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EVALUATION OF UREA AS A PARTIAL PROTEIN REPLACEMENT IN THE RATIONS OF GROWING CAMELS

(With 9 Tables and 3 Figures)

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تقييم اليوريا عند إحلالها جزئيا للبروتين في علائق الجمال النامية

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في هذه التجربة تم دراسة إمكانية استبدال جزء من بروتين عليقة الجمال النامية باليوريا ومدي تأثيرها علي معدل استهلاك العليقة وكفاءة أداء الحيوان بالإضافة إلى معاملات هضم المواد الغذائية والاتزان النيتروجيني. لذلك تم إجراء عدد أربعة محاولات غذائية علي عدد ٤ من إناث الجمال الناميه وحيدة السنام متوسط أوزانها ٢٩٥ كجم وعمرها ٣٠ شهرا. استغرقت كل محاولة ٣٠ يوما منها ٢٤ يوما كفترة تمهيدية والستة أيام الأخيرة كفترة تجميعية. المحاولة الأولى اعتبرت ضابطة وغذيت الجمال علي عليقة خالية من اليوريا بينما في المحاولات من الثانية حتي الرابعة تم استبدال ثلث (٣/١) , نصف (٢/١), ثلثي (٣/٢) بروتين العليقة باليوريا علي التوالي وقد خلصت الدراسة إلى الآتي : قل معدل استهلاك العليقة مع زيادة احلال اليوريا لبروتين العليقة وقد سجلت مجموعة الحيوانات المغذاة علي العليقة التي استبدل ثلث (٣/١) بروتينها باليوريا اعلي معدل استهلاك للمادة الجافة بينما سجلت المجموعات المغذاة على العلائق التي استبدل نصف (٢/١) أو ثلثي (٣/٢) بروتينها باليوريا اقل قيم. مجموعة الحيوانات المغذاة علي العليقة التي استبدل ثلث (٣/١) بروتينها باليوريا أعطت معدلات متساوية تقريبا مع المجموعة الضابطة في كل من النمو وكفاءة التحويل الغذائي بينما المجموعات المغذاة علي مستويات عالية من اليوريا انخفض نموها ومعدل التحويل الغذائي لها . معاملات هضم كل من المادة الجافة والمادة العضوية والبروتين الخام بالإضافة إلى مستخلص الأثير ازداد معنويا في الجمال المغذاة علي العليقة التي استبدل ثلث (٣/١) بروتينها باليوريا مقارنة بالمجموعات الأخرى. أيضا ازداد معدل اختزان النتروجين زيادة معنوية في الجمال المغذاة علي العليقة التي استبدل ثلث (٣/١) بروتينها باليوريا مقارنة بالمجموعات الأخرى. ازدادت نسب كل من البروتينات الكلية واليوريا في مصل الدم في المجموعات التي غذيت علي مستويات عالية من اليوريا مع انخفاض معنوي

في مستوي الجلوكوز في الدم. وقد خلصت الدراسة إلي أنه يمكن استبدال ثلث (٣/١) بروتين عليقة الجمال باليوريا حيث أن له تأثير إيجابي علي كل من معدل استهلاك العليقة وأداء الحيوان بالإضافة إلى معاملات هضم المواد الغذائية والاتزان النيتروجيني بالإضافة إلى الفائدة الاقتصادية.

SUMMARY

This study was conducted to predict diet conditions under which urea can partially substitute protein in the rations of growing camels, beside investigating its effect on their feed intake, performance, nutrient digestibility, nitrogen balance and some biochemical parameters. Four serial trials were carried out in using four one-humped she-camels (295 kg average weight and 30 months age). Digestion and balance measurements were made using a 24 day preliminary period and 6 day total collection in each trial. The first feeding trial was considered as control in which animals were fed on urea free ration, while in the second, third and fourth feeding trials, one-third (U 1/3), one-half (U 1/2) and (U 2/3) two-thirds of the crude protein in the ration was replaced by urea respectively. The daily rate of feed intake was 9.5, 7.7 and 7.2 kg/h/day for the U 1/3, U 1/2 and U 2/3 groups respectively. Also, weight gain of camels group fed on the ration U 1/3 was similarly as the control group and had a high relative growth rate and feed conversion, however these values were reduced in groups fed on rations containing high levels of urea substitution (U 1/2, U 2/3). The digestion coefficients of DM, OM, CP and EE were significantly ($P<0.05$) increased in the camels group fed on the ration U 1/3 compared to the other treated groups. The nitrogen retention as a percentage of total nitrogen absorbed was significantly ($P<0.05$) higher in camel groups fed ration U 1/3, while the lowest value was recorded with the group fed ration U 2/3. The total protein and urea in the blood increased significantly ($P<0.05$) as the level of urea increased, on the contrary serum glucose was decreased. Generally, this study indicated that urea when replaced up to 33% of the ration crude protein for camels was utilized more efficiently and had a positive effect on the feed intake, performance, nutrient digestibility and nitrogen balance in addition to economical benefit.

