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Comparative Dietary Utilization of Goats and Sheep

1. Effect of Roughage Quality

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THREE are some claims that goats have more ability to utilize roughages than sheep. Two performance trials were conducted to study the nutritional efficiency for native Baladi bucks and Ossimi rams. Animals were fed a supplement of concentrate mixture feed to provide 50% of SV and 80% of CP required for maintenance, berseeem hay (good roughage) at the first trial and rice straw (poor roughage) at the second one were fed ad-lib., water at all times was freely available. Goats were better than sheep in consuming roughages regardless quality, while their superiority was more pronounced when poor roughage was fed calculated in terms g/Kg $W^{0.75}$ on DM basis, however, differences between species did not attain any significance. Better results of nutrients digestibility were noted for sheep than goats, particularly, CF and cellulose when good roughage ration was fed (differences were not significant), corresponding values improved in goats when poor roughage was fed. Nitrogen balance was similar for both species and they were affected to nearly the same extent as roughage quality changed from good (14.7% CP) to poor (3.5% CP).

KEY WORDS : (Dietary roughage, Goats, sheep)

The effective utilization of especially poor quality roughages by goats represents an important ability of the species and their emerging economic importance in arid and semi-arid countries. Goats tend to frequently consume roughages more than sheep this tendency being more pronounced as

roughage quality decreased [Devendra, 1982]. The comparative dietary utilization of poor quality roughages of goats and sheep has been studied by many investigators [El-Hag, 1976; Devendra, 1977; Gihad, 1981 and Sharma *et al.*, 1982]. However, the bibliography is not clear enough to judge the dietary efficiency of goats and sheep under different feeding condition *i.e.*, when diets contained good Vs. poor roughage. Such variations are naturally observed, when animals are shifted to dry season in arid zones.

Material and Methods

Experimental animals and management

Three mature males of each of native Baladi goats and Ossimi sheep 3-5 years of age weighed in average 40 and 59 Kg respectively, were used in the present study, and they were in good health. Before starting any of the two digestibility trials, experimental animals were weighed and kept in a brickmade-pen and individually fed for 4 weeks as adaptation period, then they were confined in individual metabolic crates for a preliminary period of 15 days followed by 5 days for faeces and urine collection. During the preliminary period, animals were weighed weekly to adjust the amount of concentrate mixture feed (CMF) offered for each of them.

Feeds and feeding system

Experimental rations containing CMF [55% starch value (SV) and 14% crude protein (CP)] were offered with either 2*nd* cut berseem hay or rice straw. Roughages were chopped to approx. 10 cm length, while CMF was offered in a ground form, and was consisted of : 38% undecorticated cotton seed meal, 30% wheat bran, 22% yellow corn, 4% rice bran, 3% molasses, 2% limestone and 1% common salt.

The feeding system followed throughout this study was based on feeding each animal of both species a restricted amount of CMF to provide 50% of energy (12.5 g. SV/Kg $W^{0.75}$) and 80% of crude protein (3.2 g. CP/Kg $W^{0.75}$) required for maintenance. The amounts of SV and CP required to maintain confined goats and sheep were calculated according to recommendations of NRC (1981) for goats and ARC (1965) for sheep, and were in average 25 g. SV and 4 g. CP/Kg $W^{0.75}$ for both species.

The daily amount of CMF was 22.7 g/Kg $W^{0.75}$ and the whole amount for each animal was weekly adjusted according to changes in body weight be-

fore the collection period. Roughages of good quality (berseem hay) or poor quality (rice straw) were fed to appetite.

Experimental rations were offered once daily at 7.00 A.M., and during the collection period, feed residues (of usually roughages) were removed at the next morning and individually dried and weighed to determine the actual roughage consumption. Clean water at all times was freely available.

Analytical methods

Samples of the dietary ingredients and faeces was analysed for DM, CP, CF, EE and ash according to A.O.A.C. (1970). Urine was analysed for N according to A.O.A.C. (1970). Determination of fiber fractions (NDF, ADF and ADL) of feeds and faeces were carried out according to methods suggested by Goering and Van Soest (1970).

Statistical analysis using split plot design was carried out according to Winer (1971).

TABLE 1. Chemical composition (%) of different ingredients for feeds used (as fed) in the experimental rations.

Feed	Moisture	CP	NFE*	CF	EE	Ash	SV
CMF	12.1	14.0	52.5	11.3	5.3	4.8	55.0
Berseem hay	13.0	14.7	35.1	24.1	2.6	10.5	33.0
Rice straw	8.7	3.5	35.1	36.2	1.2	15.3	22.0

NFE = Nitrogen free extract; CF = Crude fiber;

EE = Ether extract.

