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Nutrient and Anti-Nutritional Composition of Crop Residues and Kitchen Wastes Fed to Small Ruminants in Choba, Port Harcourt

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ABSTRACT

The study was carried out to determine the nutrient composition, anti-nutritional factors and mineral content of crop residues and kitchen wastes fed to small ruminants in Choba and to ascertain the best crop residues and kitchen wastes suitable to these animals.

The samples of crop residues and kitchen wastes commonly fed to small ruminants were collected from farms, home of farmers and restaurants around the study area.

They were dried and analysed for moisture content, crude protein, crude fibre, ether extract, and ash and nitrogen free extract. The anti-nutritional factors (saponins, tannins and phytate) were checked and the mineral content (calcium, potassium, phosphorus, magnesium and sodium) were also analysed. The data obtained were subjected to analysis of variance (ANOVA).

The results gotten showed that the nutrient composition, anti-nutritional factors and mineral content were significantly different (P<0.05). These crop residues and kitchen wastes (maize cob, vegetable residues, ripe plantain peels, cassava leaves, cassava peels, yam peels, cocoyam peels and banana peels) showed low levels of anti-nutrients within tolerable levels (3% for saponins and 2% for tannins) for small ruminants. Cowpea pod (4.85%), pineapple wastes (5.02%) and banana peels (3.00%) had tannin levels higher than the recommended 2% for small ruminants and as such need further processing to reduce their tannin levels. All the crop residues and kitchen wastes had adequate levels of minerals especially calcium and phosphorus and their nutrient compositions fell within the requirements for small ruminants. Therefore, these crop residues and kitchen wastes should be used for small ruminant feeding.

INTRODUCTION

Small ruminants are of economic importance to peasant farmers. In Nigeria, they are known to roam around and fend for themselves on natural pastures and kitchen wastes, some of which contain low protein, high fibre and lignin (Areghare, 2000). This is a constraint especially during the dry season when the crude protein content of natural grasses go down drastically (Sarwatte et al., 2004). In many countries in the tropics, ruminants survive mainly on crop residues (Mahesh and Mohini, 2013). Some crop residues are classified as kitchen wastes (Adamu et al., 2010). Kalio et al. (2013) reported that feeding small ruminants with crop residues made them heavier and healthier. Feeding crop residues and agro – industrial by – products to ruminants have resulted to appreciable weight gains (Onyeonagu and Njoku, 2010). Out of the total feed energy needed by ruminants, 25% is supplied by crop residues, agro – industrial by – products and animal wastes (Yohanna et al., 2015). Nevertheless, crop residues have low mineral content especially phosphorus and are deficient in vitamins. They are known to have some anti – nutritional factors that limit their usage (Onyeonagu and Njoku, 2010). Some of the crop residues and kitchen wastes include cowpea pod, maize cops, cocoyam peels, pineapple wastes, vegetable residues, yam peels, cassava leaves, cassava peels, banana peels, ripe plantain peels etc.

This study was therefore aimed at determining the nutrient and anti nutritional factors of crop residues and kitchen wastes fed to small ruminants in Choba, Rivers State.

MATERIALS AND METHODS

Study area

This study was carried out at the University of Port-Harcourt Research and Demonstration farm and its environs, Choba, Obio-Akpor local government area of Rivers State in the South-South geopolitical zone of Nigeria. It is situated on latitude $4^0$53" 14" North and longitude $6^0$54"00" East of the equator (Ijeomah *et al.,* 2013). It falls within the humid rain forest zone of West Africa within a long duration of rainfall (March-November) and a very short dry season. Temperature ranges from 25^0C - 28^0C and a very high relative humidity (above 80%).

Collection of samples

Crop residues and kitchen wastes commonly fed to small ruminants in Choba were used in this study. These include; cassava peels, yam peels, cassava leaves, cowpea pod husk, maize cob, banana peels, ripe plantain peels, cocoyam peels, pineapple waste and vegetable residues (cabbage, carrot, water melon). These crop residues and kitchen wastes were collected from farms, home of farmers and restaurants within Choba, Port-Harcourt. They were chosen according to the availability of waste during the study period.

Analytical procedure

Samples of crop residues and kitchen wastes were dried and taken to the laboratory for proximate analysis. The Moisture content (MC) was determined by drying the samples at 105℃ for four hours and ash by igniting the samples in muffle furnace at 550℃ for two hours brought out and allowed to cool in a desiccator before weighing and crude protein content was determined using Kjeldahl method of nitrogen determination. Ether extracts (EE) were determined using the soxhlet extractor. Crude fibre (CF) was determined using the weende's method and nitrogen free extract was determined by adding crude protein, fat, water, ash, and fibre and the sum subtracted from 100, the difference is NFE = DM– %Moisture + %CF + %CP + % EE + %Ash. The anti-nutritional factors (saponins, tannins and phytate) and the mineral content (calcium, potassium, sodium, magnesium and phosphorus) were also analysed. The presence of Tannins was determined by adding 2ml of 5% ferric chloride to plant extract, the presence of saponins was determined by the addition of 2ml distilled water to plant extract and shaken in a graduated cylinder for 15minutes and phytate was determined by adding equal volume of chloroform to plant extract and subjecting with few drops of concentrated sulphuric acid. Sodium, potassium, calcium and magnesium were determined with an automatic atomic absorption spectrophotometer and total phosphorus was determined spectrophotometrically after incubation with molybdo-vanadate solution (AOAC, 2004).

