

**COMPARING THE NUTRITIONAL COMPOSITION OF SOME EDIBLE INSECTS  
AND SOME ANIMAL MEATS IN NORTH-WESTERN STATE OF NIGERIA**

**ABSTRACT**

Five different edible insects from Kaduna, Kebbi, Niger, Sokoto and Zamfara States of North-Western Nigeria, namely; Red Locust (*Nomadacris setemfasciata*), Desert Locust (*Schistocerca gregaria*), Variegated Grasshopper (*Zonocerus variegatus*), Termite (*Macrotermes bellicosus*) and Cricket (*Gryllotapha Africana*), were collected alongside with meats from camel (*Camellus dromedaries*), Cow (*Bos indicus*), Ram (*Ovis aries*), Chicken (*Gallus gallus*), and Fish (*Clarias lazera*). The insects were oven dried separately at 60<sup>o</sup>c for 3-5hrs while the meats were dried at 60<sup>o</sup>c for 48hrs. The dried contents of both the insects and the meats were ground separately and each was subjected to proximate analysis. The results indicated the nutrient to have Carbohydrates ranging between 0.7g-12.1g in the insects and 0.4g-10.2g in the meats, Proteins ranging from 12.6g -57.3g in the insects and 18.1g – 70.4g in the meats, Fats, Fibre, Ash and Moisture having ranges between 5g-17.9g, 5g-20g, 4g -10g, 11.5g-53.6g, respectively in insects and 18.4g-70.4g Fats, 5g Fibre, 2.4g-10.4g Ash and 13.4g-59g moisture in the meats. Equally, the minerals showed varied in both the insects and the meats. Statistical comparison of the means of the results showed that the Carbohydrates, the Proteins and the Fibre do not differ significantly in both the insects and the meats. Similarly, Copper, Iron, Sodium, Calcium, Magnesium and Potassium do not differ significantly in the two groups. This suggested that insects as diet when taken in required amount can meet the protein requirement of the human body and can therefore supplement animal meats in our diets.

Key words: Edible insects, Animal meat and nutrient composition.

**INTRODUCTION**

Insects have been used as food by man ever since his creation when he converted many available resources in the universe into food (Richard, 1993). Insects are the cheapest source of animal protein, and their consumption has been encouraged due to the inability of low income people to afford fish or animal protein (Paul and Sudipta, 2011). Insects have been reported to be an important source of protein, vitamins, minerals and fats in many countries (Bailey, 1999 and Defoliart, 1975). Insects are also described by Michael (1978) as tasty, nutritional and high protein source.

37 Ordinarily, insects are not only used as emergency food but are included as part of the diet  
38 throughout the year or when seasonally available (Banjo, *et al.*, 2006). Different types of insects  
39 are being eaten in different parts of the world, sometimes only the adults were eaten or larval  
40 stages or just some parts of the insect's body (Ene, 1963 and Gene, 1988).

41 In many parts of the world today, insects are considered as stable food possibly because they are  
42 good source of protein, easy to find, occupy a little space and have great nutritional value  
43 (Bailey, 1999). Food supplies in many African countries are inadequate in quantity and quality  
44 contributing to wide spread of malnutrition (Allotey, 2003). Therefore insects could be used in  
45 solving the problems of malnutrition in Africa.

46 In Nigeria, reports have shown that eating insects has contributed significantly to the reduction in  
47 protein deficiencies (Ashiru, 1988). Locusts, Grasshoppers, Termites, Beetles and Crickets are  
48 variously reported as being consumed by different communities, ranging from stable food  
49 sources to highly sought delicacies in different parts of Nigeria (Banjo, *et al.*, 2006). More than  
50 1000 species of insects are safe to eat, some insects are distasteful or harmful and in some cases  
51 people can even develop allergies to insect's materials (Mpunchare *et al.*, 1975).

52 The present work compares proximate composition of five different edible insects with meats  
53 from five different animals commonly consumed in North – Western Nigeria.

## 54 MATERIALS AND METHODS

55 Insects for this study were collected from four Local Government Areas each, from Kaduna,  
56 Kebbi, Niger, Sokoto and Zamfara states of North-Western Nigeria located between longitude 9<sup>0</sup>  
57 10<sup>1</sup>N and 13<sup>0</sup> 50<sup>1</sup>N and latitude 3<sup>0</sup> 35<sup>1</sup>E and 9<sup>0</sup> 00<sup>1</sup>E and it covers an area of about 223,150.39  
58 KM<sup>2</sup>. The region has a projected population of 54,077,402.95 million people (National  
59 Population Commission [NPC], 2019)

60 The survey of edible insects and vertebrate meats conducted in the study area, the following  
61 insects and vertebrates were identified as the most preferred edible insects and vertebrate meats;  
62 Red Locust (*Nomadacris septemfasiata*) Desert locust (*Schistocerca gregaria*) Variegated  
63 grasshopper (*Zenocerus variegates*), Termite reproductive forms (*Macrotermes bellicosus*),  
64 Brown Cricket (*Gryllotapha africana*) and the beetle was not used for this study, while the

65 vertebrates selected were *C. dromedaries*, *B. indicus*, *O. aries*, *G. gallus* and *C. lazar*. These  
66 insects and vertebrates were then oven-dried for 3-5hrs at 60<sup>o</sup>c and grounded separately and  
67 placed in separate petri-dishes.