* Calculated by difference.

TABLE 2. Fiber fractions (%) for feeds used (as fed) in the experimental rations.

Feed	NDF	ADF	ADL	Hemi-cellulose*	Cellulose**
CMF	44.1	7.2	4.4	36.9	2.8
Berseem hay	43.8	30.1	8.7	13.7	21.4
Rice straw	66.4	43.0	6.1	23.4	36.9

NDF = Neutral detergent fiber; ADF = Acid detergent fiber;
ADL = Acid detergent lignin.
* NDF — ADF ** ADF — ADL

Results

Intake

Values of nutrients intake which are given in Table (3) illustrate that goats consumed roughages of different quality (good or poor) better than sheep. Differences of nutrients intake between species — for any of the two rations — were due to difference in roughage consumption, since, the amount of CMF was constant as g/Kg $W^{0.75}$ for both species. In relative values, goats consumed 25% more roughage of good quality than sheep, while the difference increased to reach 39% when poor roughage was fed. As a result of different ability of roughage consumption between species, value of DM intake (g/Kg $W^{0.75}$) were higher by 15.2% in goats than sheep for either good or poor roughage ration.

Differences between species for different values of nutrients intake were not significant (see Table 6), moreover, both species were affected to nearly same extent by changing roughage quality from good to poor. All measurable values of intake were significantly ($P < 0.01$) decreased as roughage quality decreased.

TABLE 3. Mean values of nutrients intake (± S.E.) for goats and sheep fed rations containing good or poor quality roughage.

Intake (g/Kg W$^{0.75}$)	CMF + Good		CMF + Poor	
	Goats	Sheep	Goats	Sheep
Total dry matter	59.9	52.0	37.9	32.9
	(±2.8)	(±2.6)	(±2.5)	(±1.3)
CMF (C)	20.0	20.0	20.0	20.0
Roughage (R)	39.9	32.0	17.9	12.9
R : C ratio	66:34	61:39	46:54	39:61
Organic matter components :				
NFE	28.1	24.8	18.8	16.9
CP	9.9	8.6	3.9	3.7
EE	2.4	2.2	1.4	1.4
CF	13.6	11.5	9.7	7.7
Total	54.0	47.1	33.8	29.7
	(±2.5)	(±2.3)	(±2.1)	(±1.1)
Ash	5.9	4.9	4.1	3.2
Energy (SV) :	30.3	28.1	18.9	18.0
	(±0.9)	(±0.6)	(±0.5)	(±0.4)
From CMF	12.5	12.5	12.5	12.5
From roughage	17.8	15.6	6.4	5.5
Crude protein :				
From CMF	3.2	3.2	3.2	3.2
From roughage	6.7	5.4	0.7	0.5
% of SV and CP from roughage to whole maintenance requirements :				
SV	71.2	62.4	25.6	22.0
CP	167.5	135.0	17.5	12.5

Digestibility

Values of different nutrients digestibility recorded on goats and sheep were closely similar for both experimental rations (see Table 4). Most nutrients namely : DM, OM, CP, NFE and EE were digested to nearly same extent by both species. However, values of sheep were slightly higher than

those of goats, except CP which was better digested by goats than sheep. Changing roughage quality from good to poor lowered significantly ($P < 0.05$) CP digestibility for both species, while other nutrients digestibility were not affected. Crude fiber digestibility was higher in sheep than goats (38.1% Vs. 47.4%) fed good quality roughage ration. Unlike other nutrients, CF digestibility was significantly ($P < 0.01$) increased to 56.8% for goats and 56.4% for sheep, when poor roughage replaced the good one. This improvement in CF digestibility could be attributed to lower consumption of poor roughage than good which in turn decreased the intake of CF by about 30% for both species (see Table 3).

Digestibility coefficient of fiber components (hemicellulose, cellulose and ADL) was estimated for both rations on goats and sheep. Hemicellulose digestibility values were in average 86.6% by goats and 84.8% by sheep for both rations. Cellulose digestibility was improved in goats from 45.1% to 52.2% by changing roughage to poor, while corresponding values in sheep were nearly constant ranged from 60.0% to 58.3% for good and poor roughage rations, respectively. The fiber fraction ADL was poorly digested by both species — as expected — although, values reached 11.3% and 13.7% were obtained for sheep and goats, respectively. Its important to note that as roughage quality decreased goats exert significantly ($P < 0.01$) better digestibility of ADL than sheep, while as roughage quality improved sheep were significantly ($P < 0.01$) better than goats in digesting ADL, (see statistical analysis in Table 6).

