COMPARATIVE PROXIMATE ANALYSIS OF SOME CONVENTIONAL AND UNCONVENTIONAL ENERGY FEED INGREDIENTS IN JOS TOWN, NIGERIA

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Abstract
A research was conducted in 2015 on nutrient composition of conventional and unconventional energy sources obtained in Jos town. The conventional energy sources sampled were Maize, Sorghum, Millet, Wheat, Maize Offal, Millet Bran while the unconventional energy sources were *Fonio Digitaria* (Acha), Tiger nut, Finger Millet, Irish Potato, Sweet Potato, Sweet Potato Peels, Cassava, *Plectranthus esculentus* (Rizga), Cocoyam and Yam Peels. Samples were sun dried and analyzed for proximate nutrients at the Small Animal Chemical Laboratory of Abubakar Tafawa Balewa University, Bauchi, Nigeria. Data collected were analysed using simple percentages. The result revealed that moisture content (MC) of the conventional sources range from 6.58 – 11.58%. While that of the unconventional had 6.83-73.19%, which indicated that the unconventional sources had higher moisture content. Dry matter (DM) for the conventional sources range from 26.81 – 93.70% while that of the unconventional had 26.81-93.70%, signifying that they ranked same in terms of DM value. Crude protein (CP) for the conventional sources had 7.61 – 14.29%, that of the unconventional energy feed ingredients had 4.10 – 14.23% which indicated that they had same CP range. Crude fibre (CF) for the conventional sources range 2.10 – 34.11% that of the unconventional sources had 0.34-3.11%, which shows a high CF for the conventional sources. Ether extracts (EE) for conventional sources range 1.70 – 4.11%, the unconventional had 0.3-8.11% which indicated high EE for the unconventional sources. Ash value ranged 1.36 – 10.49% for conventional sources; the unconventional had 1.20 – 4.60%. Nitrogen Free Extracts (NFE) for the conventional sources range 36.83 – 78.05%, unconventional, sources had NFE ranged 18.70 – 83.83%. The study revealed that the unconventional energy feed ingredients, having similar dry matter (DM), to the conventional energy sources, higher EE, and NFE than the conventional energy sources could be incorporated into livestock feeds to assess their biological value.
Keywords: Proximate Analysis, Conventional, Unconventional, Energy feed ingredients.

Introduction

The demand for animal protein in human diets have been on the increase while animal protein production is insufficient to meet the demand particularly in developing countries like Nigeria, (F.A.O, 1966, Kafatos and Hatzis, 2008).

The available Feedstuffs within our environment are yet to be fully exploited due to the fact that a little or none is known about their nutrient composition (Tewe and Egbunike, 2016). In the tropics, the most important problem in animal production has been the increasing unavailability and consequent high cost of Feedstuff (Philip, 2016 Mamo, 2012).

The unavailability of Feedstuff is also due to high competition between man and livestock for items such as Grains and Root Crops (Tewe and Egbunike, 2016). Again with our imperfect distribution systems, a grain may be surplus in United State of American (USA) and might as well be in high demand for human consumption in other countries and

may only be fed to livestock when in excess (F.A.O, 2016).

The continuous search for alternatives Feedstuff which can be used as replacement to some conventional ones has led to the worldwide use of cassava as animal feed for dairy, Beef, Buffalo, Goats and Sheep either by direct feeding as concentrate mixtures (Matawal *et al*, 2013).

The unconventional energy sources which are relatively cheap, available and accessible can serve as alternative replacement to the conventional ones in periods of scarcity and high cost (Iji *et al*, 2016).

The objective of study was to examine the nutrient composition of the conventional and unconventional energy sources which may serve as potential energy source for formulating livestock feeds

Materials and Method

Sample Collection

The Feedstuff used as energy sources were collected from various locations. The Maize Offal, Sorghum, Millet, Millet bran, Finger Millet, Hungry Rice (Acha),Wheat, Irish Potato, Cocoyam, Yam Peels, Rizga, Tiger nut, Rice bran, Maize and Cassava were collected from Jos town.

Sample Processing

The samples were sun dried after collection to prevent them from spoilage. The samples were pounded and sieved using 1mm sieve and were then taken to Abubakar Tafawa Balewa University Small Animal Production Chemical Laboratory and were analyzed for the following.

Moisture Content (MC) - The moisture content of the energy sources were determined by the weight difference between dry and wet material. 10g of the feedstuff was weighed and Sample was placed in a drying oven at 105^0C for 12hours. The samples were cooled in a dryer. The Samples were weighed again, care was taken not to expose sample to the atmosphere again.

The moisture content was calculated using a formula below.

$$MC\ (\%) = 100\ \frac{(B - A) - (C - A)}{B - A.}$$

Where A = Weight of Clean Dry Scale Pan (g)

B = Weight of scale Pan + Wet Sample (g)

C = Weight of Scale Pan + Dry Sample (g)

As reported by science alert, (2017).

