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NUTRITIONAL EVALUATION OF TREATED RICE STRAW FOR SHEEP

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ABSTRACT

This study was carried out to investigate the possibility of utilizing the processed rice straw as an animal feed ingredient. Sixteen growing male Barki lambs were divided into four similar groups. The groups were assigned at random to receive one of the four experimental rations. All four rations consisted of a concentrate mixture in a mash form (50%), and roughage – urea mixture (50%). The roughage – urea mixture was made of rice straw (76%), wheat bran (12%), molasses (10%) and urea (2%).

Treatments represented different forms of the roughage –urea mixture. It was offered mixed with no treatment (R1), ensiled (R2) or made into a feed blocks (R3). In the fourth treatment (R4) both the concentrate and the roughage portions were mixed and blocked. The feeding experiment followed by metabolism trial was lasted for days along with studying fermentation in the rumen and some blood metabolites.

Results showed that ration R4 resulted in higher DM intake and rate of DM and CP digestibilities. Animals fed R2 and R4 had the highest values of nitrogen retention. Growing sheep fed R4 had higher values of digested nutrient intakes expressed as TDN intake g/Kg BW (19.6) and DCP intake g/Kg BW (2.90).

Animals fed R4 (Blocked) had the highest values of average daily gain (76 g/d) followed by those fed R2 (62 g/d) (ensiled), while R3 resulted in the lowest ADG values (44 g/d).

Processing of rice straw with concentrate feed mixture as feed blocks improved the performance of growing sheep.

Keywords: Rice straw, Barki sheep, feed blocks, nutritive value, rumen fermentation parameters, blood metabolites, growth.

INTRODUCTION

In recent years, efforts were concentrated on maximizing the use of local agricultural by-products in animal feeding as apartial solution of feed shortage problems and the dramatic increases in the prices of traditional animal feed ingredients.

Rice straw is a poor quality roughage ,having a low nutritive value Therefore, the productivity of animals consuming such low quality roughage is limited sinc it has low nitrogen and energy content. Several treatments were applied to ameliorate the utilization of rice straw as an animal feed ingredient.

Due to the increased production per head of livestock, ration formulation started to rely on feeds of high nutritive value components rather than seeking the role of roughage material and its mechanical function in filling the rumen.

Accordingly, unless rice straw is used for manufacturing processes or animal feeding it starts to accumulate and its disposal becomes, a problem.

getting ride of rice straw through burning could cause pollution and a lot of environmental complications.

Some studies showed that processing of low quality roughage have improved digestion and productive performance of ruminants (Youssef *et al.* 1999, Abd El Baki *et al.*, 2001).

The new feed supplements for ruminants in developing countries constitute an innovative approach based on the manufacturing and distribution of multinutrient blocks supplying the necessary nutrients aiming to take the maximum advantage of locally available poor quality forages. (Kunju, 1986; Sansoucy, 1986 and 1995). In China, eleven million tons of straw, affecting some 3.3 million farmers were treated in 1993 for feeding beef cattle after weaning till they were slaughtered (Dolberg and Finlayson, 1995).

The objective of this study was to test some combinations of fibrous ingredients used with rice straw in different forms and make a good cheap ration for growing sheep.

MATERIALS AND METHODS

Sixteen growing male Barki lambs of average body weight of 21.0 Kg were divided into four groups to evaluate the role of processing methods of the roughage components in the ration on animals performance. All rations contained mashed CFM (50% of the ration) while the other half was formed of rice straw (76%), wheat bran (12%), molasses (10%) and urea (2%) as roughage component of the diet.

The experimental treatments differed in form of roughage as :

(R1) : 50% roughage (non treated) + 50% CFM (mash).
(R2) : 50% roughage (ensiled) + 50% CFM) (mash).
(R3) : 50% roughage (as feed block) + 50% CFM (mash).
(R4) : Both 50% roughage and 50% CFM were included in blocks.

