INFLUENCE OF VARYING LEVELS OF RUMEN DEGRADABLE TO UNDEGRADABLE PROTEIN ON MILK YIELD, COMPOSITION AND SOME BLOOD PARAMETERS OF KARADI EWES

Jalal Eliya Alkass Kamal Noman Dosky Emad Tayar Sadeeq Buti
School of Animal Production, Faculty of Agriculture and Forestry, University of Duhok, Duhok, Kurdistan Region IRAQ
E-mail: nljealkas2001@yahoo.com

ABSTRACT

Twenty-four lactating Karadi ewes, 3-5 years old and 54±0.69 kg in body weight were used to study the effect of rumen degradable protein (RDP) to rumen undegradable protein (RUP) ratio on milk yield, composition and some blood metabolites. Ewes with their lambs were placed in individual pens and fed *ad libitum* on three rations containing different levels of RDP:RUP namely 68:32 (T1), 56:44 (T2) and 50:50 (T3). Milk yield was recorded in two successive days at biweekly intervals commencing at 2nd week post lambing by using hand milking and lamb suckling technique. Also, blood samples were withdrawn at start, mid and at the end of the experimental period (84 days).

Daily milk yield and total milk yield averaged 1.16±0.038 and 98.31±4.44 kg, respectively. Feeding ewes protected soybean meal (SBM) resulted in a non-significant increase in milk yield in T3 (15.22%), and 12.06% in fat corrected milk (FCM) in T2 as compared to control. A significant (P<0.05) effect of treatment on both percentage and yield of fat and protein was observed. However, the highest fat percent and yield was recorded in T2, whereas, the highest percent and yield of protein was noticed in T2 and T3, respectively. Cholesterol and urea levels was significantly (P<0.05) lower in T1 as compared to other groups.

Keywords: RDP: RUP ratios, Milk, Blood biochemical, Karadi ewes.

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INTRODUCTION

In ruminant animal diets, dietary protein is provided in the form RDP and RUP and the requirement of each part especially RDP vary according to physiological state like growth, lactation and pregnancy (Ali et al, 2009). Sufficient RDP is essential to support the growth of rumen microbes, which may constitute 60 to 75% of amino acids flow to the small intestine (Anonymous, 1980).

Low RDP levels may compromise microbial growth, dry matter digestibility, and protein availability to the host. However, excess RDP that is not utilized for microbial growth is excreted in feces or deaminated to ammonia and excreted via urine and milk (Castillo *et al.*, 2001).

It is established that the higher the RUP content in diet**,** may be necessary for optimal performance of the animal (Schingoethe *et al.*, 1988; Broderick *et al.*, 1990) but with inconsistent response (Wattiaux *et al.*, 1994). Also it has been reported that milk yield increased quadartically with increasing dietary undegradable intake protein

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(UIP) resulting in the greatest milk yield with 75 g/d of UIP (Toghdory *et al.,* 2009). Similarly, supplementation RUP in the form of expeller soybean meal increased the flow of non-ammonia, non-microbial nitrogen to the small intestine and increased milk production by 10% (Broderic *et al.,* 2002) in dairy cattle. Moreover, it was concluded that a ratio of 55:45 RDP: RUP in the diet may result in a higher milk production as compared with a ratio of 75:25 in lactating goats (Mishra and Rai, 1996).

The aim of the current work is to study the effect of different ratios of rumen degradable to undegradable protein in isonitrogenous and isocaloric rations in Karadi ewes on feed intake, milk yield and composition, and some blood parameters.

MATERIALS AND METHODS

Twenty-four lactating Karadi ewes, 3 to 5 years old, and 54±0.69 kg in weight were randomly divided into three groups, placed in individual pens (1.3×1.5 m) with their lambs, and fed on three rations differ in their contents of RDP to RUP through treated SBM by mixing with formaldehyde 6 ltlers of formalin (37%) with 3 liters of acetic acid, and the mixture was diluted with 45 liters of water, and sprayed over the SBM using electrical mixer. After that the mixture was covered by polyethylene for 48 hrs, and then was sprayed on the floor to disposal the odor and formaldehyde gas for 72 hrs (Table 1). Concentrate was offered *ad libitum*, twice daily at 8.00 a.m and 6.00 p.m, and refusals were collected and weighted on the next day before the morning feeding. Wheat straw was offered also *ad libitum*. Clean water was available constantly. Samples of feedstuff were collected after formulation of diet, and were chemically analyzed according to AOAC (Anonymous , 1980) for dry matter, organic matter, ether extract, crude protein and ash.

