



Nutritional evaluation of baby corn husk — A new feed resource for livestock

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ABSTRACT

This study was taken up to assess the nutritional worth of baby corn husk (BCH) for ruminants. Fresh chaffed BCH, or BCH wilted for 2–3 days and ensiled for 42 days or fresh BCH mixed with chaffed rice straw in 70: 30 ratio (BCH-RS) and ensiled for 42 days in lab silos in triplicate. The *in-vitro* gas production studies revealed that the net gas production (NGP), NDF and true OM digestibility, and ME availability was highest in BCH followed by that in ensiled BCH and lowest in ensiled BCH-RS. The methane production as per cent of net gas production was also lowest in BCH and highest in ensiled BCH-RS. The total and individual volatile fatty acid production was highest BCH, statistically, comparable with that of ensiled BCH but higher than BCH-RS silage. The relative proportion of individual volatile fatty acid was comparable in all the groups. For *in vivo* evaluation, 10 male Murrah buffalo calves divided into 2 equal groups were offered *ad lib.* either chaffed conventional green maize fodder or fresh chaffed BCH with daily supplementation of 25g mineral mixer and common salt for 30 days. The daily DM intake was significantly higher in buffalo calves fed conventional green fodder as compared to chaffed BCH. The digestibility of all the nutrients was higher in fresh BCH as compared to green maize fodder. The N-retained and apparent biological value of protein was high in fresh BCH as compared to green maize fed group, but the differences were statistically nonsignificant. The calves offered BCH as compared to those offered green maize had higher total-N, TCA-N but slightly lower TVFAs. In another *in vivo* trial, the digestibility of nutrients and N-retention were considerably higher in 5 male Murrah buffalo calves offered concentrate mixture, ensiled BCH and wheat straw in 40: 30: 30 ratio on DM basis as total mixed ration (TMR) as compared to those offered fresh BCH. The higher digestibility of nutrient, N-retention, apparent biological value and favourable rumen environment conclusively revealed that fresh or ensiled BCH was highly acceptable and palatable as compared to conventional maize fodder.

Key words: Baby corn husk, Buffalo calves, Ensiled, *In-vitro* evaluation, *In-vivo* evaluation, Nutrient utilization, Rumen metabolites, Total mixed ration

In India, there is shortage of feed stuffs for livestock and poultry (Bakshi and Wadhwa 2004). At present only 5–6 kg green fodder is available per animal per day in India which meets only 7–8% DM requirements of a milk producing crossbred cow of 500kg body weight. Therefore in order to bridge the gap between demand and supply, new alternate feed resources should be tapped. Baby corn—a highly export oriented product, earlier used as delicacy, is becoming very popular amongst the new generation and its consumption has increased remarkably. It resulted in increased cultivation of baby corn from 827 acres in 2008–09 to 2100 acres in 2010–11 covering from 57 to 150 villages in Punjab State (Anonymous 2010). On an average about 30–35q baby corn is produced/acre. Only 15% is the edible baby corn cob, while 85% is constituted by outer peels called baby corn husk with

silk (threads like component). In this study an attempt was made to assess the nutritional worth of baby corn husk with silk as livestock feed.

MATERIALS AND METHODS

In vitro evaluation of baby corn husk: Fresh BCH was chaffed, or BCH wilted for 2–3 days and ensiled for 42 days as such or fresh BCH was mixed with chaffed rice straw in 70: 30 ratio (BCH-RS) and ensiled for 42 days in lab silos in triplicate. The lab silos were opened after the stipulated period and the samples were analyzed for chemical composition and evaluated by *in-vitro* gas production technique.

In vivo evaluation of fresh baby corn husk: Male Murrah buffalo calves (10) of 147.6±15.9 kg BW, divided into 2 equal groups, were offered *ad lib.* either chaffed conventional green maize fodder or fresh BCH with daily supplementation of 25g mineral mixer and common salt for 30 days. The animals had free access to water twice-a-day and were exercised daily for 1 h. The animals were weighed for 3 consecutive days at

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15 day interval before feeding. After adapting for 30 days on the respective diet, a 7-day metabolic trial was conducted on all the animals in each group.

Rumen studies: Simultaneously fresh BCH and conventional green fodder were evaluated on 3 rumen fistulated buffalo calves. One fodder was tested at a time. The animals were offered either green maize fodder or BCH supplemented with mineral mixture and common salt once-a-day at 9.00 AM. After 30 days adaptation period, rumen contents were collected for 3 consecutive days at 0, 2, 4, 6, 8 and 12 h post feeding and were strained through 4 layers of muslin cloth. Equal quantity of strained rumen liquor (SRL) from each collection was pooled for the respective animal. A few drops of HgCl_2 were added in each sample of SRL to stop microbial action and refrigerated till analyzed.

