Potential of *Sarson Saag Waste*-a Cannery Waste as Ruminant Feed

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ABSTRACT : The nutritional worth of *Sarson Saag Waste* (SSW), a cannery waste, was assessed in comparison with conventional complete diet as a total mixed ration (TMR), and a conventional green fodder, *Avena sativa.* Each diet was offered *ad libitum*, supplemented with mineral mixture and common salt, to 4 male murrah buffaloes. The control TMR was made iso-nitrogenous to SSW. Simultaneously, each diet was offered to 3 rumen fistulated male buffaloes for assessing the biochemical changes in the rumen. The nutrient digestibility of unconventional SSW was comparable to that of conventional green fodder-*A. sativa* but significantly (p<0.05) higher than that of control TMR. The tri-chloro acetic acid (TCA) precipitable-N in the strained rumen liquor of animals fed SSW was considerably higher than that of animals fed *A.sativa*. The urinary excretion of total purine derivatives was comparable in animals fed SSW and conventional green fodder but significantly (p<0.05) higher than those fed conventional control TMR. The significantly (p<0.05) lower purine nitrogen index (PNI) in animals fed control TMR resulted in significantly (p<0.05) lower microbial protein synthesis than that in animals fed SSW and conventional green fodder. The N-excretion as per cent of nitrogen intake was significantly (p<0.05) lower in animals fed SSW as compared to either of the conventional feeds tested, resulting in significantly (p<0.05) higher N-retention and apparent biological value. SSW supplemented with mineral mixture could serve as an excellent source of nutrients for ruminants. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 4 : 479-482)***

Key Words : Cannery Waste, Nutritional Evaluation, Rumen Metabolites, Purine Derivatives, Buffaloes

INTRODUCTION

The current shortage of feed and fodders in India (Bakshi and Wadhwa, 2004), demands the exploitation of newer, lesser known non-conventional feed resources, to meet the dietary requirements of the existing livestock. Cannery wastes like fruit juice waste, pea pods and sarson saag waste, available in plenty, are currently being used as soil conditioners and if left in the open can pose great threat to the environment. Such non-conventional feed resources may act as excellent source of nutrients for our livestock if used judiciously and can bridge the gap between demand and supply of nutrients for livestock. Sarson saag, a vegetarian dish is prepared by cooking leaves of *Brassica campestris* (Mustard), *Spinacea olervacea* (Spinach) and *Trigonella fenugrecon* (Fenugreek) in 95:4:1 ratio. All the 3 are cut in small pieces, washed thoroughly in fresh water and then steam cooked. The contents are then put in a pulper where pulp is separated. It is cooked with butter oil, condiments and then packed in sterilized cans while hot and is used as delicacy for human consumption in India and abroad. The left over material (-50% of the original material used) called *Sarson Saag Waste* (SSW) is dumped on waste land, posing a great threat to the environment. Currently, 325 metric tons of SSW is produced per annum in a cannery. This study was planned to evaluate the nutritional worth of SSW as a complete feed in comparison to conventional feedstuffs for buffaloes.

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MATERIALS AND METHODS

Sarson Saag Waste (SSW)

The SSW was procured free of cost from a nearby cannery and was fed *ad libitum* to the animals.

Processing of straw

The naturally fermented wheat straw (FWS) was prepared by dissolving 3.5 kg urea in 50 l water, sprayed on 96.5 kg wheat straw, mixed and stacked for 9 days (Bakshi et al., 1987; Bakshi and Wadhwa, 2001).

Total mixed ration (TMR)

A TMR iso-nitrogenous to SSW was prepared by mixing FWS, *Trifolium alexandrium*, solvent extracted mustard cake and rice bran in 65:3:21:11 ratio (DM basis). The TMR had a roughage to concentrate ratio of 68:32 (DM basis).

