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EFFECT OF DIFFERENT PROCESSING METHODS ON THE NUTRITIONAL AND ANTI-NUTRITIONAL FACTOR OF *CIRINA FORDA* (WESTWOOD) LARVAE

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ABSTRACT: *A study was conducted to determine the effect of the different processing methods on the proximate and anti-nutrient composition of Cirina forda larvae consume in wukari-local government of Taraba state. Proximate analysis was used to determine nutritional and anti-nutritional content of Cirina forda larva using boiled and dried method of processing. Data obtained were subjected to Statistical Analysis System, (SAS). Statistical significant means were compared using Duncan Multiple Range Test DMRT, (Duncan). Boiled processing method had significant (P<0.01) effect and high nutritional content for protein (15.53±0.03), lipid (30.87±0.03), crude fibre (7.83±0.03) and moisture (9.06±0.01) with the exception of Ash and carbohydrate, which showed non-significant values between the two processing methods. The anti-nutritional content of fried processing method had high values recorded in phytate (4.6±0.13), saponin (0.16±0.30) and flavonoid (0.24±0.00) compared to the boiled processing method with exception of tannin and alkaloid, which showed non-significant differences between boiled and fried processing methods. Results obtained in this study showed that the boiled processing method of C. forda is richer in nutrients and generally lower in anti-nutrients within the safe consuming level than the frying process. Further studies should be geared towards determining fatty acid content of Cirina forda larvae.*

KEYWORDS: Processing method, Nutrition, Factor, Cirina forda.

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INTRODUCTION

The yearly increase in human population has created a quest for other alternative sources of food nutrients. There is shortage and scarcity of awareness on the availability of other natural food sources which has been recognised as one the of the major factors against nutrient glut as intended by the "creator" the consumption rate of these selected edible insects in various ways is a positive response to this search. Yoloye (1998) reported that, insect is the most abundant and productive groups of animals that makes of about 70% of known species of animals. Insects can serves as either destroyer of man's valuable materials and crops or as his nutrient sources. One of the nutritive component of the insects known as the chitin which has high function of reducing cholesterol level and serve as haemostatic agent for tissues repairs and quickening healing wounds and burn (Goodman, 1989). Over thousands of years all over the planet, insects and other related invertebrate have serve as food for the people. The commonly insects consumed include locust, termite, grasshopper, weevils and various caterpillar (Ene, 1963). The edible larva of the *Cirina forda* is an important commodity of trade and has a wide acceptability as food source in Nigerian states such as Oyo, Kwara, Niger, (Ande 1991, Fasoranti and Ayiboye 1993). Kaduna, Benue and Taraba have become most valuable and marketable for these insects. This study was aimed to determine the effect of the different processing methods on the proximate and anti-nutrient composition of *Cirina forda* larvae consume in wukari-local government of Taraba state.

MATERIALS AND METHODS

Sample collection and preparation

The larva of *Cirina forda (*Westwood) were handpicked form the crowns of sheabutter tree, *Vittellaria paradoxa* in Wukari local government Area of Taraba state, Nigeria. *Cirina forda* larvae were starved for 24hrs to eliminate their gut contents and then the first sample was boiled for two hours in laboratory (Fasoranti and Ajiboye, 1993). The second sample was fried for 20mins without using oil. After removing the body hairs, the larva sample were milled into powder using the laboratory mill and kept in an air tight container and labeled. All analyses were done in the institute of Agricultural Research, Ahmadu Bello University Zaria where the nutritional and anti-nutritional factor of *Cirina forda* larva was determined using boiled and fried processing methods.

PROXIMATE ANALYSIS

Determination of moisture content using A. O. A. C. (1980)

Principle: This was on the difference between the net weights after oven drying at 105^0c for 8 hours. The crucible and its contents were cooled in desiccators and weighed (w_3). The procedure was continued until a constant weight was obtained

Calculation

The moisture content was calculated as percentage moisture = $\frac{W2-W3\ x\ 100}{W3-W1}$

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W = weight of empty crucible

W_2 =weight of crucible + sample before oven drying

W_3 = weight of crucible + sample after oven drying

Determination of Ash content using A. O A. C. (1980)

Principle: The ash content was determined from loss in weight that occurs during igniting the sample at 55^0c in muffle furnace which is enough to allow the entire original matter to burn off without permitting any appreciable decomposition of the ash constituents.

