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EFFECT OF DIETARY ROUGHAGE LEVELS ON THE LACTATION PERFORMANCE OF EGYPTIAN GOATS

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SUMMARY

Twelve lactating local (Baladi) goats were randomly ranked in two groups to study the effects of dietary roughage levels on intake, digestibility and milk production and composition. Treatments were isocaloric, isonitrogenous diets of mixed concentrates and berseem hay with roughage: concentrate ratios (DM basis) 50:50 and 70:30.

The dry matter intake per 100 kg body weight decreased ($P < 0.01$) with increasing level of dietary roughage. Ether extract and crude fibre digestibilities increased ($P < 0.01$) as roughage level increased.

Milk contents (%) of total solids and lactose were lower ($P < 0.05$) and ash was higher ($P < 0.01$) by increasing roughage level. Neither milk fat nor protein content (%) were significantly affected by changing roughage level.

Yield (g/day) of milk, SNF, fat and protein and milk gross energy (Kcal/day) were higher ($P < 0.01$) in dose fed low roughage diets.

No significance has been attained between groups concerning different efficiencies in utilizing dietary energy or protein for lactation.

Keywords: Roughage: concentrate ratio, milk yield, composition, goats, lactation

INTRODUCTION

Numerous studies have been conducted on Egyptian goats to verify their productive efficiencies under different

feeding conditions. There are some claims that goats have higher ability than other ruminants to consume and utilize high fibrous diets (Gihad, 1981; El-Gallad et al., 1988 and El-Badawi et al., 1988). In comparative studies between ruminants, goats can survive and produce better than other species when good quality feeds are scarcely available (Louca et al., 1982).

Regardless the exceptional efficiency of goats to utilize roughages, milk production from goats is dependent on quality of forage consumed and net energy content of the forages (deSimiane, 1978). Moreover, supplementary supplies of concentrates in diets of lactating goats is advisable to improve milk production, particularly during early lactation (Morand-Fehr and Saunant, 1980).

Utilization of diets containing different levels of roughages fed in either restricted amounts or ad.libitum are constrained by their contents of crude fibre and net energy (Van Soest, 1982). However, inclusion of certain amounts of roughages in diets of lactating ruminants are essential for normal rumen function and normal milk fat percentage (Gado, 1992).

The objective of this study was to evaluate the effect of roughage: concentrate ratios of isocaloric, isonitrogenous diets on intake, digestibility and milk production and composition by local lactating goats.

MATERIALS AND METHODS

Twelve lactating local (Baladi) goats in their first lactation season, aged 14-16 months old, weighing 17.65 kg ±0.58 weight were ranked in two groups each of six animals according to their post-partum body weight. Does were housed in two pens and individually fed on either low or high roughage diets. The roughage protein of any of the two diets was berseem hay (IFN 1-40-340), whereas concentrate portions were, mixture (1) in the low roughage diet (LR) and mixture (2) in the high roughage diet (HR).

Concentrate mixture (1) was cubes made of; 38% undecorticated cotton seed meal, 30% wheat bran, 33% yellow corn, 4% rice bran, 3% molasses, 2% lime stone and 1% common salt.

Concentrate mixture (2) consisted of (W/W); 40% concentrate mixture (1) + 40% faba bean (5-09-262) + 20%

yellow corn (4-02-935).

Concentrate mixtures were offered in a ground form along with 5-10 cm length chopped hay to both groups of animals.

Table 1. Chemical composition of feed ingredients and predicted nutritive values of the two experimental diets

Item	Moisture %	% on DM basis CP	EE	CF	NFE	Ash	TDN* %	DCP* %
Concentrates mixture(1)	11.20	16.92	5.67	14.20	58.33	4.88	60	12.00
Concentrates mixture(2)	8.80	17.75	4.40	8.41	65.18	4.26	70	14.20
Berseem hay	12.40	15.70	2.65	26.15	42.78	12.72	46	9.00

	% DM Roughage : Concentrate ratios Hay	Mix (1)	Mix (2)		
Low roughage diet (LR)	50	50	--	53	10.50
High roughage diet (HR)	70	--	30	53	10.65

* *Calculated from Abou-Raya (1967).

