

Nutritional Compositions of Field Crickets (*Gryllinae*) Obtained in Sokoto State, Nigeria

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Abstract

Original Research Article

Field cricket (*Gryllinae*) obtained in Sokoto State, Nigeria was evaluated for its nutritional compositions. The proximate compositions were analyzed using the methods of the Association of official Analytical Chemist (AOAC), while minerals were estimated using Flame Emission Spectroscopy (FES), and Atomic Absorption Spectrophotometry (AAS). Antioxidant vitamins and anti-nutrient compositions were determined using standard laboratory methods. The result of proximate analysis showed that the Field crickets are rich in protein (63.54 ± 2.76 g/100g), crude lipids (10.78g/100g) and fiber (8.56g/100g). Minerals analysis indicated that, the Field crickets contain appreciable concentration of both macro and micro mineral elements with Calcium (725.00 mg/100g), Magnesium (8.14 mg/100g,) and sodium (20.08 mg/100g) as the predominant macro elements. However, iron (25.13 ± 1.35 mg/100g) and zinc (6.14 ± 2.11 mg/100g) are the micro elements present in higher amount. On the other hand, the content of antioxidant vitamins on dry weight basis are 1.18 mg/100g, 2.91 mg/100g, and 31.80 mg/100g for vitamin C, β -carotene, and vitamin E respectively. The anti-nutrients content are within the permissible limits and may not pose any threat to their usage as food supplement, the anti-nutrient to nutrient molar ration are below the critical value known to impair mineral bioavailability. The present study showed that Field crickets if properly utilized may be important supplementing protein, fat and minerals in our diet, also as an important raw material in the formulation of animal feeds.

Keywords: Field cricket; *Gryllinae*; Nutrients; Anti-nutrients; Minerals.

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1. INTRODUCTION

With the high rate at which the world population is growing, the world food supply should grow at the same rate if not faster. Therefore, it is essential that cheaper sources of protein and other nutrients be found for human food and domestic animal feeds (Dun Wang *et al.*, 20014). Apart from using wild plants as nutritional, insects have been eaten traditionally for thousands of years but the industrialization of insect rearing and processing for food is relatively new. A wide variety of insects can potentially be consumed for food, e.g. crickets, locusts and grasshoppers. Insects are potentially rich source of protein and lipids, as well as micronutrients and minerals (Navneet Singh, 2019). In fact, insects have played an important role in nutrition, especially in areas where human and domestic animal populations were subjected to chronic protein deficiency (DeFoliart, 2018).

Field Crickets (*Gryllinae*) (Plate 1) are a subfamily of insects in the order *Orthoptera* and the family *Gryllidae*. They hatch in spring, and the young crickets eat and grow rapidly. They shed their skin eight or more times before they become adults. They eat a broad range of food ranging from seeds, plants, or insects (Giordano *et al.*, 2017). Field crickets are among the most commonly eaten insects on earth, and they are surprisingly versatile and found everywhere when it comes to food. They are rich in a number of vital elements needed by human body. It was reported that, 100 grams of cricket contains more calcium than the same amount of milk, more fiber than 100 grams of green beans, and more than three times the iron present in a comparable amount spinach (Harrison and Bogdanowicz, 2015).



Plate 1: Field cricket (Giordano *et al.*, 2017)

Crickets are been consumed as food in Asia, Latin America, and Africa as far back as prehistoric times. In China, crickets are been consumed as food for over 2,000 years (Feng *et al.*, 2017). In Africa, crickets have formed a daunted cuisine and a valuable complement of food enrichment for many years (Ayieko *et al.*, 2016). In recent years, consumption of edible crickets have become more appreciated in Europe, America, Australia, and Africa with the recognition of its nutritional benefits and food security (FSIN, 2019).

Edible crickets are excellent source of proteins, lipids, carbohydrates, mineral salts, and vitamins. Edible crickets are an excellent source of a wide range of watersoluble vitamins such as thiamine, riboflavin, niacin, and vitamin B12. However, the nutritional composition of these crickets varies across the different species (Orinda, 2020). The nutritional contents can also vary within the same species of cricket influenced by the stage of development, habitat, climate, sex, and the food substrate fed on by the cricket (Musundire *et al.* 2016). The nutritional value may also be influenced by the method in which the crickets are processed (i.e., drying, cooking, smoking, deep-frying, roasting, and toasting) before consumption (Van Huis *et al.*, 2013). Most of the edible crickets supply adequate energy and proteins to the consumer diet, at the same time meeting the amino acid requirements. Crickets also possess a high value of monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA) such as Linoleic acid, Oleic acid, and Arachidonic acid. They also contain an appreciable quantity of saturated fatty acids such as palmitic, myristic, and stearic acid (Ml̄cek *et al.*, 2018).