Procedure: 2g of the formerly ground sample was weighted (w_2) a previously weighed clean crucible (w_1) which had been ignited into the muffle furnace at 550^{0c} for 30 minutes and cooled in a desiccator. The crucible ends it content were transferred into the muffle furnace and temperature was gradually increased until it reached 550^0c, after maintaining the sample at this temperature for 8 hours the crucible and it residue were allowed to cooled to 200^{0c}. This was removed and cooled in a desiccators and the procedure was continued until constant weight was obtained (W_3)

Calculation

Percentage Ash = $\frac{W3-W1\ x\ 100}{W2-W1}$

W_1 = weight of empty crucible

W_2 =weight of sample in crucible before incineration

W_3 = weight of sample in crucible after incineration

Determination of fibre using A. O. A. C 1980

Principle: This involved sequential digestive of the sample with dilute acid and alkali solution, the residue stained was ignited to obtain the crude fiber.

Procedure: 2g of few finely grinded samples was put into a round bottom flask, 100cm of 0.023m suphuric acid solution was added and the mixture boiled under reflux for 30min. the hot solution was quickly filtered under suction. The insoluble matter was washed several times with hot water until it was acid free. This was quantitatively transferred into a flask and 100cm of 0.312m NaOH was added and the mixture boiled for 30 minutes. Under reflux and quickly filtered while hot the insoluble portion was washed several times with hot water until it was base free. It then dried to a constant weight in the oven set at 100^{0C}, cooled in a desiccators and weighed C_2 the weighed residue was then incinerated n a muffle furnace of 5500c for 2 hr, cooled, in the desiccators and reweighed (C_3).

Calculation

Percentage Crude fiber = $\frac{C2-c3\ x\ 100}{W}$

Where W = weight of original sample
$C_2 – C_3$ = the loss in weight on ashing

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Determination of lipid content using A. O. A. C. 1980

Principle: This is the continuous extraction from fat content form the sample using suitable solvent e. g. petroleum ether in a soxhlet extractor. In this principle, non–polar component of the sample are easily extracted it on the organic solvent.

Procedure: 200cm^3 of petroleum ether (40 – 60ºC) was transferred into a clean dry 250cm^3 round bottom flask fitted with soxhlet extraction unit. The fat free extraction thimbles were weighted (w_1) and an approximate of 0.5g of the sample was added and weighed (w_2) the thimble was fixed into the soxhet extraction unit with forceps and cool water circulation put on the heating mantle was switched on and heating rate was adjusted at temperature between 40ºC−60ºC until solvent was refluxing at a ready rate. Extraction was carried out for 8 hrs and the heating mantle was switched off. The thimble was removed and dried to a constant weight in an oven at 70ºC and weighed (w_3).

Calculation

Percentage LIPID (W/W) = $\frac{\text{Weight of lipid extracted x 100}}{\text{Weight of direct sample}}$

Percentage lipid (w/w) = $\frac{\mathbf{w_2 - w_3}}{\mathbf{W_2 - w_1}}$

Where the weight of lipid extracted (crude fat) given by the loss in weight ($w_3 - w_1$) of the thimble content after extraction.

Determination of crude protein using A. O. A. C. 1980

Principle: the principle of this method is to digest the organic matter with sulphuric acid in the presence of a catalyst, render the reaction alkaline then distilled and titrate the liberated ammonia.

Digestion: This involves oxidation of organic matter with sulphuric acid and reduction to nitrogen to ammonium sulphate

$$\mathbf{2H_2SO_4 \longrightarrow 2SO_2 + 2H_2O + O2}$$

$$\mathbf{R \longrightarrow COOH + O_2 \longrightarrow XCO_2 + YH_20 + ZNH_3H}$$

$$\mathbf{R \longrightarrow NH_2}$$

$$2NH + H_2SO_4 \longrightarrow (NH_4)\ SO_4$$

Distillation: This involves the liberation of ammonia by sodium hydroxide. The ammonia is trapped in excess boric acid and titrated with hydrochloric acid.

