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Research Article

Chemical Composition of Differently Treated Forms of Cocoa POD Husk Meal (CPHM)

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Abstract: The research aimed at determining the chemical compositions of differentforms of cocoa pod husk meal using freshly broken composite cocoa pod husks, which were washed, sun-dried and milled to produce Cocoa Pod Husk Meal (CPHM). The resultant meal was divided into three portions: the raw (RCPHM), Fermented (FCPHM) and hot-water treated (HCPHM), respectively. Results obtained showed significant ($p<0.05$) differences in proximate and mineral compositions in the differently treated forms of CPHM. The RCPHM recorded the highest crude protein (9.37%) and crude fibre (61.80%) contents compared to the 7.70 and 8.94% CP and 57.42 and 53.37% CF contents, respectively in the FCPHM and HCPHM. The ether extract, ash and Nitrogen Free Extract (NFE) values were however highest in HCPHM, followed by FCPHM and RCPHM in that order. The ADF and NDF values were highest in the FCPHM (73.09 and 79.45%, respectively), low in RCPHM (68.64 and 75.08%, respectively) and lowest in the HCPHM (64.60 and 71.09%, respectively). The RCPHM recorded the highest calcium (11.16g/kg) content, followed by HCPHM (7.23g/kg) and least in FCPHM (5.65g/kg). The magnesium, phosphorus and potassium contents recorded a similar trend as calcium in the RCPHM. However, sodium (0.74 g/kg) was highest in the HCPHM, followed by FCPHM (0.48 g/kg) and least in RCPHM (0.35 g/kg). Results from these analyses have shown that CPHM in the raw, fermented and hot-water treated forms have marginal differences in chemical compositions. Fermentation and hot-water treatedforms did not however improve the nutrient contents appreciably compared to the raw CPHM.

Keywords: Cocoa, composition, fibre, husk, mineral, proximate

INTRODUCTION

The utilization of agro by-products and farm wastes as alternative feed resources in livestock feeding trials has been the current trend in animal production. Some of these by-products include wheat and rice offals, maize bran and brewers dried grains; which can replace conventional feed resources in animal diets without deleterious effects (Atteh and Opawande, 2000; Awesu *et al*., 2000; Afolayan, 2004). However, the current prices of these by-products have escalated as a result of high demand; thereby necessitating the quest for cheaper alternatives for the purposes of promoting optimum performance of animals and reduction in the overall cost of production (Tuluen and Patrick, 2007).

One of the agro by-products that has been utilized in animal feeding trials with optimum results is cocoa pod husk meal (Barnes *et al*., 1985; Adomako and Osei-Amaning, 1996; Adomako *et al*., 1999; Agyente-Badu and Oddoye, 2005). Reports have shown that each ton of dry cocoa (beans) represents ten (10) tonnes of cocoa pod husk (Lopez *et al*., 1984). Presently, cocoa pod husks are causing environmental pollution problem in cocoa producing areas of the world. They serve as potential sources of disease transmission when used as mulch in cocoa farms. However, when properly processed to reduce the theobromine content and promote digestibility; the cocoa pod husk in meal form can be used in livestock feed formulation as a valuable ingredient.

Several methods have been adopted in the treatment and processing of cocoa pod husk meal for the purpose of animal feed formulation. Some of these methods include hot-water treatment (Adegbola and Omole, 1973); alkali treatment (Isika *et al*., 2012); enzyme (mannanase) treatment (Bedford, 2000; Zakaria *et al*., 2008); urea treatment (Olubamiwa and Akinwale, 2000; Iyayi *et al*., 2001); fungal treatment (Adamafio *et al*., 2011) and microbial detheobromination (Mazzafera, 2002). These treatment procedures are somehow expensive and complex for the local farmers to adopt, hence the need to devise cheaper and less

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cumbersome methods like fermentation and hot- water treatment of cocoa pod husk meal and further ascertaining their nutrient/chemical compositions vis –a –vis their suitability for in animal feeding trials.