68 100g of the materials obtained were subjected to proximate analysis separately according to  
69 official methods of analysis recommended by AOAC (2000). Moisture content, fibre, free  
70 nitrogen extract, fats and mineral salts were determined and crude protein was obtained using the  
71 Kjeldahl technique (AOAC, 2000).

72 The results obtained were tasted for significances between the composition in the insect's body  
73 and the animal meats using paired t-test with SPSS 16.0 for Windows statistical package.

## 74 **RESULTS**

75 The mean nutrient composition of the insects and the meats were shown in Table 1. The highest  
76 amount of carbohydrates was observed among the insects with *S. gregaria* having 14.17g per  
77 100g, followed by *Z. variegatus* with 11.13g while *G. Africana* had the lowest content of 1.17g  
78 per 100g. Generally, carbohydrates were observed to be in all the animal meats studied ranging  
79 between 1.73g on *G. gallus* and 6.73g on *O. Aries*. Crude protein was higher on meats from the  
80 animals than in the insect. The highest amount of the protein per 100g of the sample was  
81 observed in *C. dromedarius* (70.57g) followed by *G.gallus* (65.77g). Fats were higher among  
82 insects than the meats with *M. bellicosus* having the highest with 17.63g per 100g the *N.*  
83 *setemfasciata* (13.33g). Among animal's meat, the meat from *B. indicus* with 11.3g had the  
84 highest then *O. Aries* with 10g. The fibre content was almost the same in the animal meats but  
85 was relatively higher in the insects, particularly, in *S. gregaria* with 18.33g and *N.*  
86 *Septemfasciata* with 16.67g per 100g. *C. lazera* was observed to have the lowest values of the  
87 components except for moisture content where it ranked the highest with 58.07g per 100g. The  
88 ash was considerably low in all the organisms.

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97 **TABLE1: NUTRIENT COMPOSITION OF SOME EDIBLE INSECTS AND SOME ANIMAL**  
 98 **MEATS**

99 (Each observation was based on three replicates)

<b>Insects/Meat</b>	<b>Carbohydrates (g)</b>	<b>Crude Protein (g)</b>	<b>Fat (g)</b>	<b>Fibre (g)</b>	<b>Moisture (g)</b>	<b>Ash (g)</b>
<i>N. septemfasciata</i>	9.23	18.80	13.33	16.67	36.97	5.00
<i>S. gregaria</i>	14.17	16.40	6.67	18.33	39.53	5.00
<i>Z. variegates</i>	11.13	25.13	6.67	11.67	42.07	5.00
<i>M. bellicosus</i>	6.27	12.93	17.63	6.67	51.63	5.00
<i>G. africana</i>	1.17	57.07	13.30	5.00	11.77	10.00
<i>C. dromedaries</i>	3.90	70.57	8.33	5.00	14.50	2.70
<i>B. indicus</i>	5.87	62.30	11.33	5.00	16.00	5.00
<i>O. aries</i>	6.73	61.47	10.00	5.00	16.90	5.00
<i>G. gallus</i>	1.73	65.77	8.30	5.00	14.50	9.70
<i>C. lazar</i>	6.10	18.87	8.33	5.00	58.07	8.40

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101 Sample ranging between 3.00 as the lowest observed on C. lazar and the highest amount of 25.  
 102 75 mg in G. africana. Phosphorus, sodium and potassium were considerably higher composition  
 103 of mineral present in the entire samples while magnesium was variable among in all the samples

104 **TABLE 2: MINERAL CONTENTS OF SOME EDIBLE INSECTS AND SOME ANIMALS MEATS**  
 105 (Each Observation was based on three replicates)  
 106

