



COCKROACH (*Periplanata americana*) MEAL NUTRITIVE COMPOSITION



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Abstract: The nutritional potential of insect protein source as potential feed ingredient has been widely researched. Cockroach meal (*Periplanata americana*) being a readily available renewable resource animal protein food is hereby investigated for its chemical composition and fatty acid content. The proximate composition revealed crude protein content 53.10±0.09%, fat 10.56±0.11%, fibre 11.69±0.23%, ash 8.37±0.13%, moisture content 5.22±0.08%, NFE 11.10±0.32% and metabolisable energy 1482.12±9.38 KJ kg⁻¹. Mineral content analysis showed K as the highest (10007.69±79.68 mg/kg), while the other elemental nutrients were lower in concentration; P (4527.40±90.64 mg/kg), Na (4518.72±213.33 mg/kg), Ca (2174.10±15.01 mg/kg), Mg (1180.50±14.06 mg/kg), Fe (1303.37±9.77 mg/kg), Zn (185.66±2.70 mg/kg), Cu (50.22±1.52 mg/kg) and Mn (20.85±1.55 mg/kg). The essential amino acid profile revealed leucine as highest (8.29 g/100g) and tryptophan least (0.97 g/100g) with the limiting methionine (2.40 g/100g) and lysine (5.65 g/100g) while the non-essential amino acid glutamic acid was highest (13.17 g/100g) and cysteine (0.84 g/100g) was least. The saturated fatty acid lignoceric C24:0 (21.45±0.38%) was highest and butyric C4:0 (2.72±0.26%) was least; mono-unsaturated fatty acid oleic C18:1n9 (17.35±0.24%) was highest and palmitoleic C16:1n7 (17.02±0.45%) while poly-unsaturated fatty acid linoleic C18:2n6 (16.72±0.06) was highest and arachidonic C20:4n6 (12.97±0.19) was least. This study validates the outcome of previous researches on the *Periplanata americana* and new information on its fatty acid profile. Hence, the need for further research into its digestibility and utilization as a protein source in animal feed and its health implication on livestock.

Keywords: Cockroach, entomophagy, insect meal, fatty acid

Introduction

Insect rearing could be one of the ways to enhance food and feed security (Van Huis *et al.*, 2013). The growth, reproduction, high feed conversion efficiency when reared on bio-waste with one kg of insect biomass produced from an average 2 kg of feed biomass (Collavo *et al.*, 2005). Strong recommendations have been clamoured for the use of insects as human food and animal feed and as a tool for poverty alleviation (FAO 2010; Van Huis *et al.*, 2013). The potential of insect suitability for animal feed cannot be underestimated (Van Huis *et al.*, 2013). Insects are good protein source (Ewete, 2015).

The Cockroaches (*P. americana*) represents an example of insect species such as housefly, mealworm and cricket that can be used for producing protein for use as livestock and fish feed likewise for human consumption. Oghale *et al.* (2014) reported the availability of cockroach all year round and it is presently not used in entomophagy in his study area and Odibo *et al.* (2019) reported an average of fourteen cockroaches per household and no seasonal difference in species found in human abode. The ubiquitous nature of the insect and the need for its control in food, stored products and human habitation is the opinion of Rejitha *et al.* (2014) while Ojiezah and Ogundipe (2015) raised the issue of public health concern on the insect. However, Costa-Neto and Oliveira (2000), Barbara (2013), Feng *et al.* (2014), Diehl *et al.* (2014), Latifi *et al.* (2015), Chen (2018) and Butler (2018) have allayed the fear on health and even possible use in treatment of human diseases when cultured cockroach is used as meal.

This study therefore research into the chemical composition of the *P. americana* for its consideration in livestock nutrition while focusing on Rumpoldt and Schluter (2013) with regards to fatty acid content.