Key words: Urea, replacement, growing camels

INTRODUCTION

In the developing countries, there is a quantitative and qualitative shortage of animal feeds which had resulted in deterioration of animal wealth with deep reflection on the needs of peoples to animal protein. Protein is often the major limiting nutrient for ruminants because the shortage of the protein rich leguminous forages in many areas grazed by animals and vegetable protein supplements are usually expensive or not available. Protein nutrition of ruminants continues to receive a great deal of research emphasis. This is appropriate in that we need to learn how to optimize the protein nutrition of ruminants and capitalize on their ability to convert non-protein nitrogen to protein in meat, milk and wool (Berger, 1987).

Many workers tended to add different cheap nitrogen supplements to poor protein rations to improve their quality (Price & Greenhalge, 1978). In this respect, the most important supplement which is now regarded as a fact in animal nutrition suitable for most developing countries is the addition of urea as a source of non-protein nitrogen (Swingle & Waymack, 1977; Martin *et al.*, 1981; Abdel-Gawad, 1984; Kubesy, 1987 and Gihad *et al.*, 1989).

The manufacture of urea and ammonia to be used as a fertilizer has been greatly expanded in many countries, but these compounds could be used more widely in feeds for ruminants (Loosli & McDonald, 1968). The ability of the ruminal microorganisms to utilize these non-protein nitrogen sources to form microbial protein, that can be converted to meat and milk by these animals represents an important contribution to human food supply (NRC, 1976).

Urea is used to lower the costs of ration, since the necessary protein required in a ration is usually cheaper when urea is used to replace part of the oilseed meals when are high priced (Diggins *et al.*, 1983; Naylor & Ralston, 1991 and Stanton, 2001).

Ruminants can use urea as a replacement for all their dietary protein, but in practice for efficient urea utilization, it should be metered into rumen in amounts which will be released at a rate not exceed the ability of the ruminal microbes to assimilate it (Loosli & McDonald, 1968; Owens *et al.*, 1980).

Urea should not be supplemented to replace more than 20-30% of the total nitrogen in the ration unless animals are gradually adapted to utilize higher levels. Increasing the frequency of feeding of low levels of

urea improved performance of urea utilization and decreased the hazards of increased ammonia concentration (Prior, 1974 and Kubesy, 1987).

When urea replaced protein in a diet, special care in mineral supplementation must be exercised, since most sources of protein provide substantial amounts of sulfur, and phosphorus which are absent in non-protein nitrogen. Ruminal microbes need minerals, vitamins and a readily available source of energy for fast growth. Therefore, more ammonia can be utilized when high energy feeds are fed (Rohr *et al.*, 1986; Wanderley *et al.*, 1987 and Arelovich *et al.*, 1998).

The objective of this study was to investigate the effects of replacing part of protein by urea in the rations of camels on their feed intake, performance, nutrient digestibility, nitrogen balance and to ensure the safety of urea use as partial protein replacement for camels.

MATERIALS and METHODS

Animals, housing and feeding:

Four one-humped female growing camels of about 30 months of age and 295 kg in weight were used in this experiment. The animals appeared clinically healthy and the parasitological examination revealed no gastrointestinal infestation. The four animals forming one group, were housed individually in separate pens, where feed intake was recorded and feces and urine were collected.

Four serial feeding trials were carried out to study the effects of replacing one-third (U 1/3), one-half (U 1/2) and two-thirds (U 2/3) of the crude protein in the rations by urea on the feed intake, performance, digestibility, nitrogen balance in addition to some biochemical parameters in camels. Each trial extended for 30 days of which 24 days as a preliminary period to adapt the animal on the new diet and establish the effect of urea substitution, while the last 6 days for feces and urine collection and digestibility determination.

