Indian Journal of Animal Sciences **92** (2): 254–257, February 2022/Short communication
https://doi.org/10.56093/ijans.v92i2.122105

Utilization of biscuit waste in the ration of growing goat bucks

M P S BAKSHI[1✉], J K SAINI[2] and M WADHWA[1]

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab 141 004 India

Received: 16 October 2021; Accepted: 11 November 2021

Keywords: Biscuit waste, Goat bucks, *In vitro* evaluation, Nutrient utilization, Performance, Rumen microbes

India is the highest milk producing nation in the world [187.75 million tonnes, 2018–19] and for sustaining this status, sufficient feedstuffs are required (ARDB 2020), but there is a worldwide shortage of feedstuffs. The deficit of green fodder, dry fodder, and concentrates in India will increase by 23, 40 and 38%, respectively by 2025 (Anonymous 2016–17). The only option to bridge the gap between demand and supply of feedstuffs is to explore new non-conventional feed resources. About 931 MT of food waste was generated worldwide in 2019. The household food waste estimate is 50, 59 and 64 kg per capita per year in India, US and China, respectively or 68.8, 19.4 and 91.6 MT a year, respectively (UNEP 2021). Substantial quantum of biscuit waste is available in India from the biscuit manufacturing industries. Only a few reports are available on the utilization of biscuit waste in animal feed, e.g. pigs (Tiwari and Dhaka 2020), broilers (Adeyemo *et al*. 2013), snails (Ajasin *et al*. 2010) and rams (Apata *et al*. 2010). This study was therefore taken up to assess the impact of biscuit waste in isonitrogenous and isocaloric ration on the nutrient utilization and performance of goats.

The biscuit waste was procured free of cost from Cremica Industries, Phillour, Ludhiana. It was finely ground in a Willey mill using 1 mm screen.

The nutritional value of TMRs containing iso-nitrogenous and iso-caloric concentrate mixtures were evaluated by *in vitro* gas production technique (IVGPT; Menke *et al*. 1979, Menke and Steingass 1988). Three goat bucks fitted with permanent rumen fistulae were offered concentrate mixture (maize 20, soybean meal 16, groundnut extraction 15, wheat bran 20, deoiled rice bran 26, mineral mixture 2 and salt 1% each) and green fodder in 50:50 ratio on DM basis as per NRC (2007) feeding standard for goats.

After 24 h of incubation, a 5 mL aliquot of fluid from each syringe was mixed with 1 mL of 25% meta-phosphoric acid and kept for 1 h at ambient temperature (Erwin *et al.* 1961). Thereafter, it was centrifuged at 5,500 rpm for 10 min and clear supernatant was collected and stored at 20ºC until analyzed. The volatile fatty acids were estimated using Netchrom 9100 gas chromatograph (Cottyn and Boucque 1968).

A 106 days feeding trial was conducted on 10 growing *Beetal* goat bucks (average live weight 43.03±1.18 kg) randomly distributed into two equal groups. The animals in control group were fed TMR containing concentrate mixture [Rice broken (Kani) 31, soybean meal 15, groundnut extraction 16, rice bran 35, mineral mixture 2 and salt 1% each] and green berseem (*Trifolium alexandrinum*) in 50:50 ratio on DM basis as per NRC (2007) feeding standard. Those in experimental groups were fed TMR in which rice kani was replaced with biscuit waste in isonitrogenous and isocaloric concentrate mixture (Table 1). The daily record of feed intake and orts was maintained. The bucks were weighed for 3 consecutive days every fortnight and the feeding schedule was revised accordingly. The animals were stall fed individually at 9:00 AM daily and had free access to fresh water twice a day and were taken out in the yard for 1 h exercise daily.

A 7-day digestion-cum-metabolism trial was conducted by adopting standard procedure. The animals were kept individually in specially designed metabolic cages where urine and faeces were collected automatically in separate containers. The fresh pooled faecal and urine samples were analyzed for nitrogen only (AOAC 2007).

The rumen studies were conducted on 3 adult *Beetal* goat bucks fitted with permanent rumen fistula, in 1st trial; animals were offered control TMR once a day at 9.00 h as per NRC (2007). After 30 days adaptation period, rumen contents were collected at 0, 2, 4, 6, 8, 12 h post feeding for 3 days. Equal quantity of strained rumen contents (SRC) from each collection were pooled for the respective animal. The samples were stored in a refrigerator till analyzed for VFAs. In 2nd trial, rumen fistulated bucks were offered TMR in which concentrate mixture contained 30% biscuit waste. The procedure for collection, processing and preservation of samples of rumen contents was same as adopted in 1st trial.