Data Analysis

The obtained data were subjected to one way (ANOVA) analysis of variance to determine the variation among the samples. Significant differences among the samples were assessed using post hoc test. The Statistical Package for Social Sciences Program (SPSS) was used for this analysis.

RESULT

Nutrient composition of crop residues and kitchen: The result of the nutrient composition of crop residue and kitchen waste fed to small ruminants in Choba, Port-Harcourt is shown in table 1 below. The results obtained were significantly different. Plantain peels had the highest moisture content (7.28±0.03%) while pineapple peels had the least (4.24±0.21%). Vegetable residues

had the highest ash content (26.90±0.08%) while maize cob had the least (7.94±0.25%). Banana peels had the highest ether extract (6.20±0.17%) while cocoyam peels had the least (1.06±0.29%). Cassava leaves had the highest crude protein content as (27.83±0.55) while cocoyam peels had the least (5.22±0.00%). Maize cob had the highest crude fibre content (44.70±0.00%) while yam peels had the least (17.25±0.01%). Yam peels had the highest nitrogen free extract (58.80±1.84%) and vegetable peelings have the least as (19.06±0.21%).

Table 1: Nutrient composition of crop residues and kitchen wastes fed to small ruminants

	Ingredients (%)					
Samples	**MC**	**Ash**	**EE**	**CP**	**CF**	**NFE**
Cowpea pod	6.52±0.45^{ab}	7.97±0.01^{g}	2.33±0.58^{bc}	5.67±0.00^{ef}	35.99±0.00^{b}	41.51±0.12^{d}
Maize cob	5.37±0.16^{bcd}	7.94±0.25^{g}	2.51±0.00^{b}	5.22±0.00^{f}	44.70±0.00^{a}	34.25±0.42^{f}
Cocoyam peels	6.32±0.32^{abc}	12.02±0.33^{d}	1.06±0.29^{d}	9.45±0.34^{c}	18.77±0.00^{g}	52.76±1.00^{b}
Pineapple waste	4.24±0.12^{d}	9.31±0.28^{f}	2.43±0.04^{b}	6.09±0.42^{ef}	29.71±0.00^{d}	48.21±0.45^{c}
Vegetable residues	6.38±0.04^{ab}	26.90±0.08^{a}	1.24±0.30^{cd}	13.31±0.22^{b}	33.04±0.28^{c}	19.06±0.21^{h}
Yam peels	5.40±0.68^{bcd}	9.77±0.47^{ef}	2.25±0.68^{bc}	6.52±0.00^{e}	17.25±0.01^{h}	58.80±1.84^{a}
Cassava leaves	4.63±0.30^{cd}	10.72±0.05^{e}	2.76±0.30^{b}	27.83±0.55^{a}	23.67±0.00^{e}	30.38±0.00^{g}
Cassava peels	6.87±0.79^{ab}	8.07±0.02^{g}	2.31±0.16^{bc}	6.08±0.43^{ef}	36.38±0.64^{b}	40.27±2.01^{d}
Banana peels	6.31±0.92^{abc}	19.45±0.57^{b}	6.20±0.17^{a}	9.33±0.22^{c}	22.47±0.00^{f}	36.23±0.40^{ef}
Ripe Plantain peels	7.28±0.03^{a}	17.96±0.83^{c}	5.94±0.23^{a}	7.85±0.45^{d}	22.43±0.00^{f}	38.52±0.57^{de}

$^{a-j}$Means on the same row with different superscript differ significantly (P<0.05).
MC=moisture content, EE=ether extract, CP=crude protein, CF=crude fibre and NFE=nitrogen free extract.

Anti-nutritional factors of crop residues and kitchen waste

Table 2 shows the anti-nutritional factors of these crop residues and kitchen waste. Result gotten were significantly different (P<0.05). Pineapple wastes had the highest saponins value (3.10±0.01%) and the lowest (0.67±0.01%) was for cocoyam peels. The sample with the highest mean value for tannins was pineapple wastes having 5.02±0.01% and the least was in maize cob having 0.03±0.01% and cassava peels had the highest phytate value (9.01±0.01mg/g) and cowpea pod had the least (0.02±0.02mg/g).