For ensiling, 2% urea solution was sprayed on rice straw (chopped to approximately 5 cm length) so that 2g urea were added/100 g DM of straws. Urea solution was prepared by dissolving 2 gm of urea (46% nitrogen) in 100 ml of water. The treated rice straw was mixed with molasses and wheat bran then covered under anaerobic conditions for five weeks. The treated straw was used after one week. For blocking, the ingredients were mixed, baked and pressed using simple equipment. After 2 weeks, the blocks are easy to handle and transport. Experimental rations were offered as 3.5% of body weight once daily at 8.00 a.m. The feeding experiment was extended for 90 days. Feed consumption and refusals were weekly recorded. Offered amounts of rations were bi-weekly adjusted according to changes in body weight. Drinking water was freely available and water intake was recorded . Animals were weighed bi-weekly. At the end of feeding period , four digestibility and N. balance trails were carried out on four animals of each group to evaluate nutrient digestibility and dietary N. utilization . Each trail lasted 8 days for preliminary periods and 7 days for collection periods followed by one day for rumen and blood sample collection. Chemical composition of feed, faces and urinary nitrogen were determined according to

A.O.A.C. (1990), and fiber fractions determination of feeds and faeces was carried out according to the methods of (Goering and Van Soest, 1970).

Rumen liquor samples were taken at zero and 4 hours post feeding by stomach tube to determine pH value, rumen ammonia nitrogen (NH_3-N) (A.O.A.C., 1990) and total volatile fatty acids (T.V.F.A,s) (Warner, 1964).

Blood samples were withdrawn at zero and 4 hours post feeding from the jagular vein to determine urea (Patton and Crouch, 1977) and creatinine (Henry, 1965). Data were subjected to the statistical analysis using SAS, (1990) . Differences among means were compared by Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

The chemical composition of the experimental rations given in Table (1), indicated that the R1 had higher contents of CF (22.3) and NDF (50.4), while R2 had the lowest contents of CF (20.7) and NDF (47.5) as ensiling roughages accompanied with reducing it content of CF and NDF, (Youssef,1999). The range of NDF in the rations was 47.5 – 50.4% which would represent good quality diets (Van Soest, 1964). In general all rations attained comparable amounts of CP, EE, Ash, ADF and ADL.

Table (1): Chemical composition of ingredients and experimental rations (DM basis).

Item	DM	CP	CF	EE	Ash	NFE	NDF	ADF	ADL
Ingredients:									
Concentrate feed mixture (CFM)	90.8	15.8	13.1	3.1	11.9	56.1	45.3	8.3	4.9
Rice straw	91.2	3.9	38.7	1.6	15.8	40.0	68.1	51.3	7.6
Wheat bran	88.4	14.1	10.8	3.8	5.8	65.5	41.6	12.7	2.8
Experimental rations :									
Ration 1 (R1)	69.1	13.3	22.3	2.4	13.0	49.0	50.4	25.1	6.4
Ration 2 (R2)	78.5	12.8	20.7	2.6	13.6	50.3	47.5	26.4	6.9
Ration 3 (R3)	91.1	13.1	21.0	2.5	13.2	50.2	49.3	25.2	6.4
Ration 4 (R4)	90.6	13.0	21.5	2.5	13.3	49.7	48.9	25.6	6.5

Concentrate feed mixture contained ; 30% undecorticated cotton seed meal, 30%wheat bran, 24% yellow corn, 10% rice bran, 3%molases, 2% limestone and 1% common salt.

Digestibility of nutrients and TDN results are presented in Table (2). It was clear that animals of group R4 had the highest dry matter intake while group R3 had the lowest DM intake. These results are in agreement with those of Chenost and Kayouli (1997) who found that feed blocks can improve feed performance.

It was clear that animals fed R4 had the highest DM and CP digestibilities. Most nutrients digestibilities increased with R2 and R4 which may be due to either ensiling or moulding whole ration in block. The present results are in agreement with Kayouli (1995), Ben Salem *et al.* (1995) and Moawd and Ebrahem (2001) who found that ensiling rice straw , increased the nutrients digestibilities . Also Nyarko *et al.* (1993) and Sansoucy (1995) reported that nutrient digestibility tended to increase as rations were mixed and blocked. Total digestible nutrient intake (g/ Kg BW) was higher ($P<0.05$)

with animals fed R2 and R4 compared to the other groups. This result is in parallel with the results of intake and digestibility coefficient especially CF and its fractions.

Nutritive values of experimental rations in terms of TDN % were significantly higher for R4 and R2 than others.

Table (2): Feed intake, digestibility and total digestible nutrients intake of experimental rations, during digestibility trail.