A part of SRC (0 and 4 h post-feeding samples) was processed immediately for estimation of rumen microbial profile. Total bacteria and fungi were enumerated in rumen fluid by roll-tube technique (Hungate 1969) and the results were reported as colony forming units (cfu/mL rumen fluid)

Present address: [1]Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab. [2]Central University of Haryana, Mahendergarh, Haryana. ✉Corresponding author email: bakshimps2@gmail.com

Table 1. Ingredient and chemical composition of concentrate mixtures and green fodder

Constituent	Concentrate mixture		Green fodder
	Control	Biscuit waste	
Ingredient composition (%)			
Rice kani	31	–	
Biscuit waste	–	30	
Soybean meal	15	12	
Groundnut extraction	16	14	
Rice bran	35	–	
Deoiled rice bran	–	24	
Wheat bran	–	17	
Mineral mixture	2	2	
Salt	1	1	
Chemical composition (%)			
Total ash	7.68	7.76	12.40
OM	92.32	92.24	87.60
CP	21.04	20.99	18.96
EE	4.98	5.10	2.77
NDF	37.80	30.40	49.60
ADF	13.90	11.00	37.43
Cellulose	12.10	11.90	31.05
Hemicellulose	23.90	19.40	12.17

and thallus forming units (TFU/mL rumen fluid), respectively (Saini *et al*. 2012). The composition of the medium used for dilution and for total bacterial and fungal counting were the same as described earlier (Hungate 1969, Joblin 1981). Protozoa were enumerated by direct microscopic counts by using a hemocytometer after fixing one part of rumen fluid with one part of methyl green formal saline overnight and counted microscopically (Kamra *et al*. 1991).

The finely ground samples of feedstuffs, orts and faeces were analyzed for CP and total ash (AOAC 2007) and cell wall constituents (Van Soest *et al.* 1991). Hemi-cellulose was determined by difference in NDF and ADF. The fresh fecal and urine samples were analysed for total-N (AOAC 2007). The data were analyzed by using one way ANOVA, but that of microbial population in the rumen by 2×2 factorial design (Snedecor and Cochran 1994) by using SPSS (2009) version 16.0 and the means were tested for the significant difference by using Tukey's B test and Duncan's Multiple Range test, respectively.

The biscuit waste contained 4.11% total ash, 0.82% acid insoluble ash, 7.95% crude protein, 13.70% ether extract, 44.23% starch, 20.65% water soluble sugars, and 2.51% crude fiber on DM basis, thereby indicating that it is an excellent source of energy and moderate source of protein. The comparable CP and EE content in both the concentrate mixtures indicated that these were iso-nitrogenous and iso-caloric (Table 1). The *in vitro* gas production studies revealed that the net gas production (NGP) was improved ($P<0.01$) in TMR containing biscuit waste (Table 2). The total and individual VFAs concentration was also improved ($P<0.01$) in TMR containing biscuit waste.

Table 2. Impact of biscuit waste in the TMR on *in vitro* nutrient utilization and on the performance of growing goat bucks