Animals were fed a completely mixed basal diet containing the recommended requirements for energy (2.3 Mcal ME/kg diet) and protein (12.26%) following the nutrient requirements stated by Gihad and El-Bedawy (1995) for growing camels. The first feeding trial was considered as a control period in which the animals were fed on urea free ration, while in the second, third and fourth feeding trials, one-third (U 1/3), one-half (U 1/2) and two-thirds (U 2/3) of the total crude protein in the rations was replaced by urea respectively. The proximate analysis of

feed ingredients and chemical composition of the used rations are shown in Tables (1&2).

Diets were mixed daily and fed ad-libitum and had free access to water. Feed intake was daily recorded and the camels were weighed at the beginning and at the end of each feeding trial. For estimating the digestibility, chromic oxide was thoroughly mixed with the ingredients of the ration at a rate of 0.5% as an indicator.

Collection and analysis of feed, fecal matter and urine samples:

The feed ingredients which were used in the formulation of rations were sampled, ground and analyzed for different components. The fecal matter was collected from each animal during the collection period at the rate of one kg/day, dried at 60°C for 24 hours, ground, mixed and stored for further analysis. Fecal samples were analyzed for the different nutrients following AOAC (1984). The volumetric urinary output was recorded daily using plastic containers especially designed for the urinary tract of the female camels (Bengoumi *et al.*, 1993), then representative sample (100 ml) was taken, acidified with 2 ml conc.HCl as a preservative and then kept in a refrigerator at 4°C for nitrogen determination. Nitrogen content of feces and urine samples were estimated according to AOAC (1984).

Digestion coefficients:

From the analysis of feeds and fecal matter together with tracing the concentration of chromic oxide (Williams *et al.*, 1962), digestibility of dry matter and the several nutrients were calculated using the following equations:

$$\text{DM digest.} = \frac{\text{g indicator/kg feces} - \text{g indicator/kg food}}{\text{g indicator /kg feces}} \times 100$$

(McDonald *et al.*, 1995)

$$\text{Nutrient digest.} = 100 - \{\, 100 \times \frac{\%\text{ indicator in feed} \times \%\text{ nutrient in feces}}{\%\text{ indicator in feces} \times \%\text{ nutrient in feed}}$$

(Cho *et al.*, 1982)

Nitrogen balance:

Nitrogen balance was calculated using the following equations:

Nitrogen absorbed = N intake – Fecal nitrogen

Nitrogen retained = N intake – {fecal N + Urinary N }

(Maynard, 1979)

Biochemical parameters:

Blood samples were collected at the end of each feeding trial from the jugular vein of the animals. The samples were taken in the morning before feeding and sera were separated and kept at –20°C till analysis. Total serum protein, glucose and urea were determined using standard kits supplied by Bio-Merieux (Baines/France).

Statistical analysis:

Statistical analysis was performed using one-way analysis of variance (ANOVA). Differences between treatments were tested for significance ($P<0.05$) by Duncan's multiple range test *(1955)*.

RESULTS and DISCUSSION

Feed intake:

There were significant ($P<0.05$) differences between treated groups and the control one in the amount of feed intake as shown in Table (3), while no significant ($P<0.05$) differences were recorded between the control group and camels of group fed on the ration U 1/3. The amount of feed intake was decreased as the amount of urea substitution was increased and the camels group fed on the ration U 1/3 showed the highest values for dry matter intake (9.5 kg/h/d) followed by the control group (8.6 kg/h/d), while the camel groups fed on rations U 1/2 and U 2/3 recorded the lowest values (7.7 & 7.2 kg/h/d, respectively). These results agreed with those found by some authors (Kubesy, 1987; Stanton, 2001 and Bohnert *et al.*, 2002) who reported that feeding higher levels of urea would cause lower feed intake in cattle and sheep. The reduced feed intake on the high levels of urea in the diets was probably due to poor palatability and possibly to elevated ruminal ammonia concentration as reported by Poos *et al.* (1979). Other workers (Van Horn *et al.*, 1967, 1975) have reported a depression in feed intake when urea comprised more than 2% of concentrates in the ration of dairy cattle. In contrast, Greathouse *et al.* (1974) and Plegge *et al.* (1983) found no differences in the dry matter intake by cattle fed finishing diets containing either supplemental urea or other natural protein sources.

