J. Anim. Prod. U.A.R., 8, Nos. 1-2, 1 - 9 (1968).

THE EFFECT OF REPLACING PART OR ALL OF THE WHEAT STRAW WITH GROUND RICE RULLS ON THE PERFORMANCE OF LAMBS.

By

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Summary

1. — The use of ground rice hulls as an alternative to wheat straw in dry lot feeding for fattening lambs was tested in a growth experiment. The lambs receiving ground rice hulls instead of all or half the wheat straw made similar daily gains to the lambs receiving wheat straw and showed similar efficiencies.

2. — Digestibility trials showed that the ration containing ground rice hulls had lower coefficients of digestibility, TDN and starch equivalent but more feed was consumed and a trend towards higher nitrogen retention was observed.

3. — Most of the silica in the ration was excreted in the faeces and very little was retained. The retained silica did not cause urinary calculi.

4. — It was concluded that ground rice hulls could be used in dry lot feeding, replacing part or all of the wheat straw without affecting the performance of growing lambs.

Introduction

Rice hulls represent 20% of unmilled rice. It contains 24.45% ash; 96% of the ash was found to be silica (McCall *et al.*, 1953). About half a million tons of rice hulls are produced every year through the rice milling processes. Badr and Abou Akkada (1965) reported that the addition of ground rice hulls to berseem 1st. cut improved its digestibility. The growth rate of lambs fed berseem plus wheat straw or rice hulls were very similar and it was concluded that feeding on ground rice hulls had no effect on the formation of urinary calculi.

Jones and Handreck (1965) indicated that the solubility of silica is low, practically all the solid silica which is ingested should emerge in the faeces. Gooley and Burroughs (1962) claimed that small additions of sand (2%), improved the performance of yearling beef cattle, on completely mixed high concentrate rations. Blood and urine analysis indicated no absorption of the added silica into the blood stream.

The present experiments were done with the aim of studying the nutritive value of ground rice hulls as a feed supplement replacing part or all of wheat straw and of finding its effect on growth rate and efficiency of feed utilization of lambs.

Materials and Methods

Experiment I. Group feeding

Twenty-four lambs of different breeds were divided into three groups containing equal numbers of each breed and similar in the average initial weights.

The ration administered to each lamb is given in Table 1. It was calculated to meet 10-15% excess of requirements of fattening lambs (Morrison, 1954). The animals consumed all the feed that was administered. Each group was kept in a seperate pen.

Group 1. received all the concentrate mixture and half the amount of wheat straw at 9 a.m., the other half was administered at 2 p.m.

Group 2. received ground rice hulls, mixed with the concentrate mixture in two parts at 9 a.m. and 2 p.m.

Group 3. received the concentrate mixture plus roughage, which was formed of 0.25 kg. wheat straw and 0.25 kg. of rice hulls, at 9 a.m. and the other part of the roughage at 2 p.m. The animals were weighed at the begining of the experiment and then once every week before introducing the morning drink or feed extended over a period of fourteen weeks.

TABLE 1

The composition of the rations given to sheep.

Constituents	Group 1	Group 2	Group 3
Concentrate mixture (kg.)[1]	1.5	1.5	1.5
Wheat Straw (kg.)	0.5	—	0.25
Rice hulls (kg.)	—	0.5	0.25
Vitamin A+D_3 (g)[2]	0.5	0.5	0.5

1. — Concentrate mixture consists of cotton seed cake and rice bran in the ratio of 1:1 plus 2% calcium carbonate and 1% common salt.

2. — One gram of vitamin A+D_3 (Pfizer) contains 5000 I.U. vitamin A + 1000 I.U. vitamin D_3

Experiment II. Digestibility trials

The digestibility of concentrate mixture plus wheat straw and concentrate mixture plus rice hulls were determined with sheep. Two Egyptian barky rams (1095 and 1047) over 2 years old and of similar weight were chosen from the farm stock of the Faculty of Agriculture, Alexandria University, to serve through the digestion trials.

Each trial continued for 21 days; 14 days preliminary period followed by seven days collection period.

During the collection period, the rams were fitted with harnesses and bags and put in individual metabolic cages. In the first trial each animal was offered 1.5 kg. concentrate mixture plus 0.5 kg. rice hulls mixed together and in the second trial it was given 1.5 kg. concentrate mixture plus 0.5 kg. wheat straw.