Parameter	Control	Biscuit waste	PSE	P value
In vitro studies				
NGP	233.33^{a}	240.44^{b}	1.65	0.002
Volatile fatty acid production (*mM/dl*)				
TVFA	5.59^{a}	6.30^{b}	0.21	0.003
Acetate (A)	3.70^{a}	3.96^{b}	0.08	0.013
Propionate (P)	1.13^{a}	1.27^{b}	0.04	0.004
Isobutyrate	0.062^{a}	0.079^{b}	0.005	0.001
Butyrate	0.521^{a}	0.779^{b}	0.07	<0.001
Isovalerate	0.101^{a}	0.145^{b}	0.01	0.001
Valerate	0.074	0.069	0.002	0.185
A:P	3.27^{b}	3.11^{a}	0.03	0.003
In vivo studies on growing bucks				
DM intake, kg/day	1.53^{a}	1.76^{b}	0.08	0.020
Digestibility of nutrients (%)				
DM	72.34^{a}	81.25^{b}	2.15	0.026
OM	74.22^{a}	82.87^{b}	2.09	0.027
CP	80.15^{a}	86.06^{b}	1.39	0.020
NDF	58.70^{a}	72.86^{b}	3.64	0.042
ADF	49.45^{a}	73.80^{b}	5.52	0.014
Cellulose	58.72	77.18	3.29	0.058
HC	70.97	70.59	2.06	0.933
N-retention (*g/day*)				
N-intake	51.25	51.82	1.18	0.828
Faecal-N	10.16	7.32	1.10	0.062
Digestble-N	41.09	44.50	1.01	0.092
Urinary-N	14.53	15.65	0.74	0.485
N-retention	26.56^{a}	28.85^{b}	0.77	0.013
Rumen studies				
Volatile fatty acid production (*mM/dl*)				
TVFA	4.94	5.23	0.19	0.490
Acetate (A)	3.13	3.21	0.11	0.730
Propionate (P)	1.03	1.26	0.08	0.148
Isobutyrate	0.057	0.045	0.004	0.200
Butyrate	0.593	0.581	0.014	0.699
Isovalerate	0.073	0.050	0.007	0.102
Valerate	0.060	0.083	0.006	0.026
A:P	3.04^{b}	2.59^{a}	0.005	0.037
Changes in body weight (*kg*)				
Initial BW	43.10	42.92	1.18	0.944
Final BW	55.64	54.00	1.63	0.642
Gain in BW	12.54	11.08	0.87	0.432
ADG, g	118.33	104.53	8.19	0.432

NGP, ml/g DM/24 h; TVFA, Total volatile fatty acids; BW, Body weight; ADG, Average daily gain. Means with different superscripts in a row differ significantly.

The results of 106 days feeding trial conducted on 10 growing *Beetal* goat bucks fed either control TMR or TMR in which concentrate mixture contained 30% biscuit waste revealed that DM intake was improved ($P<0.05$), resulting in higher acceptability and palatability of TMR (Table 2), confirming the earlier report (Apata *et al*. 2010). The digestibility of all the nutrients was improved ($P<0.05$),

Table 3. Impact of biscuit waste in the TMR on microbial population (LN organisms/g) in the rumen of growing goat bucks

Parameter	Treatment (T)		Period (P)		PSE	P value		
	Control	Biscuit waste	0h	4h		T	P	T×P
Fungi	1.94^{a}	1.97^{b}	2.06^{B}	1.85^{A}	0.007	0.003	<0.001	0.426
Bacteria	2.19^{b}	2.13^{a}	2.27^{B}	2.05^{A}	0.007	<0.001	<0.001	0.876
Holotrichs	2.66	2.64	2.51^{A}	2.79^{B}	0.028	0.582	<0.001	0.377
Entodinium	1.98^{b}	1.82^{a}	2.01^{B}	1.79^{A}	0.006	<0.001	<0.001	<0.001
Total protozoa	2.00^{b}	1.86^{a}	2.02^{B}	1.83^{A}	0.006	<0.001	<0.001	0.002

Means with different superscripts in a row differ significantly.

except that of cellulose and hemicellulose which were comparable in both the groups. The N-intake was comparable in both the groups. The higher digestible-N in group fed TMR containing biscuit waste was responsible for higher ($P<0.05$) N-retention in growing bucks. The total and individual VFAs concentration was comparable in both the TMRs.

The body weight changes in the growth trial revealed that there was no adverse effect of biscuit waste incorporation in concentrate mixture on the gain in body weight. The average daily gain in weight was also comparable in both the groups (Table 2). The rumen studies revealed that bacterial and total protozoal (both holotrichs and entodinium) population decreased ($P<0.01$), while fungal population in the rumen increased ($P<0.01$) in the bucks fed diet containing biscuit waste (Table 3), resulting in higher fibre digestion. The bacterial, fungal and total protozoal population was higher ($P<0.01$) in the strained rumen liquor before feeding as compared to after feeding. The results conclusively revealed that biscuit waste is a rich source of nutrients that can be incorporated in the concentrate mixture at 30% on DM basis without affecting palatability, nutrient utilization and body weight gain in goat bucks.