Edible crickets are a good source of mineral elements such as phosphorus, sodium, potassium, calcium, magnesium, iron, and zinc. Based on dry matter, edible crickets have phosphorus ranging from 0.80 to 1169.60 mg/100 g; potassium ranging from 28.28 to 1079.90 mg/100 g, and sodium ranging from 0.99 to 452.99 mg/100 g as the most abundant mineral macro mineral elements (Henlay *et al.*, 2021).

A research carried out on field crickets obtained in China revealed that, the protein and fat contents on dry weight basis recorded 53.30% and 10.30% respectively, and also contain an appreciable amount of both essential amino acids (36.42%) and nonessential amino acids (36.42%) of which leucine (5.52), lysine (4.87) and valine (4.42) are the predominant essential amino acids while glutamic acid (9.06), alanine (5.54) and proline (4.5) are the predominant nonessential amino acids (Dun Wang *et al.*, 20014).

Information on the nutritional compositions of field crickets found in Sokoto State, Nigeria is yet to be documented. The research therefore aimed to evaluate the nutritional contents of field crickets to determine its potential as food supplement and as raw material in the formulation of fortified animal feeds such as poultry.

2. MATERIALS AND METHODS

2.2 Sample Collection and Treatment

Adults of the Field cricket (*Gryllinae*, 50 % female and 50% male) were collected from the valley around Sokoto State University, Sokoto State, Nigeria. Shortly after collection, the insects were identified at the Zoology unit, Department of Biological Sciences, Sokoto State University, Sokoto, and a Voucher number was deposited at the unit for future reference. They were washed with tap water, rinsed with distilled water, oven dried at 50°C for 72 hrs, pulverized to fine powder and then stored in airtight sample bottles until analyses.

2.3 Proximate analysis

Standards methods of AOAC (1990) was used for the proximate analysis. The moisture contents was determined by weighing two grams (2g) of fresh seed kernel in a crucible and dried in an oven (Gallenkamp, UK) at 105°C for 24 hrs. The dried sample was cooled in a desiccator for 30 minutes and weighed.

The ash contents was determined by incinerating 2g dried sample in a muffle furnace at 55°C for 2hrs. Crude lipid (CL) was extracted using Soxhlet

extractor from 2g dried sample with n-hexane for 8hrs. The nitrogen (N) contents was estimated by micro-Kjeldahl method and crude protein (CP) contents calculated as $N\% \times 6.25$. Crude fiber (CF) contents was determined by treating 2g dried sample with 1.25% (w/v) H_2SO_4 and 1.25% (w/v) NaOH. The available carbohydrate (CHO) was calculated by difference and the Calorific value (CV) by using equation 1.

$$CV \text{ (kcal/100g)} = (CHO \times 4) + (CL \times 9) + (CP \times 4) \dots\dots\dots (1)$$

2.3 Minerals analysis

Mineral analysis was carried out after sample digestion of two (2g) grams of the dried sample with 24 cm^3 mixture of nitric acid/perchloric/sulphuric acids in the ratio 9:2:1 respectively. Atomic Absorption Spectrophotometry, Na and K by Atomic Emission Spectrometry, and P by the molybdenum blue colorimetric method (James, 1995) determined the concentration of Ca, Mg, Fe, Mn, Ni, Co, Cu and Zn.

2.4 Anti-nutrients analysis

The contents of oxalates, phytates, tannins, saponins, and hydrogen cyanide was determined using the analytical methods reported by Muhammad and Umar (2015).

In the determination of total oxalates, to 1g of the sample, 75 cm^3 of 15N H_2SO_4 was added. The solution was carefully stirred intermittently with a magnetic stirrer for 1hr and filtered using what-man No1 filter paper. 25 cm^3 of the filtrate was collected and titrated against 0.1N $KMnO_4$ solution until a faint pink color appeared that persisted for 30 sec.

Phytate was estimated by soaking 4g of the sample into 100 cm^3 of 2% HCl for 5 hours and filtered. To 25 cm^3 of the filtrate, 5 cm^3 of 0.3% ammonium thiocyanate solution was added. The mixture then titrated with iron (III) chloride solution until a brownish-yellow color that persisted for 5minutes was obtained.