The two experimental diets were individually fed. Hay was offered ad. libitum twice daily, while concentrates were offered once in the afternoon meal. Offered amount of hay were weekly adjusted according to the actual intake on the pervious week. The amounts of concentrates were accordingly adjusted to keep roughage: concentrate ratios (R:C) on 50:50 and 70:30 for LR and HR diets, respectively. To assure all animals fed to appetite, additional 10% over the amounts actually consumed were offered from both diets. Refusals of-mainly-hay were daily collected, dried at 60°C and weekly weighed.

The experimental period started after three days colostrum period (Lu and Potchoiba, 1988) and lasted for eight weeks. Does were hand-milked twice daily. Daily milk was individually recorded once weekly, and it was the sum of a.m/p.m milking on the testing day. Composite samples of morning and afternoon milk were individually collected once weekly for chemical analysis.

Body weight was weekly recorded for each doe before the morning meal after milking. Towards the end of the 4th week of lactation, does were kept in metabolic cages for ten days with the same diets. The first five days were for adaptation and five days for quantitative collection of faeces.

Dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF) and ash of feeds and faeces were analyzed according to A.O.A.C., (1984). Milk total solids, fat, protein (NX 6.38), non-protein nitrogen and ash were analyzed according to (Ling, 1963). Milk lactose was calculated by difference. True protein nitrogen of milk was the difference between total N (TN) and non-protein N (NPN) fraction. Milk gross energy was calculated applying the formula : Energy Kcal/100 g milk = 9.11 fat% + 6.38 x 5.86 (TN % - NPN %) + 3.95 lactose% (Perrin, 1958).

To calculate feed efficiency in terms of energy, the equation one kg TDN = 4.409 Mcal was employed (NRC, 1981). Recommendations of Garrett et al. (1959) were used to convert one form of energy (E) into another being; 100 Kcal gross E (GE) = 76 Kcal digestible E (DE) = 62 Kcal metabolizable E (ME). For each gram body weight gain or loss nine Kcal ME were calculated according to Rajpoot et al. (1981). Net energy for maintenance (NE_m) balance was calculated as 57.2 Kcal/Kg $w^{0.75}$ and digestible crude protein (DCP) was 2.82 g/Kg $w^{0.57}$ according to NRC (1981) recommendations.

Data were statistically analyzed according to Steel and Torrie (1960), applying completely randomized design.

RESULTS AND DISCUSSION

Means of dietary intakes, nutrients digestibilities and nutritive values of the two experimental diets are presented in Table 2. Mean daily intake of DM (g/Kg or g/Kg $w^{0.75}$) was about 16% higher from the LR diet. The difference between groups of DM intake was significant ($P < 0.01$) when expressed relative to 100 kg body weight (3.85% vs. 3.36%).

Consumption of roughage tended to be higher ($P<0.01$) by dose fed HR diet (403 (HR) vs. 309 (LR) g/d). Average roughage percent of DM intake was 44.63 and 68.46 by LR and HR dose, respectively. With regard to present plan of nutrition, the lower intake of roughage by does fed 50:50 R:C ratio-diet could be attributed to higher available concentrates offered to this group. Huguet et al. (1974) noted that additional supply of hay in goat diets did not increase the intake of total DM. Moreover, forages are consumed well if they are provided as a sole

choice but may be rejected if offered with alternative feeds (Van Soest, 1982). The lower intake of high roughage diets was attributed to the higher level of crude fibre (Morand-Fehr and Sauvant, 1980) and recently, to neutral detergent fibre (NDF) level (Gado, 1992). In the present study, it was observed that does fed on LR diet consumed more CF than does on HR (135 vs. 121 g/d). This difference was not significant and if CF intake calculated relative to Kg $w^{0.75}$, values tended to be nearly similar in both treatment groups (from 14.2 to 15.6 g/kg$w^{0.75}$).