This study was therefore designed to determine the chemical status (proximate and mineral compositions) of the differently treated forms (raw, fermented and hot-water) of cocoa pod husk meal in a tropical environment.

MATERIALS AND METHODS

Location of the study: The chemical analyses of the cocoa pod husk meal samples were carried out in the Teaching and Research Laboratory, Department of Animal Science, University of Calabar, Calabar, Nigeria. Calabar is located at latitude 3^0N and longitude 7^0E, with an average rainfall ranging from 3000-3500mm per annum and average daily temperature of 25-30°C as well as relative humidity of 70-80% (Akpan *et al*., 2002).

Collection of cocoa pods and treating of Cocoa pod husk meal: Freshly broken composite cocoa pods (from improved/hybrid cocoa varieties-CRINc1-8, WACRI 11 hybrids and F3-Amazons) were obtained from the fermentary units of the Cocoa Research Institute of Nigeria (CRIN) sub-station at Ajassor, Ikom LGA of Cross River State, Nigeria. The broken pods were washed and sun-dried for 14 days, bulked and milled with hammer mill to obtain Cocoa Pod Husk Meal (CPHM) as earlier described by Teguia *et al*. (2004). The resultant meal was divided into 3 portions: the first untreated portion was the raw CPHM; the second portion was the fermented CPHM while the third portion was the hot-water treated CPHM, respectively. CPHM for the fermented treatment was thoroughly mixed with 60% water, relative to its weight as ascertained in the *in vitro* fermentation study (Bello *et al*., 2012) and bagged in air-tight polythene bags; allowed to ferment anaerobically for 3 days under room temperature. Thereafter, the fermented bags were opened and contents shade dried for 5 days, before being packed, bagged and stored in a cool dry place for use in the analysis. The third portion was treated with hot water that was boiled to 100°C for 15 min (Odunsi *et al*., 1999; Olubamiwa *et al*., 2006; Adeyina *et al*., 2010), which was later drained, shade dried and stored for the laboratory analysis.

Chemical assay:

Proximate analysis: The proximate compositions of the differently treated forms of cocoa pod husk meal were determined using the standard A.O.A.C (2000) methods of analysis as summarized thus: Dry Matter (DM) content was based on the weight loss after 24 h in an oven at 100°C; Nitrogen (N) content by the macro kjeldahl method, where Crude Protein (CP) was calculated as N×6.25. The ash content was determined as the residue left after incinerating the sample at 600°C for 3 h in a muffle furnance. The analyses for proximate fractions were done in triplicate for each sample.

Mineral analysis: The raw, fermented and hot-water treated samples of CPHM were subjected to mineral analysis, followed by quantitative deter minationsaccording to methods described by Swain (1999). Potassium and sodium were determined by flame photometry using the flame photometer at 967 and 589 nmwavelengths, respectively. Calcium and Magnesium were determined using the Perkin-Elmer (model 403) Atomic Absorption Spectrophotometer (AAS). Calcium was determined by first treating the digest with 1% lanthanum solution before using the appropriate lamp. Phosphorus was estimated by the automated procedure which utilizes the reaction between phosphorus and molybdovanadate to form phosphomolybdovanadate complex which was measured colorimetrically at 450 nm using Technicon Autoanalyser (Pearson and Cox, 1976). The analyses for minerals were done in triplicates for each of the samples.