Faces were collected daily in plastic bags and were mixed thoroughly weighed and 10% of each collection was used for dry matter determinations and the samples collected over the whole period (7 days) were pooled together, ground and kept in tightly closed containers for chemical analysis.

The volume of urine was measured daily and small samples were used for the determination of urinary nitrogen, combined 10% portions were stored at O°c for silica determination.

Methods of Analysis

Analysis of foodstuffs and faeces were carried out according to the official methods of the A.O.A.C. (1960). Total nitrogen in urine was estimated by the microkjeldahl method (Chibnall *et al* 1943) using the Markham microdistillation apparatus (Markham, 1942). Silica in the urine was estimated in 200 ml. aliquots of the combined samples according to the official method of the A.O.A.C. (1960). The chemical analysis of feedstuffs used in the present experiments are given in Table 2.

TABLE 2

Chemical analysis of feeds used in feeding trials.

Feed	Dry matter	Crude extract	Ether fiber	Crude	NFE	Ash	Silica
Concentrate mixture	90.87	17.91	11.62	11.79	40.36	9.17	1.95
Rice hulls.	90.95	2.71	0.93	41.39	27.10	18.30	16.58
Wheat Straw . . .	91.17	4.94	1.49	30.97	40.14	13.63	3.05

Results

Experiment I. Group feeding experiment

Results in Table 3, show that the average weight gain, average daily gain, relative growth rate and feed efficiency appeared to be higher in group 3 fed on a mixture of rice hulls and wheat straw (0.25 kg./day of each). Group 1 which was given wheat straw, as the only roughage, showed the lowest gains. Analysis of variance (Snedecor (1956) showed that the differences were not statistically significant.

TABLE 3.

Growth rates and efficiency of feed utilization of lambs fed on wheat straw, rice hulls or a mixture of the two roughages + concentrate. (1)

	Group 1	Group 2	Group 3
Number of lambs	8	8	8
Average initial weight (kg.)	38.93	38.56	37.56
Average weight gain in 14 weeks (kg).	14.00	15.07	16.69
Average daily gain (kg.)	0.143	0.154	0.170
Relative growth rate (%)	35.96	39.08	44.43
Feed intake/animal (kg.)	195.50	197.50	196.00
TDN consumed (kg.)	113.14	97.49	105.17
SE consumed (kg.)	95.57	77.67	86.19
Feed efficiency:			
kg feed/kg gain	14.0	13.1	11.7
kg TDN/kg gain	8.1	6.5	6.3
kg SE/kg gain.	6.8	5.2	5.2

(1) Analysis of variance showed no significant differences among the treatments.

TABLE 4.

The average coefficients of digestibility for the two rams used in experiment 2.

Constituents	Coefficients of digestibility	
	Concentrate+ rice hulls	Concentrate+ wheat straw
Dry matter	51.54±1.33	59.33±0.93
Crude protein	62.04±2.03	66.71±1.00
Ether extract	87.03±4.61	86.31±0.00
N.F.E.	58.77±3.18	66.13±1.22
Crude fiber	27.33±1.41	31.70±0.77
TDN.	53.47	62.18
SE.	41.66	53.80

Experiment II. Digestibility trials

The consumption of the concentrate + rice hulls ration was higher than that of the concentrate + wheat straw ration (10.4 kg. concentrate + 3.4 kg. rice hulls against 9.7 kg. concentrate + 1.3 kg. wheat straw).

Digestibility coefficients of dry matter, crude protein, nitrogen-free extract and crude fiber tended to be slightly higher for the concentrate + wheat straw ration than that of the concentrate + rice hulls ration (Table4).

TABLE 5.

Nitrogen retention in sheep fed concentrate plus rice hulls and concentrate plus wheat straw.

	Concentrate mixture+	
	Rice hulls	**Wheat straw**
Nitrogen intake (g./day)	44.52±1.54	41.06±0.00
Nictrogen excreted		
in faeces (g./day)	17.06±1.69	13.57±0.53
in urine (g./day)	12.68±0.87	13.96±1.14
Total (g./day)	29.74±2.57	27.53±1.61
Nitrogen retained (g./day)	14.78±1.01	13.53±1.65
N retained /N intake (%)	33.33±3.95	32.95±4.00
N retained /N absorbed (%)	53.82±3.49	49.11±5.11

TABLE 6.

