Improving the intake and utilization of by-product-based diets

Abstract

The voluntary feed intake or chopped corn stalks was improved (23%) by just increasing moisture content from 30 to 60%. Due to such treatment, sheep performance turned from losing 54 g/head/day to gaining 21.3 g/head/day. Addition of 5% linseed meal doubled the consumption of corn stalks and resulted in a daily gain of 53 g/head/day. Such percentage of linseed meal was comparable to 20% concentrate mixture supplement.

Supplementation of the urea treated corn stalks with 1.5% urea and 3% molasses improved the intake by 63%. Supplements varied in their effect on consumption, however, it did not affect the (TDN) content of the supplemented diet.

Recognising the deficient minerals in a by-product based diet (by mineral balance trials) and supplementing the diet with the recognized deficient amounts of minerals, resulted in improving the (TDN) content, the rate of body weight gain and the kg feed/gain ratio.

Introduction

Feed intake of agricultural by-products is mostly below the required level to maintain the animal's body weight. Its tough texture, poor digestibility and nutrient deficiencies all contribute to its low level of consumption.

This present paper describes some approaches to improve both the voluntary feed intake of by-products based diets and the efficiency the animal utilizes such diets. Moistening, supplementing and compensating for deficient minerals were tried as feasible methods of improvement.

Materials and methods

Experiment 1. Effect of moistening the by-product-based diet on its voluntary feed intake by sheep

A group (10 animals) of Barki male sheep of an average body weight of 30 kg was fed a diet of chopped (3-5 cm) corn stalks to which molasses, urea, vitamin A and minerals were added (Table 1). Moisture content of this diet was 30%. It was increased by water addition in two steps, e.g., 47 and 60% voluntary feed intake was measured at the three moisture levels. Measurement of intake was made in the third week of each treatment.

Table 1. Composition of the corn stalks diet.

Ingredients	Per cent
Chopped corn stalks	86
Molasses	10
Urea	1.5
Vitamin A	0.1
Mineral mixture *	2.4
Crude protein	7.9
(TDN)	52

* Composition of the mineral mixture was (%): 36 magnesium sulphate, 0.8 zinc oxide, 1.2 manganese oxide, 14 ferrous chloride and 48 bone meal.

Experiment 2. Effect of some supplements on the voluntary feed intake

Chopped corn stalks were fed to a group (10 animals) of 32 kg Barki male sheep for two weeks. Voluntary feed intake was measured during the last 5 days of the two weeks experimental period. Supplements which are shown in Table 2 were tested in sequence. The TDN content of the diet with each supplement was conventionally estimated using two male sheep.

Table 2. The tested supplements to the corn stalks-based diet.

1.	Corn stalks (CS)
2.	1% urea + 0.1 % vitamin A
3.	30% concentrate mixture *
4.	Treatment with 5% urea solution
5.	1.5% urea + 3% molasses
6.	0.3 phosphoric acid + 0.1% minerals *
7.	20% concentrate mixture + 1% Ca carbonate + 0.1% minerals
8.	5% linseed meal

* Contains (%): 2 g cottonseed meal, 30 yellow corn, 30 wheat bran, 5 rice bran, 3 molasses, 1 salt and 2 Ca carbonate.

** Contains (%): 36 magnesium sulphate, 0.8 zinc oxide, 1.2 manganese oxide, 14 ferrous chloride and 48 bone meal.

Experiment 3. Effect of compensating for recognised deficient minerals on the TON content and on the performance of buffalo calves fed the same diets after mineral supplementation.

Three diets containing rice straw at a rate of 40 to 55% (Table 3) were fed to three groups (10 heads per each diet) of buffalo calves. Growth rate and the kg feed/gain ratio were measured. The initial body weight of the animals was about 200 kg. Digestibility and mineral balance trials were conducted conventionally on two male animals. The recognised deficient mineral amounts were added to each diet and all parameters were measured again.

Table 3. Composition of the experimental diets.

Ingredients	Per cent		
	1	2	3
Rice straw	40	55	43
Berseem has	10	25	-
Concentrate mixture	40	7.5	14
Molasses	6	8	8
Urea	1.5	1.5	2
Minerals and vitamin A	2.5	3	3
Horsebean straw	-	-	30

* Composition of concentrate mixture (%): 29 cottonseed meal, 30 yellow corn, 30 wheat bran, 5 rice bran, 3 molasses, 1 salt and 2 Ca carbonate.

Results

Experiment 1. Effect of moistening a corn stalks-based diet on its consumption by sheep

About 23% improvement in sheep intake was induced by just adding water to the by-products diet (Table 4). The body weight change was negative before moistening and it turned to positive at 15 g/head/day (Table 4). Improvement due to raising moisture from 30% to 47% was less than that due to increasing it to 60%.

Table 4. The voluntary feed intake (on DM basis) and body weight changes of sheep fed chopped corn stalks of different moisture contents.

