EFFECT OF USING REDUCED RUMINAL DEGRADABILITY RATION ON MILK PRODUCTION, SOME BLOOD PARAMETERS AND LAMB GROWTH IN AWASSI EWES

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ABSTRACT

This study was conducted in Al-Rashidiya Animal Breeding Station, using 28 ewes (2-6 yrs old) with an average body weight of 57.1 Kg with their single new born lambs. Divided into 4 equall groups just after the second week of birth were used in the experiment lasted 56 days, over 4 intervals (14 days each) to investigate the effect of MP:ME in the ration (gm MP: ME MJ). Four rations, the first consist mainly of barley, yellow corn, soybean meal and wheat bran (control R1). While the second ration R2 (barley and wheat bran were treated), third ration R3 and forth R4 also soybean meal, were treated with acidic formaldehyde (9 L/ton), the ration were iso calories and iso nitrogen except that crude protein % in R4 was elevated by additional urea, but differ in MP: ME (6.61, 8.87, 9.98 & 9.98) respectively. Results showed that feeding ewes on rations, R2, R3 and elevating RDP with additional urea R4 significantly ($p < 0.05$) increased total milk production (19.2, 35.7 and 40.3%) compared with R1 respectively. Treating barley and wheat bran (R2)significantly ($p < 0.05$) increased milk fat content (7.3%), but milk protein and lactose percentage was not affected by treatments. A decrease in milk production was found as the nursing season proceeded, except R4 ration show non-significant difference in daily milk production between the 4 intervals. Treatment R3 and R4 increased ($p < 0.05$) serum total protein and albumin compared with control R1, treated rations (R2, R3 and R4) significantly increased ($p < 0.05$) serum glucose and triglycerides concentrations but decreased ($p < 0.05$) urea concentration compared with control R1. Treatment R4 ($p < 0.05$) increased lambs body weight compared with R1 and R2 group.

Keyword: Degradability, ration, milk production .

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تأثير استخدام الغذاء المخفض تحلله في الكرش على إنتاج الحليب وبعض قياسات الدم ونمو الحملان في النعاج العواسية

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المستخلص

اجريت هذه الدراسة في محطة الرشيدية لتربية الحيوان التابعة لوزارة الزراعة العراقية باستخدام 28 نعجه أعمارها بين (2–6 سنوات) بمعدل وزن 57.1 كغم مع مواليدها المفردة. قسمت الحيوانات إلى أربعة مجاميع متساوية بعد الاسبوع الثاني من الولادة حيث أستمرت الدراسة لمدة 56 يوماً ولأربعة فترات (كل منها 14 يوم) لدراسة تأثير نسبة البروتين الممثل إلى الطاقة الممثلة في العلف (بروتين ممثل غم/الطاقة الممثلة ميكا جول). غذيت كل مجموعة على أحد المعاملات الاربعة، الأولى تكونت من الشعير والذرة الصفراء وكسبة فول الصويا ونخالة الحنطة (السيطرة R1) والمعاملة الثانية R2 (الشعير ونخالة الحنطة عوملت كيميائياً) والمعاملة الثالثة R3 والرابعة R4 عومل فيها كسبة فول الصويا أيضاً إضافة إلى الشعير والنخالة بمحلول الفورمالديهايد الحامضي كل من الشعير وكسبة فول الصويا ونخالة الحنطة (6 لتر فورمالديهايد + 3 لتر حامض الخليك/طن) كانت المعاملات متناظرة في الطاقة والبروتين الخام عدا المعاملة R4 حيث رفع فيها نسبة البروتين الخام بمزيد من اليوريا لكن اختلفت هذه المعاملات بنسبة البروتين الممثل/الطاقة الممثلة (6.61 و8.87 و9.98 و9.98) بالتتابع. اشارت النتائج إلى أن المعاملات R2 وR3 وR4 رفعت معنويا (أ< 0.05) إنتاج الحليب الكلي (19.2 و35.7 و40.3%) مقارنتاً بمعاملة السيطرة R1 بالتتابع كذلك المعاملة R2 رفعت معنوياً (أ < 0.05) نسبة الدهن (7.3%) لكن لم يتأثر محتوى كل من بروتين ولاكتوز الحليب (%) في الحليب الكلي بالمعاملات. لوحظ انخفاض في إنتاج الحليب مع تقدم موسم الحليب للمعاملات الغذائية عدا المعاملة R4 التي لم تظهر أي اختلاف في إنتاج الحليب اليومي بين الفترات الاربعة. المعاملتين R3 و R4 رفعت معنوياً (أ< 0.05) البروتين الكلي والبومين مصل الدم مقارنة بالمعاملة R1، المعاملات (R2 وR3 وR4) زادت معنوياً (أ<0.05) تراكيز كل من كلوكوز والكليسريدات الثلاثية بينما انخفض معنوياً (أ<0.05) تركيز اليوريا في مصل الدم مقارنة بالمعاملة R1. أرتفع معنوياً (أ<0.05) وزن الجسم للحملان في المعاملة R4 مقارنة بالمعاملتين R1 وR2.