Silica balance for sheep fed on concentrate+rice hulls and concentrate± wheat straw.

	Concentrate+	
	Rice hulls	**Wheat straw**
Silica intake (g./day)	108.65±3.24	32.59±.59
Silica excreted:		
in faeces (g./day)	105.53±4.00	31.78±0.55
in urine (g./day)	0.47±0.00	0.37±0.13
Total (g./day)	106.00±4.11	32.15±0.46
(Silica retained g./day)	2.65±0.05	00.44±0.10
Retained silica/silica intake (%)	2.45±0.10	1.37±0.31
Silica excreted in faeces/ silica intake (%).	97.12±0.43	97.52±0.19
Silica excreted in faeces/ Total excreta of silica (%)	99.56±1.50	98.54±0.52
Silica excreted in urine/ total excreta of silica(%)	0.44±0.03	1.46±0.43

Nitrogen retention data given in table 5 show that on the concentrate + rice hulls ration, the animals consumed more nitrogen. Nitrogen retention, the ratio of retained nitrogen to nitrogen intake and retained nitrogen to absorbed nitrogen were similar for both rice hulls and wheat straw rations.

It could be observed from the results given in Table 6, that about 97% of the silica intake was excreted. About 99% of the excreted silica was recovered in the faeces, lower urinary silica excretion, as a percent of total silica excretion, was observed in the case of rice hulls. None of the animals, even those which retained silica suffered from urinary calculi.

Discussion

The results of feeding lambs on wheat straw, or ground rice or a combination of wheat straw and rice hulls at 25% of the ration for 98 days showed that there was no significant difference among treatments in average daily gain and feed efficiency. The difference was in favour of rice hulls.

The ration containing ground rice hulls had somewhat lower coefficient of digestibility than wheat straw and although the sheep in metabolic cages consumed more of the rations containing rice hulls, this was not observed in the feeding experiment where the three groups consumed almost the same amount of feeds over the whole period.

Balch (1950), Blaxter and Graham (1956), and Campling and Freer (1966) found that grinding of roughage led to an increase in voluntary intake and decrease in the digestibility of the food. The depression in the digestibility associated with grinding was due in part to passing through the reticulo-rumen at a faster rate. This may explain the results given in these experiments where rice hulls seemed to induce higher intake of diet and lower coefficients of digestibilities. Blaxter *et al.* (1955), Campling *et al* (1961) and Coombe and Kay (1965) reported that there is a negative correlation just statistically significant between feed intake and mean retention time. Voluntary intake of roughage is regulated in relation to their respectiverates of disappearance from the alimentary tract in such a way as to maintain a constant amount of food residues in the reticulo-rumen.

In the feeding trial reported in these experiments, it was observed that the total digestible nutrients intake was less in groups given rice hulls than in those given wheat straw, however, the gain in live weight in lambs fed the hulls was higher than that of lambs fed the wheat straw suggesting better utilization of food which might be explained on the basis of a greater loss of heat in case of the ration containing wheat straw than that containing ground rice hulls. Although grinding depresses digestibility there is good evidence that it increases efficiency of utilization (Blaxter and Graham, 1956 and Meyer *et al.* 1959).

The results of N-retention suggested a trend towards higher nitrogen retention and therefore, better utilization of nitrogenous matter on the diet containing the rice hulls. This may be mainly due to the increase of crude protein and energy intake from the concentrate mixture on the ration (Walker and Faichney, 1964 and Topps, 1960).

Egan (1965) found that with higher N-balance, gut fill was greater.

The results of the silica balance trial, showed that most of the silica intake was excreted in faeces and a percent not exceeding 1.2% of total excretion was found in urine. Silica is low in solubility, practically all the solid silica which is ingested should emerge in the faeces. Gallup *et al.* (1945) reported that the recovery of ingested silica in the faeces was generally about 100%. Beeson *et al.* (1943), Baker *et al.* (1961), Forman and Sauer, (1962) reported that the amount of silicic acid excreted in the urine probably represent only a small proportion of the total amount of ingested silica. A high silica intake leading to a high concentration of silicat in the urine is not sufficient by itself for the formation of uroliths, the polymerization of silicate is favoured by acidic pH (Bailey *et al.* 1963). Silicic acid polymerization is most rapid at pH 5-6 (Forman and Sauer, 1962).

