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Effect of Replacing Barley Grain by Urea in the Diet of Iraqi Lambs

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ABSTRACT: This study conducted to seeks the effects of partially changing barley grain (BG) with different levels amount of urea on growth performance, rumen fermentation, nutrient digestion and blood parameters in fattening lambs. Twelve Awassi male lambs were divided according to body weight (BW) into three equal groups (4 lambs per each group) and housed in individual pens and assigned to one of three dietary treatments in a randomized block design: barley grain (BG)were given to animals according to the body weight of lambs (3 % of BW) and (BG) reduced and replace with 0, 10, 20, gm urea.
Compared with the control the lambs fed the reduced GB diet plus urea was higher ($p < 0.01$) concentrations of ruminal ammonia and increased with increasing the urea supplementation. As well as increased the crude protein (CP) intake , blood urea nitrogen (BUN), final BW, dry matter intake (DMI) and average daily gain (ADG) were observed with the increasing urea addition to the diet, results showed that 10 gm of urea could substitute of 10 gm BG per kg feed DM without any negative effect on health performance of fattening lambs when fed urea.

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INTRODUCTION

Ruminant animals, such as cattle, sheep, and goats, can convert poor-quality protein roughages and non-protein nitrogen like urea to high-quality protein such as meat or milk these ability due to rumen microorganisms . Most farmers use high-concentrate diet to enhance animal performance (Liu et al,. 2013). Barley grain (BG) used in the ruminant diets but (BG) is an important food for human.

Thus, BG is high cost ,that why the researchers searching for alternative nitrogen source for ruminant production

Urea consider as a non-protein nitrogen feedstuff that high in nitrogen content with low price. Many studies showed fed urea had no bad effect on the rumen fermentation, sheep consider as the most important livestock that supporting economic activities so the strategies to increase sheep production by feed supplementation should be considered .

Many reasons behind using non-protein nitrogen (NPN) source such as ease of obtainability , high N density and its low cost.as well as ,urea consider as a popular N source for ruminants due to its lower cost compared to another protein sources (Almora et al,. 2012)

Feeding high concentrate diet lead to produce high levels of volatile fatty acids (VFA) with decrease pH inside rumen (Zhang et al,. 2017, Wang et al,. 2016) , when pH rumen is 6.5 or lower, the main form of the ruminal ammonia primarily absorbed as $NH4+$ and it is slower compared to that of $NH3$ (Siddons et al,. 1985) . Consequently low rumen pH may lowering the risk of ammonia toxicity through decrease the absorption of ammonia from the rumen to blood stream , as well as, decrease the partially ammonia toxicity due to increase the microbial growth because of high energetic diets(Abdoun et al,. 2006) . Therefore, the aim of this study that when fed urea together with high concentrate diet may partially replace the protein of diet without effect animal performance or increase the toxicity of ammonia in rumen.

MATERIALS AND METHODS

Animals and experimental design

Twelve Awassi male lambs (24.3 ± 0.5 kg initial body weight (BW)) at the age of 3 to 4 months were weighted at the start of the experiment after an adaptation period 10 days then lambs were randomly and equally divided and individually penned (1 ×2

m) divided into three equal groups (4 lambs per each group)all groups were fed barely grain BG at 3% of live body weight , treatments were T1 fed BG then urea replaced with BG as levels 10 and 20 gm in T2 and T3 respectively.

Statistical analysis

The statistical analysis system SAS (SAS, 2012) program was used. Duncan range tests were used to significant compare between means in this study.

Statistical model: Yijk = µ + Ai+ eijk.

RESULTS AND DISCUSSION

1 - Rumen fermentation characteristics

Statistical analysis revealed that there was no difference in ruminal pH was noted among the dietary treatments. Results in table (1) showed that NH3-N and TVFA were significantly improved (P<0.05) as compared with control treatment , NH3-N concentrations were 4.3 , 16.60 and 27.8 (mg/100ml) for T1, T2 and T3 treatments respectively , while TVFA was highest in T2 compare to T1 and T3 , the values of TVFA were 105.02 , 119.81 and 106.85 mmol /L) for T1, T2 and T3 treatments respectively. From current results can be concluded that T2 leading to maximum synchronization between energy and nitrogen thus increase more amount of TVFA with decrees amount of NH3-N in the rumen and increasing synthesis of microbial protein. as well as , Results showed that significant increase (P<0.05) in Acetic acid in all treatments as compared with control group, while Propionate and Butyrate acid were not significantly affected.

