes, then distributed into two sterile 1 ml eppendorf tubes. Tubes containing the serum were kept frozen until the analyzes were performed. Concentration of glucose (BG), total protein (TP), urea (BUN) and triglycerides (TG) in the serum were determined using a German-made Reflotron and Kits carried on the strips for each analysis depending on the enzymatic reaction occurred on the surfaces of those strips once the blood sample was placed on them, readings were recorded directly.

The data of the study was analyzed statistically according to factorial experiments (2 × 2) in completely randomized design (CRD) using Statistical Analysis System, SAS (36).

Results and Discussion

Table (2) shows the effect of level of concentrate and the addition of sb on the blood parameters including concentration of glucose (BG), total protein (TP), urea nitrogen (BUN) and triglycerides (TG) in the serum. Results showed that BG concentration was not significantly affected by increasing level of concentrate though it was slightly increased from 52.24 to 54.41 mg/100 ml. This is consistent with the results of other studies carried out on lambs (5, 21, 22, 39). The absence of increasing level of concentrate on concentration of BG in the current study may be due to the lack of influence of the production of propionic acid, which is the main fatty acid responsible for the synthesis of glucose through gluconeogenesis (15).

Table 2- Main effect of level of concentrate feeding and addition of sodium bicarbonate on blood parameter (% ± SE)

Blood parameter	Level of conc. % of BW		sb kg/ton conc.		*P*	
	2.5	3	0	20	Conc.	sb
BG mg/100 ml	52.24 1.73 ±	54.41 1.32 ±	51.28 1.59 ±	55.37 1.16 ±	NS	NS
TP g/100ml	7.47^{b} 0.28 ±	8.14^{a} 0.15 ±	7.29^{b} 0.22 ±	8.32^{a} 0.11 ±	**	**
BUN mg/100 ml	27.89^{b} 1.44 ±	35.43^{a} 0.64 ±	29.19^{b} 1.86 ±	34.13^{a} 1.15 ±	**	**
TG mg/100 ml	27.90^{b} 0.59 ±	30.70^{a} 0.50 ±	28.06^{b} 0.70 ±	30.54^{a} 0.48 ±	**	**

Means in the same row with different superscripts are significantly different
**** (P<0.01) NS= Non significant**

Although concentration of BG was no significantly affected by increasing the level of concentrate in the diet, the concentration of TP was increased (P<0.01) from 7.47 to 8.14 g/100 ml. This result is consistent with the findings of Iqbal, et. al., (20), who indicated that increasing the level of concentrate from 0.5 to 1.5% resulted in a significant increase (P<0.01) in the TP concentration in the blood serum from 6.12 to 6.97 g/100 ml.

The concentration of BUN was increased (P<0.01) from 27.89 to 34.43 mg/100 ml as a result of increasing level of concentrate. This is consistent with the results of other studies (6, 21, 39). Increasing level of concentrate also led to a significant increase (P<0.01) in the concentration of TG from 27.90 to 30.70 mg /100 ml. This increase may be attributed to a decrease in the digestion of dietary fats, due to the effect of increasing the level of concentrate and the consequent passage of quantities of these fats post rumen and their direct absorption as esterified lipids into the blood through the lining of jejunum (26).

Regarding the effect addition of sodium bicarbonate (sb), results showed an increase

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(P>0.05) in the concentration of BG in blood serum from 51.28 to 55.37 mg /100 ml. This is in line with the findings of Tayeb, et. al (38), Imik, Gunlu (19), Al-Abbasy, et. al., (2). However, a significant increase (P<0.01) was observed in the concentration of TP from 7.29 to 8.32 g/100 ml due at addition of sb. This result was not consistent with the results obtained in other studies in which TP concentration in serum was not significantly affected by addition of sb (19, 37, 38).

The increase in TP concentration in the blood serum is a reflection of the rate of ruminal degradation of protein and it appears that the change in that important criterion on the state of protein in the body has been linked to the effect of addition of sb, which plays an effective role in improving the digestion process of protein and changes in the structure of amino acids and creation of microbial protein (31).

Regarding concentration of BUN in blood serum , results revealed that it was increased (P<0.01) from 29.19 to 34.13 mg/100 ml as a result of addition of sb. This may be related to the concentration of ammonia nitrogen in the rumen liquid, where there is a close relationship between the two variables (7).

Addition also of sb also led to an increase in the concentration of TG (P<0.01) from 28.06 to 30.54 mg /100 ml. This may be due to the role of sb in improving microbial activity and the efficiency of lipolytic enzymes and enhancing the utilization of dietary contents of fats. Cottee, et. al., (10) reported similar conclusion.

The results revealed that the concentration of BG in the blood was not significantly affected by the interaction between the level of the concentrate diet and the addition of sb. Lower concentration was recorded by lambs fed T_1 (50.08 mg/100 ml), whereas, higher concentration of 56.33 mg/100 ml was recorded by lambs fed T3. This mathematical increase in BG concentration may be due to changes occurred in rumen fermentation associated with increased production of propionate in addition to increased amounts of starch reaching the intestine (12).

With regard of the other blood serum parameters, its concentrations recorded a significant increase (P<0.01). The lower concentration was associated with feeding concentrate diet without addition of sb, higher concentration was recorded with high level of concentrate and addition of sb. Concentrations of TP were increased from 6.77 to 8.46 g /100 ml and BUN from 24.30 to 36.77 mg /100 ml. These significant increases may be due to the consumption of higher amounts of protein by lambs as a result of increasing the level of concentrate diet and the consequent probable increase in amount of protein degraded and the increase in the concentration of ammonia nitrogen in the rumen. Chen et al. (9) confirmed the relation between ruminal concentration of ammonia nitrogen and the level of dietary protein.

