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Proximate Compositions, Mineral Levels and Phytate Contents of Some Alternative Protein Sources (Cockroach, *Periplaneta americana*, Soldier Ants *Oecophylla* sp. and Earthworm *Lubricus terrestics*) for Use in Animal Feed Formulation

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Abstract: Cockroach, earthworm and soldier ants were analyzed for their proximate compositions, minerals and phytate contents. Values for proximate composition ranged thus: cockroach (protein 9.26%; fat 21.21%; fibre 7.52%; ash 6.85%; moisture 13.85% and carbohydrate 41.33%; earthworm (protein 50.22%; fat 8.62%; fibre 1.36%; ash 26.56%; moisture 8.53% and carbohydrate 4.73%; soldier ants (protein 12.09%; fat 18.92%; fibre 20.13% ash 8.54% moisture 12.62% and carbohydrate 27.72%. Calcium was the most abundant mineral present while Cd was not detectable. The levels of phytate and phytate phosphorus were high and the samples had more than 30% of their total phosphorus linked to phytate. The Ca: Phytate molar ratios of the samples were relatively low. Based on the results it is suggested that nutritional potentials of cockroach, soldier ants and earthworm should be harnessed for use in animal feed formulation.

Key words: Cockroach, earthworm, soldier ants, minerals, proximate composition, phytate

Introduction

The productivity of Nigerian livestock is well below their genetic potential mainly due to poor nutrition and inadequate quality feed. The high cost and poor quality of finished feed in the recent past have caused serious economic losses in poultry industry in Nigeria (Emenalom, 2004). Effort to improve on this situation according to Abulude (2005), include harnessing the potentials of good quality and relatively inexpensive feed ingredients as replacement of the more expensive feed ingredients. The cheaper the feed source, without sacrificing quality, the better the returns to the farmers.

Cockroach, earthworm and soldier ants are lesser-known protein sources that had hitherto had little attention. They are cheap to procure and process and are readily available in and outside the farms and households. The biochemical compositions of these lesser-known protein sources are not known. Adequate information on the nutrient composition of any feedstuffs is a pre-requisite for its effective utilization hence. Several authors (Wekhe and Nyeche, 2002; Oladotun *et al*., 2003; Emenalom, 2004; Akinmutimi *et al*., 2004; Taiwo *et al*., 2005) have studied lesser-known protein sources, but none had gone to find out the usefulness of the nutritive values of samples earmarked for this study. Therefore the aim of the research was to evaluate the proximate compositions, mineral profile and phytate contents of cockroach, earthworm and soldier ants. Evaluation of the nutritive value of these insects become important as the insects could form a base for new feed product of considerable nutritive value.

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Materials and Methods

Sampling

The cockroach, *Periplaneta americana*, solder ants *Oecophylla* sp. and earthworm *Lubricus terrestics*) samples were collected at the Federal college of Agriculture, Akure. Ondo State. Nigeria in June 2004. One hundred grams of each specimen were washed in distilled water, over dried at 60°C for 6 h, ground, sieved (twin sieve), mixed thoroughly and stored prior to analysis.

Procedure

Samples were analyzed for proximate composition using the AOAC (1990) a procedure, carbohydrate was determined by difference. Total phosphorus (P) was determined using a colorimeter employing phosphovanadmolybdate method (AOAC, 1990). Phytate P and phytate were determined using the methods of Young and Greaves (1940) as modified by Oduguwa *et al*. (1999). Phytate P as % total P and Ca: phytate were calculated by the methods of Abulude (2001). Minerals were analyzed using the solution obtained by dry ashing the sample and dissolving it in 100% HCL and making up to 100 cm^3. Ca, Mg, Fe, Cd and Pb were determined with a Buck atomic absorption spectrophotometer. Na and K were measured with a flame photometer (AOAC, 1990).

Results and Discussion

Table 1 depicts the proximate composition and nutrient composition of cockroach, earthworm and soldier ants. Nutrients were generally higher in cockroach and soldier ants, except for crude protein that was higher in earthworm (50.22%) than cockroach (9.26%) and soldier ants (12.00%). Nutrient distribution recorded in this work agreed with literature values for fish meal (Aduku, 1993) and termite (Fadiyimu *et al*., 2003) but higher than results reported for shrimps waste meal (Fanimo *et al*., 1998) and millipede (Abulude and Folorunso, 2003). The protein contents from the samples would be very appropriate as livestock feed. The fibre contents of earthworm (1.36%) and cockroach (7.52%) were low while that of soldier ants (20.13%) was high. Moisture contents were low (8.53-13.85%). This accounts for low deterioration of the samples if left unprocessed for a long time. The presence of ash content in all the samples is a measure of the likely mineral contents in the entire sample. The results of the mineral analysis are shown in Table 2. Calcium was high in cockroach (620 mg 100 g^{-1}) and soldier ants (800 mg 100 g^{-1}) but not detected in earthworm. If the amount of calcium is adequate in the animal feed, iron is utilized to better advantage. Also, Ca, P and vitamin D combine together to prevent rickets in young animals and osteomalacia (adult rickets) (Adeyeye, 2002). The samples were rich sources of potassium (230-320 mg 100 g^{-1}) and sodium (68-200 mg 100 g^{-1}). Plants and animal tissues are rich sources of potassium, thus a dietary lack is seldom found, sodium is widely distributed in feeds, with plants containing less than animal sources (Adeyeye, 2002). The samples were good sources of iron. Cadmium was not detected. Lead was not detected in cockroach. The levels of lead in the samples should be of major health concern because of the toxicity of the element at very low concentration, particularly their effects on the nervous system of livestock animals and man. The iron