Performance of animals:

There were significant ($P<0.05$) differences in the weight gain between the different treated groups and the control one as shown in Table (4). Camels group fed on the ration U 1/3 gained (15.7kg) nearly

similar to the control group (15.2 kg), while the other camel groups fed the rations U 1/2 and U 2/3 showed lower gains (11.9 & 9.4 kg). These results agreed with that reported by Rakha (1985) and Stanton (2001) who found that lamb fed on ration supplemented with different levels of urea-nitrogen recorded a marked decrease in the live weight gain especially with high levels of urea. Also, Orskov *et al.* (1972) reported that, the daily body gain of early weaned lambs was high with the lowest level of urea. Similarly, Milton and Brandt (1994) and Shain *et al.* (1998) reported that supplementing finishing cattle diets with an inexpensive source of ruminally degradable nitrogen (urea) improved animal performance.

A significant ($P<0.05$) decreased relative growth rate (2.75) was observed in camels group fed on ration containing high level of urea (U 2/3) in comparison with the control group (5.03) and camels group fed on ration U 1/3 (4.94) and this may be attributed to the decreased feed intake. On this respect, Kubesy (1987) reported significant decrease in growth rate of lamb fed on diet supplemented with high level of urea.

Data of the feed conversion showed that camel groups fed on the control ration and the ration U 1/3 were more efficient (16.96 & 18.16) than that fed on rations U 1/2 and U 2/3 (19.39 & 23.0). These results agreed with those of Stanton *et al.* (2001) who recorded that feeding high levels of urea would cause poorer feed conversions

Digestion coefficient of nutrients:

The digestion coefficient of dry matter was significantly ($P<0.05$) increased in the animals group fed on ration U 1/3 (68.35%) and the control group (69.14%), while camel groups fed on rations U 1/2 and U 2/3 recorded the lowest values (61.8 & 58.33%, respectively). There were significant ($P<0.05$) differences between different treated groups and the control one in the organic matter and crude protein digestibilities although the digestion coefficients of organic matter and crude protein were nearly similar in the camel groups fed ration U 1/3 and the control one (70.27, 61.57 & 70.60%, 60.02% respectively). It was observed that, as the level of urea substitution increased, the digestion coefficient of protein was decreased as shown with camel groups fed on rations U 1/2 and U 2/3 (43.52 & 31.97%). Thoronton (1970) and Orskov *et al.* (1972) reported that digestibility of dry matter, organic matter and crude protein were significantly increased when urea was added to the basal rations of sheep. Ether extract digestibility was significantly ($P<0.05$) increased

with the animal groups fed on the control ration and U 1/3 ration (71.45 & 69.05%) in comparison with other groups, while no significant ($P<0.05$) differences were found between camel groups fed on rations U 1/2 and U 2/3 (59.84 & 58.73%). There were significant differences ($P<0.05$) between different treated groups and the control one in the digestion coefficient of crude fibre and the treated groups recorded the lowest values (53.0, 46.53 & 45.84%) compared to the control one which recorded the highest value (61.08%). On the contrary, Abdel-Gawad (1979) reported that urea supplementation resulted in a higher crude fibre digestibility. However, Allam *et al.* (1982) noticed no significant differences between groups of animals fed either urea-molasses mixture or urea free rations. Matter *et al.* (1995) stated that replacing up to 25% from the crude protein of concentrate feed mixture by NPN sources in dairy Friesian cows rations had a positive effect on crude protein and crude fibre digestibility. For nitrogen-free extract digestibility, there was significant difference ($P<0.05$) between different experimental groups although there was no significant differences ($P<0.05$) between camels group fed on ration U 1/3 and control one and the digestion coefficient of NFE was high compared to the other digestion coefficients of other nutrients. Abdel-Hafeez and Tony (1975) stated that urea improved the digestibility especially that of protein and nitrogen free extract, while the digestibility of ether extract was highly decreased. As with the previous criteria, the animals fed on ration U 1/3 were superior in their data concerning the digestion coefficients of the nutrients compared to the other groups including the control.

