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EFFECT OF USING REDUCED RUMINAL DEGRADABILITY CONCENTRATE RATION ON MILK YIELD, COMPOSITION AND SOME BLOOD BIOCHEMICAL PARAMETERS IN KARADI EWES

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Abstract

Thirty-two lactating Karadi ewes, 3-4 years old and 55.80±1.03 kg in body weight were used to study the effect of reducing ruminal degradable protein in concentrated ration on milk yield, composition and some blood metabolites. Ewes were allocated to four groups. The first was control (C), fed on concentrate ration (14% CP) and untreated barley, wheat bran and soybean meal, the second (T1), third (T2) and fourth group (T3) have 15,17 and 20% crude protein and feed ingredients barley, wheat bran and soybean meal was treated with formaldehyde solution. Estimated RDP level in the concentrate ration for all 4 treatments was 99.13, 54.78, 70.64 and 76.48 g/day, while the estimated corresponding un-degradable protein levels for the same treatments were 32.46, 89.83, 94.77 and 109.48 g/d, respectively. Results showed that milk production in ewes increased significantly ($P<0.05$) in 17% CP treatment (1518.5 g/d) compared with control (1097.25 g/d). Milk protein percentage increased significantly ($P<0.05$) in 20% CP treatment compared with control ration. Milk protein yield increased significantly ($P<0.05$) in T1 and T2 compared with control. Milk lactose yield increased significantly ($p<0.05$) in T2 treatment compared with control diet. Blood urea and triglyceride concentrations increased significantly ($P<0.05$) in T3 compared with control and T1 respectively, whereas Globulin/Albumin ratio increased significantly ($p<0.05$) in T3 group ewes blood compared with the rest of the treatments.

Keywords: Karadi ewes, Milk yield, blood biochemical, formaldehyde, treated diet.

INTRODUCTION

Milk production of sheep is an important economic functions in many countries not only because the ewe remain an important dairy animal, but because efficient lactation is the foundation for good lamb performance necessary in any system of production. Protein is usually considered the most crucial and valuable nutrient in a dairy rations that must be used efficiently. Utilization of N and energy in the rumen influenced by the source of crude protein and energy then the flow of nutrients to the small intestine (Sahoo et al., 2006). Many studies suggested that chemical or physical protecting of dietary protein reduced their degradation in the rumen. In this aspect some researchers found that milk yield and components were increased when lactating animals fed rumen protected protein (Al-Dabagh, 2010, Kassem, 2010, Dosky et al., 2011, Dosky, et al, 2012, Kassem and Saleh 2013, and Almallah et al., 2018). Moreover, Al-Hamdani (2012), and

Kassem et al., (2015) showed that heat treatment of barley has a positive effect on milk production in ewes. Also, it has been known that formaldehyde (HCHO) treatment of the diet decreased, the breakdown of protein by rumen microorganisms (Faichney and Davies, 1973) and supplementation UDP to the ruminants diet improves the flow of nitrogen and amino acids into the small intestine (Volden, 1999). Dietary amino acid lose as urea and ammonia reduced when ruminants fed bypass protein then energy conserved through reducing urea synthesis, protein efficiently synthesized and improved reproductive efficiency (Tandon et al., 2008 ; Kumar et al., 2015). Slow degradation of proteins in the rumen are used more efficiently to supplement diets (NRC, 2007). Formaldehyde treatment of soybean meal improved nitrogen utilization, performance and feeding efficiency (Spears et al., 1985). The present experiment was planned to study the effect of formaldehyde-protected protein on milk yield, composition and some blood biochemical parameters in Karadi ewes.