The tannin contents was determined using Folin Denis reagent, in that method, a standard calibration curve was prepared and the Absorbance (A) against concentration of tannins at specific wave length was estimated as follows: Suitable aliquots of the tannin-containing extract (initially: 0.05, 0.2 and 0.5 cm^3) were pipetted into test tubes, the volume made up to 1.00 cm^3 with distilled water, then 2.5 cm^3 of sodium carbonate solution was added. The tubes were shaken and the absorbance recorded at 725nm after 40 min. The amount

of tannin was calculated as tannic acid equivalent from the standard curve.

For saponins content, five grams (5g) of the sample was weighed into a thimble and transferred into a soxhlet extractor fitted with a condenser and a flat bottom flask. A known volume (100ml) of acetone was poured into the flask. The sample in the flask was exhaustively extracted of its lipids for 3 hours by heating the flask on a hot plate. This was the first extraction. Afterwards, a pre-weighed round bottomed flask containing 100 ml of methanol was used to exhaustively extract the saponin for 3 hours. The methanol was distilled off and collected for further use and the flask reweighed. The difference between the final and initial weights of the flask represented the weight of saponins extracted.

Alkaline Picrate method was used to determine the cyanogenic glycoside contents. Five grams (5g) of the sample was dissolved in 50 ml distilled water in a conical flask and allowed to stand overnight to extract cyanide. The extract was filtered and the filtrate used for cyanide determination. To 1ml of the filtrate, 4 ml of alkaline picrate was added and incubated in a water bath for 5 minutes. After colour development (reddish brown colour), the absorbance was read at 490 nm. The cyanide contents was extrapolated from a cyanide standard curve.

2.5 Analysis of Antioxidant Vitamins

2.5.1 Determination of Ascorbic acid (Vitamin C)

The method reported by Olajire and Azeze (2011) was employed. One gram of the sample was extracted with 1% 10 mL metaphosphoric acid for 45 min at room temperature and filtered. The filtrate (1 mL) was mixed with 9 mL 2,6 - dichloroindophenol and the absorbance measured spectrophotometrically at 515 nm against the blank. The contents of vitamin C in the sample was calculated on the basis of the calibration curve of L- ascorbic acid.

2.5.2 Determination of Tocopherol (Vitamin E)

The method reported by Eromosele *et al*. (1994) was adopted. One gram of the sample was treated with ethanol, xylene and then centrifuge to separate the extract. The extract (2 mL) then treated with bathophenanthroline, ferric chloride solution and phosphoric acid. The mixture allowed standing for five minutes. The standard solution was prepared using α -tocopherol dissolved in distilled water instead of ethanol in a separate test tube. The absorbance of the test sample (Ax) and the standard (As) were then measured using spectrophotometer at 534 nm and the amount of vitamin E in the sample calculated using the formula presented in equation 3.

$$\text{Concentration of vitamin E} = \frac{A_x}{A_s} C_s \dots\dots\dots (3)$$

2.5.3 Determination of β -carotene

Carotene contents in the sample was analyzed using Ultraviolet-Visible (UV-vis) spectrophotometer at 446 nm as reported by Egbal *et al.* (2011). The sample was homogenized and weighed to the nearest ± 0.0001 g into a 25 mL volumetric and then be dissolved with *n*-

hexane and diluted to the mark. This was followed by transferring the solution into a 1 cm quartz cuvette and the absorbance measured at 446 nm against n-hexane. The carotene contents wsa calculated as β -carotene in parts per million (ppm) using equation 4.

$$\text{Concentration of Carotenoids} = \frac{V \times 383 \times (A_s - A_b)}{100 \times W} \dots\dots\dots(4)$$

Where

V = Volume used for the analysis; 383 = Extinction coefficient of carotenoids; A_s = Absorbance of the sample; A_b = Cuvette error and W = Weight of the sample in g.

2.6 Statistical Analysis

The data obtained were statistically analysed using one-way analysis of variance (ANOVA) with SPSS version 16.0 statistical package and the results

reported as mean \pm standard deviation of the triplicate values.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Proximate and Minerals composition

The results of proximate and minerals composition of Field crickets are presented in Figure 1 and Figure 2 respectively.