In the rumen microbial protein is the main source for protein and ammonia consider as an important source for nitrogen for microbial protein synthesis and its growth (Patra et al. 2018)). 8.8 mg/dL consider as a suitable concentration for rumen ammonia (Hume et al,. 1970).But if ammonia concentration exceeds 140 mg/dL ruminants will suffer from ammonia toxicity in the rumen (Currier *et al.,* 2004) , as well as, rumen ammonia concentration can determined through ruminal urea influx in the urea circulation and nitrogen level of diet, furthermore ruminal ammonia concentration consider as main negative regulator of urea influx and rumen microbes can be easily and rapidly hydrolyzed urea to ammonia(Patra et al. 2018)

In the present study noticed that increased total VFA concentration in rumen fluid may be attributed to the increase the

Table 1. Effects of urea supplementation on rumen fermentation characteristics in fattening Awassi lambs.

Items	pH	NH_3-N (mg/100ml)	TVFA (mmol/L)	Acetate (Ac) (%)	Propionate (Pr) (%)	Butyrate (Bu) (%)
T1	6.17 ± 0.16 [a]	4.3 ± 1.23 [a]	105.02 ± 2.44 [c]	64.85 ±3.25 [b]	26.23 ±4.68 [a]	11. 7 ±2.98 [a]
T2	6.08 ± 0.04 [a]	16.60 ± 0.74[b]	119.81 ± 5.06 [a]	76.23 ±2.65 [a]	27.62±1.25 [a]	11.9 ±3.58 [a]
T3	6.41±2.04 [a]	27.8 ±1.88 [c]	106.85±1.89 [b]	66.27±1.44 [b]	25.11±1.13 [a]	12.39±1.77 [a]
(±SE) Sign.	NS	**	**	*	NS	NS

2- Feed Intake

Results in table (2) showed that the daily intake of DM, OM , CP , NDF and ADF were increased (P<0.05) as compared with control , the intake of DM, OM, CP , ADF and ADF for the lambs in T2 and T3 was higher (P<0.05) than the lambs in control treatments T1 , while EE digestibility was not effected for all treatments.

Using urea usually increasing the intake of nutrients, the positive effects of using urea in animals diets on feed intake were in agreement with many studies (Mathis et al., 2000, Köster et al., 2002, Ortiz-Rubio et al., 2007)

As well as, this study corresponded with other studies (Lazzarini et al., 2009, McGuire et al., 2013) when they reported there were an increase of nutrients intake in the ruminants that fed urea supplemented diets, same results were obtained by many studs when increase DM intake in dairy cows that fed treated straws with 5.5% urea (Wanapat et al., 2009, Gunun et al., 2013). As well as, Emmanuel et al., (2015) noticed that improving the digestibility's of DM, CP, CF, EE, and ADF in camels that fed urea were significantly higher (*P* < 0.05) than camels which fed control without urea.

Table 2. Effects of urea supplementation on feed intake in fattening Awassi lambs.

Items	DM	OM	CP	NDF	ADF	EE
T1	895.5± 0.76 [c]	802.22± 0.27 [b]	113.2± 1.43 [c]	280.9 ±0.37 [c]	193.1±0.62[c]	33.2±0.99[a]
T2	1113.2± 0.02 [a]	909.14± 0.75[a]	156.4± 1.05 [b]	324.1 ±0.82[a]	226.3±0.45[a]	33.7±1.30[a]
T3	1110.1±1.01 [b]	906.21 ±0.89 [a]	184.8 ±1.88 [a]	311.0 ±1.40 [b]	211.4±0.69[b]	33.1±0.47[a]
(±SE) Sign.	*	**	**	*	*	NS

3- Growth Performance

Final weight , average daily gain (ADG) and dry matter intake (DMI) were significantly increased (P<0.05) in all treatments as compared with control, the highest increase was observed in T2 in which lambs were fed 10 gm urea replacement with BG . This may be due to increase nutrient intake as shown in table (2) and improvement of nutrient digestibility.