Badr and Abou Akkada (1965) found that rams receiving berseem plus rice hulls produced urine at pH 9.0 which is considered normal for ruminants. From these results it could be concluded that the silica intake in amounts as in the ration used was not sufficient for the formation of silica calculi and that it is possible to replace all or part of the wheat straw with ground rice hulls in drylet feeding.

Similar results were obtained by many workers showing that replacing part of the ration (25 - 40%) with ground rice hulls or ammoniated rice hulls had no effect on the performance of cows or steers (Conrad, 1967).

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استخدام سرس الارز فى تغذية الحيوانات الزراعية

الملخص

أجريت تجربة تغذية لاربعة وعشرين من ذكور الحملان النامية وقد قسمت الى ثلاثة مجاميع وكان مصدر المادة المالئة فى المجموعة الاولى تبن قمح بنسبة ٢٥ ٪ وفى المجموعة الثانية قدم سرس الارز بنسبة ٢٥ ٪ وفى المجموعة الثالثة قدم تبن القمح وسرس الارز بنسبة ١ : ١ وكانت المادة تمثل ٢٥ ٪ من العليقة علما بأن المادةالمركزة المستعملة فى المجاميع الثلاثة مكونة من كسب قطن غير مقشور ورجيع أرز بنسبة ١ : ١ ومن نتائج هذه التجربة التى استمرت أربعةعشر أسبوعا وجد أن الحيوانات فى المجموعة الثالثة حصلت على أكبر زيادة فى الوزن ومعدل نمو وكفاءة غذائية عن المجموعة الثانية والاولى بينما كانت المجموعة الاولى أقل المجاميع فى هذه القيم وان كانت الاختلافات غير جوهرية احصائيا ، وكانت كمية الغذاء المستهلكة متساوية تقريبا مما يدل على أن سرس الارز المطحون ليس له أى تأثير ضار على القناة الهضمية وكذلك على شهية الحيوان ، ولمعرفة معاملات الهضم واتزان السليكا والنتروجين المحتجز أجريت تجارب هضم على اثنين من ذكور الأغنام البرقى اختيرت من قطيع الكلية وكان كل حيوان يغذى فى التجربة الاولى على ١٫٥ كجم مخلوط كسب قطن غير مقشور ورجيع أرز بنسبة ١ : ١ مضاف اليها ½ كجم من سرس الارز المطحون وفى التجربة الثانية استبدل سرس الارز بتبن القمح .

وقد وجد أن معاملات الهضم بالنسبة للمادة الجافة والبروتين الخام والكربوهيدرات الذائبة والألياف الخام وكذلك مجموع المواد الغذائية المهضومة كانت أعلى قليلا عند استعمال تبن القمح عما فى حالة سرس الارز المطحون وكانت كميات الغذاءالمستهلكة فى حالة سرس الأرز أكبر منها بالنسبة لتبن القمح وهذه النتائجمتوافقة مع ما هو معروف من أنه بزيادة الكمية المأخوذة من الغذاء لعملالقيمة الغذائية ومعاملات الهضم لهذه المادة .

ومن نتائج الآزوت المحتجزظهر أن نسبة النتروجين المحتجز الى النتروجين الممتص فى حالة سرسالارز كانت أعلى منه فى حالة استخدام تبن القمح وهذا متفق مع ما هوثابت من أنه بالرغم من تأثير الطحن الذى يخفض معاملات الهضم فهو أيضا يعمل على تحسين الاستفادة من الغذاء وقد اظهرت نتائج اتزان السليكا التى أجريت لمعرفة سلوك كمية السليكا الكبيرة المأخوذة فى الغذاء من سرس الارز الذى يحتوى تقريبا على ١٨ ٪ سليكا أن حوالى ٩٧ ٪ منه يخرج فى الروث والبول وان كميات ضئيلة هى التى تحتجز وان هذه الكميات المحتجزة لم تسبب تكوين أى حصاوى فى الكلية وأن حوالى ٩٩ ٪ من الكميات المزوجة تتسرب عن طريق الروث .