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$(NH_4)_2SO_4 + 2NaOH \longrightarrow Na_2S0_4 + 2NH_4$
$NH_3 + H_20 \longrightarrow NH_40H$
$H_3BO_3 + 3NH_4OH \longrightarrow (NH_4)_3\ BO_3 + {}_3H_2O$

C. TITRATION: The back titration method is employed the ammonia reacts with the boric acid in receiving flask and the amount of the excess Na0H is determined by titration with HCl. The ammonium borate estimate is titrated with standard Hydrochloric acid.

$(NH_4)_3BO_3 + 3HCl \longrightarrow 3NH_4Cl + H_3BO_3$

Procedure: 2g of the sample was weighed into 100ml kjeldahl flask and a few anti-bumbling granules were added. One gram of the mixed catalyst ($CUSO_4$ andK_2SO_4 ratio8:1) and 15ml of concentrated sulphoric acid was add. The flask was placed kjeldahl digestion rack and heated until a clear solution was obtained. At the end of digestion, the flask cooled and the sample was quantitatively to 100ml volumetric flask and made up to mark with distilled water

100ml of the digest was pipetted into Markham semin micronitrogen steel and 10ml of 40% Na0H solution was added consciously. The sample was steam distilled liberating ammonia into 100m conical flask containing 10ml of 4% boric acid and a drop of mixed indicator until indicator change color from pink to light yellow about 30ml volume of sample was collected.

The content of the conical flask was titrated with 0.1m HCL with the end point indicated by a colour change from a light yellow to pink.

Calculation

PERCENTAGE NITROGEN = $\frac{\boldsymbol{M\ x\ V\ x\ 100x\ 100\ x\ 14}}{\boldsymbol{W\ x\ 100\ x\ 10\ x\ 1}}$

M = Molarity (conc) of HCL

V = Volume of acid used

14 Atomic weight of nitrogen

100 = Total volume of digest

10 = volume digest (distillate) taken

W = weight of sample taken n gram

1000 = to covet to litter (dm3)

100 = % conversion

Therefore

Percentage Nitrogen = $\frac{AVx1.4}{W}$

A.V. Average titter value

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W = weight of sample

The crude protein (CP) was calculated as % crude protein (cp) = 6.25 x %N

Where 6.25 = conversion factors since it is assumed the level of Nitrogen in protein i.e. 100/16 = 6.25

ANTI-NUTRIENT

Determination of Percentage Phytate (Reddy, 1978)

Procedure: 2g of finely ground sample was soaked in 100ml of 2% HCl for 5 hours and to the filtered 25cm^3 of the filtrate potassium thiocynate solution was added as indicator. The mixture was titrated with a standard solution of FeCl until a brownish yellow color persisted for 5 minutes

Calculation

Concentration of phytate phosphorous = $\frac{\text{Titre value x } 0.0601}{1000 \text{ x sample weight}}$

Determination of Percentage of Saponnins (Reddy, 1978)

Principle: A gravimetric method employing the use of a soxhlet extractor chamber fitted with a condenser and a round flat bottom flask, some quantity of acetone enough to cause reflux is poured into the flask. The sample was exhaustively extracted of it lipid and interfering pigment for 3 hours by heating the flask on a hot plate and the solvent distilled off, this was the first extraction.

For the second extraction, a pre-weighted round bottom flask is fitted into the soxhlet apparatus bearing the sample containing thimble and methanol was poured into the flask. The methanol was enough to cause reflux. The saponin was then exhaustively extracted for 3 hours by heating the flask on a hot plate after which the solvent is distilled off. The flask was re-weighted. The difference between the final and initial weights of the flask represents the weights of the saponin extracted.

Calculation

Concentration of SAPONINS = $\frac{\boldsymbol{Acetone\ weight - methanol\ weight}}{\boldsymbol{Weight\ of\ the\ sample}}$

Determination of tannic acid percentage (A. O. A. C. 1980)

Procedure: 1g of the finely ground sample was weighted into a beaker. The sample was soaked with solvent mixture (80mls of acetone and 20mls of glacial acetic acid) for 5 hours to extract tannin the filtrates were removed. The samples were filtered through a double layer filter paper to obtain the filtrate. A set of standard solution of Tannic acid was prepared ranging from 10ppm to 5ppm. The absorbance of the standard solution as well as that of the filtrate were read at 50nm on a spectronic 2D.