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كلمات مفتاحية: النعاج العواسية، إنتاج الحليب، وزن الجسم.

INTRODUCTION

The microbial conversion of feed grains to volatile fatty acids and to microbial biomass is the pivotal process in the digestion of these feed stuffs. At least 90% of the starch in barley is fermented in the rumen (1). The rapid digestion of barley often causes digestive disturbances such as acidosis, rumenitis and liver abscess (2). Economic losses due to these disturbances would be reduced if the rate of the microbial starch digestion could be controlled (3). The rate of microbial digestion of feed grains depends on the accessibility of the endosperm to the rumen microorganisms (3 & 4). The intact hull of cereal grains not readily digestible by rumen bacteria and this structure must be fractured in order for bacteria to gain access to endosperm (4). The endosperm cells contain starch granules embedded in a protein matrix (5). It has been demonstrated that barley is fermented more rapidly in the rumen than sorghum or maize. (4). (6) suggested that reduced rate of starch digestion in corn and sorghum is due to the resistance of the protein matrix to the micro-bial digestion. Therefore, it may be possible to control the rate of barley starch digestion by reducing the susceptibility of the protein matrix to microbial digestion. Formaldehyde has been used extensively to support dietary protein resistant to microbial digestion in the rumen (7). However, most of the research has been on the effects of formaldehyde treatment on protein supplements. The requirements of protein for milk production depend on both the total protein available and the ratio of protein to non-protein substrate absorbed by the animal. The rumen un-degradable protein (RUP) requirements for milk production in the ewes have not been defined, where the sources of dietary protein are often of unknown degradability and the total dry matter intake of lactating animals may fluctuate. Thus, the ratio of metabolisable protein (MP) to the metabolisable energy (ME) consumed is constantly changing. Inadequate rumen degradable protein (RDP) content of the diet could result inefficient nutrient utilization (8). In dairy sheep, there is an established milk response to increasing dietary CP. In mid-lactation ewes fed diets with CP ranging from 14 to 21%, milk production reached a plateau with the diet containing 18.8% CP, regardless of dietary energy level (9), RUP bypasses rumen degradation and reach the small intestine unaltered, since this protein source does not rely on rumen fermentation, given dietary RUP can increase the flow of amino acids above microbial crude protein supply. However, intestinal absorption of RUP depends on their post-ruminal digestibility, which varies between and among protein sources. While RUP supplementation increased the flow of essential amino acid to the small intestine, the flow of the first limiting amino acids were not consistently increased. Therefore, both source and quality of protein must be considered when evaluating results with RUP sources on milk production and milk composition (10). Protected protein seem to improve production, possibly by improving protein: energy ratio of absorbed nutrients (11). This experiment was conducted first to determine the effectiveness of formaldehyde reagent (9 L/ton) treatment of ground barley and wheat bran in concentrated ration with high level of CP 18% second to increase ration’s RUP by treating soya bean meal with the same reagent, third to elevate the rations RDP with additional urea , on milk production and milk composition.