MATERIALS AND METHODS

The experiment was conducted at Animal Production Department Farm, College of Agricultural Engineering Sciences, University of Duhok. Thirty two lactating Karadi ewes, with an average live body weight 56.05±1.3 Kg, were assigned randomly into four treatment groups (8 ewes each). Animals of each group were housed in separately and fed as groups for 28 days. Fresh and clean drinking water was available all the time. Four experimental diets were formulated (Table 1). The first group was fed control diet contained 14% crude protein (CP) and untreated barley, wheat bran and soybean meal, while the second, third and fourth diets contained 15,17 and 20 % CP and the ingredients barley, wheat bran and soybean meal was treated with formaldehyde solution (9L/ton) according to Kassem et al., (1987). Ewes fed daily 1kg/ewe and allowed to grazing for 7 hour daily. At the end of experiment, milk yield was recorded for two consecutive days. Ewes were hand milked and lamb suckling and milk yields were recorded, a uniform milk sample were taken from each ewe for analyzing for its constituents. Blood samples (10ml) were collected from jugular veins at the end of the experiment using plastic disposal syringes. The serum was immediately obtained and stored at -20 C^{o} for further analysis. The experimental diets were analyzed according to AOAC (1980) for dry matter (DM), crude protein (CP), ether extract (EE) and ash. Milk protein was analyzed by Kjeldahl method. Milk fat was determined according to Ling (1963). Serum urea, total protein, albumin, triglyceride and glucose analyzed by using specialized kit for each one by, automated method using Biochemistry auto analyzer (KENZA 240 TX France). Globulin content of each serum sample was obtained by subtracting albumin contents from the serum total protein concentration. Metabolizable total protein was estimated from the summation of true microbial protein produced in the rumen, and dietary protein that escapes from bacterial degradation in the rumen (AFRC, 1998). The microbial true protein (MTP) was calculated assuming that each Mega Joule metabolizable protein (MJ ME) intake leads to the production of 9.6 g of microbial protein, were the microbial protein contains 0.75 true protein and the digestible

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coefficient of true microbial protein in the small intestine is 0.85 (AFRC, 1998). Ruminal UDP was calculated from the sum of the total ingested undegraded protein for all food items according to Ensminger et al., (1990) and Kassem, (1986).

Table 1: Ingredient and chemical composition of diets.

Item %	**Experimental diets**			
	Control	**T1**	**T2**	**T3**
Barley	52	45	45	50
Wheat bran	16	23.5	24	25
Soybean meal	5	7	8	12
Wheat	15	15	15	7.5
Urea	0.6	0.5	1	1.5
Straw	10.4	8	6	3
Salt	0.5	0.5	0.5	0.5
Limestone	0.5	0.5	0.5	0.5
Chemical analysis				
Dry matter DM *	93.58	93.33	93.40	93.47
Crude protein CP *	14.06	15.5	17.7	19.89
Ether extract EE *	4.46	4.04	4.60	3.09
Ash *	8.28	7.51	7.98	8.78
ME MJ/kg DM **	10.31	10.34	10.40	10.44

*Determined at nutrition lab. Animal production Dept.
**Calculated according to Al-Khawaja et al, (1978).

The data were statistically analyzed using ANOVA (SAS, 2001) as in the following animal model:

$$Yij = \mu + Ti + eij$$

where Yij is the individual observation of the parameter measured**.** μ = overall mean, Ti= effect of i^{th} treatment, eij = experimental error assumed to be NID with (0, σ^2 e). Duncan's multiple range test was used to determine the significance of differences between treatments means (Duncan, 1955).

RESULTS AND DISCUSSION

Dry matter intake (DMI) and metabolizable energy intake (MEI) MJ/d, the percentage and quantity of CP, and the rumen status from the RDP (g/day) are presented in Table (2). While ME (MJ/day), the estimated ruminal degradation protein (RDP) (g/MJ ME), the calculated crude microbial protein (g/day), the actual microbial protein (g/day), the rumen UDP (g/d) and calculated MP g/d are illustrated in Table (3). Metabolizable energy concentrations (ME MJ/kg DM) averaged 10.31, 10.34, 10.4 and 10.44 MJ for control,T1, T2 and T3, respectively (Table 1). Control diet contained 11.02 g of RDP/MJ, while formaldehyde treated concentrate led to a marked decrease in the amount of RDP

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in T1 (5.9 g/MJ), and was (7.54 g/MJ ME) in T2 diet (Table 3). It seem from Table (2). that RDP are higher by 30 and 0.3% for control and T3 group respectively as compared with recommendations of (ARC, 1980), while a decrease was -26 and -6% for T1 and T2 respectively. Therefore, it was noticed that RDP in T3 was closer to the recommendations of (ARC, 1980) which indicate that food should contain (7.81 g RDP / MJ metabolizable energy).

Table 2: Average of DMI kg/d, MEI MJ/d, CP g/d, CP% in the diet, RDP%, UDP%, intake RDP g/d, intake UDP g/d, required RDP g/d and Rumen status of RDP g/d.