Table 2. Intake, digestibility and nutritive value of low (LR) or high (HR) roughage diets fed by lactating does

Item	Diets			
	LR	HR	SEM	
No. of does	6	6		
Mean body weight, kg	17.78	17.52	0.58	NS
Intake, g/h/ day (Dm basis):				
Concentrate	378	185	32.20	**
Roughage	309	403	23.00	**
Total	687	588	34.85	NS
Crude fibre	135	121	23.73	NS
%Roughage of total DM-intake	44.63	68.46	3.62	**
DM, intake % of body weight	3.85	3.36	0.10	**
Intake, g/Kg$w^{0.75}$:				
DM	78.93	68.78	2.37	*
TDN	37.96	33.09	1.13	*
DCP	8.32	7.31	0.25	*
Nutrients digestibility %:				
OM	45.74	46.23	0.32	NS
CP	64.56	65.30	0.35	NS
EE	45.50	50.98	0.95	**
CF	36.64	38.92	0.47	**
NFE	50.74	52.13	0.57	NS
Nutritive Value, % :				
TDN	48.19	48.26	0.31	NS
DCP	10.57	10.66	0.05	NS

NS = not significant *Significant (P<0.05)
** Significant (P<0.01)

Ether extract and crude fibre digestibilities were higher (P <0.01) by does fed HR diet. Digestibility

values of OM, CP and NFE were almost similar in both treatment groups. The lower digestibility of CF by does fed LR diet might be a result of their higher intake of DM especially from concentrate which might depress cellulolytic activity of rumen microbes. The negative correlation between CF or NDF digestibility and voluntary feed intake could also be due to higher passage rates from the rumen (Van Soest, 1982 and Gado, 1992). The differences between calculated and determined TDN% of low or high roughage diets (53.00 vs 48.19 or 48.26) could be regarded to species difference, since calculated TDN values were obtained from experiments carried out on cattle or sheep.

Milk composition and yield of different measurable constituents are presented in Table 3. Milk contents of SNF, fat, protein and NPN were not affected by changing dietary roughage level. Total solids and lactose contents were higher ($P < 0.05$) in milk samples of LR group, while ash content was higher ($P < 0.01$) in HR group. The higher values of milk total solids% and lactose% in LR group could be fairly attributed to the higher energy intake. Similar results were reported on dairy goats by Morand-Fehr and Sauvant (1980) and El-Alamy et al. (1987).

Lactation curve in Figure 1 illustrates that; does of both groups reached the peak point at the 3rd week of lactation. Slopes of lactation curves tended to decline thereafter at lower rates for does fed LR diet and sharply for does fed HR diet. Average yield (g/d) of milk SNF, fat and protein and milk gross energy (Kcal/d) were higher ($P < 0.01$) in LR group. Such result could be attributed to the lower intake of net energy of high roughage diet (70:30 R:C ratio). deSimiane (1987), Morand - Fehr and Sauvant (1980) and El-Alamy et al. (1987) concluded that, increasing roughages in diet of lactating goats resulted in lower intake of net energy, lower milk and milk fat yields. However, Gado (1982) did not find differences in milk yield of lactating goats fed diets varied in roughage- to - concentrate ratios from 40:60 to 60:40.

Feeding the high roughage diet (70% hay)did not increase either milk fat content(%) or milk gross energy (Kcal/d). Several studies reported by Gado (1992), explored that shifting energy out-put from tissue energy to milk is controlled by level of ruminal VFAs and

acetate- propionate ratio. Diets of high CF content increased ruminal acetate and milk fat content (El-Gallad et al., 1988), while low fibrous diets increased ruminal propionate and promoted more energy deposition in body tissues (Morand-Feher and Sauvant, 1980). The previous studies indicated that the higher dietary CF level was almost associated with higher milk fat content. Such result was not achieved in the present study, since the average daily CF intake- regardless it's source- was 135 g of LR diet and 121 g of HR diet. This similar level of CF intake might explain the non-significant difference of milk fat contents between groups fed 50% or 70% roughage in their diets.

Results of milk fat yield and milk energy indicated that, they were positively influenced by the net energy intake rather than composition of diets (R:C ratios), milk total N, true-protein N and NPN contents were not affected by changing dietary roughage level as shown in Table 3. The average daily yield of milk protein was

Table 3. Milk composition, daily yield of different milk components and milk gross energy of does fed low or high roughage diets.