RESULTS

Chemical composition of differently treated forms of cocoa pod husk meal: The proximate composition and fibre fractions of the raw, fermented and hot-water treated CPHM are summarised in Table 1. All parameters, except the Total Digestible Nutrients (TDN) recorded significant ($p<0.05$) differences between processing methods of CPHM. The CP values were 9.37, 7.70 and 8.94% for the raw, fermented and hot-water treated CPHM, respectively. The raw CPHM recorded the highest CF content (61.80 %), followed by the fermented CPHM (57.42%) and the least value was recorded in the hot-water treated CPHM (53.37%). The trend was however reversed for ether extract (EE) and ash and Nitrogen Free Extract (NFE) contents as the highest values were recorded in the hot-water treated CPHM, followed by the fermented CPHM and least in the raw CPHM. The EE values were 8.83, 9.52 and 11.68% while the values for ash content were 9.30, 10.80 and 10.85% and NFE values were 10.70, 14.56 and 15.16%, respectively, for raw, fermented and hot-water groups. The Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) values were highest in the fermented CPHM (73.09 and 79.45%, respectively), followed by the raw CPHM (68.64 and 75.08%, respectively) and least in the hot-water treated CPHM (64.60 and 71.09%, respectively).

Table 1: Proximate composition and fibre fractions of raw and processed cocoa pod husk meal

	Test Ingredient			
Parameter (%)	RCPHM	FCPHM	HCPHM	S.E.M
Dry Matter	94.60[a]	84.40[b]	85.28[b]	3.27
Crude Protein	9.370[a]	7.70[b]	8.94[a]	0.50
Crude Fibre	61.80[a]	57.42[b]	53.37[c]	2.44
Ether extract	8.830[b]	9.52[b]	11.68[a]	0.86
Ash	9.300[b]	10.80[a]	10.85[a]	0.51
Nitrogen free extract	10.70[b]	14.56[a]	15.16[a]	1.40
ADF	68.64[b]	73.09[a]	64.60[c]	2.46
NDF	75.08[b]	79.45[a]	71.09[c]	2.42
TDN	1.520	1.28	1.430	0.07

[a,b, c]: Means on the same row with different superscripts are significantly different ($p<0.05$)

Table 2: Mineral composition of raw and processed cocoa pod husk meal

Mineral (g/kg)	RCPHM	FCPHM	HCPHM	S.E.M
Calcium (Ca)	11.16[a]	5.65[b]	7.23[b]	1.64
Magnesium (Mg)	2.79[a]	2.44[a]	1.53[b]	0.38
Phosphorus (P)	0.51[a]	0.30[b]	0.47[a]	0.06
Potassium (K)	1.98[a]	1.07[b]	1.15[b]	0.29
Sodium (Na)	0.35[b]	0.48[b]	0.74[a]	0.11

[a,b]: Means on the same row with different superscripts are significantly different ($p<0.05$)
RCPHM: Raw Cocoa Pod Husk Meal
FCPHM: Fermented Cocoa Pod Husk Meal
HCPHM: Hot-water treated Cocoa Pod Husk Meal

Mineral composition of cocoa pod husk meal: The mineral composition values of the different forms of cocoa pod husk meal are presented in Table 2. The mineral composition of the differently processed forms of CPHM recorded significant ($p<0.05$)differences. The Raw CPHM recorded the highest mineral values for calcium (11.16 g/kg), magnesium (2.79 g/kg), phosphorus (0.51 g/kg) and potassium (1.98 g/kg) and the least in sodium (0.35 g/kg) content. The hot- water treated CPHM was next in calcium content (7.23 g/kg) and the least value was recorded in the fermented CPHM (5.65 g/kg). The fermented recorded the following values for (2.44, 0.30, 1.07 and 0.48 g/kg) magnesium, phosphorus, potassium and sodium, respectively. The hot-water treated CPHM had magnesium (1.53g/kg), phosphorus (0.47g/kg), potassium (1.15g/kg) and sodium (0.74g/kg), respectively.