Item	R1	R2	R3	R4	±SE
Live body weight , Kg	25.8	26.3	24.9	27.9	1.19
DM intake g/Kg BW	30.19	32.93	28.59	34.41	1.98
Nutrient digestibility, %					
DM	59.5^{b}	63.4^{a}	61.6^{ab}	65.1^{a}	2.64
CP	57.8^{c}	62.1^{b}	60.3^{bc}	64.9^{a}	1.17
CF	52.6^{c}	63.3^{a}	57.4^{b}	62.3^{a}	1.93
EE	58.8^{b}	62.2^{a}	61.2^{a}	62.1^{a}	1.08
NFE	64.1^{a}	61.7^{b}	63.3^{a}	63.6^{a}	1.73
Fiber fraction digestibility, %					
NDF	63.3^{b}	67.0^{a}	64.1^{b}	67.5^{a}	1.79
ADF	53.0^{b}	58.4^{a}	53.7^{b}	57.2^{a}	0.85
ADL	27.4^{b}	31.6^{a}	28.7^{ab}	30.4^{a}	1.06
TDN intake g/day	420.8^{c}	482.6^{b}	392.8^{c}	546.5^{a}	2.77
TDN intake g/Kg BW	16.3^{b}	18.3^{a}	15.8^{b}	19.6^{a}	0.65
TDN %	54.0	55.7	55.2	56.9	1.74

A,b,c values with different superscripts on the same row differ at 5%.

Table 3 shows some indicatives for the mechanism of utilization and metabolism executed due to type of rations offered.

Feeding the whole blocked ration (R4) was accompanied with the best utilization of nitrogen of the ration. This was represented in the largest intake of nitrogen (715.7mg), least secretion of nitrogen in feces (251.2 mg), largest secretion of nitrogen in urine (307.0mg) and accordingly the highest digestion rate of nitrogen (464.5mg) and nitrogen retained in the body (157.5mg). Similarly Dolberg and Finlayson (1995) reported that nitrogen utilization was increased when the rations (rice straw and cotton cake plus urea) were mixed and blocked .

Ensiling roughage component (R2) of the ration came next in efficiency of nitrogen utilization by the animals where all above parameters were of less values but without significanct differences. Animals receving R1, where all ingredients were offered as it is, performed significantly less than R2 and R4. The poorest utilization was that of animals receving blocked of fibrous component (R3).

Table (3). Nitrogen utilization and digestible crude protein intake of experimental rations.

Item **Nitrogen utilization (mg/Kg BW)**	R1	R2	R3	R4	±SE
Nitrogen intake	642.5^{b}	674.1^{a}	599.5^{b}	715.7^{a}	27.11
Faecal Nitrogen	271.0^{a}	255.5^{b}	237.7^{c}	251.2^{b}	11.51
Urinary nitrogen	258.4^{b}	285.1^{a}	266.5^{b}	307.0^{a}	12.66
Digested nitrogen	371.5^{b}	418.6^{a}	361.8^{b}	464.5^{a}	13.05
Total Nitrogen excretion	529.4	540.6	504.2	558.2	19.36
Nitrogen retention	113.1^{bc}	133.5^{b}	95.3^{c}	157.5^{a}	2.91
% of intake	17.6^{c}	19.8^{b}	15.9^{c}	22.0^{a}	1.16
DCP intake, g/day	59.9^{c}	68.8^{b}	56.3^{c}	81.0^{a}	2.54
DCP intake, g/Kg BW	2.32^{c}	2.62^{b}	2.26^{c}	2.90^{a}	0.30
DCP %	7.69^{c}	7.94^{c}	7.91^{c}	8.44^{a}	0.67

A,b,c values with different superscripts on the same row differ at 5%.

Feed and water intake and body weight changes results (Table 4) indicated that DM intake of R4 was 3.46% of body weight over the whole feeding period followed by R2 (3.32%), while animals fed R3 could not consume more than 2.81% DM of body weight . The present results concerning the effect of the feeding form on DM intake was confirmed by many studies , Finlayson (1993) and Perdok *et al* (1984) who found that multinutrient blocks provide an efficient mean for improving the nutritional value (intake and digestibility) of straw and low quality forages.

Table (4): Feed and water intake and body weight changes during the experimental growth period (90 days).