Item	Diets			
	LR	HR	SEM	
Milk composition, %:				
Total Solids	12.05	11.56	0.12	*
SNF	8.20	7.95	0.08	NS
Fat	3.85	3.61	0.09	NS
Protein (Nx6.38)	3.17	3.19	0.03	NS
Lactose	4.29	3.93	0.09	*
Ash	0.74	0.83	0.01	**
Nitrogen (N) fraction (mg/100 ml milk) :				
Total N	497	500	5.38	NS
True protein N	455	459	5.39	NS
Non-protein N	42	41	0.29	NS
Yield, g/day :				
Milk	945	669	52.11	**
SNF	78	53	4.69	**
Fat	37	24	2.66	**
Protein (Nx6.38)	30	21	1.75	**
Gross energy, Kcal/day	657	437	43.41	**

NS = not significant * Significant (P<0.05)
** Significant (P<0.01)

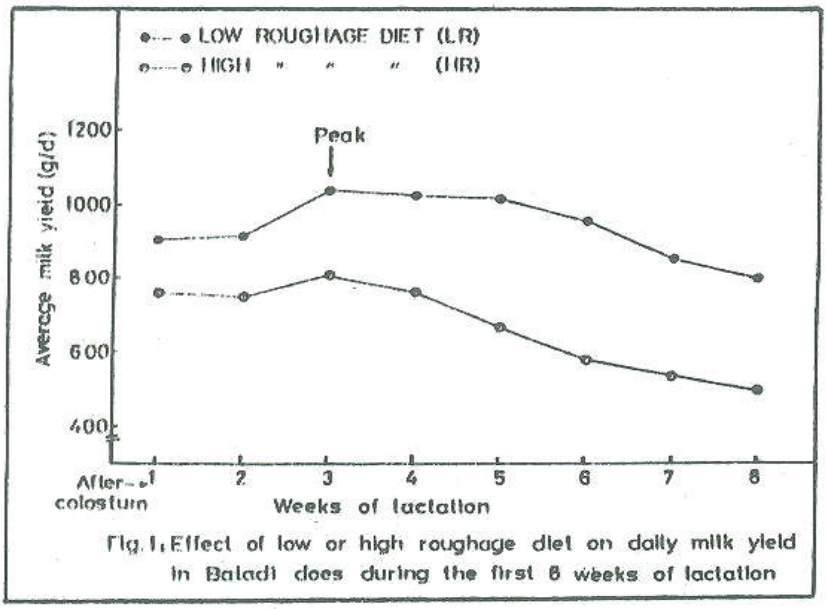

Fig. 1: Effect of low or high roughage diet on daily milk yield in Baladi does during the first 8 weeks of lactation