SUMMARY

A feeding trial of 106 days was conducted to assess the impact of incorporating biscuit waste in the iso-nitrogenous and iso-caloric TMRs on the *in vitro* nutrient utilization and on the performance of growing goat bucks. The biscuit waste is an excellent source of EE (13.70%), starch (44.23%) and moderate source of CP (7.99%). The *in vitro* gas production studies revealed that the NGP, total and individual VFAs concentration improved significantly in TMR in which concentrate mixture contained biscuit waste. The DM intake, digestibility of the nutrients and N-retention was improved significantly in growing bucks fed TMR containing biscuit waste. The rumen studies revealed that bacterial and total protozoal population decreased, while fungal population in the rumen increased significantly in the bucks fed diet containing biscuit waste. The bacterial, fungal and total protozoal population was higher in the strained rumen liquor before feeding as compared to after feeding. The total and individual VFAs concentration was comparable in both the TMRs. The results conclusively revealed that biscuit waste a rich source of nutrients can be incorporated in the concentrate mixture at 30% on DM basis without affecting palatability, nutrient utilization and body weight gain in growing goat bucks.

REFERENCES

Adeyemo G O, Oni O R and Longe O G. 2013. Effect of dietary biscuit waste on performance and carcass characteristics of broilers. *Food Science and Quality Management* **12**: 1–9.

Ajasin F O, Omole A J, Fapohunda J B and Obi O O. 2010. The feeding value of biscuit waste as replacement for maize in the diet of growing snails (*Archachatina marginata*). *Journal of American Science* **6**: 1–5.

Anonymous. 2016–17. Standing Committee on Agriculture. Report # 36. Ministry of Agriculture and Farmers Welfare (Department of Animal Husbandry, Dairying and Fisheries).

AOAC. 2007. *Official Methods of Analysis,* 18th ed. Association of Official Analytical Chemists, Gaithersburg, Maryland, USA.

ARDB. 2020. Animal Husbandry, Dairying and Fisheries (Section III). *Agricultural Research Data Book-2020*. ICAR-Indian Agricultural Statistics Research Institute (ICAR-IASRI) and Indian Council of Agricultural Research. 23rd edn.

Apata E S, Eniolorunda O O, Ojo K A and Okubanjo A O. 2010. Effect of feeding graded levels of biscuit waste based diet on non-carcass components of Yankasa rams. *African Journal of Biotechnology* **9**: 4499–4502.

Cottyn B G and Boucque C V. 1968. Rapid method for the gas chromatographic determination of volatile fatty acids in rumen fluid. *Journal of Agriculture and Food Chemistry* **16**: 105–07.

Erwin E S, Marco G J and Emery E M. 1961. Volatile fatty acid analyses of blood and rumen fluid by gas chromatography. *Journal of Dairy Science* **44**: 1768–71.

Hungate R E. 1969. A roll tube method for cultivation of strict anaerobes. (Eds) Norris J R and D W Ribbons. *Methods in Microbiology*. Academic, New York, pp. 117–313.

Joblin K N. 1981. Isolation, enumeration and maintenance of rumen anaerobic fungi in roll tubes. *Applied Environmental Microbiology* **42**: 1119–22.

Kamra D N, Sawal R K, Pathak N N, Kewalramani N and Agarwal N. 1991. Diurnal variations in ciliate protozoa in the rumen of blackbuck (*Antelope cervicapra*) fed green forages. *Letters Applied Microbiology* **13**: 165–67.

Menke K H and Steingass H. 1988. Estimation of the energetic feed value obtained by chemical analysis and *in vitro* gas production using rumen fluid. *Animal Research and Development* **28**: 7–55.

Menke K H, Rabb L, Salewski A, Steingass H, Fritz D and Schneider W. 1979. The estimation of the digestibility and ME content of ruminant feedstuffs from the gas production when they are incubated with rumen liquor *in vitro. Journal of Agriculture Science Camb.* **93**: 217–22.

NRC. 2007. *Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids*. National Research Council, National Academy of Sciences, Washington, D.C.

Saini J K, Hundal J S, Wadhwa M and M P S Bakshi. 2012. Effect of roughage to concentrate ratio in the diet on the rumen environment and nutrient utilization in goat and sheep. *Indian Journal of Animal Nutrition* **29**: 333–38.

Snedecor G W and Cochran W G. 1994. *Statistical Methods*. 7th Edn. Oxford and IBH Publications, New Delhi.

SPSS. 2009. *Statistical Packages for Social Sciences*. Ver. 12, SPSS Inc., Linois, USA.

Tiwari M R and Dhaka H R. 2020. Bakery waste is an alternative of maize to reduce the cost of pork production. *International Journal of Research in Agriculture and Forestry* **7**: 1–9.

UNEP. 2021. The Food Waste Index Report 2021. United Nations Environment Programme.

Van Soest P J, Robertson J B and Lewis B A. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* **74**: 3583–97.