Nitrogen balance:

The nitrogen balance data of different experimental animal groups are presented in Table (7). The N intake (g/day) was minimum in the camels group fed on rations U 1/2 and U 2/3 (131.56 & 121.45 g/d) in comparison with the control group (152.27g/d) and group fed on ration U 1/3 (164.94 g/d). The increased nitrogen intake in the animal group fed on ration U 1/3 may be due to the increased feed intake. The amount of N-excreted in fecal matter was significantly ($P<0.05$) high in camels group fed on high level of urea (103.79 g/d), while the lowest amounts were recorded with animal groups fed on ration U 1/3 (59.03 g/d) and the control one (60.42 g/d), while there was no significant ($P<0.05$) differences between camel groups in the N-excreted in the urine. However, nitrogen absorbed and retained (g/d) as a percentage of

N-intake was significantly (P<0.05) high in camels group fed on ration U 1/3 (105.91 & 94.72 g/d) and the control one (91.85 & 80.89 g/d) compared to other treated groups and the lowest values were observed with the camels group fed on high level of urea substitution (17.66 & 8.19 g/d). Concerning nitrogen balance, all animal groups showed positive nitrogen balance. This could be attributed to the fairly tolerated urea of the ration by the animals. The nitrogen retention as a percentage of total nitrogen absorbed was significantly (P<0.05) higher in camel groups fed on ration U 1/3 (89.43%) and control one (88.07%) in comparison with the other treated groups and the lowest value was recorded with the group fed on ration containing high levels of urea substitution (46.38%). The increasing values of absorbed and retained percentages in the camels group fed on ration U 1/3 may be a reflection of increasing the digested N-intake.

Biochemical parameters:

The mean values of the total proteins, glucose and urea in the sera of the experimental groups are shown in Table (8).

The total serum proteins of camels group fed on ration U 2/3 were significantly (P<0.05) higher than in camels of other treated groups including the control one. These results agreed with those found by Abdel-Samme *et al.* (1989) who recorded significant increase in serum total proteins in animals supplemented with urea. On the contrary, Kubesy (1987) found decreased levels of total protein in sheep fed on rations supplemented with urea.

The biochemical study declared significant (P<0.05) decrease in the serum glucose level as the level of urea substitution was increased in the ration. These results agreed with that found by Kubesy (1987) who reported that blood glucose was low in sheep fed on higher levels of urea substitution. Propionic acid level which is the precursor of blood glucose was found to be decreased with feeding urea supplemented rations (Holter *et al.*, 1971; Abd El-Gawad, 1984 and Rakha, 1985). On the other hand, some authors reported significant increase in the plasma level of glucose in animals supplemented with urea.(Amin *et al.*, 1980; Abdel-Samme *et al.*, 1989 and Abdel-Hafez, 1995).

The mean values of urea in the camel's serum were significantly (P<0.05) higher in the group fed on high levels of urea substitution (U 1/2 and U 2/3) compared to the control and the one-third substitution group. The results are in agreement with that found by Rys and Rocz

(1960) and Fievez *et al.* (2001) who found that direct relationship between urea levels in both serum and rations.

Across all the treatments there was a highly significant preference for the diet with (U 1/3) urea substitution.

Economical evaluation:

As shown in Table (9) feed cost of one Kg of live body gain (LE) and economic feed efficiency were calculated. Results obtained in the present study conducted that use of one-third of urea replacement increase economic feed efficiency to 161.3% compared to the control ration. These result was similar to those reported by Stanton (2001) who reported that replacement concentrate meals partially with urea in ruminant rations reduced the feed cost.

It could be concluded that urea are still the cheapest nitrogen source and the most suitable to replace not more than one-third of the crude protein of the rations of growing camels with complete safe in addition to its economic value.

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Table 1: Chemical composition (%) of the feed ingredients used in the ration formulation.

Ingredients	DM	On DM basis								
		OM	CP	EE	CF	NFE	Ash	Ca	P	ME**
Corn	88.4	98.6	8.6	4.6	3.3	82.1	1.4	0.03	0.31	3.11
SBOM	91.7	92.7	46.1	2.5	6.6	37.5	7.3	0.36	0.75	3.15
Wheat bran	89.5	92.3	16.3	4.7	11.7	59.6	7.7	0.12	1.32	2.67
Wheat straw	93.7	81.3	3.2	0.5	36.2	41.4	18.7	0.21	0.08	1.60
Molasses	73.5	91.7	4.0	0.3	---	87.4	8.3	1.19	0.11	2.76
Urea (46.5%N)	99.0	100	290.6*	---	---	---	---	---	---	---
Bone meal	96.0	14.0	4.7	1.0	1.6	6.7	86.0	30.51	14.31	0.26

*Crude protein equivalent. **ME=Metabolizable energy Mcal/kg diet (NRC, 1984).