Milk yield was recorded in two successive days at biweekly intervals starting from the 2nd week post lambing. The lambs were separated from their mothers at 9.00 p.m., and ewes were hand milked at 9.00 a.m., in the following morning. Then the lambs were weighed and allowed to suckle their mothers for about 15 minutes and were weighed again to find out the amount of milk suckled. The daily milk yield was calculated by summing up the milk obtained by hand and milk suckled and multiplied the result by 2.

Milk samples (50ml) were collected at biweekly intervals and immediately were analyzed by Ekomilk total (Eon Trading LLC, U.S.A) to determine the chemical composition of the milk.

Blood samples (10ml) were collected via jagular vein at 9.00 a.m in the morning before feeding at the start, mid and at the end of lactation. Blood samples centrifuged at (3500 rpm) and frozen for later analysis. Serum samples were analyzed for total protein, albumin, globulin, glucose, cholesterol, triglycerides and urea using analytically kits.

Data were analyzed statistically using GLM procedure of theSAS, (2002), taking into account the effect of treatment, period and their interaction assuming the following model:

$$\mathbf{Y_{ijk} = \mu + T_i + P_j + TP_{(ij)} + e_{ijk}}$$

Where:

Y_{ijk} = Observational value of K^{th} animal,
μ = Overall mean,
T_i = Effect of i^{th} treatment ($_i$ = treated, non treated)
P_j = Effect of j^{th} lactation Period ($_j$ = 1, 2, 3, 4, 5 and 6).
$TP_{(ij)}$ = Effect of interaction between $_i^{th}$ treatment and $_j^{th}$ Period of lactation
e_{ijk} = Random error associated with each observation assumed to be NID with (0, σ^2 e)

Also, the same model was used to study the effects of treatment only on milk yield and feed intake. Duncan multiple test (1955) within SAS (Anonymous , 2002) was used to detect differences among least square means within each factor.

Table (1): Ingredients and chemical composition of the experimental diets.

Ingredient %	Level of RDP : RUP		
	T1	T2	T3
	68: 32	56: 44	50:50
White barley	40	40	39
Wheat bran	21	21	15
Corn	25	25	26.5
Untreated soy bean meal	12	----	----
Formaldehyde treated SBM	----	12	18
Urea	0.5	0.5	----
Salt	0.5	0.5	0.5
Limestone	0.5	0.5	0.5
Vitamins	0.5	0.5	0.5
Chemical composition			
Dry Matter *	93.24	93.59	93.25
Organic Matter *	88.35	88.64	88.32
Ether Extract *	2.55	2.21	2.63
Crud Protein % *	14.3	14.3	14.2
Ash% *	4.89	4.95	4.93
Metabolic Energy (ME) MJ/kg **	11.15	11.15	11.17

* Chemical analysis was carried out (on the basis of dry matter) at the nutrition lab. School of Animal Production. ** Calculated according to AlKhawaja *et al.* (1978).

RESULTS AND DISCUSSION

Daily Nutrient Intake: In this study, results in Table (2) showed no significant effect of rumen degradable to undegradable protein ratios on DM, OM, CP and ME intake. This result agree with the finding of Firkins, et. al., 1986 who noted that supplementation of RUP did not affect DMI using plant CP sources. Braud (2005) demonstrated that feeding low RDP to non lactating cows resulted in no appreciable impact on feed intake or apparent diet digestibility. On other hand Hassan and Bryant (1986) showed that the supplemental RUP increases feed intake and body growth rate of sheep .

Table (2): Effect of RDP: RUP on DMI, OMI, CPI, MEI (MJ), RDPI and RUPI of rations.

Treatments	RDP: RUP			Significant effect
	T1	T2	T3	
DMI (gm/d)	1694.45±5.76	1699.78±3.55	1696.35±7.24	NS
OMI (gm/d)	1605.59±5.46	1609.88±3.37	1604.58±6.29	NS
CPI (gm/d)	242.76±0.82	243.35±0.51	242.56±1.03	NS
MEI (MJ)/d	18.89±0.06	18.95±0.04	18.94±0.08	NS

NS not significant, ** p< 0.01, Means with different letters within grouping differ significantly.