MATERIALS AND METHODS

Twenty eight ewes (2-6 yrs) with average body weight of 57.1 Kg after 1st week of lambing with their single lambs were used and divided into 4 groups (7 each). The experiment was a 4 period (14 days each). The animals fed on a primary period of 10 days, while the experiment began actually on Dec 13th – Feb 7th. The experimental ration ingredients showed in table 1. First group fed on R1 (ground black barley, soya bean meal, wheat bran, urea and ground yellow corn). While 2nd, 3rd and 4th group were fed on R2, R3 and R4 respectively. Barley and wheat bran was treated with acidic formaldehyde reagent (9 L/ ton). R3 contained same ingredients but soya bean meal, wheat bran and barley were all treated with formaldehyde reagent, R4 was similar to R3 but with additional urea (5gm/kg DM).Group feed system was applied with 1.5 kg of dry matter/ewe as with additional average DM intake of lamb 84, 195, 343 and 455 gm/lamb/day from the 1st to the 4th

fortnight experimental period which counted during isolation from their mothers, the lambs were fed along with their mothers. Ewes and their lambs were weighed pre-experiment and at the end of each period (14 days) before morning feeding for 2 subsequent days. Average milk production was calculated at the beginning of the experiment and at the end of 2 subsequent days precisely on day 13 & 14 of each period where lambs were isolated from mothers evening to empty the udder. Same procedure was followed at day 14. Milk samples were taken for chemical analyses. Milk fat, protein and lactose yield were calculated for each ewe from daily milk yield, fat, protein and lactose percentages. Blood was collected from jugular vein at the end of each period, 2 hours after morning feeding, samples were centrifuged at 3000 rpm for 10 min and plasma was then collected and stored at -20°c until analyzed.

CHEMICAL ANALYSIS:

Samples of feed were analyzed for DM, ash, crude protein. Feed DM was determined by oven drying at 105°c for 48 hours. Ash was determined by inserting 5grm of air dried sample at 550°c for 6 hours. Nitrogen was determined by the standard Kjeldahl method and the crude protein by NX6.25. Milk samples were analyzed for fat, protein and lactose by using EKOmilk. Plasma glucose, total protein, albumin, globulin, triglyceride and urea were determined by enzymatic methods supplied by Biolabo Co France.

ESTIMATION OF NUTRIENT AVAILABILITY

The amount of ME available in diet was estimated from sum of the ME content of individual feed ingredient ingested by an animal using the composition table of (12). The amount of MP available was calculated as the sum of microbial true protein (MTP) synthesized in the rumen plus dietary digestive protein escaping rumen degradation. MTP was estimated by assuming: 9.6g microbial crude protein/MJ ME, 0.75g true protein in microbial protein and 0.85 small intestine amino acids digestibility (13). Dietary RUP of feed was estimated from sum of the RUP content of individual feed ingredient SBM ingested by an animal using the nutrient composition table of (14), treated barley and wheat bran was 72%, (11). Efficiency of amino acids utilization are 0.75 (15).

STATISTICAL ANALYSIS:

Data were analyzed using complete randomized design (C.R.D.) for simple experiment in one direction. The model used was as follows: Yij=m+ti +eij

Yij is the observed value for a dependent variable on ti protein protection and eij as the random error, while m is the general mean.(16) test was used to estimate significant difference among means in computer using (17) software.

