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Improving Uuilization of Rice Straw by Goats and Sheep

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FOUR digestibility and nitrogen balance (NB) trials were carried out on three mature males of each of Baladi goats and Ossimi sheep. The animals were fed four experimental rations in sequence each for a period of 50 days. In all rations, a restricted amount of concentrate mixture feed (CMF) — 55% SV and 14% CP — was offered to provide animals with $\frac{1}{2}$ of their maintenance requirement of SV (12.5 g/kg W^{75}), While chopped rice straw (RS) was fed ad-lib. Rations were resp., I CMF + RS, II CMF + 3% (w/w) urea-supplemented RS (URS), III 1% formaldehyde treated-CMF (HCHO-CMF) + RS and IV HCHO-CMF + URS.

The results showed that goats could consume significantly higher amounts of RS than sheep in all rations. Urea supplementation decreased the intake of RS for sheep approx. 18% than that of control ration (I). Moreover, it decreased significantly ($P < 0.01$) CF digestibility for both species compared with ration (I). HCHO-CMF + RS decreased significantly ($P < 0.05$) CP and ($P < 0.01$) E.E. digestibility and all animals were in negative NE. Both goats and sheep recorded the best utilization of dietary N and nutrients digestibility when HCHO-CMF + URS were fed (ration IV), however, their intake of RS was not significantly changed than that of control ration.

Key Words (Rice strow, goats, sheep)

Improving utilization of poor quality roughages such as straws, hulls, stovers... etc. for animal feeding is a target necessary to overcome the insufficiency of concentrates and green fodder.

In Egypt, over than two million tons of rice straw are yearly available providing about 440,000 tons starch value and 70,000 tons crude protein. Rice straw is a low lignin roughage [Ahmed, 1983] which may help approaches to improve its utilization by ruminants through using chemical or physical treatments. Urea supplementation has been used to increase the nitrogen content of poor quality roughage [Kempton and Leng, 1979] and improving utilization of rice straw by ruminants [El-Shinnawy and Abou-Raya, 1983 and Soliman *et al.*, 1985].

Nowadays, formaldehyde treatment is suggested to be one of the treatments to increase the utilization of rations containing poor quality roughages through decreasing dietary-nitrogen losses and increasing amino acids to the host animal [Beever and Thomson, 1977; Kempton *et al.*, 1979 and Soliman *et al.*, 1985]. The method and level required for protecting different protein sources from rumen degradation by formaldehyde have been examined by many workers [Ferguson *et al.*, 1967; Faichney and Davis, 1973 and Mudgal and Sengar, 1981].

The objectives of this study are to compare the efficiency of goats and sheep to utilize four rations containing nonsupplements or urea supplemented rice straw with or without formaldehyde-treated concentrate feed mixture.

Material and Methods

Animals and their management

Three healthy mature males of each of native goats (Baladi) and Ossimi sheep 3-5 years of age weighed in average 40 kg and 59 kg resp. were used in the present study. The six experimental animals were fed on four sequent rations for a period of 50 days for each of them. Animals were weighed and kept in a pen for an adaptation period of 30 days, and were confined in metabolic crates for a preliminary period of 15 days followed by 5 days for faeces and urine collection. Animals were weekly weighed and fed residues (of usually rice straw) were individually removed and weighed at the next morning. Rations were offered once daily at 7.00 A.M., while fresh water was available all day round.

Rations and feeding regime

Experimental rations were : I concentrate mixture feed (CMF) + rice straw (RS), II CMF + 3% urea supplemented rice straw (URS), III 1%

formaldehyde treated-CMF (HCHO-CMF) + RS and IV HCHO-CMF + URS. The CMF was offered in a mash form and RS was chopped to approx. 10 cm length. Urea supplementation was carried out by dissolving 37 g. urea (46% nitrogen) in 500 ml water, sprayed on 1 kg of chopped RS, mixed properly on a plastic sheet and left for drying 24 hrs in a shady place. Exactly 3 g. urea providing 1.35 g. nitrogen was retained on 100 g. air dried RS. HCHO-CMF was prepared by spraying the ground CMF with 1 g. formaldehyde/100 g. crude protein of CMF. The treated CMF was stored for 2 weeks in well tight plastic container in room temperature before being used, fresh amount of HCHO-CMF was prepared for each experiment. The level of 1 g. HCHO treatment per 100 g. crude protein was suggested for maximum protection of plant proteins [Fergueson, 1975].