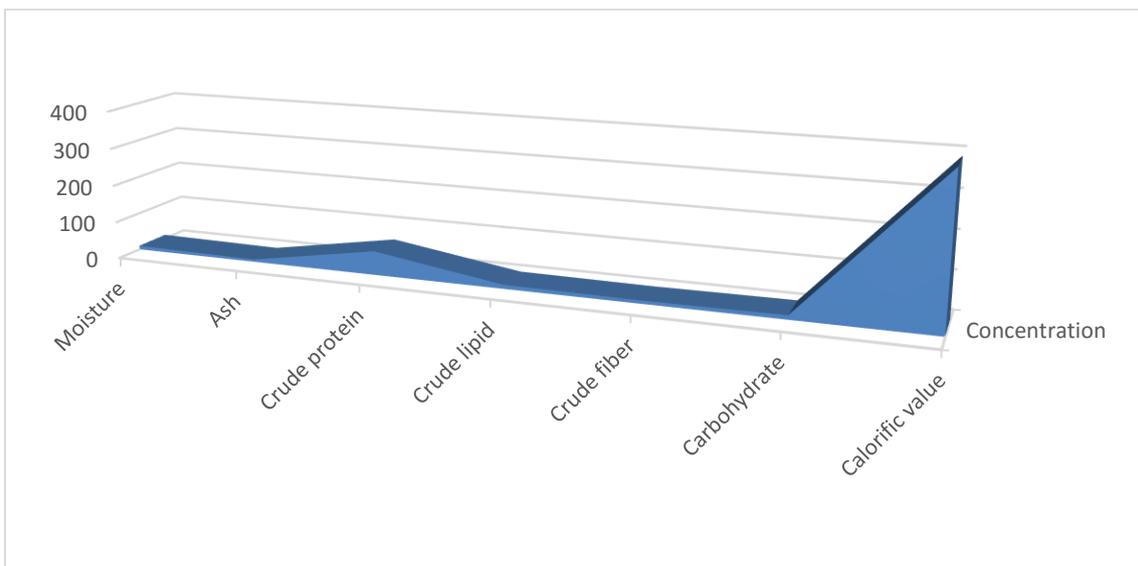


Figure 3.1: Proximate compositions of Field crickets (g/100g dry weight), Calorific value (Kcal/100g)

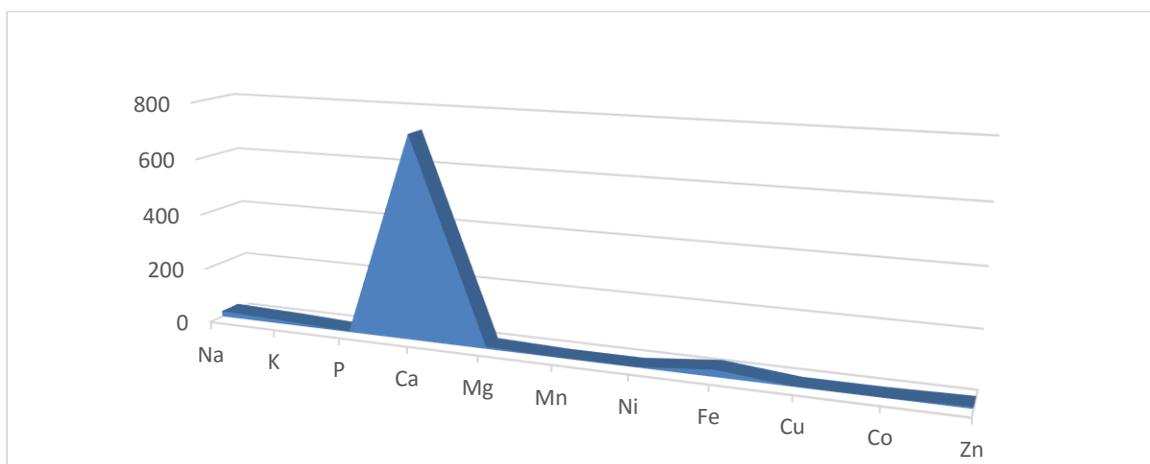


Figure 3.2: Minerals composition of Field crickets (mg/100g dry weight)

3.1.2 Anti-nutrients composition

The anti-nutrients content of the Field crickets on dry weight basis are generally low with oxalates having the highest concentration of 19.34 ± 1.23

mg/100g, followed by cyanogenic glycosides (3.26 ± 0.67 mg/100g), saponins (1.31 ± 0.12 mg/100g), tannins (0.47 ± 0.11 mg/100g), and the lowest contents of phytates (0.14 ± 0.01 mg/100g) as presented in figure 3.