Table 1. Rations components and their chemical composition g/kg DM, calculated metabolizable protein (MP) content (units: g/kg DM unless stated)

Ingredients	R1	R2	R3	R4
Barley	750	750 T	750 T	750 T
Wheat bran	70	70 T	70 T	70 T
Soybean meal	100	100	100 T	100 T
Yellow corn	46.5	46.5	46.5	46.5
Urea	13.5	13.5	13.5	18.5
Nacl	10	10	10	7.5
CaCO3	10	10	10	7.5
DM	917.8	917.8	917.8	917.8
OM	874.7	874.7	874.7	874.7
CP	177.8	177.8	177.8	192.2
EE	19.7	19.7	19.7	19.7
CF	68.7	68.7	68.7	68.7
RDP%	79.11	55.73	44.23	48.39
RUP%	20.90	44.27	55.77	51.61
Estimated ME (MJ/kg DM)	11.73	11.73	11.73	11.73
Estimated RDP (g/MJ ME) in diet	11.99	8.45	6.70	7.93
Estimated MP (g/kg DM)	77.55	104.05	117.09	117.09
MP/MJ ME	6.61	8.87	9.98	9.98

T= treated with formaldehyde

RESULTS AND DISCUSSION

FEED QUALITY AND INTAKE

The chemical composition and the estimated ME and MP content of diets are given in table. 1. These diets were adequate in fermentable energy (average, 11.73 MJ/Kg DM) but vary in rumen degradable protein (6.7-11.99gm RDP/MJ ME) according to the (18) recommendation (7.81gm RDP/MJ ME). The extents of RDP were somewhat deficient with the R3 diet (about 14%). This means that there was inefficient microbial fermentation which lowered the efficiency of microbial protein production.

MILK PRODUCTION

Treating barley and wheat bran (R2) significantly increased ($p<0.05$) milk production 19% and milk fat percentage 7.3% significant ($p<0.05$) increases in milk production was registered 35.7% and 40.3% with treatment R3 and R4 respectively in comparison with untreated ration (R1), no statistical differences were found between R3 and R4 rations in milk production (Table 2), in comparison to untreated ration (R1), While milk protein and lactose % were not affected with formaldehyde treatment.The results of averages daily milk production of differentexperimental rations given to the animals during an 8 week experimental period is shown in figure 1 and figure 2.