Table 1: Proximate composition of samples (% DM, n = 3)

Parameters	Cockroach	Soldier ants	Earthworm
Moisture	6.85 (0.5)[a]	8.54 (0.5)	26.56 (0.5)
Ash	13.85 (0.05)	12.62 (0.5)	8.53 (0.5)
Crude protein	9.26 (0.01)	12.09 (0.05)	50.22 (0.01)
Crude fat	21.21 (0.05)	18.92 (0.05)	8.62 (0.05)
Crude fibre	7.52 (0.05)	20.13 (0.05)	1.36 (0.05)
Carbohydrate	41.33 (0.1)	27.75 (0.1)	4.73 (0.1)

[a](mean±SE), n = number of determinations

Table 2: Metal (mg 100 g^{-1} DM) composition of samples (n = 2, p<0.05)

Parameters	Cockroach	Soldier ants	Earthworm
Ca	620 (55.70)[a]	800 (60.24)	ND
K	270 (10.06)	320 (12.45)	230 (10.25)
Na	120 (10.06)	68 (0.1)	200 (5.83)
Pb	ND	0.4 (0.05)	0.5 (0.05)
Mg	520 (40.20)	660 (45.55)	370 (20.61)
Cd	ND	ND	ND
Fe	2.97 (0.05)	3.10 (0.1)	3.2

ND-Not detected, [a](mean±SE), n = number of determinations

Table 3: Table phosphorus (P), phytate P and phytate concentration (mg 100^{-1} DM), phytate P (%) of total P and calculated Ca: phytate molar ratio of samples

Parameters	Cockroach	Soldier ants	Earthworm
Total P (mg100 g^{-1})	138 (4.10)[a]	152 (3.25)	140 (98.55)
Phytate P (mg 100^{-1})	106 (7.25)	120 (12.60)	137 (17.10)
Phytate (mg 100 mg^{-1})	377 (50.00)	427 (60.10)	488 (55.50)
Phytate (as % of total P)	36.6 (50.00)	32.8 (3.00)	31.31 (2.52)
Ca: Phytate	0.04 (0.01)	0.03 (0.01)	-

[a](mean±SE), n = number of determinations

present in these samples may be well absorbed as in comparison with meat (Bender, 1992). Not only is the iron of meat well absorbed, it enhances the absorption of iron from other sources (Adeyeye, 2002). Table 3 shows the total phytate in earthworm, cockroach and soldier ants, the phytate content may vary depending upon the variety, climatic conditions, locations, type of soil and time (season) during which they were obtained. Similar differences were reported for millipedes obtained from different sources (Abulude and Folorunso, 2003). Abulude (2001) reported values ranging from 390 to 1170 mg 100 g^{-1} DM phytate in 10 different varieties of vegetables. The availability of P in the form of phytate depends on the species the age of the animal and the level of phytate activity in the intestinal tracts of species in question. The utilization of natural phytate in the rumen of ruminants is attributed to the presence of phytate (Reddy *et al*., 1982). Calculated Ca: phytate ratios for the samples ranged between 0.03 and 0.04. These values were lower than the critical value of 6:1 (Wise, 1983). The phytate P ranged between 106 (cockroach) and 137 mg 100^{-1} DM (earthworm). These values were similar or in agreement with the concentrations found for Cuban boa (Ogunkoya *et al*., 2006). There is some indication that the ability of the swine to utilize phytate P improves with age and chicks utilize phytate P from foodstuffs of plant origin for deposition in the growing bones (Reddy *et al*., 1982). Phytate P expressed as percentage of total P ranged between 31.1 and 36.6%. These values were relatively low compared to those obtained by Abulude *et al*. (2006) for some wild under-utilized crop seed and Abulude (2001) for vegetables. The availability of phosphorus from phytate P source has been found to range from 20 to 60% with an average value of 3% for pigs (Reddy *et al*., 1982).

Conclusions

The nutrient compositions of these samples showed their potentials as good sources of protein, fat, carbohydrates and macro- elements. However, the high phytate content present in these samples may interfere with mineral absorption. These samples may have to be subjected to various processing methods, such as cooking, autoclaving and soaking to reduce or eliminate the phytate contents.

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