In vivo evaluation of ensiled baby corn husk in TMR: Fresh BCH was wilted for 2–3 days and then ensiled in silo pits for 42 days. After the stipulated period, the pit was opened from one side, the required quantity of silage was taken out and the pit was again covered with polythene sheet. Five male Murrah buffalo calves (347.8 ± 14.4 kg BW) were offered concentrate mixture, ensiled baby corn husk and wheat straw in 40: 30: 30 ratio (on DM basis) as TMR for 30 days. The concentrate mixture contained maize 30, mustard cake 10, deoiled mustard cake 20, rice bran 15, deoiled rice bran 22, mineral mixture 2 and common salt 1, part each. After 30 adaptation period, a 7 day metabolism trail was conducted.

Chemical and statistical analysis: Samples of feed, orts and faeces were ground to pass through 1 mm sieve and analyzed in duplicate for nitrogen and total ash (AOAC 1995), cellulose (Crampton and Maynard 1938) and other cell wall constituents (Robertson and Van Soest 1981). The urine samples were analyzed for nitrogen content only. The samples were evaluated by *in-vitro* gas production technique (Menke *et al.* 1979, Menke and Steingas 1988). The SRL samples were analyzed for total-N, ammoniacal-N (AOAC 1995), trichloroacetic acid precipitable N (Cline *et al.* 1958). The volatile fatty acids were estimated using gas chromatograph equipped with glass column (packed with chromosorb 101) and flame ionization detector (Cottoyn and Boucque 1968). Methane was estimated in GLC equipped with stainless steel column packed with porapak-Q and flame ionization detector. Standard calibration gas consisted of 50% methane and 50% carbon dioxide. The flow rates for nitrogen, hydrogen and zero air were 30, 30, 320 ml/min respectively. From the headspace of each syringe, 100 ml gas was collected by puncturing the silicon tube and injected in gas chromatograph for the estimation of methane. The data of *in vitro/in vivo* experiments were analyzed by simple ANOVA (Snedecor and Cochran 1994) by using the software package SPSS (2007) version 16 and differences in mean were assessed by using Tukey's b test.

RESULTS AND DISCUSSION

The chemical composition of BCH in comparison to ensiled BCH and ensiled BCH-RS revealed that the BCH had the lowest ($P < 0.01$) total ash, EE and cell wall constituents except hemicellulose and highest ($P < 0.01$) OM content (Table 1). The CP content was highest ($P < 0.01$) in the ensiled BCH followed by fresh BCH and lowest in BCH-RS silage.

In vitro evaluation of BCH: The *in vitro* gas production studies revealed that the net gas production (NGP), NDF and true OM digestibility, and ME availability was highest ($P < 0.01$) in fresh BCH followed by that in ensiled BCH and lowest in ensiled BCH-RS (Table 2). The methane production as per cent of net gas production was comparable, but methane production per gram of DM was lowest ($P < 0.01$) in

Table 1. Chemical composition (% DM basis) of fresh baby corn husk, baby corn husk ensiled alone or with rice straw

Constituent	BCH	BCH silage	BCH-RS silage	PSE
Total ash**	5.18 ^a	7.10 ^b	9.48 ^c	0.18
OM**	94.82 ^c	92.90 ^b	90.52 ^a	0.79
CP**	11.55 ^b	12.07 ^c	6.05 ^a	1.35
EE*	1.75 ^a	2.85 ^b	2.25 ^{ab}	0.22
Cellulose**	24.4 ^a	31.8 ^b	34.2 ^c	1.88
NDF**	60.9 ^a	65.7 ^b	70.8 ^c	1.83
ADF**	24.8 ^a	40.95 ^b	51.25 ^c	4.87
Hemicellulose	36.1 ^c	24.75 ^b	19.55 ^a	3.09

N, 3; BCH, Baby corn husk; RS, rice straw; Figures with different superscript in a row differ significantly, ** $P < 0.01$; * $P < 0.05$; PSE, pooled standard error.