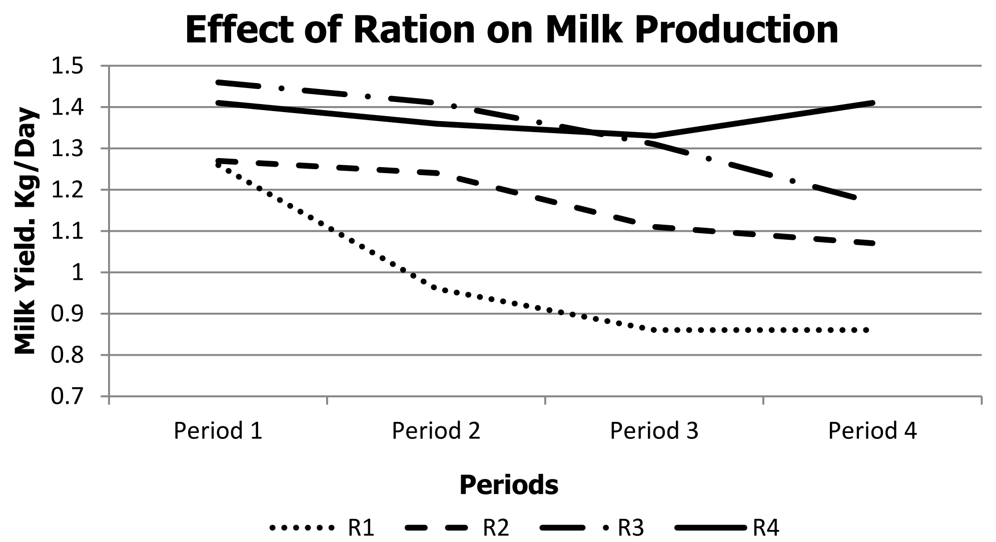
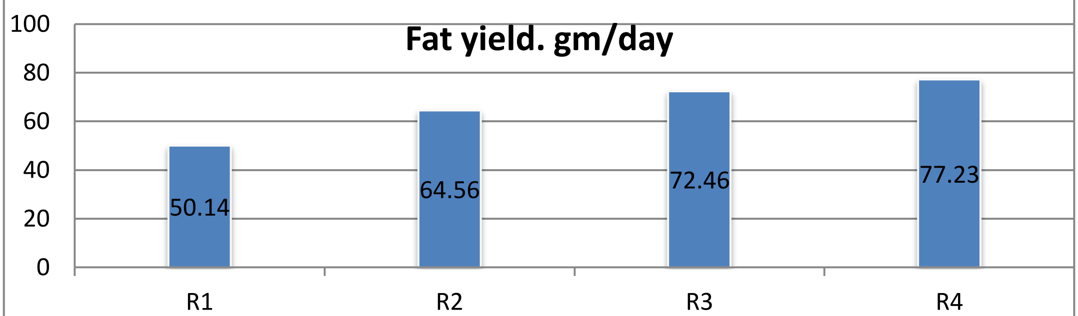
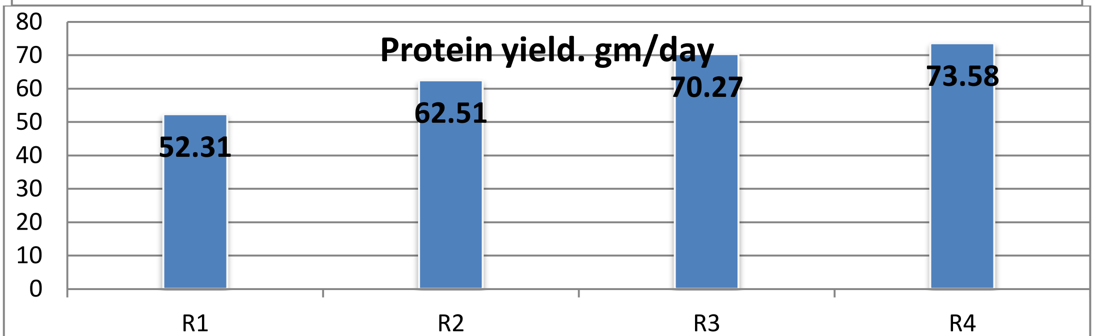


Figure 1



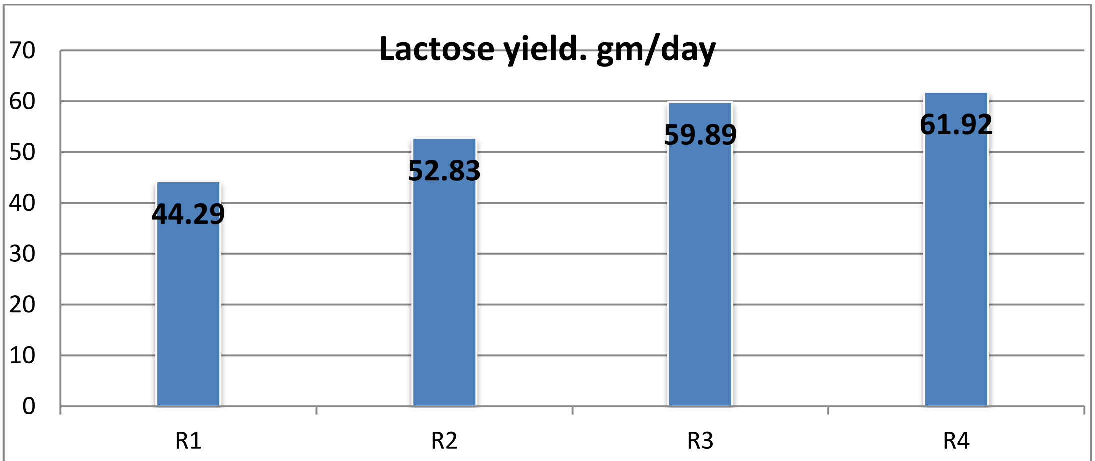
Fortnight average milk, fat, protein and lactose yield of different groups of animals during 8 weeks of lactation