The CMF of 55% starch value and 14% crude protein (CP) was offered in all rations to provide animals with ½ of their maintenance requirements of energy as starch value (SV) kg $W^{0.75}$. Maintenance requirements of energy and protein for both species as calculated from the ARC, 1965 for sheep and the NRC, 1981 for goats were in average 25 g. SV and 4 g. crude protein per kg $W^{0.75}$. An amount of 22.7 g. of CMF or HCHO-CMF/kg $W^{0.75}$ containing 12.5 g. SV and 3.2 g. CP was daily offered, while nonsupplement or urea supplemented RS was fed to appetite in all rations.

Chemical analysis for samples of feeds, faeces and urine were carried out according to A.O.A.C. (1970) fiber fractions of feeds and faeces were determined according to Van Soest and Jones (1968). Differences between ration I (control) and each of other 3 rations for both species were statistically analysed using split plot design [Winer, 1971].

Results

Results of feed intake which are shown in Table (2) indicate that, goats were significantly better than sheep in consuming RS. Goats could consume RS (on DM basis) up to 56.9% of total intake (ration IV), while the maximum intake of RS recorded for sheep was 39.2% (ration I). Consumption of RS in terms g/kg $W^{0.75}$ was 17.9, 24.1, 22.3 and 26.4 for goats and 12.9, 10.7, 11.9 and 12.0 for sheep of rations I, II, III and IV, respectively. Although, goats exert better response than sheep to urea supplementation and HCHO treatment, difference of RS intake between different rations did not attain any significancy for both species.

TABLE 1. Chemical composition (%) of diffeent ingredients for feeds of experimental rations.

Feed	Moisture	CP	NFE	CF	EE	Ash	NDF	ADF	ADL	Hemicellulose	Cellulose
Concentrate mixture feed* (CMF)	12.1	14.0	52.5	11.3	5.3	4.8	44.1	7.2	4.4	36.9	2.8
Rice straw (RS)	8.7	3.5	35.1	36.2	1.2	15.3	66.4	43.0	6.1	23.4	36 9
Rice straw supp. with 3% urea (URS)	9.6	11.8	28.1	34.7	1.1	14.7	66.2	43.0	6.1	23.2	36.9

* 38% undecorticated cotton seed meal, 30% wheat bran, 22% yellow corn, 4% rice bran, 3% molasses, 2% lime stone and 1% common salt

CP = crude protein; NFE = nitrogen free extract; CF = crude fiber; EE = ether extract; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin.

Calculations :

$$CP\ \% = \%\ N \times 6.25 \qquad NFE\ \% = 100 - (\%\ \text{of CP} + CF + EE + \text{Ash})$$

Hemicellulose = NDF − ADF, cellulose = ADF − ADL.

By comparing results of nutrients digestibility of rations II, III and IV with the control (ration I), it seems clear that both goats and sheep exhibited similar efficiency in digesting various nutrients. Values in Table (3) show that, urea supplementation (ration II) decreased digestibility coefficient of measurable nutrients for goats and sheep. The CF digestibility, in particular, decreased to reach 39.4% in goats and 24.1% in sheep when URS + CMF was fed, and although the CP digestibility was improved by adding urea in both species due to the fact that the whole urea could be absorbed, the NB results indicate that a part of urea N was badly utilized because N excreted in urine was clearly increased (see Table 3). Formaldehyde treatment (ration III) remarkably decreased digestibility coefficients of DM, OM, CP and cellulose in goats, while sheep were poorly affected by HCHO treatment. Such decrease in digestibility values may be interpretated partially to the increase in DM intake in goats (11.6%) in ration III compared by control (ration I).

In general, differences between species were not significant, and in all rations both species had nearly the same trend which reflected the similarity between goats and sheep in digesting nutrients of various experimental rations.

Results of nitrogen balance (NB) illustrate that the control ration (I) provided animals with a marginal level of CP sufficient to keep them in a positive N status (see Table 3). Urea supplementation significantly ($P < 0.01$) altered values of NB for both species compared to control ration, however, the results of the present study indicate that goats exert better rate of urea utilization regardless of different levels of intake between species. Formaldehyde treatment (ration III) increased total N losses, particularly in urine. Urinary N losses formed about 70% of N-intake for both species, and all animals were in a severe N-balance, however, goats were more significantly ($P < 0.01$) affected by treatment than sheep. When HCHO-CMF was fed with URS (ration IV), urinary-N losses decreased to about 50% of N-intake for goats and sheep and values of NB calculated as % of N-intake were 35.8 for goats and 36.6 for sheep.