Animal feeding

Twelve male buffaloes (live weight 386.6±7.8 kg) divided into 3 equal groups were offered either control TMR, *Sarson Saag Waste* or green oats (*Avena sativa*) exclusively. The diet, supplemented with mineral mixture and common salt, was fed *ad libitum* as complete feed once a day at 9 h. Fresh water was offered twice a day. The animals were adapted on respective diets for 30 days followed by 7 days metabolism trial. During the trial, the animals were kept in metabolic cages and feed intake, faeces, orts and urine voided were recorded. Urine was collected in 500 ml of 20% sulphuric acid to maintain the

Table 1. Chemical composition of feed stuffs* (% DWB)

Constituent	Control, TMR	Sarson saag waste, SSW	*Avena sativa*	Pooled SE
Total ash	8.3^{b}	7.0^{a}	9.3^{c}	0.16
Organic matter	91.7^{b}	93.0^{c}	90.7^{a}	0.23
Crude protein	14.5^{b}	14.7^{b}	10.9^{a}	0.17
Neutral detergent fiber	64.5^{a}	67.0^{b}	67.0^{b}	0.29
Acid detergent fiber	42.8^{b}	50.0^{c}	37.5^{a}	0.24
Hemi-cellulose	21.7^{b}	17.0^{a}	29.5^{c}	0.20
Cellulose	32.1^{a}	36.5^{b}	32.0^{a}	0.12
Acid detergent lignin	5.4^{b}	6.5^{c}	3.0^{a}	0.16

* n=3, Figures with different superscript in a row differ significantly, p<0.05.

Table 2. Voluntary dry matter intake and digestibility of nutrients

Parameters	Control TMR	SSW	*Avena Sativa*	Pooled SE
Dry matter intake (kg/d)	8.0	8.2	7.6	0.3
Dry matter intake (as % live weight)	2.1	2.1	2.0	0.1
Digestibility coefficients (%)				
Dry matter	63.2^{a}	68.4^{ab}	72.1^{b}	2.4
Organic matter	68.0	70.4	75.4	2.4
Crude protein	68.3^{ab}	70.9^{b}	65.1^{a}	1.2
NDF	62.7^{a}	70.6^{b}	73.4^{b}	2.4
ADF	54.0^{a}	69.9^{b}	66.7^{b}	2.8
Hemicellulose	80.4^{b}	72.9^{a}	82.1^{b}	2.1
Cellulose	76.5	75.6	81.2	2.1

Figures with different superscripts in a row differ significantly, p<0.05.

pH below 3. A portion of urine sample was diluted five times with distilled water, kept in a deep freezer at -20°C, till analyzed for purine derivatives and creatinine. The animals were weighed at the start as well as at the termination of experiment for 3 consecutive days.

Rumen studies

To examine the effect of different diets on the changes in the rumen metabolites, one diet was tested, at a time, on 3 rumen fistulated male Murrah buffaloes (live weight 424.2±13.6 kg). Each diet, supplemented with minerals and common salt, was offered *ad libitum* for 30 days adaptation period. It was followed by collection of rumen liquor for 3 consecutive days before feeding (0 h) and at 2 h interval up to 10 h post feeding. The rumen liquor was strained through 4 layered muslin cloth and pH was determined (digital pH meter) immediately after collection. The strained rumen liquor (SRL) was preserved with a few drops of saturated mercuric chloride and stored at 4°C till analyzed.

Analytical methods

The finely ground samples of feedstuffs, orts and faeces were analyzed for DM, CP and total ash (AOAC, 1990), cellulose (Crampton and Maynard, 1938) and other cell wall constituents (Robertson and VanSoest, 1981). The ME was determined from apparent digestible organic matter (OM) by using the relationship given by Broster and Oldham (1981). The urine samples were analyzed for total-N (AOAC, 1990), allantoin (Young and Conway, 1942), uric acid (Trivedi et al., 1978) and creatinine (Folin and Wu described by Hawk et al., 1976). Purines absorbed were calculated from the purine derivatives excreted in the urine (Annon, 1997). Purine nitrogen index (PNI) presents the ratio between purine-N and total-N in urine.

The SRL was analyzed for total-N, ammonical-N (AOAC, 1990), tri-chloro acetic acid precipitable-N (TCA-N; Cline et al., 1958) and total volatile fatty acids (TVFA; Barnet and Reid, 1957). The data were analyzed statistically by using completely randomized design (Snedecor and Cochran, 1968).

RESULTS AND DISCUSSION

Nutrient digestibility

The chemical constituents of FWS and that of *Trifolium alexandrinum* were similar to the values reported earlier (NRC, 1989; Bakshi and Wadhwa, 2001). The SSW had significantly higher (p<0.05) OM, acid detergent fiber (ADF), cellulose and acid detergent lignin (ADL) content as compared to the other 2 diets (Table 1). SSW had the lowest (p<0.05) hemicellulose content. The crude protein content of TMR and that of SSW was significantly (p<0.05) higher than that of conventional green fodder *A. sativa*. The neutral detergent fiber (NDF) content in SSW and green fodder *A. sativa* was significantly (p<0.05) higher than TMR.