Figure 2 A



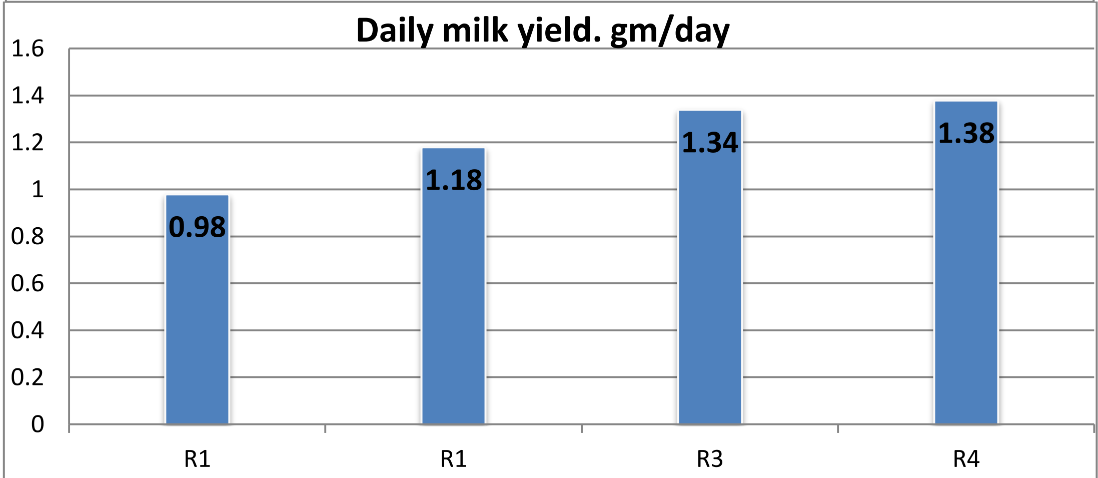
Fortnight average milk, fat, protein and lactose yield of different groups of animals during 8 weeks of lactation

Figure 2 B



Fortnight average milk, fat, protein and lactose yield of different groups of animals during 8 weeks of lactation

Figure 2 C



Effect of ration on daily milk yield

Figure 2 D

Milk production of R1 treatment declined directly during the first experimental period, while ewes in R2, R3&R4 treatments reached peak production within 2 weeks and then declined linearly except R4. The decline in milk yield was significantly lower in 4th period with rationsR1, R2 and R3 compared with the 1st period of production but the average milk yield with R4 treatment didn't change compared with the 1st period (figure 1).Milk fat content was the highest significantly with the formaldehyde treated rations R2, R3 & R4 compared with untreated diet (R1), while milk protein and lactose % did not change (Table 2).

Table 2. Effect of rations on total milk yield (kg) and milk composition

	R1	R2	R3	R4
Milk yield kg	**55.10 c ± 5.723**	**65.70 b ± 2.562**	**74.80 a ± 2.839**	**77.30 a ± 3.991**
Fat %	**5.08 b ± 0.102**	**5.45 a ± 0.129**	**5.50 a ± 0.204**	**5.55 a ± 0.208**
Protein %	**5.32 ± 0.110**	**5.35 ± 0.107**	**5.28 ± 0.229**	**5.34 ± 0.082**
Lactose %	**4.48 ± 0.021**	**4.50 ± 0.015**	**4.49 ± 0.021**	**4.49 ± 0.012**

Different horizontal letters refer to significant differences ($p<0.05$)

Milk fat % was not affected by treating soya bean meal or adding urea to elevate RUP content with RDP increase in R3 & R4 respectively compared with R2. It's worth mentioning that both milk fat and protein content did not change by manipulating RUP content of indoor dried feeds trails or grazing,cut and carry trials, (10), while milk fat content increased with rations totally or partially treated compared with untreated ration without effecting milk content of protein & lactose in recent study (11 & 19)inAwassi sheep. The increase in milk fat content when treating barley and wheat bran could be due to reduction in ruminal starch digestion which reduced fiber digestion with the reduction of propionate and enhanced butyrate production in comparison with untreated barley (29).