Materials and Methods

Cockroaches *P. americana* were collected by Year Two students of College of Agricultural Sciences, Olabisi Onabanjo University and preparation of samples was done

according to Ayssiwede *et al.* (2011) and Sule and Ojetayo (2016). Sterilization was carried out in an autoclave (YX-280A) for 10 min at 150 psi and oven dried at 50°C for 8 h before pulverizing with electric blender. Proximate analysis was according to AOAC (2005) and metabolizable energy calculated according to Finke (2002). Mineral analysis was determined by wet ashing with perchloric acid and nitric acid and macro and micro element separated using atomic absorption spectroscopy (AAS) at the Department of Agronomy, fatty acid profile was determined spectrophotometrically at the Department of Animal Science, University of Ibadan, according to the methods of Baker (1964); Lowry and Tinsley (1976). Amino acid analysis was by the use of Model 120A PTH Amino acid Analyzer at the University of Jos. Samples n=24 adult *P. americana* lengths, wet and dry weight were carried out using metre rule and sensitive scale. Descriptive statistics using IBM SPSS 20 was used for data analysis and results reported as means ± SE.

Results and Discussion

The size of adult *P. americana* in this study (Table 1) was within the range reported for adult *Eublaberus distant*, *Gromphadorhnia portentosa* by Ooninx and Dierenfeld (2012).

The proximate analysis (Table 2) was similar to Bernard and Allen (1997) for the same species and that of *Blaptica dubia* (Lam Pei Yee *et al.*, 2016) lower to that of Ayssiwede *et al.* (2011), Rumpoldt and Schluter (2013), Amariei *et al.* (2014), Sule and Ojetayo (2016) but falls within the range reported by Rumpoldt and Schluter (2013) for *P. americana* and Ooninx and Dierenfeld (2012) for other Blattodea species. Crude protein (53.10%) was similar to that of cricket meal and raw fishmeal in Taufek *et al.* (2016); Egan *et al.* (2014) for caterpillar larva but greater than for all edible insects reported by Banjo *et al.* (2006). The use of cockroach meal, its acceptance by consumers and legality of inclusion in livestock nutrition will generate debate as this is also the view of Rumpoldt and Schluter (2015). Crude fibre (11.69%) was

higher in this study than values reported by Ayssiweide *et al.* (2011), Rumpoldt and Schluter (2013) and within the range of Ooninx and Dierenfeld (2012). Ash (8.37%) followed the same trend and higher than values reported by Ayssiweide *et al.* (2011) and Amariei *et al.* (2014) but falls within the range reported by Ooninx and Dierenfeld (2012). Lipid content (10.56%) was lower to the values of Ayssiweide *et al.* (2011), Ooninx and Dierenfeld (2012), Rumpoldt and Schluter (2013), Amariei *et al.* (2014) while Lam Pei Yee *et al.*, (2016) values were three times higher than for this study when used in domesticated cat dietary inclusion. The metabolizable energy (1482.12 kcal) is similar to Finke (2012) for Turkestan cockroaches' nymphs. The finding of this study does not agree with the report of Abulude *et al.* (2007) for the same species especially with regards to crude protein. Diehl *et al.* (2014) reported that cockroach is a promising insect to be used as animal feed.

Table 1: Length and weight in relation to production of one kilogramme meal from samples

(n=24)	Wet weight (g)	Dry weight (g)	Length (cm)
Total	25.29	8.99	82.60
Mean average	1.05±0.06	0.28±0.02	3.44±0.06
Range	0.63 – 1.79	0.21 – 0.61	2.80–4.00
Number to make 1 kg	960	2650	-----

Table 2: Proximate analysis of cockroach meal

Proximate	%
Crude Protein	53.10±0.09
Crude fat	10.56±0.11
Crude fibre	11.69±0.23
Ash	8.37±0.13
Nitrogen free extract	11.10±0.32
Moisture content	5.22±0.08
Metabolisable energy (Kcal)	1482.12±9.38

Table 3: Mineral content profile of cockroach meal

Mineral	(mg/kg)
Phosphorus (P)	4527.40±90.64
Calcium (Ca)	2174.10±15.01
Magnesium (Mg)	1180.50±14.06
Potassium (K)	10007.69±79.68
Sodium (Na)	4518.72±213.33
Manganese (Mn)	20.85±1.55
Iron (Fe)	1303.37±9.77
Copper (Cu)	50.22±1.52
Zinc (Zn)	185.66±2.70