Moisture content %	Voluntary body weight		
	Feed intake	Change (g/head/day)	kg feed/gain ratio
30	258	-54	-
47	280	0.0	-
60	319	15	21.3

Experiment 2. Effect of some supplements on the voluntary feed intake and TDN content of the corn stalks-based diet

Table 5 shows the response of voluntary feed intake of sheep and TDN content of the corn stalks-based diet to different supplements. Urea supplementation at the rate of 1% improved the feed intake by about 25%. Combining urea treatment with urea addition resulted in 63% improvement in intake. Supplementation with concentrate mixture (30%) resulted in 47% increase in the intake. Combining concentrates with minerals raised the rate of improvement to 78%. Linseed meal at a rate of 5% was as effective in improving intake almost as 20% concentrate mixture plus minerals.

Table 5. Effect of different supplements on the voluntary feed intake and TON content of corn stalks-based diet.

	Voluntary feed	**TDN %**	
	Added supplement	intake (g/head/day)	on DM basis
1	- No supplement	563	54
2	- 1% urea and 0.1% vit. A	706	55
3	- 30% concentrate mixture	832	56
4	- Treatment with 5% urea	814	54
5	- Treatment with 5% urea		
	+ 1.5% urea + 3% molasses	920	56
6	- Treatment with 5% urea + 0.3%		
	phosphoric acid + 0.1% minerals *	774	54
7	- 20% concentrates mixture ** +		
	1% Ca carbonate + 0.1% minerals	1003	56
8	- 5% linseed meal	968	55

* Its content is (%): 36 magnesium sulphate, 0.8 zinc oxide, 1.2 manganese oxide, 14 ferrous chloride and 48 bone meal.

** Its content is (%): 25 cottonseed meal, 30 corn, 30 wheat bran, 5 rice bran, 3 molasses, 1 salt and 2 Ca carbonate.

Experiment 3. Effect of adjusting the mineral pattern of the diet according to the results of balance experiments, on the diet's nutritive value and efficiency

The results of some mineral balance experiments are shown in Table 6. The negative balances of some minerals were corrected by adding the corresponding deficient amount of salt to the diet.

Table 6. Balance of some minerals measured on buffalo calves fed the three experimental diets.

Mineral (g/head/day)	Diet number		
	1	**2**	**3**
Ca	-10	-14	-13
P	14	7	4
Na	2	13	5
K	12	16	-13
Fe	-2	-1	-1
Cu	0	0.2	-1
Zn	0	0	0
Mg	1	2	2
Mn	-0.1	0	0.4

The TDN contents, body weight gain and the kg feed/gain ration, measured before and after this adjustment are presented in Table 7. Diet 3 showed more mineral deficiencies than the other two diets. Accordingly, it benefited more from compensating for the recognised deficient minerals. This could be judged from the improvement of daily body weight gain and kg feed/gain ratio (Table 7).

Discussion

Increasing the moisture content of corn stalks improved its intake, and resulted in better utilization of the consumed amount. It is just some calculated amount of water, added to the diet of sheep losing weight that turned the situation to gaining weight. The details of such a phenomenon is not understood yet. This is a point that needs to be investigated further to make better use of it with tough by-products feed. The present results in this connection draw the attention to try levels of moisture higher than that presently tested (60%). It is thought that this is the simplest and cheapest method of treating poor quality byproducts.

Table 7. The TDN body weight gain and kg feed/gain ratio measured on buffalo calves fed the three experimental diets, before and after adjusting the mineral pattern of the diets.

Item	Diet number		
	1	2	3
TDN(%):			
Before	51	51	58
After	59	61	64
Gain (kg/head/day):			
Before	0.65	0.68	0.25
After	0.87	0.79	1.10
Kg feed/gain ratio:			
Before	8.4	13.9	24.2
After	6.4	10.0	7.1

Ammonia treatment showed to be very effective in improving the level of voluntary feed intake of chopped corn stalks. Supplementing the ammonia-treated material with urea (1.5%) again improved the level of voluntary feed intake. The alkaline treatment helped through the process of delignification or dislocation, while urea addition enriched the protein level in the diet. However, linseed meal at a level of 5% was equivalent or even better than the combined alkaline treatment and urea addition. The cheaper of these two treatments would be the clue to improving the intake and perhaps the better utilization of such by-products. It was very interesting to observe that TON content of any of the supplemented (Table 5) diets was almost constant. Since the rate of defecation is a reflection of the rate of ruminal outflow, it could be concluded that the tested supplements (Table 5) exerted its improving effect on intake by increasing the rate of ruminal outflow without increasing the extent of digestion.

The approach of investigating the mineral balance on a diet and supplementing the diet with the deficient amounts of minerals showed to be very effective in improving the feeding value of the by-products based diets (Table 7). The accumulated experience in this connection showed the significance of adjusting the Ca/P and the adequacy of K and Na. This approach showed frequently that minerals which may be estimated in a diet would not necessarily be of value for the animal because they may be unavailable to a certain degree or even completely. This means that some diets would contain high levels of some minerals even though there may be a need to supplement with such minerals. Availability of minerals is suggested to be estimated besides the estimation of the minerals themselves. This will be an important clue to the improvement of the by-products consumption and utilization.