CHEMICAL COMPOSITION AND *IN-VITRO* DIGESTIBILITY OF BLENDED RATIOS OF WHEAT OFFAL AND WET SORGHUM BREWER RESIDUE

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ABSTRACT
This study evaluated the chemical composition and in-vitro digestibility of blended ratios of wheat offal and wet sorghum brewer residue. Fresh wet sorghum brewer residue (WSBR) was collected from local gin (Burukutu) producers and blended with wheat offal (w/w); 1WO: 1WSBR, 1WO: 1.5WSBR, 1WO: 1.2WSBR, 1WO: 2.5WSB, 1WO: 1.3WSBR and 1WO: 3.5WSBR, arranged in a Completely Randomised Design. The blends were air-dried for 3 days. Samples of blended ratios were analysed for chemical composition, and in-vitro digestibility study according to standard procedures. The dry matter contents of ratios 1:1, 1:2, 1:2.5, 1:3 and 1:3.5 were significantly higher (p<0.05) than the 1:1.5 ratio. The crude fibre content significantly increased (p<0.05) as the blended ratio increased. The carbohydrate fractions of 1:2, 1:2.5 and 1:3 were significantly higher (p<0.05) than that of ratios 1:1 and 1:1.5. The neutral detergent fibre was significantly higher (p<0.05) in ratio 1:3.5 than other blended ratios Furthermore, the hemicellulose content was significantly highest (p<0.05) in ratios 1:1.5, 1:2.5 as well as 1:3 than ratio 1:1 and least 1:3.5. The gas production was significantly highest (p<0.05) ratio 1:1 from 3 - 24 hours of in-vitro digestibility compared to other ratios. It could be therefore concluded that increasing blended ratios of wheat offal and wet sorghum brewer residue led to improved nutrient contents and in-vitro dry matter digestibility.

Keywords: Chemical composition, *in-vitro* digestibility, wheat offal, wet brewer residue.

DESCRIPTION OF PROBLEM

One valuable possibility in the field of animal nutrition is the recycling of these materials as alternative feedstuffs, in particular for herbivores (1). The use of agro-industrial by-products as animal feeds has been a matter of interest for the last few decades (2). Brewer's grains are a highly variable by-product whose composition and nutritional value depend on the grain used, on the industrial process and on the method of preservation. Brewers' grains are sold wet or dried, and can be ensiled (3). Wet brewery waste is a typical example of alternative food, being used in diets for ruminants due to its high nutritional content, especially energy and protein, and great availability throughout the year at a low cost, which may minimise the costs of animal feeding (4). However, difficulty in the conversion of high-moisture by-products arises from the high cost of drying equipment and the lack of simple and appropriate alternatives (5). (6) developed a quick method (maximum of 4-h drying period) to convert into animal feed such wet sorghum brewer residue using vegetable carriers (wheat offal) as absorbents. The wheat offal prevents nutrient seepage while enhancing drying. Therefore, this study was to determine the chemical composition and in-vitro digestibility of blended ratios of wheat offal and wet sorghum brewer's residue.

MATERIALS AND METHODS

Experimental location

This study was conducted at the Department of Animal Health and Production Technology, The Oke Ogun Polytechnic, Saki Teaching and

Research farm, located at the longitude 8.6275ºN and latitude 3.4058ºE.

Processing of wheat offal and sorghum brewer wet waste blended ratios

Wheat offal (WO) was purchased from a reputable feed mill, while fresh wet sorghum brewer wet waste (WSBR) was collected in polyethene woven sacks from local gin (Burukutu) producers in Ago Are at ATISBO Local Government Area of Oyo State. Nigeria. The blended ratios were mixed weight for weight (w/w). 1WO: 1WSBR, 1WO: 1.5 WSBR, 1WO: 1.2 WSBR, 1WO: 2.5 WSBR, 1WO: 1.3 WSBR and 1WO: 3.5 WSBR. The mixtures were air-dried by spreading thinly on black polythene sheets (0.7 mm thickness) in two replicates each on the concrete roof (20.5 m high) for 3 days. The dried blends were stored in high-density polythene bags and then put in a cool, dry place.