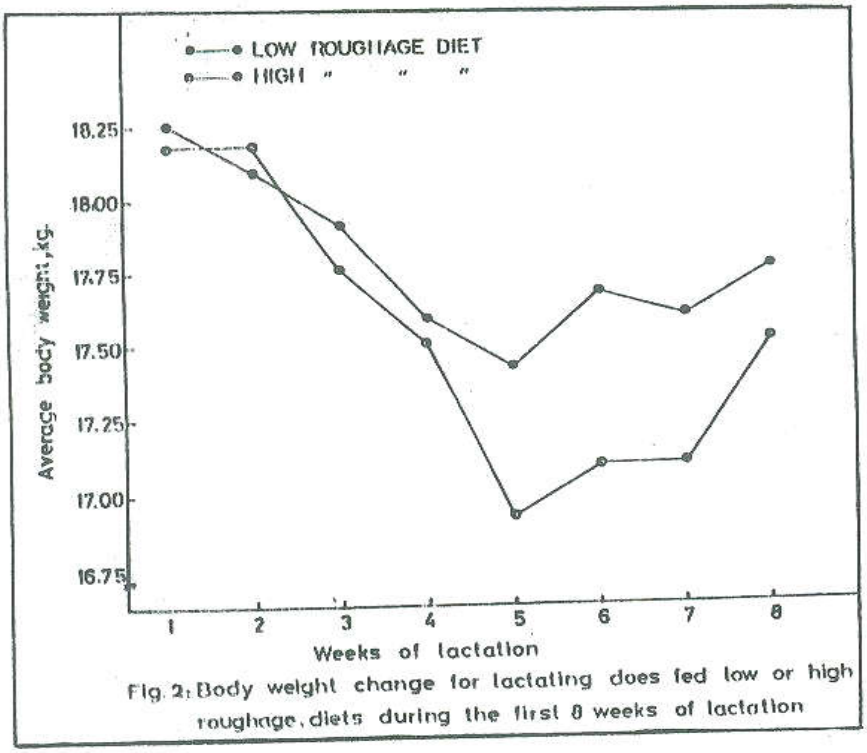

Fig. 2: Body weight change for lactating does fed low or high roughage diets during the first 8 weeks of lactation

however lower (P <0.01) in animals fed HR than those fed LR diet (21 vs. 30 g/h/day). This result might indicate that the contents of N-fractions (TPN and NPN) of goats milk were potentially stable within the present change of the dietary roughage level from 50% to 70%. Similar conclusion was reported by El-Alamy et al. (1987) who found no change in N-fractions of goats milk when fed diets contained 30, 50 and 70% roughage levels. On the other hand, the change of daily milk-protein yield was positively related to the intake of energy and DCP, however, the efficiency of utilizing dietary protein seemed lower by goats fed HR diet (Table 5).

Body weight change and weekly body weight fluctuation during eight weeks lactation of the two groups are shown respectively, in Table 4 and Figure 2. Dose of both treatment groups lost weight of their bodies. Mean daily weight losses were 8.90 g for dose in group LR and 11.95 g for HR group. Maximum weight loss was in the fifth week of lactation for both groups, while slight weight recovery was observed in the following weeks. Similar trend was recorded on lactating Zaraibi goats by El-Gallad et al. (1988). In earlier studies, Mackenzie (1967) stated that, loss of weight in goats particularly, during early lactation period is perfectly normal, make necessary energy for high yields available without overstaining the digestive system.

Table 4. Body weight change of lactating does fed low or high roughage diets

Item	Diets[a]		
	LR	HR	SEM
Initial body weight, kg	18.25	18.17	0.62
Final body weight, kg	17.75	17.50	0.56
Body weight change, kg	-0.50	-0.67	0.15
Average daily gain/loss, g	-8.90	-11.95	2.68

NS = not significant

a = No significant differences were detected between the two dietary levels

Based on the same calculations principals followed by Rajpoot et al. (1981), to predict requirements of energy and protein for Indian lactation goats; predicted

efficiency of ME utilization for lactation in the present study was 90.20% of does fed LR diet and was 81.83% of does fed HR diet (Table 5). These values

Table 5. Efficiency of dietary energy and protein utilization by lactating does fed low (LR) or high (HR) roughage diets

Item	Diets			
	LR	HR	SEM	
Energy :				
TDN, g/h/day	330.76	283.88	16.59	NS
DE, kcal(TDNx4.409)	1458	1252	73.09	
ME, kcal(DEx62/76)	1196	1027	59.96	
ME available from body wt. loss, kcal(1 g body wt. loss = 9 kcal ME)	80	107	24.10	NS
Total ME, kcal	1276	1134	69.95	NS
NE_m, Kcal(57.2 Kcal/$Kgw^{0.75}$)	494	490	12.00	NS
NE_L Kcal(milk gross energy)	657	438	43.41	**
Total NE_{m+L}, Kcal	1151	928	71.82	**
Efficiency of ME utilization,%	90.20	81.83	1.55	NS
Protein:				
DCP, g/h/day	72.51	62.76	3.62	NS
DCP for maintenance (2.82 g/$kgw^{0.75}$)	24.37	24.15	0.59	NS
Available DCP for lactation	48.14	38.61	3.09	NS
Yield of milk protein, g/day lactation	30.05	21.29	1.75	**
Efficiency of dietary DCP utilization (g milk protein/100 g DCP)	62.42	55.14	3.08	NS