The voluntary dry matter intake (DMI) either as kg/d or as per cent of live weight was statistically comparable, in all the groups (Table 2). The digestibility of DM, NDF and ADF in SSW and *A. sativa* fed groups was statistically comparable but significantly (p<0.05) higher than that of TMR. However, the digestibility of hemicellulose was the lowest (p<0.05) in animals fed SSW as compared to the animals fed TMR or conventional green fodder. The low hemicellulose digestibility in SSW could be due to its extraction as a part of the pulp. The digestibility of OM and that of cellulose was statistically comparable in all the groups.

Biochemical changes in the rumen

Feeding of SSW or other conventional diets showed no significant differences in the production of total volatile

Table 3. Biochemical changes in rumen liquor

Parameters	Control TMR	SSW	*Avena sativa*	Pooled SE
Total volatile fatty acids (mm/l)	120.8	121.7	111.7	7.5
N-Fractions (mg %)				
Total	108.8^{ab}	130.1^{b}	87.6^{a}	8.0
NH_3	17.8	16.6	14.8	1.6
NPN	37.4	45.7	31.7	4.2
TCA	71.4^{ab}	84.4^{b}	55.9^{a}	5.6

Figures with different superscripts in a row differ significantly, p<0.05.

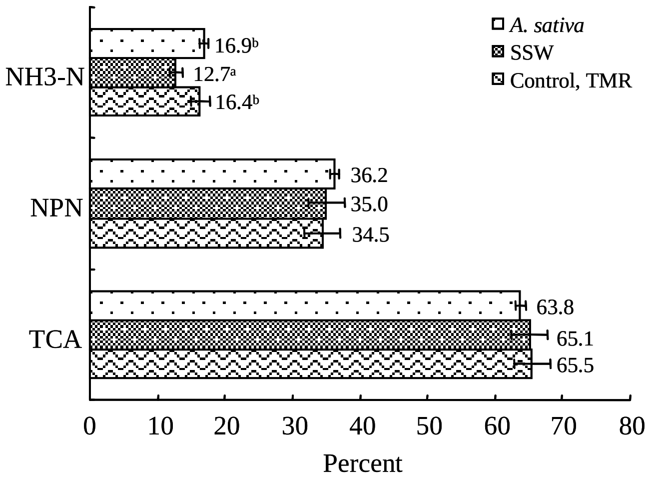

Figure 1. N-fraction as percent of total nitrogen in rumen liquor.

fatty acids (TVFA) in the SRL, indicating fermentability of SSW equivalent to any other conventional diet (Table 3). The total-N concentration in the SRL of the animals fed *A. sativa* was significantly (p<0.05) lower than that in the SRL of animals fed either SSW or TMR because of the low CP content of *A. sativa*. No effect of diets was observed on ammoniacal-N or non-protein nitrogen (NPN) concentration in the SRL. The TCA precipitable-N concentration was observed to be highest in SRL of animals fed SSW although comparable to those fed TMR but significantly (p<0.05) higher than those fed *A. sativa*. However, when different nitrogen fractions in the SRL were expressed as per cent of total-N, the ammoniacal-N was observed to be significantly (p<0.05) low in animals fed SSW as compared to other diets. The relative proportion of NPN and TCA precipitable-N were not affected by the diet (Figure 1).

Microbial protein synthesis

The urinary excretion of purine derivatives (an indicator of microbial protein synthesis in the rumen) revealed that excretion of allantoin was statistically comparable in the animals fed SSW or conventional green fodder but significantly (p<0.05) higher than that in animals fed TMR (Table 4). The uric acid excretion in the urine was statistically comparable in all the groups. The urinary excretion of total purine derivatives, by animals fed either SSW or *A. sativa* was comparable, but significantly

Table 4. Urinary excretion of purine derivatives (mmol/kg $W^{0.75}$/d)

Parameters	Control TMR	SSW	*Avena sativa*	Pooled SE
Allantoin	0.24^{a}	0.40^{b}	0.42^{b}	0.04
Uric acid	0.06	0.08	0.10	0.06
Total PDexc	0.30^{a}	0.48^{b}	0.52^{b}	0.05
Creatinine	0.55^{a}	0.72^{ab}	0.88^{b}	0.09
PD:CRT	0.55	0.67	0.59	0.05
PD:CRT/ $W^{0.75}$	47.93^{a}	61.43^{b}	52.43^{ab}	3.89
Purines absorbed	76.26^{a}	211.14^{b}	235.10^{b}	37.81
Microbial nitrogen (g/d)	51.81^{a}	153.46^{b}	170.92^{b}	27.48
PNI	0.033^{a}	0.054^{b}	0.058^{b}	0.006

Figures with different superscripts in a row differ significantly, p<0.05.