Chemical analysis

The blended ratios were subjected to proximate analysis using the standard procedures of (7) in triplicate. The cell wall constituents, such as neutral detergent fibre (NDF), acid detergent fibre (ADF), lignin, cellulose and hemicellulose of feeds were estimated by the methods of (8).

In-vitro gas production method

The samples' blended ratios were analysed for *in-vitro* gas production and digestibility according to the method of (9). Rumen contents were squeezed through four layers of cheesecloth kept in a water bath at 39 °C until incubation took place. Representative samples of the mixtures (2.5g DM) were taken in a separate bottle having 0.05 litres rumen liquor, 0.2 litres buffer solution (Buffer solution: KCl 0.57 g/L, MgSO4. 7H2O 0.12 g/L, NaCl 0.47 g/L, CaCl2 0.04 g/L, Na2HPO4.12H2O 9.30 g/L, NaHCO3 9.80 g/L, Cysteine 0.25 g/L (10, 9). The bottles were kept in a water bath at 39 °C. The samples were run for in-vitro dry matter digestibility at 6, 9, 12, 15, 18, 21 and 24 hours of incubation.

Data analysis

The data collected were subjected to a one-way analysis of variance procedure of the General Linear Model of (11). Significant means were separated using the Duncan New Multiple Range Test.

RESULTS AND DISCUSSION

Chemical composition of WO: WSBR blended ratios

There were significant differences ($p<0.05$) among all of the chemical components across the blended ratios except for crude protein, Metabolizable energy and cellulose contents (Table 1). The dry matter contents of ratios 1:1, 1:2, 1:2.5, 1:3 and 1:3.5 were significantly ($p<0.05$) higher than the 1:1.5 ratio. The crude fibre content significantly increased ($p<0.05$) as the blended ratios increased. The carbohydrate fractions of 1:2, 1:2.5 and 1:3 were significantly higher ($p<0.05$) than those of ratios 1:1 and 1:1.5. The neutral detergent fibre was significantly higher ($p<0.05$) in ratio 1:3.5 than in other blended ratios. The ratio 1:3.5 had significantly higher ($p<0.05$) neutral detergent fibre, acid detergent fibre and acid detergent lignin than the other blended ratios. The moisture content in this study was less than 12% desirable pertaining to good keeping quality of feedstuffs (12). The crude protein concentrations of the blended ratios were far lower than the recommended value of 7-8% for ruminants to have an active and healthy rumen environment (13). The crude fibre in this study was higher than 7.61 - 10.00 reported by (14) for blended ration of pineapple wastes and wheat offal but lower than 24.70 reported for rice bran by (15). The carbohydrate fraction was slightly lower than 59.17 – 65.66 revealed by (16) for recycled cashew pulp as animal feed. The NDF values in this study were lower than 72.62 -81.86 for maize fodder (17), while the ADF was higher than 46.45 reported for corn bran (13). The Hemicellulose content in this study was lower than 17.24 – 28.59 for agro-industrial by-products, however, within 13.96 – 19.51 for grains reported by (18).

In-vitro gas production and digestibility of WO: WSBR blended ratios

In-vitro gas production and digestibility of WO: WSBR blended ratios

There was no significant difference (p<0.05) in gas production at 3 hours across the blended ratios (Table 3). Conspicuously, the gas production was significantly highest (p<0.05) ratio of 1:1 from 3 - 24 hours of in-vitro digestibility, compared to other ratios. Furthermore, the methane and carbon dioxide gas produced were significantly higher (p<0.05) in the ratio 1:1 than in other ratios. The measurement of *in vitro* gas production is a good indicator to predict rumen degradability efficiency and metabolizable energy of animal feed (19). The highest rate of fermentation for ratios 1:1 may be due to the high concentration of fermentable carbohydrate in it, which is a good substrate for rumen microbes for gas production (20). The 24-hour gas production was lower than 32.67 – 40.35 reported by (17) for ensiled Elephant grass. The volume of methane produced in this study was lower than 5.50 for corn bran (15) but similar to the value of 20, who compared with wheat bran and palm kernel. Methane production is of no use to ruminants but a big waste of energy and in fact, it contributes to greenhouse emission (21) in which its production to the atmosphere should be reduced. The digestibility in this study was comparable with 47.67 -61.41 reported by (17).