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Calculation

Concentration of Tannin = $\frac{\text{Absorbance x average gradient x dilution factor}}{10000}$

Where:

Absorbance = reading form the spectrophotometer

Average gradient = constant i.e. 100

Dilution factor = 100

Determination of Alkaloid (Horbone, 1980)

Procedure: 1g of the sample was weighed and dispersed into 50ml of acetic acid solution of 10% ethanol, shake the mixture and allow standing for 4 hours before filtering, and then evaporating the filtrate to another one quarter (1/4) of its original volume using water bath. Add drop wise (NH_4OH to precipitate the alkaloids. Filter the precipitate with a weighed filter paper the filtering should be done with a weighed filter paper. Dry the precipitate in a filter paper in the oven at 690c for 30 minute and reweigh. Now by weight difference, the weight of alkaloid is determined.

Calculation

Concentration of Alkaloid = $\frac{W2-W1}{W}$

Where

W = the weight of the sample

W_1= weight of filter paper before drying

W_2 = weight of filter paper after drying

100 = expression in percentage.

Determination of flavonoid (anti-oxidant) using Boham and Kocipai, (1994)

Procedure: 2g of the sample was weighed into a volumetric flask and 50ml of 80% of methanol was added and filtered to extract the filtrate and was transferred into a weight crucible (w_1) to evaporate to dryness using water bath and was weighed after drying (W_2). The difference in weight gives percentage of flavonoid present.

Calculation

Concentration of flavonoid = $\frac{W_2 - W_1}{\text{Sample weight}}$

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Statistical analysis

Data obtained were subjected to Statistical Analysis System, (SAS, 2004). Statistical significant means were compared using Duncan Multiple Range TestDMRT, (Duncan, 1955)

RESULTS AND DISCUSSION

Mean (± SE) nutrient values of processed *Cirina forda* lavae are presented in table 1. Boiled processing method had significant and high nutritional content for protein, lipid, crude fibre and moisture with the exception of Ash and carbohydrate, which showed non-significant values between the two processing methods. Based on the results obtained, boiled processing method had a tendency or likelihood of having high nutritional content or value compared to the fried processing method. The results of this research agreed with the findings of (Onaotoso and Ogunley, 2005) who reported lower nutritional content in fried processing method than the boiled processing method.

The Mean (± SE) anti-nutrient values of processed *Cirina forda* larvae are shown in table 2. The anti-nutritional content of fried processing method had high values recorded in phytate, saponin and flavonoid compared to the boiled processing method with exception of tannin and alkaloid, which showed non-significant differences between boiled and fried processing methods. The results of this study is in consonant with findings of (Ndubuakaku *et al*., 1998) who reported that anti-nutrients are more prominent in fried processing method than boiled processing method.

Table 1. Mean (± SE) nutrient values of processed *Cirina forda* lavae

Nutrients	Boiled	Fried
Protein	15.53 ± 0.03^{a}	14.21 ± 0.05^{b}
Lipid	30.87 ± 0.03^{a}	30.28 ± 0.04^{b}
Crude fibre	7.83 ± 0.33^{a}	6.84 ± 0.03^{b}
Moisture	9.06 ± 0.01^{a}	8.79 ± 0.01^{b}
Ash	8.16 ± 0.03^{b}	8.24 ± 0.03^{a}
Carbohydrate	28.55 ± 0.03^{b}	31.64 ± 0.03^{a}

[ab]Means with different superscripts along same row shows significant differences ******P<0.01. SE= Standard Error