<b>Insects/Meat</b>	<b>Copper (mg)</b>	<b>Iron (mg)</b>	<b>Zinc (mg)</b>	<b>Phosp (mg)</b>	<b>Sodium (mg)</b>	<b>Calcium (mg)</b>	<b>Magnesium (mg)</b>	<b>Potassium (mg)</b>
<i>N. septemfasciata</i>	1.17	9.00	0.34	80.43	271.70	30.80	65.00	1001.67
<i>S. gregaria</i>	0.67	4.92	0.41	92.80	163.00	17.07	32.58	490.27
<i>Z. variegates</i>	1.33	11.08	0.34	84.80	163.00	16.67	18.70	490.27
<i>M. bellicosus</i>	2.17	9.10	0.34	84.80	217.30	14.57	41.89	255.80
<i>G. africana</i>	3.83	25.75	0.34	69.27	851.37	14.17	38.30	703.50
<i>C. dromedaries</i>	0.75	6.00	0.91	100.90	68.80	28.87	15.90	1278.80
<i>B. indices</i>	1.42	8.92	0.42	119.73	68.83	29.49	6.87	1278.80
<i>O. aries</i>	1.08	7.00	0.34	67.27	14.50	25.33	22.00	1236.10
<i>G. gallus</i>	1.17	6.00	0.29	83.43	18.10	23.27	38.30	959.10
<i>C. lazar</i>	0.92	3.00	0.26	71.13	32.60	17.87	29.47	383.60

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108 Statistical comparison of the means was conducted and the results presented in table 3,

109 It indicated that were no significant differences between the means of proximate composition of  
 110 insects and the animals meats on carbohydrates, protein, fibre, copper, iron, sodium, calcium,  
 111 magnesium and potassium while only fats, moisture, ash, zinc and phosphorus differ at 5% level  
 112 of significance.

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114 **TABLE 3: COMPARSION BETWEEN MEANS OF PROXIMATE ANALYSIS OF SOME**  
 115 **EDIBLE INSECTS AND ANIMAL MEATS**

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Nutrients/Minerals (Means±SE)	Edible Insects (Means±SE)	Animal Meats
Carbohydrates	8.39±1.40	4.87±0.74
Proteins	26.07±4.24	35.79±5.02
Fats	11.52±1.24*	9.26±0.56
Fibre	11.67±1.52	5.00±0.00
Moisture	36.39±3.55*	23.99±4.56*
Ash	6.00±0.55*	6.16±0.69*
Copper	1.83±0.30	1.07±0.09
Iron	11.97±1.98	6.18±0.52
Zinc	0.36±0.01*	0.44±0.13*
Phosphorus	82.42±2.06*	88.49±5.27*
Sodium	3.33E2±70.5	40.57±6.91
Calcium	18.65±1.67	24.97±1.29
Magnesium	39.30±4.22	22.51±3.10
Potassium	5.88E3±67.54	1.03E3±92.02

117 Values with asterisk (\*) within the same row are significantly different at (P<0.05).

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120 **DISCUSSION AND CONCLUSION**

121 The proximate analysis of the edible insects conducted showed that the insects have almost all  
 122 the nutrients required by human body. The organic compound observed from the analysis of the  
 123 insects bodies were proteins, fats, and carbohydrates in varying amounts. Similar observations  
 124 were made by Omotoso (2006), who showed that the larvae of *Cirina forda* contained high levels  
 125 of protein with ash, moisture, fats and carbohydrates. Vandky (2000) reported that large  
 126 grasshoppers have 14.2 percent of protein, 3.3 percent fats, and 2.2 percent carbohydrates while  
 127 termites have 14.2 percent protein, 28 percent fats, 2.7 percent fibre and 44.5 percent moisture.  
 128 The showed that fibre could be found in the nutrient content of insects despite the previous  
 129 assertion by Omotoso (2006). However, Omotoso's finding could be related to the insect he  
 130 worked with, being a Lepidopteran Larva. From the result, it was observed that meats from  
 131 animals and insects both have nutritional values that varied in minor respects. It was also

132 observed that some insects have higher moisture content and protein that are relatively similar to  
133 those found in animal meats. Though insects have good nutritional composition, in case of  
134 carbohydrate the highest percentage was found in insects (*S. gregeria*) with 14.17 compared to  
135 vertebrate meats (*O. aries*) which has 6.97. Whereas, highest percentage of protein was found in  
136 vertebrates (*C. dromedaries*) 70.57 compared to insects (*G. africana*) with 57.07. Insects  
137 therefore can be consumed to obtain the body nutritional requirement as can be obtained from  
138 animal meats. Therefore, where meat is not readily available or cannot be afforded, insect's diet  
139 can be supplemented.

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#### 141 **AUTHORS' CONTRIBUTION**

142 The research work was carried out in colorations with all Authors. Authors HAS  
143 designed the study, managed the literature searchers and wrote the protocol and the first draft of  
144 the manuscript. Authors QM, HMB, MMY and IA finished the design, protocol and check the  
145 draft report. All Authors read and approved the final manuscripts.

#### 146 **Competing interests**

147 All Authors have declared that no competing interests exist.

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