Rumen fermentation products are represented in forms of total VFA composition , NH3 –N concentration and pH and this is especially true for NH3 –N which consider as an important nitrogen source to growth in the rumen and synthesis of microbial protein (Sweeny et al., 2014, Benedeti et al., 2014)

As well as, nutrient utilization can also represented in the terms of nutrient digestibility and intake and parameters (Reid , 1958) Urea supplementation lead to positive effect on ADG, according to the present study it is appear that urea can increase DMI, OMI, CPI,DMD and CPD,increasing of intake and digestibility lead to positively affect body weight gain, this results similar to (Broderick, 1986) when he found increasing in fattening performance due to the increase in CPD and rumen microorganisms that having a quickly available N source from urea .

Emmanuel et al., (2015) reported that Camels received diet contain urea were higher ADG (P < 0.05) than camels received control diet without urea , as well as, average daily gain was increased with the maximal gain at 1% urea. Many different investigations showed that Urea up to 2 % level in diet enhanced positive influence (Zinn et al., 2003, Burque et al., 2008, Tan et al., 2011)

Table 3. Effects of urea supplementation on Growth Performance in fattening Awassi lambs.

Items	Initial	Final	DMI, g/d	ADG, g/d
T1	24.1± 0.76 [a]	34 ± 0.27 [b]	892.3.3± 1.43 [c]	111.2±2.27 [b]
T2	24.1± 0.02 [a]	38.8 ± 0.75[a]	1233.3± 1.05 [a]	164.9±1.62[a]
T3	24 ±1.01 [a]	38.1 ±0.89 [a]	1209.5±1.88 [b]	156 ±1.49 [a]
(±SE) Sign.	NS	**	**	*

4- Blood parameters

Statistical analysis revealed that were significant (P<0.05) differences in serum cholesterol (SCH) between control and treatments, values were 64.16 for control group and 61.8 mg/100ml for T2 . Table (4) shows that serum glucose SG was improved (P<0.05) in T2 as compared with other treatments, the highest concentrations of SG was 80.4 in T2 while it recorded 60.2 mg/100ml in control treatment, while Statistical analysis showed that there were no significant effect on Globulin and Albumin

The values of serum urea SU were in the normal range for all treatments it was within the normal range , it were 17.21, 27.11 and 29.36 mg/100ml for T1 ,T2 and T3 respectively same results were achieved by Kaneko (1980) and Elkholly et al.(2009) when they showed that SU levels were significantly higher in the sheep that received diets have urea than sheep received diets without urea. As well as, feeding lactating cows with slow-release urea lead to increased concentrations of albumin and cholesterol in the blood compared to the control treatment this due to improved N utilization as well as absence of the body fat mobilization. (P<0.05) El-Zaiat et al (2022).

Table 4. Effects of urea supplementation on blood parameters in fattening Awassi lambs.

Items	Glucose (mg/100ml)	SU (mg/100ml)	Globulin g/dL	Total cholesterol, (mg/100ml)	Albumin, g/dL
T1	60.2± 0.91 [c]	17.21±0.31 [c]	4.72± 0.58 [a]	64.16± 1.12 [a]	2.37±0.01 [a]
T2	80.4± 0.77 [a]	27.11±0.49 [b]	5.13± 0.47[a]	61.8± 0.15 [b]	2.39±0.12[a]
T3	78.1±1.38 [b]	29.36±0.58 [a]	5.05±0.11 [a]	62.3±0.34 [b]	2.35±1.33 [a]
(±SE) Sign.	*	*	NS	**	NS

CONCLUSION

Results of the current study indicated that NPN (Urea) can partially substitute barley grain meal to enhance fattening lambs positively improved nutrients intake, digestibility, blood parameters and growth performance .Urea with concentrate diet will improve the synchronization between fermentation of feed/ TVFA production and ammonia assimilation. Urea at 20 g/kg DM feed may substitute with barley grain meal fed for fattening lambs.

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