Table 1: Chemical composition of wheat offal and wet sorghum brewers' residue blended ratios.

Parameters (%)	1:1	1:1.5	1:2	1:2.5	1:3	1:3.5	P value	SEM
Dry matter	97.11^{a}	91.66^{b}	96.94^{a}	97.05^{a}	98.26^{a}	98.20^{a}	0.0040	0.70
Crude protein	2.72	2.52	2.59	2.88	2.52	3.21	0.5176	0.11
Crude fibre	13.84^{d}	14.98^{c}	14.75^{c}	16.21^{b}	15.86^{b}	19.57^{a}	0.0006	0.49
Ether extract	8.77^{b}	9.66^{b}	9.77^{b}	9.99^{b}	9.53^{b}	10.19^{a}	0.0573	0.21
Ash	16.38^{a}	8.06^{b}	8.11^{b}	7.62^{b}	8.59^{b}	8.61^{b}	<0.0001	0.92
Carbohydrate	51.72^{c}	51.08^{c}	61.96^{a}	61.12^{a}	61.09^{a}	57.13^{b}	<0.0001	1.36
GE (KJ/kg)	29.07.50	2886.00	2860.00	2835.50	2821.00	2892.50	0.8231	18.49
NDF	66.10^{ab}	64.88^{b}	66.83^{ab}	66.21^{ab}	65.76^{ab}	67.24^{a}	0.0438	0.28
ADF	51.28^{c}	47.81^{d}	53.72^{b}	50.84^{c}	48.38^{d}	54.21^{a}	0.0007	0.77
ADL	17.65^{bc}	16.56^{c}	18.87^{ab}	16.93^{c}	15.22^{d}	20.28^{a}	0.0016	0.51
Hemicellulose	16.22^{ab}	17.89^{a}	16.26^{b}	17.07^{a}	17.15^{a}	14.67^{b}	0.0190	0.37
Cellulose	32.13	30.40	31.47	33.19	31.66	32.86	0.2958	0.36

^{abcd} Means with different superscripts are significantly different (p<0.05)

Table 3: *In-vitro* gas production and digestibility of wheat offal and wet sorghum brewer's residue blended ratios.

Parameters	1:1	1:1.5	1:2	1:2.5	1:3	1:3.5	P value	SEM
3 hours	2.33	1.33	1.00	2.33	1.00	2.33	0.0898	0.21
6 hours	4.33^{a}	3.67^{ab}	2.33^{b}	4.00^{b}	2.67^{ab}	4.00^{b}	0.1206	0.26
9 hours	6.67^{a}	5.67^{ab}	4.67^{b}	6.33^{a}	4.67^{b}	6.00^{a}	0.1206	0.26
12 hours	9.67^{a}	7.67^{bc}	6.67^{c}	8.33^{b}	6.67^{c}	8.00^{b}	0.0011	0.28
15 hours	13.00^{a}	10.00^{b}	7.67^{d}	10.67^{b}	8.67^{c}	10.00^{b}	0.0006	0.45
18 hours	16.00^{a}	12.33^{b}	8.33^{d}	13.00^{b}	10.33^{c}	12.00^{b}	<0.0001	0.59
21 hours	18.00^{a}	14.67^{b}	9.33^{e}	14.67^{b}	11.33^{d}	13.33^{c}	<0.0001	0.68
24 hours	20.33^{a}	17.33^{b}	9.67^{f}	15.33^{c}	11.67^{e}	13.67^{d}	<0.0001	0.87
Methane	4.33^{a}	4.00^{a}	2.00^{c}	4.00^{a}	3.00^{b}	3.00^{b}	0.0308	0.63
Carbodioxide	9.00^{a}	7.67^{b}	4.67^{d}	6.33^{c}	5.00^{d}	6.00^{c}	0.0344	1.19
DM Digestibility (%)	35.77^{f}	41.12^{e}	58.67^{a}	43.67^{d}	53.70^{b}	51.52^{c}	<0.0001	1.92

^{abcd} Means with different superscripts ae significantly different (p<0.05)

CONCLUSION AND APPLICATION

It could be concluded that increasing blended ratios of wheat offal and wet sorghum brewer residue led to improved nutrient contents and in-vitro dry matter digestibility.

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