BLOOD SERUM PARAMETERS

Blood serum concentration of total protein and glucose was increased as milk yield increased (table 3),which in turn can support the increase of protein and lactose synthesis and thus an increase in milk yield, This is probably the reason why milk yield with increased formaldehyde treated ingredient in the diet as in ration 3 & 4 compared with R1 & R2.The results were in agreement with indoor trials (10). However, there is a significant ($p<0.05$) increase in plasma triglyceride concentration, while there was a significant ($p<0.05$) decrease in plasma urea concentration withR2 &R3 compared with R1 (Table 3). Additional 5 grams of urea to R4 elevated blood urea concentration significantly ($p<0.05$) compared to R3, Also plasma protein increased significantly ($p<0.05$) withR3&R4 compared with R1 (Table 1). It seems that there is an apparent positive relationship between RDP concentration and plasma urea concentration with R4 compared to R3 in spite of treating diet content with formaldehyde was probably due to elevation of urea in this ration (Table 1). It's obvious from this study that the nutrition on treated barley in the diet increases the milk production by 19% in the group of ewes fed on R2 ration. A decrease in barley starch digestion in the rumen increased starch by-pass to the small intestine, which improved the efficiency of the energy intake utilization by 20 – 50% through the increase of acetate supply to body tissue metabolism (19; 20). Also the increases in milk production by 35% and 40 % with R3 and R4 rations respectively when soybean meal was treated with formaldehyde in addition to barley treatment compared with R1 might be due to the increases of starch digestion with by-pass protein in R3 and R4 and increasing the animal's glucose supply. There was a linear correlation between casein infusion in the duodenum and starch digestion in the intestine (21), also the balance in the protein content of the diet in the RDP and RUP increases amino acids supply to the animal (22; 23).

Table 3. Effect of Experimental rations on some Blood serum parameters

Properties	Rations			
	R1	R2	R3	R4
Total Protein gm/100ml	6.49 0.211± b	6.97 0.193±ab	7.30 0.220± a	7.50 1.143± a
Albumin gm/100ml	3.76 0.142± b	4.03 0.041± b	4.47 0.179± a	4.49 0.132 ± a
Glucose mg/100ml	58.71 2.625 ± b	70.44 4.562 ± a	69.85 2.971 ± a	72.28 2.146 ± a
Urea mg/100ml	42.31 0.957 ± a	34.65 0.735 ±b	27.87 0.468 ± d	32.10 0.629 ± c
Triglycerides mg/100ml	49.91 3.311 ± c	59.87 2.564 ± b	61.59 2.495 ±ab	68.48 1.917a ±

Different horizontal letters refer to significant differences ($p<0.05$)

The supplement of the metabolizable energy and amino acids requirements at the cellular level could increase milk production (24). On the other hand the intake of the reduced degradable starch in the rumen correlated with hormonal changes which represents in the increases of growth hormone/insulin ratio and this considers being more appropriate for milk production (25). It can be noticed from the result that the average milk fat % and milk fat yield improved by 8% and 42% respectively by formaldehyde treatment of barley in the three experimental treatments compared to control R1. This improvement could be due to more than one factor, about 55-70% of the glucose which reaches to the mammary gland is used to produce the lactose and 30-40% goes to energy production in the form of ATP and could be used for milk fat production through the formation of glycerol and the co-enzyme NADPH which is essential to elongate the fatty acids series in the milk through the metabolic pathway (Pentose phosphate and iso-citrate de-hydrogenase). (26; 27). Finally we are able to say that glucose is not specialized for lactose production only but also for fatty acids production in the mammary gland. And also acitic acid which was used for treating the experimental rations could be an acetate source for milk fat production.