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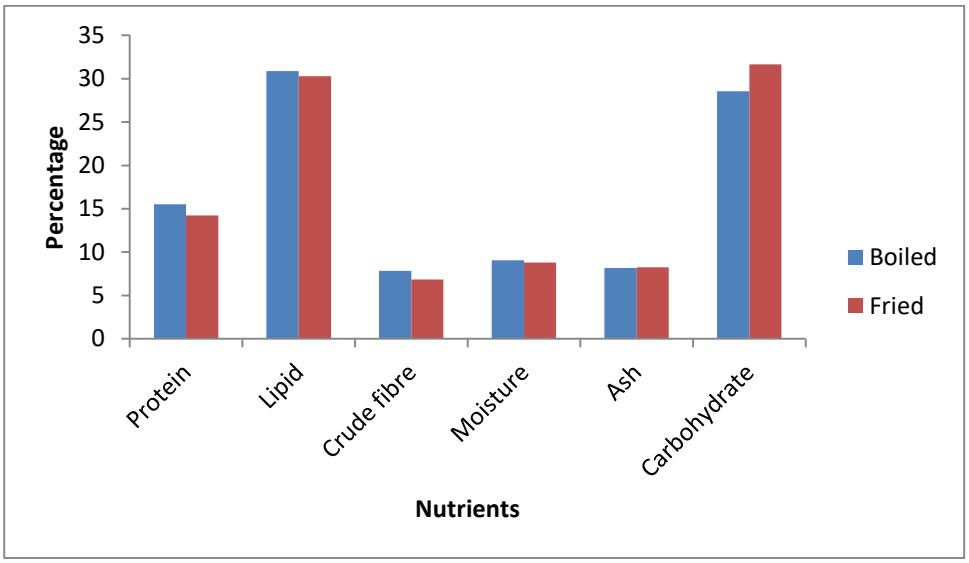

Figure 1. Multiple bar chart showing different levels of the nutritional contents of *Cirina forda* larva

Table 2. Mean (±SE) anti-nutrient values of processed *Cirina forda* larvae

Anti-nutrients	**Concentration (mg/100)**	
	Boiled	**Fried**
Tannin	0.01 ± 0.00	0.02 ± 0.00
Phytate	2.90 ± 0.10[b]	4.6 ± 0.13[a]
Saponin	0.11 ± 0.80	0.16 ± 0.30
Flavonoid	0.06 ± 0.03[b]	0.24 ± 0.00[a]
Alkaloid	0.04 ± 0.00	0.05 ± 0.00

[ab]Means with different superscripts along same row shows significant differences **P<0.01. SE= Standard Error; mg=miligram

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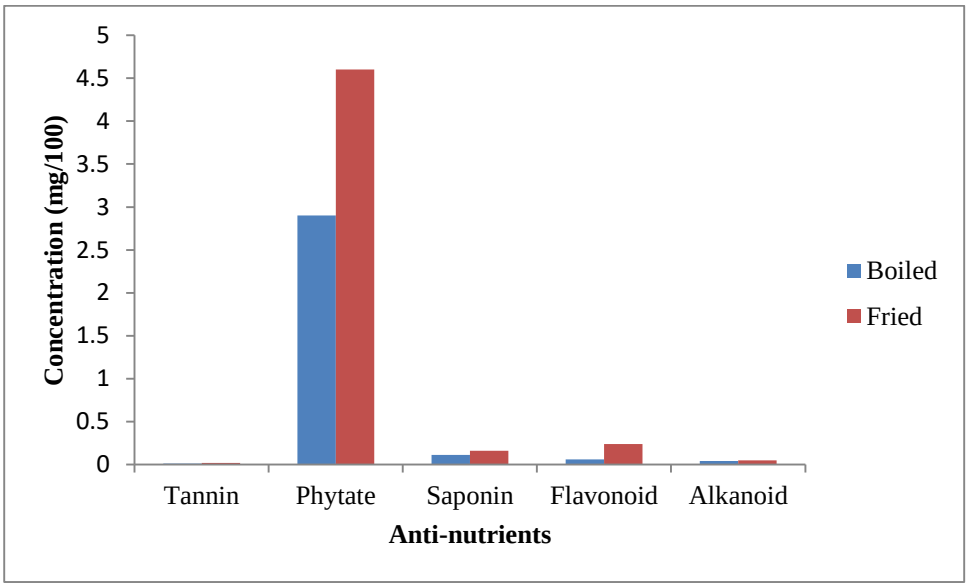

Figure 2. Multiple bar chart showing different levels of the anti- nutritional contents of *Cirina forda* larva

CONCLUSION AND RECOMMENDATION

The results obtained in this study showed that the boiled processing method of *C. forda* is richer in nutrients and generally lower in anti-nutrients within the safe consuming level than the frying process.

Boiling processing method had improved the content of *C. forda* larvae especially carbohydrate, ash, and crube fiber and reduced the anti-nutrient content of the larvae.

The Pupal stage of the ***C.*** *forda* should also be worked on as to know more of it nutritional and anti-nutrient compounds.

Further research should be geared towards determining fatty acid content of *C. forda* larvae.

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