Table 2 Anti nutritional factors of crop residues and kitchen wastes fed to small ruminants.

	Anti nutritional factors		
Samples	**Saponins (%)**	**Tannins (%)**	**Phytate (Mg/kg)**
Cowpea pod	1.97±0.01^{f}	4.85±0.00^{c}	0.02±0.02^{j}
Maize cob	2.09±0.01^{e}	0.03±0.01^{j}	0.72±0.01^{g}
Cocoyam peels	0.67±0.01^{j}	1.97±0.01^{g}	8.17±0.01^{c}
Pineapple waste	3.10±0.01^{a}	5.02±0.01^{e}	8.95±0.01^{b}
Vegetable residues	2.78±0.01^{c}	2.23±0.01^{b}	2.44±0.01^{c}
Yam peels	2.97±0.01^{b}	1.68±0.01^{d}	0.04±0.01^{i}
Cassava leaves	1.72±0.01^{g}	0.61±0.01^{h}	2.01±0.01^{f}
Cassava peels	0.76±0.00^{i}	0.31±0.01^{i}	9.21±0.01^{a}
Banana peels	0.87±0.00^{h}	3.00±0.00^{a}	0.63±0.01^{h}
Ripe Plantain peels	2.46±0.01^{d}	2.99±0.01^{f}	2.45±0.01^{d}

$^{a-j}$Means on the same row with different superscript differ significantly (P<0.05).

Mineral content of crop residues and kitchen waste

Table 3 shows the mineral content of the crop residues and kitchen waste. The results gotten were significantly different (P<0.05). Cowpea pod had the highest phosphorus (188.80±0.01%) and maize cob had the least (0.87±0.01%). Maize cob has the highest sodium (470.23±0.01%) while cassava leaves had the least (0.04±0.00%). Cowpea pod has the highest calcium (407.21±0.01%) while vegetable residues had the least (0.17±0.01%). Cowpea pod has the highest value of magnesium as (418.20±0.01%) and vegetable residues and cassava leaves have the least as (0.72±0.01%, 0.72±0.00% respectively). Cocoyam peels has the highest potassium as (479.11±0.01%) and cassava peels has the least as (1.96±0.01%).

Table 3 Mineral content of crop residues and kitchen wastes fed to small ruminants.

	Minerals (Mg/g)				
Samples	**P**	**Na**	**Ca**	**Mg**	**K**
Cowpea pod	188.80±0.01[a]	121.09±0.00[f]	407.21±0.01[a]	418.20±0.01[a]	309.11±0.01[c]
Maize cob	0.87±0.01[j]	470.23±0.01[a]	217.90±0.00[b]	18.80±0.01[b]	401.90±0.00[b]
Cocoyam peels	69.73±0.01[d]	433.12±0.01[b]	49.12±0.002[f]	33.06±0.01[d]	479.11±0.01[a]
Pineapple waste	15.76±0.01[g]	209.90±0.01[e]	92.02±0.01[e]	70.23±0.01[c]	130.31±0.01[d]
Vegetable residues	1.04±0.01[i]	28.67±0.01[h]	0.17±0.01[j]	0.72±0.01[f]	56.71±0.01[f]
Yam peels	27.06±0.00[e]	105.21±0.01[g]	55.90±0.01[g]	1.24±0.01[f]	125.43±0.01[e]
Cassava leaves	5.09±0.00[h]	0.05±0.01[i]	1.68±0.01[i]	0.78±0.01[f]	1.96±0.01[j]
Cassava peels	19.49±0.01[f]	0.04±0.00[i]	1.90±0.01[h]	0.72±0.01[f]	6.67±0.01[i]
Banana peels	121.73±0.02[c]	229.76±0.01[d]	109.90±0.00[d]	7.59±6.51[f]	34.87±0.01[h]
Ripe Plantain peels	150.21±0.01[b]	328.30±0.01[c]	187.09±0.00[c]	18.80±0.01[e]	41.76±0.02[g]

[a-j]Means on the same row with different superscript differ significantly (P<0.05).
P=phosphorus, Na=sodium, Ca=calcium, Mg=magnesium and K=potassium