Utilization of dietary N

Values of apparent N-balance obtained for goats and sheep fed good roughage ration were significantly ($P < 0.01$) higher than those of poor roughage rations 517 (goats) and 412 (sheep) Vs. 25 (goats) and 37 (sheep) mg/Kg $W^{0.75}$. Latter result was expected, since, N-intake was significantly ($P < 0.01$) decreased by changing roughage quality from good (14.7% CP) to poor (3.5% CP), (see Table 5).

Faecal and urinary N losses calculated in relative to N intake, were respectively, 25.3% and 42.1% for goats and 26.3% and 43.7% for sheep fed good roughage ration, while corresponding values of poor roughage ration were respectively, 32.0% and 64.0% for goats and 32.8% and 61.0% for sheep. It seems clear that shifting animals on poor roughage instead of good increased N losses, particularly in urine as percent of N intake.

TABLE 4. Mean values of apparent digestibility coefficient (± S.E.) for nutrients recorded on goats and sheep fed rations containing good or poor quality roughage.

Nutrients	CMF + Good		CMF + Poor	
	Goats	Sheep	Goats	Sheep
DM	66.4 (±1.1)	68.8 (±1.6)	65.9 (±4.1)	68.0 (±3.0)
OM	67.3 (±1.0)	70.4 (±1.6)	69.7 (±3.4)	72.1 (±2.7)
CP	74.7 (±0.6)	73.6 (±0.7)	68.1 (±2.7)	67.2 (±1.2)
NFE	76.3 (±1.3)	77.5 (±1.1)	74.7 (±3.5)	78.5 (±2.7)
EE	96.9 (±0.6)	97.3 (±0.4)	93.9 (±0.8)	95.1 (±0.2)
CF	38.1 (±1.2)	47.4 (±3.9)	56.8 (±3.1)	56.4 (±3.4)
Fiber components :				
Hemicellulose	88.5 (±1.1)	84.6 (±2.4)	84.7 (±2.3)	84.9 (±1.7)
Cellulose	45.1 (±2.1)	60.0 (±5.1)	52.2 (±5.5)	58.3 (±5.3)
ADL	3.4 (±0.9)A	11.3 (±1.0)B,C,a	13.7 (±0.0)B	5.9(±0.9)A,C,b

A,B,C = Means at the same row with different superscripts are significantly ($P < 0.01$) different.

a,b = Means at the same row with different superscripts are significantly ($P < 0.05$) different.

TABLE 5. Utilization of dietary nitrogen for goats and sheep fed rations containing good or poor quality roughage.

Nitrogen (mg/Kg $W^{0.75}$)	CMF + Good		CMF + Poor	
	Goats	Sheep	Goats	Sheep
Intake	1586	1375	619	589
Excreted:				
In faeces	401	362	198	193
In urine	668	601	396	359
Total	1069	963	594	552
Apparent N-balance	517	412	25	37
NB as % of DN	43.6	40.7	5.9	9.3

NB = Nitrogen balance, DN = Digestible nitrogen.

TABLE 6 : Analysis of variance for different measrable parameters

Source of variation	Intake (g/Kg $W^{0.75}$)				Digestibility coefficient									Utilization of dietary N
	Roughage	CF	CP	SV	DM	OM	CP	NFE	EE	CF	Hemi-cellulose	Cellu-lose	ADL	NB as % of DN
Bet. Sp.	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Bet. Treat.	**	**	**	**	NS	NS	*	NS	NS	**	NS	NS	NS	**
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	NS

NS = Not significantly different.

* = Significantly different ($P < 0.05$).

** = Significantly different ($P < 0.01$).

** ($P < 0.01$) * ($P < 0.05$) ns ($P > 0.05$)

The N-balance calculated as a percentage of digestible N gave the values of 43.6 for goats and 40.7 for sheep when the animals were fed the ration of good quality roughage. The corresponding values were decreased to 5.9 for goats and 9.3 for sheep by changing roughage quality to poor. The utilization of dietary N by both species was highly affected ($P < 0.01$) by its level in ration. However, it might be drawn from the results that the utilization of dietary N is also affected by N source.

It is of interest to note that goats need apparently 42 mg N/Kg $W^{0.75}$ more than sheep for their maintenance requirements when they were fed on poor roughage ration, while they were slightly better than sheep in utilizing N of good roughage ration, particularly, if difference of N intake between species has been considered.