Table 2: Physical and chemical composition (%) of the rations

Item	Rations			
	Control	U 1/3	U 1/2	U 2/3
Physical composition:				
Corn grain, crushed	19.0	20.5	19.1	16.0
SBOM	15.6	6.0	2.3	---
Wheat bran	10.5	10.0	7.0	---
Wheat straw	42.9	40.1	38.0	41.1
Molasses	9.0	19.0	28.5	37.1
Urea	---	1.4	2.1	2.8
Bone meal	1.0	1.0	1.0	1.0
Common salt	1.0	1.0	1.0	1.0
AD_3E*	0.15	0.15	0.15	0.15
Mineral mixture**	0.35	0.35	0.35	0.35
Chromic oxide	0.5	0.5	0.5	0.5
Chemical composition:				
DM	90.26	88.44	86.83	85.64
OM	86.67	87.08	87.21	86.66
CP	12.26	12.27	12.30	12.31
EE	2.0	1.82	1.54	1.05
CF	18.42	16.76	15.36	15.41
NFE	53.99	56.23	58.01	57.89
Ash	13.33	12.92	12.79	13.34
ME (Mcal/kg diet)	2.30	2.26	2.26	2.18
Ca	0.58	0.66	0.75	0.84
P	0.50	0.44	0.38	0.27

*AD3E: Each gram contains; 20.000 IU vit.A, 2000 IU vit.D and 400 IU vit.E (AGRICO Int. Company).

**Mineral mixture: Each 100 g contain ; 25.6 g Na, 1.6g K, 4.6g Ca, 1.8g P, 4g Mg, 300mg Fe, 32mg Mn, 1.5 mg Cu, 15mg I, 5mg Zn, 1mg Co and 1mg Se (AGRICO Int. Company).

Table 3: Feed intake in the four experimental trials

Trial	Kg/100 kg LBW	Kg/head/day
1 (control)	2.71±0.26	$8.6\pm0.62^{a*}$
2 (U 1/3)	2.89±0.33	9.5 ± 0.75^{a}
3 (U 1/2)	2.51±0.29	7.7 ± 0.55^{b}
4 (U 2/3)	2.39±0.32	7.2 ± 0.48^{b}

*Means within a column with different superscripts are significantly different (P<0.05).

Table 4: Performance of growing camels in the experimental trials

Item	Trials			
	Control	U 1/3	U 1/2	U 2/3
Initial weight, kg	294.8±43.1	310.0±42.9	325.7±41.7	337.6±42.8
Final weight, kg	310.0±42.9	325.7±41.7	337.6±42.8	347.0±43.49
Total gain, kg	15.2±0.43[a*]	15.7±2.8[a]	11.9±1.3[b]	9.4±1.5[c]
Gain (kg/100kg LBW)	5.16	5.07	3.65	2.78
Relative growth rate (%)	5.03	4.94	3.59	2.75
Daily gain (gm)	507	523	397	313
Feed conversion	16.96	18.16	19.39	23.00

*Means within a row with different superscripts are significantly different (P<0.05).

Table 5: Chemical composition (on DM basis) of the fecal matter

Item %	Trials			
	Control	U 1/3	U 1/2	U 2/3
Dry matter	26.32±2.70	27.97±2.50	26.78±2.10	26.69±2.30
Organic matter	82.55±0.87	81.8±1.12	80.72±0.98	80.77±1.02
Crude protein	15.88±0.38	14.9±0.41	18.2±0.35	20.1±0.55
Ether extract	1.85±0.07	1.78±0.09	1.62±0.1	1.04±0.06
Crude fibre	23.23±1.11	24.89±1.31	21.52±1.07	20.03±0.99
Ash	17.45±0.67	18.20±0.55	19.28±0.81	19.23±0.66
NFE	41.59±1.42	40.23±1.67	39.38±1.87	39.60±2.02
Chromic oxide	1.62±0.08	1.58±0.11	1.31±0.06	1.20±0.09

Table 6: Digestion coefficients (%) of the nutrients in the experimental trials

Item	Trials			
	Control	U 1/3	U 1/2	U 2/3
Dry matter	69.14±3.23[a]	68.35±4.12[a]	61.8±4.03[b]	58.33±4.63[b]
Organic matter	70.60±2.97[a]	70.27±3.02[a]	64.67±3.31[b]	61.16±4.12[b]
Crude protein	60.02±2.96[a]	61.57±3.15[a]	43.52±5.66[b]	31.97±7.14[c]
Ether extract	71.45±5.11[a]	69.05±4.32[a]	59.84±3.86[b]	58.73±4.41[b]
Crude fibre	61.08±4.02[a]	53.00±5.18[b]	46.53±5.86[c]	45.84±6.07[c]
NFE	76.22±3.87[a]	77.36±5.17[a]	74.09±4.89[b]	71.50±6.03[b]

*Means within a row with different superscripts are significantly different (P<0.05).