DISCUSSION

The nutrient composition of crop residues and kitchen wastes revealed their potential as sources of feed for small ruminants. They had low moisture content and appear adequate as they can serve as supplements to other conventional feedstuffs. The crude protein of the feedstuffs in this study was higher than the crude protein reported by Babayemi *et al.(*2010). The crude protein content of cassava leaves in this study was higher than that reported by Ukanwoko and Ibeawuchi (2014). The crude protein content reported for yam peels, cassava peels and ripe plantain peels by Kalio et al. (2013) compares favourably with those reported in this study. Vegetable residues were reported to have up to 12% crude protein (Esteban et al., 2007) which is higher than the one reported in this study. The differences in the nutrient composition of crop residues and kitchen wastes can be due to differences in sampling, procedures employed during analysis (Gizzi and Givens, 2004), stage of growth, soil type, maturity, environment and differences in variety (Promkot and Wanapat, 2004). The crude protein content of crop residues and kitchen wastes in this study meets the requirement need of small ruminants as it is not less than 6% which will provide ammonia required by rumen microorganisms to support optimum microbial activity. They also contain reasonable amount of crude fibre which can be a good source since digestibility is dependent on the cell wall constituents (fibre), especially NDF (neutral detergent fibre) and lignin (Barkshi and Wadhwa, 2004). When crude fibre content is high, the energy and protein contents are lower because crude fibre is considered indigestible. High levels of NFE (Nitrogen free extract) were also contained in these feedstuffs but are low when compared to the findings of (Okareh *et al.,* 2015). Nitrogen free extract reflects the energy content of the sample thus, this will supply reasonable amount of energy when fed to small ruminants because inadequate energy will depress reproductive performance of extensively and intensively managed goat and sheep (Banerjee, 1991).

Anti - nutritional factors reduce the full utilization of crop residues and kitchen wastes (Soetan and Oyewole, 2009). The most widely occurring ones are saponins and tannins (Akande et al., 2010). The saponin content of all the crop residues and kitchen wastes fell within the 3% safe range reported by Anhwange et al. (2009). He also reported a saponin content of 24% for banana peels, which is higher than the saponin content reported for banana peels in this study. A saponin content of 1.05±03% reported by Onyeonagu and Njoku (2010) for cassava peel is higher than the one reported in this study for same crop residue where as Isah et al. (2011) reported a favourable saponin content of 0.198%. The saponin content reported in this study for maize cob is lower than the saponin content of 3.86±0.032% reported by Olagunju et al. (2013). Akinsanmi et al. (2015) reported a saponin content of 5.99±0.02% for ripe plantain peels which is higher than that reported in this study for same crop residue. In sheep and goat, tannin level of 2% has been reported to have adverse effects on digestibility (Onyeonagu and Njoku, 2010). As such further processing ought to be carried out on cowpea pod, pineapple wastes and banana peels to reduce their tannin levels to tolerable level for small ruminants. The tannin level reported in this study for cassava peel is lower than 2.219% reported by Onyeonagu and Njoku (2010) but higher than 0.024% reported by Isah et al. (2011) for cassava peel. The tannin level of 0.028±0.008% reported by Olagunju et al. (2013) compares favourably with that reported in this study for maize cob. Akinsanmi et al. (2015) reported a higher tannin level (4.24±0.01%) than the one reported in this study for ripe plantain peels. Oresegun et al. (2016) reported a tannin level of 0.77% which is higher than the one reported in this study for cassava leaves. The phytate level of crop residues and kitchen wastes reported in this study is within the normal range for small ruminants. Oresegun et al. (2016) reported 1.14% phytate level for cassava leaves which is higher than a phytate level of 2.01% reported in this study for same crop residue. Isah et al. (2011) reported 0.263% phytate level for cassava peels and this is lower than 9.01%

phytate level reported in this study for cassava peels. A 0.02±0.02% phytate level reported for maize cob in this study is lower than 1.32±0.01% phytate reported by Olagunju et al. (2013).

The most important minerals in small ruminants are calcium and phosphorus. They are needed in small amounts. Deficiencies, excesses and imbalances of minerals can limit animal performance and lead to deficiency diseases. The calcium content of plantain peel reported in this study is higher than the calcium content of 86.00±0.7Mg/g reported by Akinsanmi et al. (2015). He also reported a phosphorus content of 214±1.18Mg/g for plantain peel which is high above the one reported in this study for plantain peel. Lopez et al. (2008) reported a potassium content of 78.10Mg/g for banana peel which is higher than that reported for banana peel in this study. The calcium content of cassava leaves in this study is higher than the calcium content of 0.98 reported by Mokemiabeka et al. (2011) for cassava leaves. The calcium content of yam peel in this study is higher than that (45.50+0.23) reported by Lawal et al. (2014).

CONCLUSION AND RECOMMENDATION

Since small ruminants are of great benefit to this environment, efforts should be intensified to improve production and productive performance of these animals using these feedstuffs which will meet their nutritional need. The crop residues and kitchen wastes (maize cob, vegetable residues, ripe plantain peels, cassava peels, cassava leaves, yam peels, cocoyam peels) have shown low levels of anti-nutrients within tolerable levels for the animals. Cowpea pod, pineapple wastes and banana peels had tannin levels higher than 2% tolerable level for small ruminants. They should be processed before they are fed to small ruminants. The crop residues and kitchen wastes in this study had low to moderate and adequate levels of important minerals and their nutrient composition fell within the requirements for small ruminants. Therefore, they are recommended for small ruminant feeding.

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