Table 2. *In vitro* evaluation of baby corn husk, baby corn husk ensiled alone or with rice straw

Parameter	BCH	BCH silage	BCH-RS silage	PSE
NGP**, ml/gDM	278.86 ^c	219.3 ^b	158.51 ^a	17.58
NDF digestibility**, %	72.67 ^b	71.30 ^b	55.15 ^a	3.56
True OM digestibility **, %	82.56 ^c	78.48 ^b	69.88 ^a	2.37
ME, MJ/kg DM	10.23 ^c	9.21 ^b	7.22 ^a	0.56
Methane, % NGP	16.35	16.89	16.88	0.13
Methane, ml/g DM	45.25 ^c	37.88 ^b	27.66 ^a	3.23
<i>Volatile fatty acids, mM/dl</i>				
Total**	5.89 ^b	5.79 ^b	4.81 ^a	0.22
Acetate**	4.66 ^b	4.55 ^b	3.79 ^a	0.17
Propionate*	0.96 ^{ab}	1.06 ^b	0.82 ^a	0.05
Butyrate*	0.27 ^b	0.23 ^a	0.20 ^a	0.01
<i>Relative proportion, %</i>				
Acetate	79.02	78.65	78.70	0.13
Propionate	16.35	18.37	17.07	0.48
Butyrate	4.62	4.02	4.23	0.13

NGP, Net gas production; Figures with different superscript in a row differ significantly, ** $P < 0.01$; * $P < 0.05$; PSE, pooled standard error.

Table 3. Dry matter intake, digestibility of nutrients and N-retention in buffalo calves fed green maize, fresh baby corn husk or ensiled baby corn husk

Parameter	Green	BCH	PSE	Ensiled BCH in TMR
DM intake*, kg/day	4.42 ^b	3.70 ^a	0.16	10.2±0.31
<i>Digestibility of nutrients, %</i>				
DM*	61.67 ^a	72.63 ^b	2.43	77.01±0.53
OM**	63.86 ^a	75.92 ^b	2.48	78.21±0.33
NDF*	57.99 ^a	71.49 ^b	2.97	74.53±0.68
ADF*	57.63 ^a	63.52 ^b	2.7	72.57±1.01
Cellulose*	67.06 ^a	77.81 ^b	2.34	79.85±0.79
Hemicellulose**	58.59 ^a	77.18 ^b	3.51	76.89±1.20
<i>N-balance, g/day</i>				
N-intake	60.6	66.32	2.54	216.93±6.55
Faecal-N	17.18	17.01	1.04	66.05±3.58
Urinary-N	19.65	17.16	1.66	82.61±5.9
N-retained	23.77	32.16	2.58	70.27±0.27
Apparent BV	54.94	64.59	3.81	

TMR, Ensiled BCH: wheat straw, concentrate mixture in 30: 30: 40 ratio; Figures with different superscript in a row differ significantly, **P<0.01; *P<0.05; PSE, pooled standard error.

BCH and highest in BCH-RS silage. The total and individual volatile fatty acid production was highest in BCH, statistically comparable with that of ensiled BCH but higher (P<0.05) than that of ensiled BCH-RS. However, the butyrate production was statistically comparable in ensiled BCH and ensiled BCH-RS. The relative proportion of individual volatile fatty acid was comparable in all the groups.

In vivo evaluation of fresh BCH: The *ad lib.* feeding of fodders revealed that the daily DM intake was significantly higher (P<0.05) in buffalo calves fed conventional green fodder as compared to chaffed BCH (Table 3). The digestibility of all the nutrients was higher (P<0.05; P<0.01) in fresh BCH as compared to green maize fodder. The N-intake, excretion through faeces and urine in animals fed green maize and fresh BCH was comparable. The N-retained and apparent biological value of protein was high in fresh BCH as compared to green maize fed group, but the differences were statistically nonsignificant. The rumen studies revealed that the calves offered BCH as compared to those offered green maize had higher total-N (115.4 vs. 109.6 mg/dl SRL), TCA-N (56.23 vs. 43.96mg/dl SRL) but slightly lower TVFA's (103.5 vs. 115.0 meq/l SRL).

In vivo evaluation of ensiled BCH in TMR: The chemical composition of BCH ensiled in lab silos and a silo pit was

almost comparable. The TMR was consumed @ 3.06% of live weight of calves. The digestibility of nutrients and N-retention in buffalo calves offered TMR were considerably higher than that of calves offered fresh BCH (Table 3). The higher digestibility of nutrient, N-retention, apparent biological value and favourable rumen environment revealed that fresh BCH was highly acceptable and palatable as compared to conventional maize fodder.

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