Item	R1	R2	R3	R4	±SE
No. of animals	4	4	4	4	
Initial body weight ,Kg	21.2	20.7	20.9	21.1	1.76
Final body weight, Kg	25.8^{ab}	26.3^{ab}	24.9^{b}	27.9^{a}	1.19
Total gain, Kg	4.6^{c}	5.6^{b}	4.0^{c}	6.8^{a}	0.23
Daily gain, g	51^{bc}	62^{b}	44^{c}	76^{a}	3.94
Dry matter intake , g/day	716	781	643	848	
Dry matter intake , g/Kg BW	30.5	33.2	28.1	34.6	
Drinking water , ml/day	1898.5	2121.0	1995.2	2456.1	
Water from feeds ml/day	221.2	167.9	56.6	79.7	
Total water intake , ml /day	2119.7	2288.9	2051.8	2535.8	
Total water intake, ml/Kg BW	90.2	97.4	89.6	103.5	
Feed efficiency (Kg DM/Kg gain)	14.04	12.60	14.61	11.31	

A,b,c values with different superscripts on the same row differ at 5%.

In other studies , Leng (1990), Nyarko- Badohu *et al.* (1993) and Chenost and Kayouli (1997) reported that mechanically treated forage and blocked which has been condensed , compacted or compressed is normally ingested by ruminants in quantities which are 60 to 80% superior to that of untreated forage which is more voluminous.

Total water intake followed the same trend of DM intake , where animals fed R3 had lower total water intake than other groups .

Animals fed R4 and R2 had higher ($P<0.05$) daily gain than those of R1 and R3 groups. This increase of daily gain in R4 and R2 groups may be due to appreciable amount of nitrogen retention . It is of interest to note that the present results are in paralled with the results previously obtained in digestibility trail (Table 2,3) which showed that R4 and R2 had higher nutrients digestibilities and nitrogen retention than the R3 and R1 groups.

All above observations were combined and reflected on the feed conversion efficiency estimated. Animals fed R4 showed the best feed efficiency values (11.31) followed by R2 (12.60), while the lowest values were shown for R1 and R3,. These results are in agreement with the finding of Leng (1990) and Chenost and Kayouli (1997) who reported that growing animals fed on feed blocks gained faster and required less feed per unit of gain than other treatments.

Rumen liquor and blood parameters results are presented in Table (5). The results indicated that ruminal pH decreased significantly ($P<0.05$) to a level lower in R2 and R4 than that in R1 and R3. Although, the change in rumen pH values due to treatments was significant ($P<0.05$), the magnitude of the change was very narrow . This may be because the high level of NDF in the rice straw showed facilitate high saliva flow and ruminal buffering (Balch, 1971) and help to minimize the drop in pH with supplementation.The values of rumen liquor pH were within the range suggested by Rakha (1988) who reported that the normal ruminal pH of sheep ranged between 4.96 and 7.92. The PH volues were always above 6.0 which ensures maximal cellulytic activity and microbial protein synthesis (Hungate, 1966).

The highest value of concentration of TVFA's was observed in group R4 while the lowest value was observed in R3. This agrees with Roddy and Roddy (1985) conclusion who stated that pH values is inversely related to VFA concentration in the rumen. Also Punia and Sharma (1990) reported that total VFA's concentration and its production rate were higher ($P<0.01$) with higher energy intake (TDN). This is also confirmed by the feeding values and intake on the present study.

Data of ruminal ammonia nitrogen showed no-significant differences among treatments at zero time. At 4hr post feeding , the NH_3-N concentration for R2 and R4 were decreased compared with R1 and R3.The decrease in rumen NH3 may be due to better synchronization between NH3 and energy availabitites. Results of table (6) indicated that blood serum urea was significantly ($P<0.5$) higher for R4 than other groups , while blood serum creatinine was lower ($P<0.05$). The values of blood serum urea and creatinine were within the normal range which obtained by Fayed (2001) and Salem *et al* (2001).

It could be concluded that , inclusion of rice straw with concentrate feed mixture in blocks is highly advisable to improve weight gain and feed efficiency of growing barki sheep. On the other hand, blocking of roughage alone has an adverse nutritional effect causing low performance of growing sheep.

Table (5): Rumen liquor and blood parameters for sheep fed the experimental rations.