BODY WEIGHTS

No statistical differences in final ewes body weight shown between ewes groups given different experimental rations (figure 3), this result is in agreement with (28). However lambs body weight with group R4 showed a significant ($p<0.05$) increased fed on the R4 compared with R1 & R2 (figure 4). This increase may be due torising MP in lambs feed as well as their mothers and the increase in milk production of the ewes that fed on 4th ration (Where RDP was increased using additional urea, 5gm/kg DM). Which may had positively affected microbial growth which led to increase in actual MP:MJ ME as a result of equilibrium in RDP:ME (15), (Table 1).

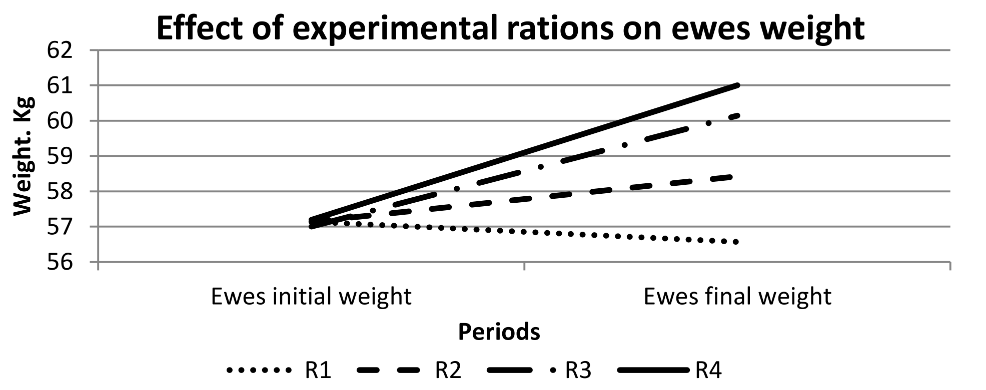


Figure 3

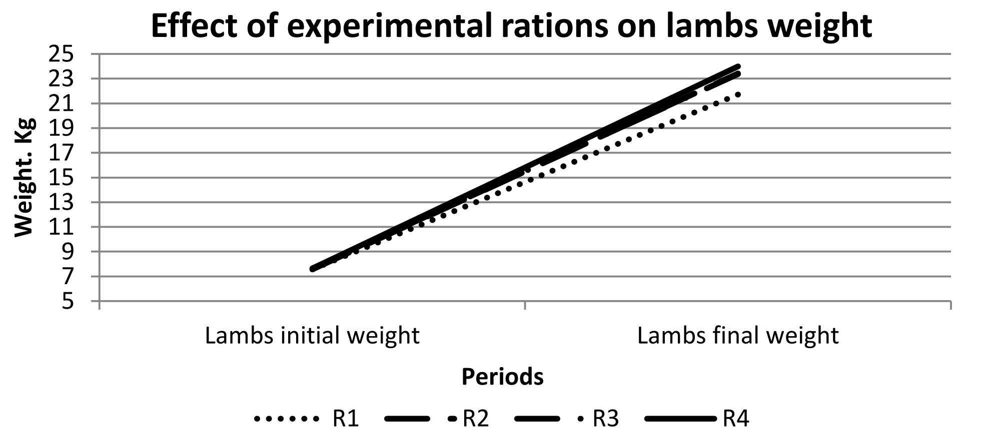


Figure 4

CONCLUSION

By- pass protein technology could increase RUP level in diet with adequate energy and RDP content resulting efficient nutrient utilization to improve milk response possibly by treating rations with formaldehyde indoor feeding by altering the protein/energy ratio of potentially absorbed nutrients.

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