The mineral content (Table 3) for Na (4518.72 mg/kg), K (10007.69 mg/kg) and Ca (2174.10 mg/kg) were higher than values reported by Ayssiweide *et al.* (2011), similar to Bernard and Allen (1997) and within the range of macro mineral, Mn (20.85 mg/kg) and Zn (185.66 mg/kg) (Ooninx and Dierenfeld, 2012) while Fe (1303.37 mg/kg) and Cu (50.22 mg/kg) in this study were higher.

The analysis of fatty acid (Table 4) revealed that the EPA and DHA were absent in *P. americana* and this corroborates the findings of Finke (2002), Kulma *et al.* (2016), Barroso *et al.* (2014) and Tzompa-Sosa *et al.* (2014). In the SFA lignoceric (21.45%) was highest followed by oleic (17.35%) in MUFA and linoleic (16.72%) in PUFA these were in line with the findings of Kulma *et al.* (2016) and Tzompa-Sosa *et al.* (2014) for the blattodea specie and Mohammed (2015) for migratory locust. The fatty acids in this study were higher than the values reported for moth caterpillar by Paiko *et al.* (2014). The butyric (2.72%) and valeric (6.63%) SFA has been indicted in fermentation and metabolism in rumen of lactating cow (Muller, 1987).

Table 4: Fatty acid composition of cockroach meal

Saturated Fatty Acid (SFA)	%
Acetic C2:0	12.99±0.43
Propionic C3:0	7.05±0.05
Butyric C4:0	2.72±0.26
Valeric C5:0	6.63±0.29
Caprylic C8:0	5.91±0.13
Lauric C12:0	11.36±0.38
Myristic C14:0	10.84±0.08
Palmitic C16:0	21.16±0.13
Margaric C17:0	14.07±0.09
Stearic C18:0	16.98±0.05
Behenic C22:0	21.12±0.41
Lignoceric C24:0	21.45±0.38
Mono-Unsaturated Fatty Acid (MUFA)	
Palmitoleic C16:1n7	17.02±0.45
Oleic C18:1n9	17.35±0.24
Poly-Unsaturated Fatty Acid (PUFA)	
Linoleic C18:2n6	16.72±0.06
Arachidonic C20:4n6	12.97±0.19

Table 5: Amino acid profile of cockroach meal

Amino acid	g/100g
Arginine	6.2
Histidine	4.21
Isoleucine	3.66
Leucine	8.29
Lysine	5.65
Methionine	2.40
Phenylalanine	5.14
Threonine	3.19
Tryptophan	0.97
Valine	4.00
Alanine	3.94
Aspartic acid	9.92
Cysteine	0.84
Glutamic acid	13.17
Glycine	3.61
Proline	4.06
Serine	3.70
Tyrosine	3.09

Amino acid has been known to indicate the protein value of feed ingredient. In Table 5, methionine (2.40 g/100g), threonine (3.19 g/100g) and valine (4.00 g/100g) were lower than values obtained by Rumpoldt and Schluter (2013) while all the essential amino acid were higher in value when compared to Rumpoldt and Schluter (2013). When compared to AFRIS/Feedipedia (2012) for fishmeal eight of the EAA compared favourably with that of this study while lysine and threonine were higher in value stressing the fact of fishmeal superiority over all other ingredients. Aspartic acid (9.92 g/100g) was not detected by Rumpoldt and Schluter (2013) but was a major focus in this study. Methionine (2.40 g/100g) was higher than values of blattodea species (Kulma *et al.*, 2016) while variations exist in lysine (5.65 g/100g) of this study with that of Kulma *et al.* (2016).

Conclusion

This study showed that constituent of *P. americana* are within the range reported in literature. The nutritive value should be used in the nutrition of livestock for optimal production while considering the health implication on consumption of end product.

Conflict of Interest

Authors declare there is no conflict of interest this study.

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