NS = not significant ** Significant (P<0.01)

seemed illogic, since applying present figures to predict metabolizable energy requirement for lactation maintenance (total Kcal ME-ME_L/kg $w^{0.75}$) result in, 72 of goats fed LR and 81 of goats fed HR diets. Such values are too far from 161.43 Kcal ME/Kg $w^{0.75}$ for lactation maintenance reported by Rajpoot et al. (1981) on Indian dose, or even 101.38 Kcal NE/$kgw^{0.75}$ recommended by NRC (1981) for maintenance of goats with low standard of

activity. It is of interest; however, to point out that converting values of energy; i.e. 62 Kcal ME = 35 Kcal NE; used in the calculation of the NRC (1981) were applied for all types of physiological activities. Such calculations might raise values of energy for maintenance balance higher than actually needed. On the other hand; utilization of dietary DCP for lactation by local goats was between 55.14% (HR) and 62.42% (LR) as shown in Table 5. Both efficiency values were lower than 125 g DCP needed per 100 g 4% FCM (80 % efficiency) suggested by Crampton and Harris (1969).

Lack of available information about feed requirements for local lactating goats make results of the present study confused, however, it could be concluded that using ration of low roughage level (50% of DM intake) improved intake, milk yield and milk gross energy of local (Baladi) lactating goats. Further detailed studies with local goats are needed to assess their efficiency to utilize dietary energy and protein for maintenance and production purposes.

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تأثير مستوى المادة الخشنة فى العليقة على أداء انتاج اللبن فى الماعز المصرى

علاء الدين يحيى البدوى

قسم تغذية وإنتاج الحيوان والدواجن- المركز القومى للبحوث - القاهره - مصر

استخدم فى هذه التجربه عدد ١٢ انثى حلابه من الماعز المحليه (بلدى) ، وكانت الحيوانات فى موسم حليبها الاول وقد تراوحت أعمارها من ١٤ الى ١٦ شهر وكانت متوسط أوزانها ١٧,٦٥ ± ٠,٥٨ كجم وقد تم ترتيب الحيوانات عشوائيا بعد الوضع فى مجموعتين متساويتين (كل من ٦ أناث) امتدت فترة التجربة الى ٨ أسابيع بدء من انتهاء فترة السرسوب ٠ غذيت احدى المجموعتين على عليقة منخفضة المحتوى من دريس البرسيم (مادة علف خشنه) بمستوى ٥٠ ٪ من الماده الجافة للعليقة المقدمه ، بينما غذيت المجموعه الثانيه على عليقه ذات محتوى مرتفع من الدريس بمستوى ٧٠٪ من الماده الجافه للعليقة المقدمه ٠ كانت العلائق لكلا المجموعتين تقدم للشبع ، وكانت التغذيه تتم فرديا. تم حساب كمية المأكول من العلائق اسبوعيا كذلك تم تسجيل تغيير الوزن وكمية إنتاج اللبن وتركيب اللبن اسبوعيا لكل حيوان على حده. تم اجراء تجارب هضم فى منتصف فترة التجربة لمجموعتى الحيوانات. شكل المأكول الفعلى من مادة العلف الخشنة من اجمالى المادة الجافة للعليقة منخفضة المحتوى من الدريس ٤٤,٦٣٪ بينما كانت النسبة ٦٨,٤٦٪ للعليقة المرتفعة من الدريس. انخفضت كمية المأكول منسوبة الى الوزن الحى بمعنوية (١٪) نتيجة إرتفاع المادة الخشنة فى العليقة. وجد أن معامل هضم كل من مستخلص الدهن والالياف الخام قد ارتفع معنويا (١٪) للعليقة ذات المحتوى المرتفع من الدريس. وجد أن انتاج اللبن اليومى ومحصول المادة الجافة الخالية من الدهن ، والدهن ، والبروتين ومحتوى طاقة اللبن تزيد معنويا (١٪) بانخفاض نسبة مادة العلف الخشنة فى العليقة . كذلك وجد أن نسبة المادة الجافة واللاكتوز تنخفض معنويا (٥٪) بينما ترتفع نسبة الرماد معنويا (١٪) فى البان الحيوانات التى تتناول كميات مرتفعه من الدريس . لم تلاحظ فروق معنويه بين المجموعتين من حيث كفاءة استخدام طاقة وبروتين العلائق لانتاج اللبن على مستويات التغذية المدروسة .