	Experimental diets			
	Control	**T1**	**T2**	**T3**
Intake DM kg/d	0.936	0.933	0.934	0.935
Intake ME MJ/d	9.65	9.64	9.71	9.76
Intake CP g/d	131.60	144.62	165.41	185.97
RDP % §	75.33	37.88	42.71	41.13
UDP %	24.67	62.12	57.29	58.87
Intake RDP g/d	99.13	54.78	70.64	76.48
Intake UDP g/d	32.47	89.84	94.77	109.48
Required RDP g/d ≠	75.37	75.29	75.84	76.23
Rumen status of RDP g/d $	+23.76	-20.51	-5.2	+0.25

≠ Required RDP (g/d)= 7.81× intake ME (ARC, 1980).

§ RDP % calculated according to (ARC, 1980): (Kassem, 1986).

$ RDP intake (g/day) – required RDP (g/day).

Table 3. ME, RDP, Crude microbial protein, True microbial protein, Rumen UDP and MP.

	Experimental diets			
	Control	**T1**	**T2**	**T3**
Metabolizable energy MJ/d	9.65	9.64	9.71	9.76
RDP g/MJ ME	11.02	9.50	7.54	8.86
Crude microbial protein g/d *	92.64	92.54	93.22	93.70
True microbial protein g/d $	69.48	69.41	69.92	70.28
Rumen UDP g/d	32.46	89.83	94.76	109.48
Metabolizable protein g/d §	64.98	101.51	104.98	114.60

Expressed according to Ensminger et al, (1990) : Kassem, (1986)

* 9.6 × Daily intake metabolizable energy MJ (AFRC, 1998).

$ Crude microbial protein × 0.75 (AFRC, 1998).

§ (True microbial protein + UDP) × 0.85 × 0.75 (Assuming the digestible amino acids reaching the duodenum is 0.85 and AA using efficiency 0.75 (AFRC, 1998).

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The effect of feeding formaldehyde treated concentrate can be noticed on the amount of UDP and RDP with alteration of diet RDP on daily milk yield (g/day), milk fat, protein, lactose content (%), net energy excreted in milk (g/MJ) and the total energy excreted in milk (MJ/day), compared to the control in Table (4). Feeding formaldehyde treated ration significantly (P<0.05) increased milk yield (1518.5 g/day) in T2 as compared to control group (1097.3 g/day). Milk net energy MJ/d increased significantly (P<0.05) in T1, T2, and T3 (4.83, 4.87 and 4.60 MJ/day) respectively as compared to control (3.07 MJ/d) (Table 4). This may be partially explained by increasing the amount of UDP (Table 3) or to increasing microbial protein production as a result of increasing the level of RDP (Hoover and Stokes, 1991) due to increasing the level of urea to 1.5% for T3, which may contributed to modifying the synergistic mechanism of key UDP quality factors such as digestibility of amino acids (Emanuele and Putnam, 2006) in the total feed intake (concentrate + pasture).

Table 4: Means and S.E. for effect of protected protein on milk yield and content

Item	Experimental diets			
	Control	T1	T2	T3
Milk yield kg/d	1097.25±134.64 b	1486.6±146.35 ab	1518.5±143.02 a	1367.4±99.44 ab
Protein %	4.75±0.08 b	4.89±0.04 ab	4.90±0.05 ab	5.09±0.07 a
Protein yield g/d	52.04±6.53 b	72.90±7.40 a	74.56±7.20 a	69.82±5.57 b
Fat %	3.25±0.33	3.55±0.16	3.45±0.16	3.75±0.48
Fat yield g/d	36.06±6.59	52.94±5.66	52.14±5.18	51.45±7.64
Lactose %	4.70±0.08	4.79±0.06	4.83±0.07	4.78±0.05
Lactose yield g/d	51.86±6.66 b	71.44±7.44ab	73.57±7.52 a	65.18±4.38 ab
Milk NE MJ/kg *	3.08±0.13	3.24±0.05	3.21±0.05	3.36±0.19
Milk NE MJ/d	3.37±0.62 b	4.82±0.49 a	4.87±0.46 a	4.60±0.43 a

Means on the same column with different superscripts are significantly (P<0.05) different. *
Milk energy values were calculated according to Economides, (1986) using the following equation: Calorific value (MJ/kg) = 1.64+ 0.42 × fat%.

In addition increasing the rumen fermentations efficiency, which may provide the opportunity to raise the ratio of C3:C2 through better digestion of fiber (Kaufmann 1976; Sutton 1976) and carbohydrates in the diet (Emanuele and Putnam, 2006 ; Stokes et al., 1991), which was reflected in the blood content of triglycerides (Table 5).