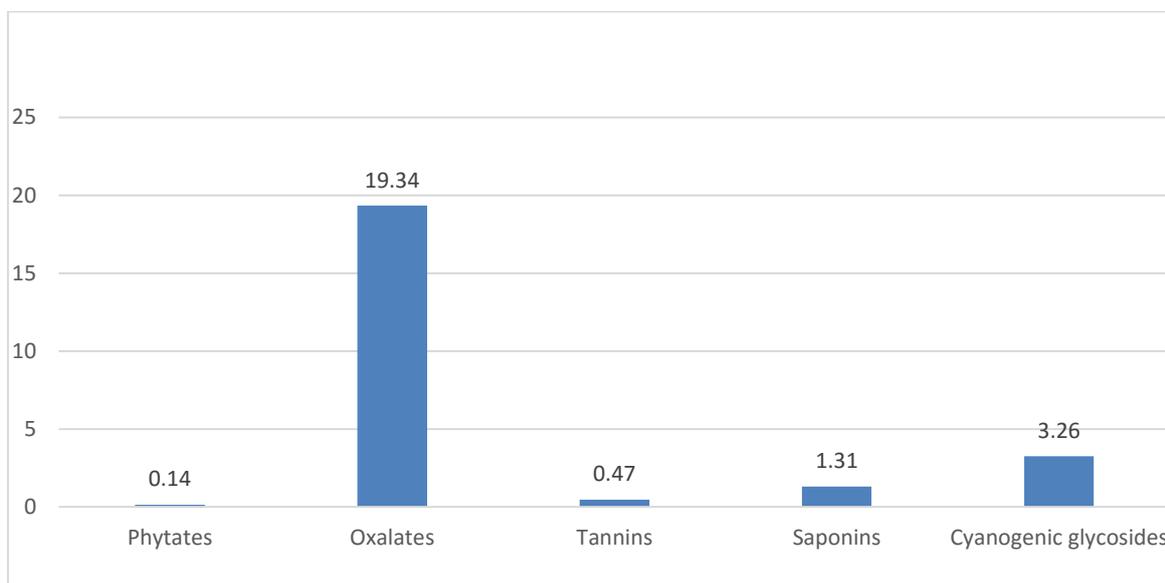


Figure 3.3: Anti-nutrients composition of Field crickets (mg/100g dry weight)

To predict the bioavailability of some important nutritional mineral elements specifically calcium, magnesium, zinc and iron, anti-nutrient to nutrients

molar ratio were calculated and the results presented in figure 4.

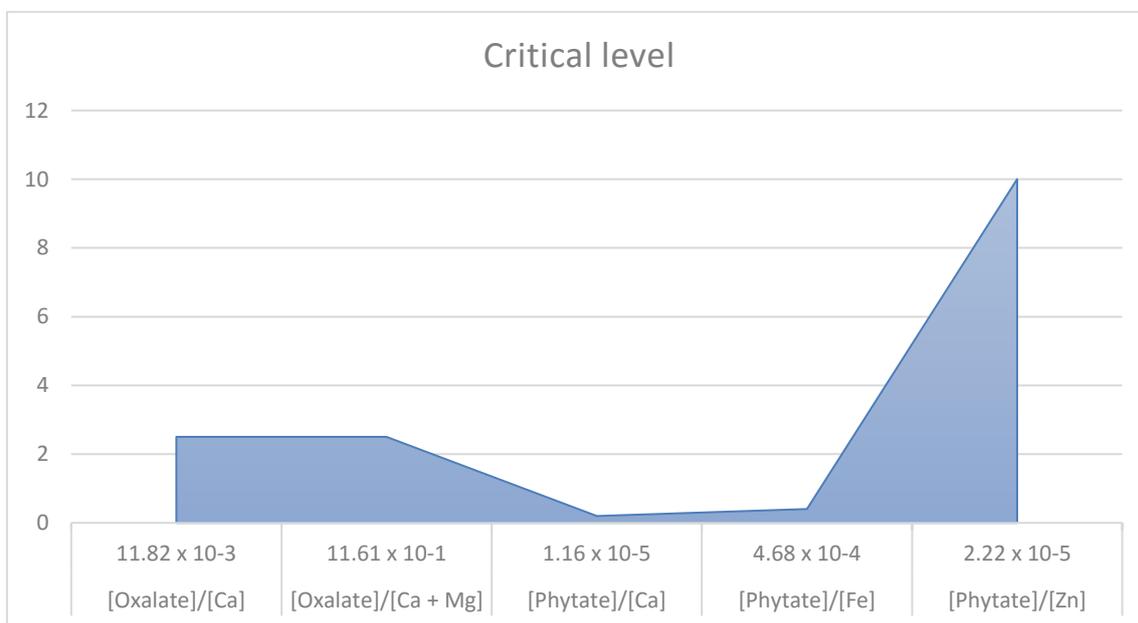


Figure 3.4: Anti-nutrients to nutrient Molar ratio

3.1.3 Antioxidant Vitamins

The Field crickets contain both fat soluble and water-soluble vitamins. The contents of vitamin C, β –

carotene, and vitamin E on dry weight basis are 1.18 mg/100g, 2.91 mg/100g, and 31.80 mg/100g respectively as presented in Figure 4.