Dry Matter (DM) – The dry matter of the samples were determined by drying of the Feedstuff to a constant weight at atmospheric pressure at a temperature of 105^0C after which samples were placed in an oven for 6 – 8 hours. The percentage Dry Matters (DM) was determined using the relationship below:

$$DM\ (\%) = \frac{\text{Sample wet weight}}{\text{Sample dry weight}} \times \frac{100}{1}$$

As described by Buck Master, (2005).

Crude Protein (CP) - The nitrogen content of each of the Feedstuff (energy sources) was determined by a known weight of the samples in a mineral digestion and distillation using sulfuric acid and sodium hydroxide according to Kjedahl's method. The nitrogen that was delivered from protein is believed to contain 16% Nitrogen. The amount of crude protein was calculated by a constant 6.25 as shown in the relationship below:

$$\%\ CP = N \times 6.25$$

Where N = Nitrogen value obtained

6.25 = A constant value of nitrogen.

The determination of overall Crude Protein was done using the Kjeldahl's methods as mentioned earlier.

Crude Fibre (CF) - This is the residue of Feedstuff which is insoluble after successive boiling for 30 minutes to 1 hour.

The samples were extracted and treated successively with boiling solution of diluted alkaline (sodium hydroxide) and sulfuric acid which gave the CF value i.e. % CF = loss in weight – (N x 6.25).
Where N = Nitrogen value obtained
6.25 = constant value of Nitrogen.

Ether Extracts (EE) - The Ether Extracts (EE) was determined by extracting the samples continuously with petrol ether for a long period (6hours) after which the solvent was evaporated to a residue (Ether Extracts).
The EE were determined using the relationship.

% EE = Sample before evaporation – Sample after evaporation x 100
Sample before evaporation 1
As reported by A.O.A.C. (2013).

Ash - The Ash content was obtained by igniting a known weight of the samples between 500 – 600^{0}C for 6 hours in a muffle furnace and was allowed to cooled and weighed.

Ash % = Sample Ash weight x 100
Sample dry weight 1
As reported by F.A.O. (2017).

Nitrogen Free Extract (NFE) - The Nitrogen Free Extract (NFE) was determined by subtracting the sum percentage of Crude Protein (CP), Ether Extracts (EE) Crude Fibre(CF) and total Ash from the percentage Dry matter (DM).

NFE = %DM – % CP + %CF +%EE + %Ash (Afolabi *et al*, 2013).

RESULT

TABLE 1: Proximate Composition of Some Conventional Energy Sources and their By Products (%)

COMPONENT	MC	DM	CP	CF	EE	ASH	NFE
Maize	10.7	89.21	8.63	2.71	2.11	1.36	74.4
Sorghum	6.58	93.40	10.61	2.01	2.31	1.78	76.70
Millet	11.75	88.25	11.56	4.26	2.90	3.23	78.05
Wheat	7.89	92.11	12.69	2.89	1.76	2.13	72.64
Maize Offal	10.07	89.93	14.29	9.11	4.11	5.91	56.51
Millet Brain	8.77	91.23	8.69	4.11	2.68	4.29	71.46
Rice Bran	7.39	92.61	7.61	34.11	3.41	10.49	36.90

Table 2 Proximate Composition of some Unconventional Energy Sources and their Waste (%)

COMPONENT	MC	DM	CP	CF	EE	ASH	NFE
Hungry Rice (Acha)	6.83	93.70	6.89	0.36	1.39	2.76	69.83
Finger Millet	17.89	82.11	7.61	0.34	2.11	2.73	76.93

Tiger nut	10.39	89.61	14.23	3.11	8.11	4.60	59.56
Irish potato	9.79	90.21	9.61	0.34	2.11	2.73	76.93
Sweet potato	71.39	28.61	5.61	0.45	0.61	3.24	18.70
Sweet potato peels	73.19	26.81	4.10	0.56	0.23	2.89	19.03
Cassava	10.37	89.63	4.29	8.23	1.32	3.61	72.18
Rizga	11.77	88.23	6.78	2.41	1.03	1.31	76.70
Yam peels	8.39	91.63	4.69	1.46	0.31	1.31	83.83
Cocoyam	13.2	92.11	7.53	1.63	0.34	4.04	78.57

MC = Moisture Content DM = Dry Matter CP = Crude Protein CF = Crude Fibre EE = Ether Extracts NFE = Nitrogen Free Extracts

Results and Discussion

The results showed that Moisture Content (MC) for the conventional energy sources and their by-products range from 6.58-11.75% (Table 1) while that of the unconventional energy source and their waste range from 6.83-73.19% (Table 2). The result indicate that the unconventional energy sources are higher in moisture content than the conventional ones, the High Moisture Content in the unconventional energy sources is a factor that limits the usage of some as feed ingredients this agrees with the findings of chow, who reported that a Moisture Content of 16% and above in Feedstuffs renders them soft and susceptible to storage fungi – (Chow, 2017). In this research, the highest moisture content was obtained in Sweet Potato Peels (73.19%), this is a little higher than the value obtained by Changlai, et al, who reported an MC of 64.6% in Sweet Potato Peels (Changlai *et al*, 2011). The least Moisture Content was obtained in Sorghum 6.58% (Table 1). This however guarantees it storage for a long time when compared to some of the unconventional energy sources.