Milk yield and Composition: In the current work, the overall mean of the daily milk yield (DMY) during pre-weaning period (84 days) averaged 1.16±0.038 kg (Table 6), and consequently the total milk yield averaged 98.31±4.44 kg. DMY produced by Karadi ewes was almost similar to those reported earlier by other workers on the same breed. According to Dosky (2007), Baker *et al.* (2009) and Kassem *et al.* (2009), DMY was 1.174, 1.223 and 1.097 kg during 90 days, respectively.

It appear from Table (3) that there is a significant (p<0.01) effect of period of lactation on DMY and FCM. Yet, the highest DMY (1.51 kg) and FCM (1.54 kg) were attained during the 3rd period of lactation and decreased gradually toward the lowest value of DMY (0.74 kg) and FCM (0.78 kg) at the final period. Also, Fuertes *et al.* (1998), and Baker *et al.* (2009) found that the period of lactation had a highly significant effect on the variation in milk yield.

The protection of SBM with formaldehyde treatment lead to a non-significant (p<0.05) increase in T3 (15.22%), and 12.06% in fat corrected milk yield in T2 as compared to T1. This result could be due to an increase in metabolizable protein availability, which may cause such increase in milk yield of T3 treatment. Similarly, Hadjipanayiotou and Morand-Fehr (1991) showed a 9% increase (p<0.05) in FCM yield of Damascus goats fed protected SBM. On the other hand this response is lower than 27% increase in FCM yield reported by Chowdhury *et al.,* (2002) working on German Fawn goats. However, dietary inclusion of formaldehyde treated SBM had no effect on milk yield in dairy cows (Small and Gordon, 1985) and goats (Brun-Bellut *et al.,* 1990). The results presented in Table (3), showed that treatments had a significant (P < 0.05) effect on both percent and yield of milk protein. While the highest percent of protein (6.58±0.11%) was observed in T2. On the other hand, the highest yield (80.58 gm/d) of protein was recorded in T3. According to Crawford and Hoover (1984), increased milk protein concentration in cows fed formaldehyde treated meals was usually a result of greater bypass of protein due to formaldehyde treatment, which would increase AA availability at the intestine level. Similarly, Robinson (2004) indicated that the increase in RUP in the ration of dairy cows resulted in a significant increase in milk protein. The results given in Tablae (3) revealed that treatments had a highly significant (P< 0.01) effect on both percentage and yield of fat. The highest percent (5.18±0.14%) and yield (56.74±2.93 gm/d) was recorded for T2, as compared to the T1. Similarly, other workers noted that protected SBM increased the fat percentage of German Fawn goats (Chowdhury *et al.*, 2002), Awassi ewes (AL-Maula , 2004) and cows (Ashes *et al.*, 1992). It seems that neither lactose percent nor yield was affected significantly by dietary treatments. Similarly, Dosky (2007) indicated that rations treated with formaldehyde had no significant effect on lactose content of milk in Karadi ewes.

Blood Parameters: In the current work, neither total protein nor their fraction of globulin and albumin was significantly by feeding Karadi ewes different level of RDO:RUP. Similarly, Shamoon *et al.* (2009), Ali *et al.* (2005) and Salih (2009) noticed that treated rations with formaldehyde had no significant effect on these parameters. Also, no significant differences in blood glucose concentration among different treatments was exist. The low concentration of glucose in the present experiment could be due to depletion of glucose for lactose synthesis in the mammary gland (Sunbel et al., 1994). Similarly, Kassem *et al*. (2009) and Shamoon *et al*. (2009) showed that the ration treated with formaldehyde had no effect on serum blood glucose in Karadi and Awassi ewes, respectively. Al-Mallah (2007) noted that feed formaldehyde treated ration had no significant effect in triglyceride concentration.The average serum cholesterol concentrations were 51.39±, 60.41± and 59.00± mg/100ml for T1, T2 and T3, respectively which are within the normal range of 52-76 mg/100ml as indicated by Kaneko *et al*. (1997). Cholesterol level was significantly ($p<0.05$) lower (51.39±2.75) in T1 compared to both T2 But T1 showed a significant lower concentration as compared with T2 and T3 (60.41±3.46) and T3 (59.00±2.38) (Table 4).