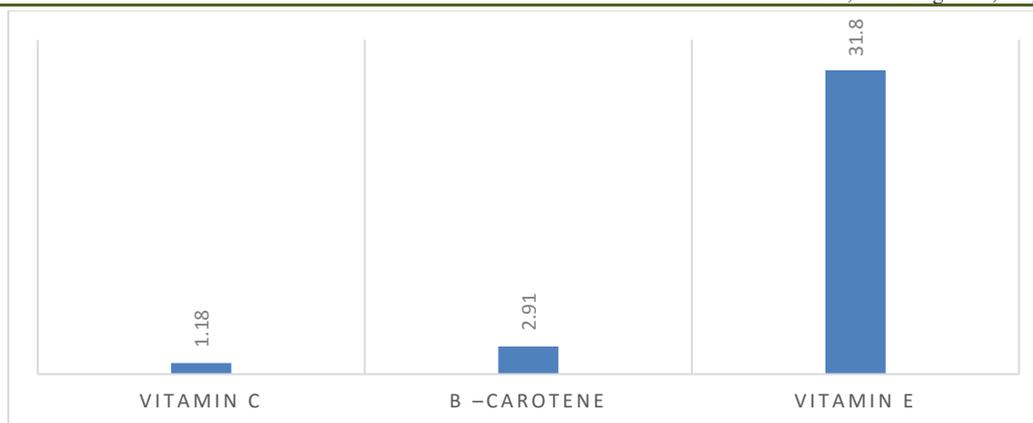


Figure 3.5: Antioxidant Vitamins of Field crickets (mg/100g dry weight)

3.2 DISCUSSION

3.2.1 Proximate Compositions

The moisture contents is generally low (10.11 g/100g dry weight). The value obtained is higher than 3.5g/100g for Field crickets reported by Dun Wang *et al.* (2004), also higher than 4.0g/100g dry weight obtained for Grasshopper reported by Oibiokpa *et al.* (2017). The variation in the moisture contents can be attributed to species difference of the insects, processing methods of the insects, the type of plants on which the insects feed, as well as the climatic conditions. The low moisture contents of the insect suggests that they may be kept for long periods without fear of deterioration or spoilage therefore they can be stored for food long when out season.

The ash contents of the Field crickets is 5.98 g/100g dry matter, which is an indication that the Crickets contain nutritionally important mineral elements. The value obtained is lower than 11.50g/100g dry matter reported in Grasshopper (Sani *et al.*, 2014), but higher than 2.96g/100g dry matter for Field crickets obtained in China (Dun Wang *et al.*, 2004).

The Field crickets contain crude lipid of 10.78 g/100g dry matter, which is lower compared to 40.88 g/100g dry weight for Field crickets, and 49.33 g/100g dry matter for Grasshopper reported by Oibiokpa *et al.* (2017) and Sani *et al.* (2014) respectively. However, the value is within the range of 10 to 60 g/100g dry matter recorded in edible insects (Leka *et al.*, 2016). Fats provide the body with energy and are essential in diets as they increase palatability of food. They also help in the transportation of fat soluble vitamins and provide the body with essential fatty acids required for healthy development of children and infants (Oibiokpa *et al.*, 2017).

Insects have been reported to contain significant amount of fiber (van Huis *et al.*, 2013). The high fiber contents is as a result of chitin, the form of insoluble fiber in insects derived from their exoskeleton. The crude fiber contents is generally higher than those reported by Banjo *et al.*, (2012) (1.10 – 3.40%) and Ekop *et al.*, (2010) for

Field crickets, and for Grasshopper. Although Mbah and Elekima, (2007) and El Hassan *et al.*, (2008) reported higher values of crude fiber in the insect as compared to that obtained in this study. The variations may be due to species differences. Dietary fibers are those components of food that cannot be broken down by human digestive system. They are known to play important roles in increasing stool bulk (aiding digestion). They also bind cholesterol and carcinogens thereby reducing plasma cholesterol and reducing the risk for coronary heart disease and cancers. Dietary fibers also slow down the rate of absorption of nutrients. This is of clinical importance because diets containing fibers slow down the rate of absorption of carbohydrate, consequently leading to a decrease in the rise in blood sugar and insulin levels if fibers are eaten with carbohydrate rich foods (Chaney, 2006). Although, there is an argument as to whether chitin plays similar roles as dietary fiber (Muzzarelli *et al.*, 2001), insects may be good sources of fiber.