Discussion

The results of the present study show that goats are more efficient than sheep in consuming RS, and they could accept it in their daily ration to a level nearly to 60% of total DM intake. Similar result was mentioned by Devendra (1981), who added that as roughage quality decreased differences

TABLE 2. Mean values of feeds intake for experimental rations recorded on goats and sheep.

Intake (g/kg $W^{0.75}$)	I CMF+RS (control)		II CMF+URS		III HCHO-CMF + RS		IV HCHO-CMF + URS	
	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep
Total dry matter (DM)	37.9	32.9	44.1	30.7	42.3	31.9	46.4	32.9
CMF or HCHO-CMF (DM basis)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
RS or URS (DM basis)	17.9	12.9	24.1	10.7	22.3	11.9	26.4	12.0
% RS of total DM	47.0	39.2	54.6	34.9	52.7	37.7	56.9	37.5
Calculated SV* for rations	19.2	18.0	20.7	15 3	16.6	17.3	24.2	19.7
SV available of CMF	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
SV available of RS	6.7	5.5	8.2	2 8	4.1	4.8	11.7	7.2
* SV of RS to maintenance reqt.**	26.8	22.0	32.8	11.2	16.4	19.2	46.8	28.8
Total crude protein	3.9	3.7	6.3	4.6	4.0	3.6	6.6	4.7
CP available of CMF	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
CP available of RS	0.7	0.5	3.1	1.4	0.8	0.4	3.4	1.5
% CP of RS to maintenance reqt.**	17.5	12.5	77.5	35.0	20.0	10.0	85.0	37.5

* Using nutrients digestibility coefficients recorded for each ration on both species and multiplied by starch equivalent factors [Abou-Raya, 1967].

** 25 g. SV/kg $W^{0.75}$ and 4 g. CP/$W^{0.75}$ according to (ARC, 1965) for sheep and (NRC, 1981) for goats.

TABLE 3. Mean values of apparent digestibility (%) and nitrogen balance for experimental rations recorded on goats and sheep.

Items	I CMF+RS (control		II CMF+URS		III HCHO-CMF + RS		IV HCHO-CMF + URS	
	Goats	Sheep	Goats	Sheep	Goats	Sheep	Goats	Sheep
Nutrients digestibility :								
DM	65.9	68.0	60.3	59.4	54.9	67.1	66.5	71.8
OM	69.7	72.1	66.2	64.0	59.8	71.7	72.5	76.8
CP	68.1	67.2	80.1	71.4	50.3	59 6	82.6	81.8
NFE	74.7	78.5	75.2	76.8	64.5	77.7	75.3	81.5
CF	56.8	56.4	39.4	24.1	52.5	60.3	60.6	60.1
EE	93.9	95.1	86.7	83.3	76.7	85.1	87.5	90.2
Hemicellulose	84.7	84.9	83.7	86.1	88.8	89 3	84.2	89.0
Cellulose	52 2	58.3	56.6	49.1	40.3	44.2	64.1	62.2
Nitrogen utilization (mg/kg $W^{0.75}$) :								
Intake	619	589	1013	732	646	582	1061	759
Excreted :								
In faeces	198	193	205	204	321	235	187	137
In urine	396	359	611	436	473	409	559	393
Balance (NB[1])	25	37	197	92	—148	— 62	315	229
% NB of digestible nitrogen (DN)	5.9	9.3	24.0	17.4	— 45.5	— 17.9	35.8	36.6

TABLE 4. Analysis of variance results of RS intake, nutrients digestibility coefficient and N-balance for goats and sheep fed the four experimental rations.

Rations		Intake of RS g/kg $^{0.75}$	Digestibility						Hemi-cel-lulose	Cel-lu-lose	NB as % of DN
			DM	OM	CP	NFE	CF	EE			
VS. II	SP	*	—	—	—	—	—	—	—	—	—
	Trt	—	—	—	—	—	**	—	—	—	**
	SPX Trt	—	—	—	—	—	—	—	—	+	*
VS. III	SP	*	*	*	**	—	—	**	—	—	**
	Trt	—	—	—	*	—	—	**	—	—	**
	SPX Trt	—	—	—	—	—	—	++	—	—	**
VS. IV	SP	**	—	—	—	—	—	—	—	—	NS
	Trt	—	—	—	**	—	—	**	—	—	**
	SPX Trt	—	—	—	—	—	—	—	—	—	NS