The reason for this may be in part due to the protection of fat from microbial degradation which may lead to increase rumen fat bypass which hydrolyzed and absorbed in the intestine (Shamoon *et al.*, 2009). Similarly, it was reported that cholesterol of serum has been increased consistently in response to the feeding of protected polyunsaturated fat with a variety of formaldehyde protected feedstuff (Bitman et al., 1974; Wren et al., 1975). Serum triglyceride averaged 62.35, 58.01 and 59.03 mg/100ml for T1, T2 and T3 respectively (Table 4) which are within the normal range of triglyceride in sheep (54-76 mg/100ml) as indicated by Hayrattin (2005). The level of triglyceride did not differ significantly among different treatments. These results resemble those of Al-Mallah (2007) who noticed that the effect of the treated rations with formaldehyde had no effect on the levelof triglyceride in Awassi ewes. Urea concentration was decreased significantly ($p<0.05$) in T1 (41.46 mg/dl) as compared to T2 (48.96 mg/dl) and T3 (49.63 mg/dl), although the differences was significant but values were in the normal range (27.-64 mg/dl) reported by Hayrettin (2005). Such difference among treatments could be attributed to the differences in RDP in the rations (Kassem *et al.*, 2009). Similarly, Al-Dabagh (2010) found a higher urea concentration in ewes fed diets treated with formaldehyde. It can be concluded that feeding protected soybean meal improve milk, fat and protein yield of Karadi sheep.

Table (3): Effect of RDP: RUP ratio and lactating period on milk yield and composition in Karadi ewes (Means and S.E.)

	TMY (kg)	DMY (kg/d)	FCM (4%) kg/d	Protein %	Protein Yield gm/d	Fat %	Fat Yield gm/d	Lactose %	Lactose Yield gm/d
Overall all mean	98.31± 4.44	1.16± 0.03	1.22± 0.40	6.36± 0.06	73.87± 2.51	4.43± 0.09	50.73± 1.78	4.60± 0.02	53.45± 1.756
Treatment									
1	94.28± 7.22	1.12± 0.06	1.16± 0.68	6.19± 0.09b	69.08± 3.86b	4.26± 0.14b	47.49± 3.02b	4.56± 0.02	51.12± 2.854
2	93.33± 6.29	1.13± 0.06	1.30± 0.64	6.58± 0.11a	72.38± 3.63ab	5.18± 0.14a	56.74± 2.93a	4.63± 0.01	51.29± 2.532
3	108.63± 9.49	1.25± 0.07	1.22± 0.76	6.32± 0.10ab	80.58± 5.41a	3.81± 0.08c	47.77± 3.19b	4.63± 0.05	58.24± 3.660
Period									
1	-	1.28± 0.06ab	1.38± 0.75a	6.08± 0.08bc	78.31± 3.87b	4.44± 0.17	57.01±3.449a	4.56± 0.01	58.79± 2.94a
2	-	1.35± 0.07ab	1.43± 0.87a	6.01± 0.17c	81.55± 5.22b	4.44± 0.21	59.81±4.136a	4.64± 0.09	63.02± 3.87a
3	-	1.51± 0.09a	1.54± 0.88a	6.58± 0.09a	97.08± 6.45a	4.38± 0.23	62.83±4.13a	4.61± 0.01	67.40± 4.06a
4	-	1.26± 0.09b	1.32± 1.05a	6.56± 0.14a	83.24± 6.61ab	4.39± 0.22	54.76±4.741b	4.58± 0.03	57.99± 4.57a
5	-	0.829± 0.05c	0.87± 0.63b	6.41± 0.16ab	52.92± 4.21c	4.50± 0.25	36.34±2.93b	4.62± 0.01	38.00± 2.70b
6	-	0.743± 0.04c	0.78± 0.48b	6.54± 0.16a	48.61± 3.35c	4.43± 0.23	32.44±2.23b	4.61± 0.02	34.25± 2.17b

Means with different letters with grouping differ significantly (p< 0.01).