Though both levels of concentrate diet offered to lambs in the current study had similar ruminal protein degradation rate, the quantity of concentrate diet consumed would be the determining factor for the concentration of ammonia nitrogen produced from its degradation in the rumen. The significant increase in the concentration of ammonia nitrogen in the rumen could be directly reflected on the concentration of BUN. Huntington et al. (18) indicated a direct correlation between the amounts of ammonia absorbed through the rumen wall and the synthesis of urea in the liver and thus its concentration in the blood. Azizi-Shotorkhof, et. al. (5) also emphasized the direct relationship between the concentration of ammonia nitrogen in the rumen and BUN.

With recpect to TG, its concentration in the blood was increased from 26.42 to 31.70 mg/100 ml, and this may be due to the effective role of sb in improving digestion of the ether extract (24). Or because of the relation between high level of concentrate diet and the improvement in the fat digestion (14).

Table (4) shows the effect of the time of withdrawing samples on blood parameters. The results showed that the concentration of BG in the blood serum was not significantly affected by the time of collecting blood samples from the lambs. Concentration of BG in the samples withdrawn before feeding was 54.86 mg /100 ml, then it was slightly

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decreased to 53.31 mg /100 ml in blood samples withdrawn after 3 hours of feeding. The slight decrease in BG concentration was continued to 52.00/100 ml in samples collected after 6 hours of feeding.

Table 3- Effect of interaction between level of concentrate feeding and addition of sodium bicarbonate on blood parameter (As appeared in table ± SE)

Level of conc. % of BW	2.5%		3%		*P*
Addition of bc , kg/ton conc.	0	20	0	20	
Blood parameter					
Glucose, mg/100 ml	50.08 2.80 ±	54.41 1.74 ±	52.49 1.74 ±	56.33 1.63 ±	NS
TP, g/100ml	6.77^{c} 0.14 ±	8.18^{ab} 0.18 ±	7.81^{b} 0.20 ±	8.46^{a} 0.09 ±	**
BUN, mg/100 ml	24.30^{d} 0.41 ±	31.49^{c} 0.99 ±	34.09^{b} 0.37 ±	36.77^{a} 0.78 ±	**
TG, mg/100 ml	26.42^{c} 0.26 ±	29.38^{b} 0.33 ±	29.70^{b} 0.66 ±	31.70^{a} 0.31 ±	**

Means in the same row with different superscripts are significantly different
**** (P<0.01) NS= Non significant**

Table 4- Effect of time of sample draw on blood parameter (% ± SE)

Time of withdrawing blood samples	Before feeding	After feeding, hours		*P*
	0 time	3	6	
Glucose, mg/100 ml	54.68 1.08 ±	53.31 1.12 ±	52.00 1.07 ±	NS
TP, g/100ml	7.81 0.18 ±	7.78 0.17 ±	7.83 0.18 ±	NS
BUN, mg/100 ml	26.03^{c} 1.05 ±	37.11^{a} 1.34 ±	31.86^{b} 1.34 ±	**
TG, mg/100 ml	29.43 0.52 ±	29.20 0.54 ±	29.41 0.48 ±	NS

Means in the same row with different superscripts are significantly different
**** (P<0.01) NS= Non significant**

The results also showed that the serum concentration of TP was not significantly affected by the time of collecting blood samples, values were 7.81, 7.78 and 7.83 g/100 ml in the samples collected before, 3 and 6 hours after feeding respectively.

Regarding serum concentration of BUN, blood samples withdrawn before feeding recorded a lower (P<0.01) concentration of 26.03 mg/100 ml. Values were increased (P<0.01) to 37.11 mg /100 ml in the samples withdrawn 3 hours after feeding, then it was decreased (P<0.01) to 31.86 mg/100 ml in blood samples withdrawn from lambs 6 hours after feeding. Saeed (33) obtained similar results.

The increase in serum concentration of BUN may be due to ruminal degradation of protein in concentrate diet at the morning meal, because concentration of BUN in blood is directly related to increased intake of crude protein and its rate of degradation in the rumen (39). Reduction in the BUN concentration in samples withdrawn after 6 hours of feeding may be attributed to a decrease in the ruminal concentration of ammonia nitrogen as a result of absorption through the wall and its use by rumen

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microbes, which is reflected in a decrease in the concentration of BUN.

Like BG and TP, the serum concentration of TG was not significantly affected by the time of withdrawing blood samples, values were 29.43, 29.20 and 29.41 g/100 ml in the samples withdrawn before, 3 and 6 hours after feeding, respectively. This agreed with results obtained by Gregory and Christopherson (16), they attributed such this case to the limited production of very low density lipoproteins or their rapid utilization by other tissues to non-esterified fatty acids for direct use as an energy source. However, Saeed and Hussian (34) indicated that the concentration of TG was associated with a significant change as affected by the time of withdrawing blood samples from Awassi lambs.

In a view of this study, addition of sodium bicarbonate is likely participated more than increasing level of concentrate in the general increase in blood parameters by improving digestion of essential nutrients (carbohydrates, proteins and fats) at different rates through the secretion of specialized enzymes and enhancing the efficiency of rumen microbes (11).

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