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

of intake between goats and sheep were increased [deSimiane *et al.*, 1981]. Inclusion of URS (3% w/w urea supplementation to RS) on goats rations improved their utilization expressed as SV or NB since, URS provided 32.8% of total SV required for maintenance and improved NB from 25 to 197 mg N/kg $W^{0.75}$, however URS provided 11.2% of total SV required for maintenance in sheep VS. 22.0% was provided from non-supplemented RS. The latter result may be attributed to the fact that, the proper utilization of urea-supplemented rations needs available source of carbohydrates to face the rapid hydrolysis of urea [El-Shinnawy and Abou-Raya, 1983], in turn the activity of rumen microbs could be enhanced. Formaldehyde treatment seems harmful for ruminants when fed without a source of soluble protein, particularly, if high fibrous rations are fed, however, the relatively high intake of RS of ration III by goats (22.3 g/kg $W^{0.75}$) compared to ration I is still questionable and could be attributed to their feeding habits.

The improvement in the utilization of HCHO-CMF + URS than other rations evidenced from results of NB and SV of URS for both species is may be explained that addition of urea had satisfied rumen microbial demands of N, while protected protein of CMF passed rumen without extra ammonia losses. Similar results were noted by Kempton and Leng (1979), they mentioned that keeping rumen activity by a source of available N is necessary when rations containing protected protein are fed.

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تحسين الاستفادة من قش الأرز فى علائق الماعز والأغنام

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لدراسة مدى تحسن الاستفادة من قش الأرز فى علائق الماعز والأغنام، تم اجراء أربع تجارب هضم وميزان أزوت على مجموعتين من الحيوانات كل من ثلاثة ذكور بالغة من الماعز البلدى والأغنام الأوسيمى . غذيت الحيوانات على أربع علائق تجريبية متتالية كما يلى : (١) علف مصنع + قش أرز (عليقة مقارنة) ، (٢) علف مصنع + قش أرز مضاف اليه بالرش ٣٪ يوريا (وزن/وزن) ، (٣) علف مصنع معامل بـ ١٪ فورمالدهيد + قش أرز ، (٤) علف مصنع معامل بـ ١٪ فورمالدهيد + قش أرز مضاف اليه بالرش ٣٪ يوريا (وزن/وزن) . وقد غذى العلف المصنع بكمية محددة تكفى لتغطية ٥٠٪ ، ٨٠٪ من الاحتياجات الحافظة من الطاقة (كمعادل نشا) والبروتين الخام على التوالى ، وقد غذى قش الأرز المقطع فى جميع العلائق الى الشبع .

أظهرت النتائج تفوق الماعز على الأغنام من حيث كمية المأكول من قش الأرز فى جميع العلائق ، وقد كانت الفروق معنوية ($P < 0.05$) بالنسبة لنوع الحيوان فى حين لم تظهر فروق معنوية بين العلائق نتيجة المعاملات . انخفض معامل هضم الألياف معنويا ($P < 0.01$) وكذلك انخفض معامل هضم السليولوز معنويا ($P < 0.05$) نتيجة اضافة اليوريا بالنسبة لكل من الماعز والأغنام مقارنة بنتائج العليقة (١) . المعاملة بالفورمالدهيد (عليقة ٣) كان لها تاثير معنوى ($P < 0.01$) فى انخفاض معامل هضم البروتين الخام مقارنة بالعليقة (١) ، وكانت الماعز أكثر تأثرا معنويا ($P < 0.05$) بالنسبة للأغنام للمعاملة بالفورمالدهيد من حيث هضم البروتين ، المادة الجافة والمادة العضوية . حسنت اليوريا قيمة ميزان الأزوت معنويا ($P < 0.01$) لكل من الماعز والأغنام مقارنة بالعليقة (١) ، وقد انخفضت قيم ميزان الأزوت معنويا ($P < 0.01$) لجميع الحيوانات عند التغذية على العليقة (٣) .

أوضحت نتائج التغذية على العليقة (٤) أن اضافة اليوريا بمستوى ٣٪ لقش الأرز مع معاملة العلف المصنع بـ ١٪ فورمالدهيد يزيد معنويا ($P < 0.01$) قيم ميزان الأزوت لكل من الماعز والأغنام ويزيد معامل الاستفادة من العلائق المحتوية على قش الأرز .