Table 5: Effect of treatment on blood biochemical parameters.

Parameter	Experimental diets			
	Control	T1	T2	T3
Urea mg/100ml	35.57±4.85 b	27.35±2.59 b	39.14±2.61 ab	50.60±5.24 a
Total protein g/100ml	6.67±0.08	6.79±0.06	6.78±0.04	6.60±0.07
G/A ratio	0.82±0.05 b	0.78±0.08 b	0.069±0.05 b	1.11±0.04 a
Triglyceride mg/100ml	54.89±3.67 b	55.44±2.82 b	62.50±4.71 ab	69.02±3.43 a
Glucose mg/100ml	72.02±4.61	73.51±3.32	74.11±3.64	69.94±2.24

Means on the same column with different superscripts are significantly (P<0.05) different.

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Such result are in accordance with Kassem (2010) ; Almallah et al., (2018) ; Hassan et al., (2019) ; Mustafa, (2021) who observed that feeding ewes with formaldehyde treated diet led to a significant increase (P<0.05) in milk yield compared to those fed control diet, as well as in goat (Dosky et al., 2012 ; Tajaddini et al., 2021). Also, it was noticed that milk protein increased significantly (P<0.05) in T3 (5.09 %) compared to control (4..75%). This may be due to some of the essential amino acids are playing a key role in some metabolic pathways or are simply stimulating protein synthesis (Mustafa, 2021). Similar results were reported by Al-Mawla, (2004) who found that feeding formaldehyde protected diet had a highly significant effect on the percentage of milk protein in Awassi sheep. However, this result disagree with those of Hassan et al., (2019) in ewes and Tajaddini et al., (2021) in goat, who reported that formaldehyde treated concentrate ration have no effect on milk protein percentage. It was clear that there was a significant increase (P<0.05) in blood urea in T3 compared to control (Table 5). This result agreed with Ababakri et al., (2021) who observed a significant increase in serum blood urea of ewes fed higher level of RUP. Also, Amanlou et al., (2011), who reported that elevating digestible undegradable protein and dietary protein resulted in an increased serum blood urea in sheep. In contrast, Shams Al-dain et al., (2019) indicated no significant effect of feeding the soybean meal treated formaldehyde for Friesian cows blood urea. Increasing the amount of metabolizable protein did not change the energy content (MJ/kg) in the milk, but it led to a significant increase (P<0.05) in the net energy (MJ/day) in the form of milk production with the treated diets, regardless of the protein level difference in the concentrate feed of the three treatments compared to the control. Our finding is in agreement with Huhtanen et al., (1991) which indicate that milk energy output was 1.9MJ/day (P<0.05) higher in cows given formaldehyde treated dried distiller's solubles (DDS) than in those given untreated DDS. Formaldehyde treatment of concentrate with different protein levels raised utilization of food energy efficiency compared to control treatment and towards milk secretion (MJ/day), however, in many studies it was noticed that increasing UDP may have been ineffective or negatively affect microbial yield and decreased protein quality, accompanied decrease carbohydrate digestion, reduction in ME supply and decrease in intake (Emanuele and Putnam, 2006). In the current study, it was shown that formaldehyde treatment increased the amount of pasture intake. Also, previous studies indicated a decrease in intake with Damascus goats as a result of the treatment of formaldehyde treated soybean meal (Hadjipanayiotou and Morand-Fehr, 1991) and Albanian goats (Brun-Bellut et al., 1990). The reason may be attributed to the deficiency of supplying ruminal degradable protein (RDP) in the diet. This study showed that formaldehyde treatment increased estimated metabolizable protein value in the diets compared to the control (Table 3), which may increase milk production in T3. Milk protein yield was significantly (P<0.05) increased in T2 (72.90 g/d) and T3 (74.56 g/d) compared to the control (52.04 g/day). Also, milk lactose yield significantly increased in T2 (73.57 g/day) compared to control group (51.86 g/day). Significantly increasing milk protein and lactose yield may be correlated to increasing milk yield in T1 and T2 as a result of increasing UDP in the rumen.

CONCLUSIONS:

Based on the results of this study, it can be suggest that supplying the undegradable dietary protein in the rumen with the provision of the appropriate amount of RDP using urea to raise the level of the metabolizable protein, which is reflected in the efficiency of energy conversion towards milk yield in ewes before weaning under pasture conditions.

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