Table 7: Nitrogen balance of growing camels in the different trials

Item	Trials			
	Control	U 1/3	U 1/2	U 2/3
Nitrogen balance (g/d):				
Intake	152.27±3.8 [a]	164.94±4.7 [a]	131.56±4.2 [b]	121.45±5.1 [b]
Fecal	60.42±4.1 [c]	59.03±3.6 [c]	84.52±2.9 [b]	103.79±3.5 [a]
Urine	10.96±1.01 [a]	11.19±0.99 [a]	10.21±1.3 [a]	9.47±1.03 [a]
Absorbed	91.85±3.4 [a]	105.91±2.9 [a]	47.04±3.7 [b]	17.66±4.9 [c]
Retained	80.89±2.8 [a]	94.72±3.4 [a]	36.83±4.2 [b]	8.19±6.02 [c]
Nitrogen intake (%):				
Fecal	39.68	35.79	64.24	85.46
Urine	7.20	6.78	7.76	7.80
Retained	53.12±2.23 [a]	57.43± 3.09 [a]	27.99±1.98 [b]	6.74±1.10 [c]
Retention (%) (from absorption)	88.07±2.50 [a]	89.43±2.80 [a]	78.30±2.15 [b]	46.38±1.20 [c]

*Means within a row with different superscripts are significantly different (P<0.05).

Table 8: Serum biochemical values of camels in the different trials

Items	Trials			
	Control	U 1/3	U 1/2	U 2/3
Total protein (g/dl)	4.8±0.10 [b]	4.9±0.15 [b]	6.2±0.12 [a]	7.3±0.10 [a]
Glucose (mg/dl)	90±6.20 [a]	88±5.90 [a]	70±5.70 [b]	60±5.81 [b]
Urea (mg/dl)	38±2.70 [b]	40±2.81 [b]	70±3.10 [a]	80±3.20 [a]

*Means within a row with different superscripts are significantly different (P<0.05).

Table 9: Economical comparison between control and most preferable ration

Item	Control	U 1/3
Feed consumption (kg/h/d)	8.6	9.5
Feed costs (LE)	110.94	105.45
Price of body gain (LE)	129.2	133.45
Net revenue (LE)	18.26	28.0
Economic feed efficiency (%)	16.46	26.55
Relative economic feed efficiency	100	161.3

Net revenue = price of body gain – feed costs

$$\text{Economical feed efficiency} = \frac{\text{Net revenue}}{\text{Feed costs}}$$

$$\text{Relative economic feed efficiency} = \frac{\text{Economic feed efficiency of group}}{\text{Economic feed efficiency of control}} \times 100$$

Fig .1 .Feed intake and weight gain in the experimental trials

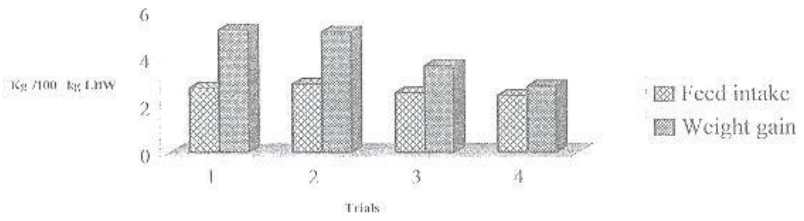

Fig .2 .Nitrogen retention % of camels in different trials

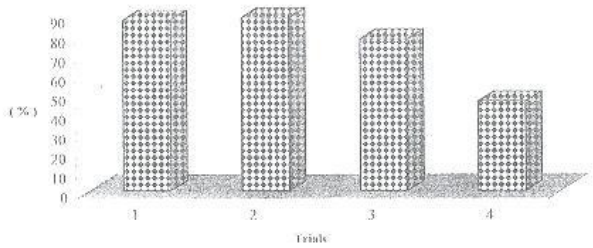

Fig .3 .Serum urea level of camels in the different trials.