The Field crickets contain relatively high crude protein (63.54g/100g dry matter). The value is higher compared to 58.30g/100g recorded for Field crickets (Dun Wang *et al.*, 2004) and is in agreement with 13 to 77g/100g set as the average range of protein contents of most edible insects (Lenka *et al.*, 2016). Protein is an important food required for development of body tissue. The high protein contents suggests the potential relevance in the prevention of protein energy malnutrition.

The main function of carbohydrate is for energy supply. The carbohydrate contents recorded was 11.14g/100g dry weight, which is lower than 29.61% for Grasshopper (Sani *et al.*, 2014), but higher compared to 2.94 g/100g dry weight for Field cricket (Dun Wang *et al.*, 2004). The Result obtained suggest that insects may not be a good potential source of carbohydrates.

The energy value of most edible insects depends on their composition of fat. The calorific value of the Field crickets was 395.74 kcal/100g dry weight and is within the range of 293 to 762 kcal per 100 g dry

matter observed for edible insects (Lenka *et al.*, 2016). The energy value is within the range of recommended daily intake of 300kcal of energy per 65kg body weight adult human (Lenka *et al.*, 2016). The Field crickets therefore if consumed in good quantity could be a good supplement of energy.

3.2.2 Minerals Composition

The minerals profile of the Field crickets (*Gryllinae*) is presented in Figure 2. The result indicates that Field crickets are rich in both macro and micro mineral elements. Calcium is the most abundant (725.00mg) followed by iron (25.13mg) and then sodium (20.06mg), potassium (12.53mg), magnesium (8.14ng) and zinc (6.14mg). The result of the present study agrees with the fact that most edible insects are interesting in terms of nutritional content of minerals such as iron, zinc, potassium, sodium, calcium, phosphorus, magnesium, manganese and copper (Van Huis *et al.*, 2013). Minerals play an important part in biological processes for instance Calcium is known for proper development of bones and teeth while potassium and sodium are important body electrolytes. The result shows that Field crickets are undeniably rich source of iron and their inclusion in the daily diet could improve iron status and help prevent anaemia in developing countries. Anemia is a preventable deficiency but contributes to 20 percent of all maternal deaths (Bednářová *et al.*, 2010). Due to its high content of zinc, Field crickets could help in alleviating zinc deficiency which is another core public health problem, especially for child and maternal health. Zinc deficiencies can lead to growth retardation, delayed sexual and bone maturation, skin lesions, diarrhea, impaired appetite and increased susceptibility to infections mediated via defects in the immune system (Bednářová *et al.*, 2010).

3.2.3 Anti-nutrients Composition

The anti-nutrients composition in the Field crickets analyzed is generally low. The low anti-nutrients content is in conformity with the reports of other researchers. Ekop *et al.*, (2010) reported low levels of HCN, oxalates, phytates and tannins in insects.

The phytates composition of the sample (0.14 mg/100g dry weight) is higher than those reported by Ekop *et al.* (2010) for cricket (0.283 mg/kg), yam beetle (0.28 mg/kg), palm weevil larva (0.289 mg/kg) and grasshopper (0.281 mg/kg). The presence of phytates in food reduces bioavailability of mineral elements such as iron, calcium, magnesium, manganese and copper. Umaru *et al.*, (2007), reported that a phytate diet of 1-6 g/100g over a long period may decrease the bioavailability of these mineral elements in monogastric animals. The phytate contents of the Field crickets is below the permissible levels of 22.10 mg/100g (WHO, 2003), and therefore may not interfere with the absorption of mineral elements.

Oxalates is the most abundant anti-nutrient (19.34 mg/100g dry weight). The result obtained is in agreement with the findings of Ekop *et al.* (2010) reported higher values of oxalates as compared to other anti-nutrients in insects. This may suggest the predominant nature of oxalates in insects. Oxalate and its contents have deleterious effect on nutrition and health, mainly by decreasing calcium and magnesium absorption and aiding the formation of kidney stone (Rathod and Valvi, 2011). The lethal dose of oxalates is between 200 to 500mg/100g (Oibiokpa *et al.* (2017). The value obtained is far below the lethal dose, suggesting the potential safety of consuming the sample as per the oxalate contents.

The presence of saponins and tannins reduce the protein digestibility of food by inhibiting the activity of trypsin and chymotrypsin. The contents of saponins (1.31 mg/100g dry weight) and tannins (0.47 mg/100g dry weight) in the field crickets analyzed are below the permissible limits of 48.05 mg/100g and 76 -90 g/100 dry weight respectively (WHO, 2003). The results indicate that the presence of these antinutrients may not affect the digestibility of proteins obtained from the insects.