Item	Sampling time	R1	R2	R3	R4	±SE
Rumen liquor						
pH	0	6.61[a]	6.45[b]	6.73[a]	6.38[b]	0.08
	4	6.55[a]	6.29[b]	6.58[a]	6.21[b]	0.07
Total VFA's	0	5.8[b]	6.2[b]	5.1[c]	6.7[a]	0.16
(ml eqmiv. /100 ml)	4	9.1[b]	9.7[b]	8.6[c]	10.6[a]	0.16
Ammonia	0	17.3	17.4	16.7	16.2	1.03
(mg/100 ml)	4	31.0[a]	29.5[b]	31.4[a]	28.6[b]	1.74
Blood parameters						
Urea (ml/100 ml)	0	15.4[b]	15.5[b]	14.7[c]	16.8[a]	0.98
	4	27.9[b]	28.4[b]	26.6[b]	30.4[a]	1.06
Creatinine (ml/100 ml)	0	1.22[b]	1.09[bc]	1.46[a]	0.98[c]	0.09
	4	0.85[b]	0.81[b]	0.97[a]	0.69[c]	0.05

A,b,c values with different superscripts on the same row differ at 5%.

Accordingly incorporating roughage with concentrates in whole blocked ration could allow more utilization of agriculture by-products in feeding animals over the year. However, evaluation is needed for different by –products before generalization of this technique.

It is of interest to note that such new technique can be widely used to produce animal rations around the year by utilizing crop residues and agro-industrial by-products to be efficiently used in animal feeding particularly with small farmers this can participate also in solving pollution problems resulting from burning such by products.

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التقييم الغذائي لقش الأرز المعامل بواسطة الأغنام

كمال محمود يوسف

قسم تغذية الحيوان و الدواجن – مركز بحوث الصحراء –القاهرة

تهدف هذه الدراسة إلى تعظيم الاستفادة من قش الأرز المتوفر بجمهورية مصر العربية بكميات كبيرة كعلف حيواني بما يساهم في التغلب على ظاهرة حرق قش الأرز الذي يسبب تلوث بيئي .

أجريت هذه الدراسة عام ٢٠٠٢م بمحطة بحوث راس سدر بسيناء التابعة لمركز بحوث الصحراء لدراسة القيمة الغذائية لقش الأرز المعامل في صورة مكمورة او بلوكات .

تم استخدام عدد ١٦ ذكر غنم برقي نامي بمتوسط وزن (٢١ كجم) وغذيت لمدة ١٠٥ يوم على ٥٠% علف مركز مطحون + ٥٠ عليقة خشنة (٧٦ % قش أرز + ١٢ % ردة + ١٠% مولاس + ٢ % يوريا)، مقدمة بأشكال مختلفة حسب المجموعات التالية :

- المجموعة (١) نقدم العليقة الخشنة بدون معاملة
- المجموعة (٢) نقدم العليقة الخشنة مكمورة .
- المجموعة (٣) نقدم العليقة الخشنة مصنعة في صورة بلوكات .
- المجموعة (٤) تخلط كل من العليقة المركزة و الخشنة وتصنع وتقدم في صورة بلوكات .

وكانت أهم النتائج كما يلي :

١. كانت أعلى مادة جافة مأكولة و معامل هضم المادة الجافة و البروتين الخام عند التغذية علىالعليقة (٤).
٢. كان النيتروجين المحتجز أعلى عند التغذية على العليقة (٢) و (٤) .
٣. المواد الغذائية الكلية المهضومة و البروتين المهضوم أعلى مع العليقة (٤).
٤. الحيوانات المغذاة على العليقة (٤) المكبوسة في صورة بلوكات حققت أعلى نمو يومي(٧٦جم /يوم) تبعتها العليقة (٢) المكمورة ، بينما العليقة (٣) أظهرت اقل معدل نمو يومي (٤٤ جم/يوم).

و توضح نتائج الدراسة أن استخدام قش الأرز و اليوريا مع المركزات في صورة بلوكات علفية متكاملة يحسن الأداء الغذائي للحيوانات النامية و كذلك فإن هذه الطريقة يمكن استخدامها لإنتاج الأعلاف الحيوانية طوال العام من مخلفات المحاصيل الحقلية و مخلفات التصنيع الزراعي و خاصة في المزارع الصغيرة كما يساهم في تقليل التلوث البيئي الناتج عن حرق قش الأرز.