DISCUSSION

The proximate composition and fibre fractions of the raw, fermented and hot-water treated cocoa pod husk meal (Table 1) recorded significant ($p<0.05$) differences between the processed methods. The dry matter content in the raw cocoa pod husk meal (94.60%) was almost similar to the value (94.18%) reported by Onifade *et al*. (1999) for the raw untreated form. The dry matter values for the fermented cocoa pod husk meal (84.40%) and hot-water treated cocoa pod husk meal (85.28%) are slightly lower than the value (88.96%) for processed forms of cocoa pod husk meal reported by Alamowor *et al*. (2009). The raw cocoa pod husk meal recorded highest values in dry matter, crude protein and crude fibre, followed by the hot-water treated cocoa pod husk meal. The fermented cocoa pod husk meal recorded the least values in dry matter and crude protein contents. The ether extract, ash, nitrogen free extract and fibre fractions were within the values reported by Marcel *et al*. (2011) for cocoa pod husk meal. The ash content of the raw (9.30%), fermented (10.80%) and hot-water treated (10.85%) cocoa pod husk meal, respectively were slightly higher than the value of 9.07% reported by Alamowor *et al*. (2009) and a bit lower than the value of 11.14% reported by Onifade *et al*. (1999) for unprocessed cocoa pod husk meal. The proximate values obtained in this study are comparable to those reported by Hamzat and Adeola (2011) for dry matter and ash contents of cocoa pod husk, but fairly higher in crude protein, crude fibre, acid detergent fibre, neutral detergent fibre and total digestible nutrients. The differences in values could be attributed to the different processing methods of cocoa pod husks adopted in the separate studies. Nutritionally, the results revealed that cocoa pod husk meal (irrespective of the processing method) is low in nutrient contents (especially crude protein), but high in crude fibre. This is in agreement with the findings of Oddoye *et al*. (2010) who reported that cocoa pod husk is not too nutritious, due to its low metabolizable energy, crude protein and high crude fibre contents.

The mineral composition of the cocoa pod husk meal in this study recorded significant ($p<0.05$) differences between the processed forms (Table 2). The major minerals in cocoa pod husk meal and other cocoa by-products are phosphorus and magnesium (Mahyuddin, 1995); calcium, phosphorus, potassium and sodium (Marcel *et al*., 2011). The raw cocoa pod husk meal recorded the highest contents of calcium, magnesium, phosphorus and potassium. The hot-water treated cocoa pod husk meal is next in calcium, phosphorus and potassium contents, but highest in sodium content; while the fermented cocoa pod husk meal is the least in calcium, phosphorus and potassium contents. The highest concentration of potassium (1.98g/kg) in the raw cocoa pod husk meal agrees with the findings of Meffeja *et al*. (2006), who reported high concentration of potassium in unprocessed (raw) cocoa pod husk, shell and other cocoa by-products. The use of cocoa by-products in soap making has been documented, due to its high content of potash (Marcel *et al*., 2011). The fermentation method drastically lowered the calcium, phosphorus and potassium contents in the cocoa pod husk meal. The study has confirmed that differently processed forms of cocoa pod husk are indeed good sources of minerals, especially calcium, magnesium, phosphorus, potassium and sodium. However, the mineral profile of raw, fermented and hot – water treated cocoa pod husk meal obtained in this study revealed fairly higher values than those earlier reported by Hamzat and Adeola (2011) in all the mineral elements. The difference could be attributed to the differently processed forms of cocoa pod husks in the different studies.

CONCLUSION

Research findings have revealed that the different forms of cocoa pod husk meal were low in crude protein (7.70-9.37%), but high in crude fibre (53.37-61.80%) and ash (9.30-10.85%) contents. The mineral composition of the raw, fermented and hot-water treated CPHM showed significant ($p<0.05$) differences between the differently treated forms of CPHM. The raw CPHM recorded the highest calcium, magnesium, phosphorus and potassium contents and least in sodium. The trend was the same in hot-water treated CPHM with higher values for the corresponding minerals but with highest sodium content. The fermented CPHM however had the least contents of these minerals. Hence, the order of importance is the fermented CPHM, followed by the hot-water treated CPHM and lastly the raw CPHM, respectively. All the different forms of cocoa pod husk meal could be utilized in feeding livestock at different levels of inclusion in the experimental diets.

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