The level of cyanogenic glycosides (3.26 mg/100g dry weight) in the field cricket analyzed is lower than the lethal dose for Hydrogen cyanide which is between 50 – 60 mg/ kg body weight. Hydrogen cyanide is released on degradation of cyanogenic glycosides. Hydrogen cyanide is a known inhibitor of cytochrome oxidase and therefore interferes with aerobic respiratory system. Dietary intake (ATSDR, 1997) of the insects may not result to acute or chronic cyanide toxicity. Owing to the low antinutrient contents of the insects, the use of insects as food may therefore not be detrimental to health.

For the bioavailability of some nutritional mineral elements, it was observed that, [oxalate] / [Ca], [oxalate] / [Ca + Mg] ratio are below the critical level known to impair calcium bioavailability (Hassan *et al.*, 2011). Similarly, the [phytate] / [Ca] is low compared to the critical value known to cause calcium deficiency by the phytate. The [phytate] / [Zinc] is lower than the critical value known to impair zinc bioavailability. Mitchikpe *et al.* (2018) reported that, for iron bioavailability, [phytate] / [Fe] should not exceed 0.4; the result obtained is lower than the critical value which indicates the bioavailability of iron. The results indicate that the anti-nutrients present may not cause deficiency of the mineral elements.

3.2.4 Antioxidant Vitamins

Vitamins are essential components of diet required in trace amounts to perform several cellular functions. The vitamin C contents of the Field crickets was found to be 1.18 mg/100g dry weight, The value is relatively higher than 1.01 mg/100g dry weight for Field

crickets, but lower compared to 1.33 mg/100g dry weight for Grasshopper reported by Oibiokpa *et al.* (2017). Vitamin C is considered an excellent antioxidant because it donates electrons for enzymes or other compounds that are oxidants (Anoop *et al.*, 2013). Vitamin C enhances non-heme iron transport and absorption, the reduction of folic acid intermediates and the production of cortisol. It is also vital in the synthesis of collagen and other connective tissues (Anoop *et al.*, 2013). Vitamin C deficiency in the body results in the fragility of blood capillaries, gum decay and scurvy (Dave and Patil, 2017). Our body required 65 mg to 95 mg of vitamin C daily (Halliwell, 2017). Although the vitamin C contents is low, Field cricket if properly utilized may assist in supplementing the daily requirements of vitamin C.

The vitamin E contents of the Field crickets was found to be 31.80 mg/100g dry weight, The value is higher than 0.33 mg/100g dry weight for Field crickets, and also higher compared to 0.48 mg/100g dry weight for Grasshopper reported by Oibiokpa *et al.* (2017). Vitamin E is an important antioxidant that plays an important role in prevention against chronic diseases (Eqbal *et al.*, 2011). The result suggests the use of Field crickets in the inhibition of lipid peroxidation, membrane stability, fluidity and permeability and protect the photosystem II from oxidative damage by scavenging lipid peroxyl radicals and singlet oxygen (Assunta *et al.*, 2015).. If properly utilized Field crickets may supply the daily vitamin E requirements of 0.4 mg and 0.3 mg for non-pregnant non-lactating female and for children aged 1 - 3 years respectively (Matthew *et al.*, 2019).

The β -carotene contents of the Field crickets was found to be 2.91 mg/100g dry weight, The value is in agreement with 2.90 mg/100g dry weight for Field crickets, but lower compared to 4.97 mg/100g dry weight for Grasshopper reported by Oibiokpa *et al.* (2017). β -carotene enhances the growth of cells and tissues, fortifies the immune system against diseases, and delays aging (Matthew *et al.*, 2019). It also helps in effective functioning of eye, skin, nails and hair (Matthew *et al.*, 2019). The value obtained indicates the potential of Field crickets to their vitamin A levels, and therefore could be converted to vitamin A in the body to supplement the daily requirements of 0.90 mg for adult men and 0.70 mg for adult women (Halliwell, 2017).

The variation of the content of vitamins in various insects has been reported by various researchers (Banjo *et al.*, 2012; van Huis *et al.*, 2013). These variations may be as a result of differences in species, habitat and diet of the insects.

4. CONCLUSION

The field crickets analyzed have been found to be a good supplement of proteins and fats. The insect also contains considerable amounts of antioxidant vitamins, and minerals required to maintain health and normal

body functions. The high caloric value and protein content of the insects suggest its relevance in the management of protein energy malnutrition. The anti-nutrient to nutrient molar ration are below the critical levels known to impair minerals bioavailability. The results suggest the use of the insect as food supplement, however the toxicity studies on the safety of consumption is still being investigated.

5. Conflict of Interest

The authors have declared no conflict of interest

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