Dry Matter (DM)

Dry Matter (DM) for the conventional energy sources and their by-products range from 88.25- 93.40% (Table 1). While that of the unconventional energy sources and their waste ranged from (26.81%-93.70). This findings shows that some of the conventional and unconventional energy sources can be ranked same in terms of Dry Matter content and can as well serve as replacement ingredients for the conventional ones for feed formulation.

The study revealed that sorghum and hunger rice (Acha) had almost same Dry Matter 93.40% and 93.70% in that order. Studies (Ukim et al, 2013) indicated that, the DM is often used as an indicator for total solid nutrient available in feedstuffs. The dry matter obtained in this study for Hungry Rice (Acha) 93.70% is higher than the value obtained by Allen, who reported a DM of 87.05% (Allen, 1987). The DM value of Sorghum 93.40% is higher than the one reported by Agrawal and Danlani 89.6% (Agrawal and Danlani, 1989). The lowest DM value of 26.81% was obtained in Sweet Potato Peels, this shows that it has a low level of digestible nutrients required.

Crude Protein (CP) - The Crude Protein of any Feedstuffs include the Protein, Amino Acids, Amines, Nitrogen. Glycosides, B – Vitamins, Purines and Ammonium Salt and Nitrogen used as index for determination of CP in Feedstuffs (Wikipedia, 2013).

It can be noted that the conventional and unconventional energy sources generally have a low CP values but can contribute towards making protein requirements of animals such as Pigs, Sheep and Goats (Macdonald, 1988, Aduku, 2005).

Crude protein (CP) of the conventional energy sources and their by-products range from (7.61%-14.29) while CP for the unconventional energy sources and their waste range from (4.10%-14.23) this shows that the CP value of the conventional and the unconventional energy sources have almost the same ranged (Tables 1 and 2).

The highest CP value was obtained in Maize Offal 14.29% higher than the value reported Ranjhan 11.9% (Ranjhan, 2001), Tiger nut had a CP value of 14.10% higher than the one reported by Balewu and others 8.0% (Balewu, et al, 2007). While the least CP was in Sweet Potato Peels (4.10%). The study shows also that Tiger nut can be incorporated at inclusion level to replace for Maize Offal because the two almost ranked same in CP values (14.10 and 14.29%), Table 1 and 2.

Crude Fibre (CF) - This represents the total insoluble carbohydrates in feedstuffs made up of lignin, cellulose, and hemi-cellulose (Macdonald *et al*, 1998).

The CP value for the conventional energy sources and their by-products ranged from 2.01%-34.11 while the unconventional and their waste had a CF range of 0.34%-3.11. Rice bran had the highest CF value (34.11%), amongst the samples analyzed indicating that it contains more fibrous materials, this value is higher than the one reported by Shweta and Vijayalakshimi (2015).

Cassava has a CF value of 8.23% and can serve as a replacement for maize as fibre sources.

Ether Extracts (EE) - This is mainly the lipid content of feedstuffs containing fats and other insoluble materials (Chlorophyll, Volatile oils, Resins, Pigment and Plant waxes which are of little value to animals (Cheeke, 1987). The EE value for the conventional energy sources and their by-products ranged from 1.76-4.11%), the unconventional and their waste had % EE ranged of (0.3-8.11%). Amongst the samples analyzed, Tiger nut had the highest EE of 8.11% lower than the EE reported by Ekpe and others 17.10% (Ekpe *et al*, 2016). This study revealed that Tiger nut can serve as a replacement feed ingredient for some of the conventional energy sources for Ether Extracts.

Ash - This include the essential and non-essential element in feed sample. In this study, Ash for the conventional energy sources and their by-products ranged from 1.36-10.49%, while the unconventional and their waste ranged from 1.20 - 4.60%. The highest Ash value was obtained in Rice bran (10.49%) and the least was obtained in Irish potato (1.20%). The study shows that Tiger nut has Ash value of 4.60% which can replace millet bran (4.29%) for Ash (Table 1 and 2). Tiger nut had % Ash value of 4.60% which can also serve as a good source of Ash (Table 1). Maize and Rizga gave % Ash value of 1.36 and 1.31%, which agrees with the value obtained by Olumo 1.0%, (Olumo, 1995), indicating that Rizga can be used in place of maize.

Nitrogen Free Extracts (NFE)

This fraction represents the soluble carbohydrate of the feed such as starch and sugar. The NFE for the conventional and their by-products ranged from 36.90-78.05% while the unconventional and their waste had NFE of 18.70-83.83%. Yam peels gave the highest NFE value 83.83 %, higher than the value reported by Afolabi 81.67% (Afolabi, 2013). The study shows that finger millet had the same % NFE values with sorghum 76.93 and 76.70 indicating that finger millet can substitute for sorghum at inclusion level Table 1and 2.

CONCLUSION

The study revealed that some of the unconventional energy sources and their waste had the same percentage nutrient composition with some of the conventional energy sources and their by-products and concluded that some of the unconventional energy feed ingredients can be use as replacements for the conventional energy sources at certain inclusion levels in periods of scarcity, high cost and seasonal distribution.

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