Table (4): Means and S.E. for effect of RDP: RUP and period of blood collection on blood parameters.

	Total protein gm/100ml	Albumin gm/100ml	Globulin gm/100ml	Glucose mg/100ml	Cholesterol mg/100ml	Triglyceride gm/100ml	Urea mg/100ml
Overall all mean	6.46 ± 0.10	2.88± 0.09	3.58± 0.11	68.49± 1.08	56.90± 1.72	59.81± 1.17	46.70± 1.37
Treatment							
1	6.34± 0.17 a	2.95± 0.18 a	3.40± 0.18 a	68.62± 1.61 a	51.39± 2.75 b	62.35± 1.97 a	41.64± 2.19 b
2	6.67± 0.16 a	2.85± 0.16 a	3.82± 0.16 a	68.43± 2.06 a	60.41± 3.46 a	58.01± 1.91 a	48.96± 2.62 a
3	6.36± 0.18 a	2.84± 0.12 a	3.52± 0.22 a	68.41± 2.03 a	59.00± 2.38 a	59.03± 2.21 a	49.63± 2.01 a
Period							
1	6.36± 0.14 b	2.80± 0.20 b	3.56± 0.15 a	68.06± 1.72 a	49.29± 2.11 c	61.24± 1.82 a	45.43± 2.79 a
2	7.01± 0.19 a	3.42± 0.14 a	3.59± 0.20 a	66.68± 2.20 a	56.99± 3.20 b	61.62± 1.75 a	47.61± 2.59 a
3	5.99± 0.10b	2.87± 0.10 b	3.12± 0.13 b	70.83± 1.63 a	64.77± 2.76 a	56.42± 2.42 a	47.08± 1.64 a

Means with different letters with grouping differ significantly ($p < 0.01$).

تأثير مستويات مختلفة من البروتين التحلل الى غبر التحلل في انتاج الحليب ومكوناته وبعض صفات الدم الكيموحيوية في النعاج الكرادية

جلال ايليا القس كمال نعمان سيف الدين دوسكي عماد طيار صديق بوتي
سكول الانتاج الحيواني، فاكولتي الزراعة والغابات، جامعة دهوك، دهوك – العراق.
E-mail: nljealkas2001@yahoo.com

الخلاصة

تم استخدام 24 نعجة كرادية حلوبة وبعمر 3-5 سنوات وبمعدل وزن 54 ±0,69 كغم لدراسة تأثير مستويات مختلفة من البروتين المتحلل الى غير المتحلل في انتاج الحليب ومكوناته وبعض صفات الدم الكيموحيوية .ثم وضع النعاج مع حملانها في اقفاص فردية وغذيت على علائق مركزة بصورة حرة تحتوي على نسب مختلفة من البروتين المتحلل الى غير متحلل وهي 68:32 (المعاملة الاولى) و 56:44 (المعاملة الثانية) و 50:50 (المعاملة الثالثة). كما تم تسجيل انتاج الحليب وليومين متعاقبين مرة واحدة كل اسبوعين ابتداء من الاسبوع الثاني من ولادة النتاج وذلك باستخدام الحلب اليدوي ورضاعة الحملان. كما تم أخذ عينات من الدم لدى بدء التجربة و وسطها وانتهاءها عند اليوم 84. بلغ معدل انتاج الحليب اليومي وانتاج الحليب الكلي 1,16± 0,038 و 98,31 ± 4,44 كتم على التوالي. لقد ادت تغذية النعاج على علائق حاوية على فول الصويا المحمية بزيادة غير معنوية لانتاج الحليب في المعاملة الثالثة مقدارها22و15% وفي الحليب المعدل لنسبة الدهن مقدارها 6و12% في المعاملة الثانية. كان للمعاملة تاثير معنوية (ا<0,05) في كل من النسبة وحاصل الدهن والبروتين حيث بلغت نسبة الدهن اقصاها في المعاملة الثانية وكان اقصى حاصل بروتين في المعاملتين الثانية والثالث. كانت مستويات كل من الكوليسترول واليوريا منخفظة معنويا (ا<0,05) في المعاملة الاولى مقارنة ببقية المعاملات.

الكلمات الدالة: RDP، نسبة RUP، الحليب، كيمياء حيوية الدم، نعاج عواسيه.

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