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UTILIZATIION OF AMMONIATED WHEAT STRAW BY SHEEP

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ABSTRACT

The ammoniation of wheat straw through urea (3.75%) has been evaluated. The ammoniated straw contained 5.07% CP against 3.19% in untreated straw. The water soluble CP in untreated straw was only 32% against 47% in ammoniated straw; the net gain in insoluble CP moiety being 24%. The voluntary intakes of treated and untreated straws based ration were statistically similar, the DMI being 1.97 and 1.93 kg/100 kg BW, respectively. There were no significant differences in the apparent digestibilities of DM, CP, CF, EE and NFE between the treatments. A similar trend was observed in the apparent digestibilities of ADF, NDF, hemicellulose and cellulose. Lignin digestibility decreased significantly ($P<0.05$) after ammoniation. The daily intake of total N, DCP and retention of N were significantly ($P<0.01$) higher in the rams given treated straw. The treatment differences in the intakes of TDN and N retention as a percentage of total or digestible N were non-significant.

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The use of straw, which has an annual world production in excess of 2000 million tonnes, as an animal feed is limited due to its low digestibility and inadequate nitrogen content[1]. Anhydrous ammonia has been shown to improve the nutritive value of low quality forages[2,3,4]. An indirect method of ammoniation of crop residues has recently been reported[5,6] which is dependent on the enzymatic release of ammonia from urea added to the roughages in an aqueous medium. This method of ammoniation appears to be relatively safe, uncomplicated and inexpensive as compared to some other chemical treatments. This experiment was undertaken to find out the efficiency of ammoniation through urea in colder regions and its subsequent utilization by sheep.

MATERIALS AND METHODS

Chopped wheat straw (11% moisture) was thoroughly mixed with urea solution to provide a urea level of 37.5 g/kg straw and a moisture level of 500 g/kg straw. This was tightly padded in iron drums with lids and subsequently urea was allowed to react for 95 days at room temperature during Jan.–March. Thereafter, the straw was air dried at room temperature and mixed into a homogenous pool. Eight adult rams were divided into 2 groups of 4 each keeping the body weights similar. The untreated and treated straws were evaluated in a switch-over trial in 2 periods of 17 days each. A 5 day metabolic trial was carried out at the end of each period. The *ad libitum* straw diet of rams in the two groups was supplemented with 300 g of concentrate mixture (maize 36; groundnut cake 36; wheat bran 31; salt 2 and mineral mixture 1, parts per 100) daily as a proprietory ration. Water was offered *ad libitum*. Standard methods of analysis were used for proximate principles[7,8] and statistical analysis[9]. Meteorological data was obtained from H.P. Agricultural University, Palampur.

RESULTS AND DISCUSSION

During ammoniation, partial browning of the straw was observed[10]. The values for crude protein, ether extract, crude fibre, nitrogen free extract and ash were observed in Gr I vs Gr 2; 3.19 vs 5.07; 0.93 vs 1.03; 40.50 vs 40.28; 46.13 vs 42.66 and 9.25 vs 10.96%, respectively. Similarly, the values for NDF, ADF, hemicellulose, cellulose and lignin were (Gr 1 vs Gr 2) 84.04 vs 84.36; 58.95 vs 61.83; 25.09 vs 22.53; 43.79 vs 45.80 and 9.28 vs 6.44%, respectively. Ammoniation increased the CP content of straw from 3.19 to 5.07%[3,4,11]. Hemicellulose and permaganate lignin values decreased due to ammoniation[12,13], but, there was no change in NDF or cellulose values[14,15]. The voluntary intake per unit metabolic mass ($W^{0.75}$) for untreated and treated straw was 61.03 and 62.29 g/d, respectively, reported similar as earlier[6,11].

Table 1. Effect of ammoniation on CP content of straw (3.75% urea)

Mode of ensiling	Period (days)	CP (% in DM)		% increase in CP
		Gr 1	Gr 2	
Lab scale-screw capped bottles	21	3.78	4 69	24.1
Lab scale-airtight thermocol containers	41	3.69	5.36	45.3
Lab scale-airtight thermocol containers	98	3.15	5.86	86.0
Large scale-drums with lids	95	3.56	5.17	45.2

Table 2. Utilization of ammoniated (through urea) straw by adult sheep

Item	Gr 1	Gr 2	Difference
Body weight (kg)	29.0	28.5	
Intake of ration (g)			
Wheat straw	286	289	
Conc. Mixture	264	264	
Total	551	533	
Total intake (kg/100 kg W.)	1.93	1.97	
Digestibility (%) :			
DM	48	49	
CP	60	60	
EE	60	59	
CF	46	52	
NFE	55	53	
NDF	44	45	
ADF	22	25	
Hemicellulose	70	71	
Cellulose	39	42	
Lignin	4	—33	*
Intake of total-N (g)	8.57	9.49	**
Intake of DCP (g)	32.2	35.6	**
Intake of TDN (g)	281	280	
Balance of N (g)	4.31	4.76	**
Balance as % of total-N intake	50	47	
N-balance as % of DCP intake	84	83	

*P<.05, **P<.01

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Ammoniation is presumed to increase dry matter digestibility through reaction with the lignin-carbohydrate complex[16]. Many workers have reported improvements in the apparent digestibility of DM and/or OM over a wide range of ammoniated low quality roughages[4]. However, no increase in the digestibility of DM and OM of ammoniated wheat straw was reported[17]. The apparent digestibility of DM, CP, CF, ADF and cellulose was almost similar, contrary to other reports[18–23]. Ammoniation significantly ($P<0.05$) reduced the apparent digestibility of lignin (Table 2). This may be due to the reduction in lignin percentage associated with ammonia treatment[12,17]. It has been observed that some of the ammonia added to the straw by ammoniation was not readily utilized by rumen microbes[18]. Ammoniation increased ($P<0.01$) the total nitrogen intake and nitrogen balance was also higher ($P<0.01$) in rams given treated straw[12,18]. No significant difference was observed in TDN intake values of two groups.

Literature review[24,25] indicated the optimum temperature for urease activity in soil to be approximately 30°C. Recently, it was observed that little conversion of urea to ammonia takes place[18] at 4°C. In the present investigation, straw was treated and kept in drums during January, February and March when the mean maximum and minimum temperatures were 13.3 and 3.4, 15.4 and 4.2 and 25.0 and 11.9°C, respectively. Lab scale treatment in thermocol containers (98 days) resulted in 86% increase in CP while large scale treatment in iron drums resulted in 45.2% increase in CP (Table 1) because of poor insulation.

The results indicate that ammoniation by urea as a method of improving the nutritive value of low quality roughages may not be very practical under field conditions in cold regions.

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