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

JALAL ELIYA ALKASS, KAMAL NOMAN DOSKY, and EMAD TAYAR SADEEQ BUTI*
School of Animal Production, Faculty of Agriculture and Forestry, University of Duhok, Kurdistan Region IRAQ
Email: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 RDP to RUP ratio on milk yield, composition and some blood attributes. Ewes with their lambs were placed in individual pens and fed concentrate and straw ad lib. Milk yield was recorded in two successive days at biweekly intervals commencing at 2^{nd} 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 Also, blood samples were withdrawn at start, mid and at the end of the experimental period (84 days).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 SBM resulted in a non-significant increase in milk yield in T3 (15.22%), and 12.06% in 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 metabolites, Karadi ewes

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INTRODUCTION

Protein is an important limiting nutrient in ruminant animals fed low quality forages. It becomes necessary when an animal attains its optimum growth or peak production. This is because nutrient requirements of ruminants vary according to the physiological state like growth, lactation and pregnancy (Ali *et al.*, 2009). In ruminant diets, dietary protein is provided in the form of rumen degradable protein (RDP) and rumen undegradable protein (RUP). 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 (ARC, 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, the better the 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 (UIP) resulting in the greatest milk

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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%, in dairy cattle (Broderic *et al.*, 2002). 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 daily feed intake, milk yield and composition, together with some blood parameters.

MATERIALS AND METHODES

Twenty-four lactating Karadi ewes, 3 to 5 years old, and 54±0.69 kg in weight were randomly divided equally into three groups, and placed in individual pens (1.3×1.5 m) with their lambs, and fed rations of different levels of RDP to RUP (Table 1). Concentrate was offered *ad libitum*, and the quantity offered daily was divided into two halves and fed at 8.00 a.m and 6.00 p.m, and refusals were collected and weighed 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 (1980).

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., on the following morning, ewes were hand milked at 9.00 a.m., and the quantity of milk was recorded. 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.

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 (as DM) at the nutrition lab. School of Animal Production.
**Calculated according to AlKhawaja *et al.* (1978).

General Linear Model was used to estimate Best Linear Unbiased Estimates effects (SAS, 2002) to study the effect of treatment, period and their interaction on daily milk yield, and milk composition, assuming the following model:

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

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 $(0, \sigma^2 e)$

The above model was used to study the main effect on blood parameters, with the exception of the period is 3. Duncan multiple test (1955) within SAS (2002) was used to detect differences among least square means within each factor.

RESULTS AND DISCUSSION

Daily Nutrient Intake

In this study, the average DMI, OMI and CPI expressed in gram per day of ewes were almost similar (p>0.05) among different treatment groups because the quantity of concentrate offered to the ewes according to their requirement for maintenance and milk production (NRC, 2001). However, the ratios of RDPI were differ significantly ($P < 0.01$) among different treatment groups being the highest in T1 (169.93±0.58), followed by T2 (146.01±0.30), and then T3 (121.28±0.52). Consequently, the RUPI were also differ significantly ($P < 0.01$) among treatment groups but in reverse order to RDPI (Table 2).

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
RDPI (gm/d)	169.93±0.58a	146.01±0.30b	121.28±0.52c	**
RUPI (gm/d)	72.83±0.25c	97.34±0.20 b	121.28±0.52a	**

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

Milk yield and Composition

In the current work, the overall mean of the DMY during pre-weaning period (84 days) averaged 1.16±0.038 kg (Table 4), 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 (4) 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 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. Protected SBM resulted in a non significant (p>0.05) increase in total milk yield 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 with protected SBM. On the other hand, this response is lower than that of 27% increase in FCM yield reported by Chowdhury *et al.*, (2002) working on German Fawn goats. However, dietary inclusion of formaldehyde treated SBM reported to have no effect on milk yield of dairy cows (Small and Gordon, 1985) and goats (Brun-Bellut *et al.,* 1990).

Table (3): Means and S.E. for effect of RDP: RUP and lactating period on total milk yield, daily milk yield (kg/d) and milk composition (% and gm/d).
Means within different letters within grouping differ significantly (p< 0.01).

From the results presented in Table (3), it appears that treatment had a significant (P <0.05) effect on both percent and yield of protein in milk. 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 attained in T3. According to Crawford and Hoover (1984), increased milk protein concentration for 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 the level of protein in milk.