Discussion

Results of the present study indicate that the intake of roughage by ruminants (goats and sheep) is positively affected by its quality. Crude protein content of roughage material is the most limiting nutrient for its quality and consequently, its consumption particularly, if has been fed with a restricted amount of concentrates.

Goats seem better than sheep in consuming roughages regardless the quality, however, their superiority was more pronounced when fed poor quality roughage (3.5% CP). Differences between species of roughage intake was increased from 25% to 39% by changing roughage quality from good to poor (see Table 3). Similar results were reported by Gihad *et al.* (1981) and Devendra (1981), that goats are more efficient than sheep in consuming roughages. Furthermore de Simiane *et al.* (1981) noted higher dry matter intake by goats than sheep and differences between species were increased as roughage quality decreased. The higher levele of intake for goats could be explained by the better N recycling in rumeen, particularly when poor roughage is fed [Harmeyer and Martens, 1980].

Nutrient digestibility results proved that goats and sheep were almost similar in digesting most nutrients of both roughage (berseem hay and rice straw) rations. These data are to agree with some extent to those of Huston (1978) and Owen and Ndosa (1982). The present study indicate that values of digestibility coefficients of CF, cellulose and ADL were not-

ably higher in sheep than goats fed good roughage ration. However, differences between species did not attain significancy except for ADL which was significantly ($P < 0.01$) higher in sheep than goats (11.3 Vs. 3.4). Shifting animals from good to poor roughage ration resulted in an improvement in CF, and cellulose digestibility for goats rather than sheep, particularly for ADL digestibility which was significantly ($P < 0.01$) altered than that for sheep (13.7 Vs. 5.9), (see Table 4). Similar conclusions was mentioned by Devendra (1981) that the effective utilization of rations by goats increased with decreasing quality of the feeds.

Utilization of the two experimental rations as energy (g. SV/ Kg $W^{0.75}$) and NB (mg N/Kg $W^{0.36}$) show that goats were slightly better than sheep in utilizing both rations. However, results of NB for poor roughage ration showed that goats may need approx. 8% more N/Kg $W^{0.75}$ than sheep for maintenance requirement. Present results may lend support to the findings of Orskov (1971) that the utilization of high roughage ration by ruminants is limited by its N level rather than energy, and it seems that N source is also of main importance for better utilization of rations through activities of rumen microbs, since, rumen compartment is the principle site responsible for active digestion of fibrous rations.

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مقارنة كفاءة استخدام الغذاء للماعز والأغنام
(١) تأثير مواصفات مادة العلف الخشنة

علاء الدين يحيى البدوى ، محمد على عبد المنعم العشرى ، حاتم محمد على
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لمقارنة مدى التغير فى كفاءة استخدام الغذاء للماعز والأغنام بتأثير تغير مواصفات مادة العلف الخشنة ، تم اجراء تجربتى هضم وميزان أزوت على مجموعتين من الحيوانات كل من ثلاثة ذكور بالغة من الماعز البلدى والأغنام الأوسيمى غذيت الحيوانات على عليقتين تجريبيتين متتاليتين تكونت العليقة الأولى من العلف المصنع ودريس البرسيم المقطع ، أما العليقة الثانية فقد تكونت من العلف المصنع وقش الأرز المقطع • تم تغذية جميع الحيوانات خلال التجربتين على كمية محددة من العلف المصنع تم حسابها بحيث تكفى لتغطية ٥٠٪ ، ٨٠٪ من الاحتياجات الحافظة من الطاقة (كمعادل نشا) والبروتين الخام على التوالى ، أما مواد العلف الخشنة فقد كانت تغذى الى الشبع •

أظهرت النتائج أن للماعز مقدرة تفوق الأغنام من حيث كمية المأكول من مواد العلف الخشنة حيث استهلكت الماعز ٢٥٪ ، ٣٩٪ أكثر من الأغنام من الدريس وقش الأرز على التوالى محسوب على أساس جم/كجم ٧٥ر٠ • لم تسجل أى فروق معنوية بين الماعز والأغنام فيما يتعلق بمعاملات هضم المادة الجافة ومكونات المادة العضوية ، وان كانت قيمة معامل هضم الـ ADL ارتفعت معنويا ($P < 0.01$) بالنسبة للماعز عن الأغنام عند التغذية على العليقة المحتوية على قش الأرز • كذلك لم تكن بين الأغنام والماعز فروق معنوية لقيم ميزان الأزوت المنسوبة الى الأزوت المهضوم عند التغذية على أى من العليقتين •