Table 5. Nitrogen utilization (g/d)

Parameters	Control TMR	SSW	*Avena sativa*	Pooled SE
N-intake	175.6^{b}	190.8^{b}	132.3^{a}	7.2
N-outgo				
Fecal	55.6^{b}	55.6^{b}	46.2^{a}	2.9
Urinary	55.8	56.4	53.2	2.1
Total	111.4	112.0	99.5	4.4
Excretion (as % of intake)	63.6^{a}	58.8^{a}	75.2^{b}	2.0
Retained	64.1^{b}	78.8^{b}	32.8^{a}	5.2
Apparent biological value (%)	53.2^{b}	58.1^{b}	38.0^{a}	2.4

Figures with different superscripts in a row differ significantly, p<0.05.

(p<0.05) higher than those fed TMR. The values were similar to those reported earlier in buffaloes (Chen and Gomes, 1995). The purine nitrogen index (PNI), an indicator of efficiency with which the dietary-N is converted to microbial protein in the rumen (Chen et al., 1999) revealed that animals fed control TMR had lowest (p<0.05) PNI resulting in minimum supply of microbial protein to the host as compared to SSW and *A. sativa* fed groups.

The creatinine excretion in urine was comparable in animals fed SSW or *A. sativa* but significantly (p<0.05) higher than those fed TMR. The level of creatinine excretion was well within the range as reported earlier (Moscardini et al., 1999). The ratio of purine derivatives to creatinine was statistically comparable in all the groups. But the ratio of purine derivatives to creatinine corrected for metabolic weight was significantly (p<0.05) higher in animals fed SSW or *A. sativa* as compared to those fed control TMR.

Nitrogen utilization

The higher N-intake, observed in SSW fed group, could be because of higher DM intake, which differed non-significantly from TMR fed group (Table 5). The nitrogen intake was lowest (p<0.05) in animals fed *A. sativa* both due to low N-content and low DM intake. The N excretion

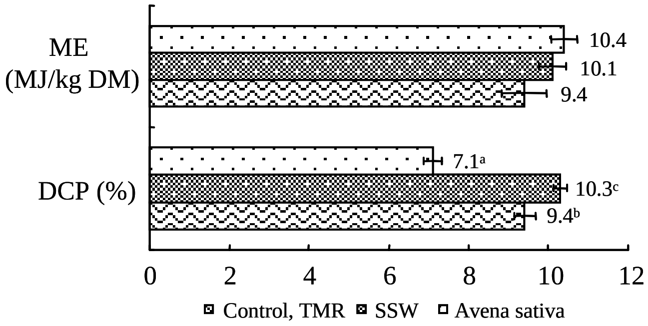

Figure 2. Nutritive value of diets

via faeces in animals fed SSW or TMR was statistically comparable but, significantly ($p<0.05$) higher than that in animals fed conventional green fodder *A. sativa*. The total-N excretion was statistically comparable in all the groups. The N-excretion as per cent of N intake was lowest ($p<0.05$) in animals fed SSW amongst the test diets. The low nitrogen excretion along with high TCA-N in SRL, were responsible for higher N-retention and efficiency of its utilization (Apparent BV) in animals fed SSW. These values were statistically comparable with TMR but, significantly ($p<0.05$) higher than that observed for animals fed *A. sativa*.

Nutritive value

The SSW showed the highest ($p<0.05$) DCP content whereas the *A. sativa* the lowest (Figure 2). The ME content of all the diets was statistically comparable. The animals gained weight, whether fed SSW or any conventional feed. The skin of animals fed SSW became lustrous as compared to animals fed other conventional diets and showed no adverse effect on the health of the animals.

The results conclusively revealed that SSW, supplemented with minerals, and fed *ad libitum* to ruminants, can serve as an excellent source of nutrients.

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