	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

The results given in Table (3) revealed that treatment 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 control group. 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 treatment. 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 affected by feeding Karadi ewes different level of RDP: 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 glucose among different treatment groups exist. The low concentration of glucose in the present experiment could be due to depletion of glucose for lactose synthesis in the mammary gland (Subnel *et al.*, 1994). Similarly, Kassem *et al*. (2009) and Shamoon *et al*. (2009) showed that ration treated with formaldehyde had no effect on serum blood glucose in Karadi and Awassi ewes, respectively.

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 (60.41±3.46) and T3 (59.00±2.38) (Table 5). Moreover, cholesterol level tended to increase significantly from 49.29 to 64.23 mg/100ml at the end of the experimental period.

The reason for this rise is 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).

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

	Total protein gm/100 ml	Albumin gm/100 ml	Globulin gm/100 ml	Glucose mg/100ml	Cholesterol mg/100ml	Triglyceride gm/100ml	Urea mg/100 ml
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	2.95± 0.18	3.40± 0.18	68.62± 1.61	51.39± 2.75 b	62.35± 1.97	41.64± 2.19 b
2	6.67± 0.16	2.85± 0.16	3.82± 0.16	68.43± 2.06	60.41± 3.46 a	58.01± 1.91	48.96± 2.62 a
3	6.36± 0.18	2.84± 0.12	3.52± 0.22	68.41± 2.03	59.00± 2.38 a	59.03± 2.21	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	49.29± 2.11 c	61.24± 1.82	45.43± 2.79
2	7.01± 0.19 a	3.42± 0.14 a	3.59± 0.20 a	66.68± 2.20	56.99± 3.20 b	61.62± 1.75	47.61± 2.59
3	5.99± 0.10b	2.87± 0.10 b	3.12± 0.13 b	70.83± 1.63	64.77± 2.76 a	56.42± 2.42	47.08± 1.64

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

Serum triglyceride averaged 62.35, 58.01 and 59.03 mg/100ml for T1, T2 and T3 respectively (Table 5) which are within the normal range of triglyceride in sheep (54-76 mg/100ml) as indicated by Hayrettin (2005). The level of triglyceride did not differ significantly among different treatment groups. These results resemble those of AL-Mallah (2007) who noticed that the effect of the treated rations with formaldehyde had no significant effect on the level of triglyceride in Awassi ewes.

Urea concentration averaged 41.64, 48.96 and 49.63 mg/100ml in T1, T2 and T3, respectively (Table 8). The present values of serum urea are within the normal range (27-64 mg/100 ml) reported by Hayrettin (2005). Analysis of variance revealed that the effect of treatment on urea concentration was significant ($p<0.05$). Such difference among treatments could be attributed to the differences in RDP in the rations (Kassem *et al.*, 2009). Similarly, Al-Dabagh (2010) found 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.

تاثير نسب مختلفة من البروتين المتحلل بالكرش: البروتين غير المتحلل بالكرش على انتاج الحليب ومكوناته وبعض مقاييس الدم في النعاج الكرادية

جلال إيليا القس كمال نعمان دوسكي عماد طيار
قسم الإنتاج الحيواني-كلية الزراعة والغابات –جامعة دهوك
Email:nljealkas2001@yahoo.com

الخلاصة

اجريت الدراسة على 24 نعجة كرادية منتجة للحليب يتراوح عمرها بين 3-5 سنوات وبمعدل وزن 54 كغم وذلك لدراسة ت أثير نسبة البروتين المتحلل في الكرش : البروتين غير المتحلل في الكرش على انتاج الحليب ومكوناته وبعض الصفات الدموية . تم وضع النعاج مع حملانها في اقفاص فردية وغذيت على عليقة مركزة وتبن بشكل حر. وتم تسجيل انتاج الحليب ليومين متتالين كل اسبوعين بدأً من الاسبوع الثاني بعد الولادة وبطريقة يدوية مع رضاعة الحملان .تم سحب نماذج الدم عند بدء المعاملة وفي منتصفها وعند نهايتها (بعد 84 يوم) . كان معدل انتاج الحليب اليومي وانتاج الحليب الكلي هو 1.16 +_ 0.38 كغم و98.31 +_4.44 كغم على التوالي .وان تغذية النعاج على عليقة فول الصويا المحمية لم يؤد الى فروق معنوية في انتاج الحليب ، في حين سجلت اختلافات معنوية في النسبة المئوية وكمية بروتين ودهن الحليب ،وان اعلى نسبة وكمية دهن سجلت في المعاملة الثانية ، اما اعلى نسبة وكمية بروتين فقد سجلت في المعامليتن الثانية والثالثة . اما مستوى كولسترول ويوريا مصل الدم فكانت اقل معنويا في المعاملة الاولى مقارنة مع بقية المعاملات.

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