HARVESTING AND PROCESSING TECHNIQUES FOR THE LARVAE OF THE PALLID EMPEROR MOTH, *CIRINA FORDA* WESTWOOD (LEPIDOPTERA: SATURNIIDAE), AMONG THE TIV PEOPLE OF BENUE STATE, NIGERIA.

***Agbidye, F. S.[1] and Nongo, N. N.[2]**

[1]Department of Forest Production and Products, University of Agriculture Makurdi, P. M. B. 2373, Makurdi, Nigeria. **E-mail**: fagbidye@yahoo.com, **GSM**: +234-805-728-1144

[2]Department of Veterinary Parasitology and Entomology, University of Agriculture Makurdi, P. M. B. 2373, Makurdi, Nigeria.

***Corresponding Author**

ABSTRACT

The manner in which edible insects are harvested and processed affects their nutrient content, shelf life as well as their acceptability among different socio-economic groups. Raw extracts of Cirina forda larvae had been reported to have toxic effects on rats compared to processed extracts. The study therefore investigated the techniques employed by the Tiv people of Benue State, Nigeria, in harvesting C. forda larvae from its sole host tree in the country, the sheabutter tree, Vitellaria paradoxa. The processing techniques for the insect larva, the conservation strategies employed by the natives to ensure sustainability of the insect resource alongside the survival strategies used by the insect were also investigated. One hundred and twenty (120) copies of semi-structured questionnaire were administered in three (3) Tiv speaking Local Government Areas (Gboko, Katsina-Ala and Tarka). Data obtained were subjected to log transformation (Log_{10}) and then to one-way ANOVA. Results showed significant differences among the harvesting and processing techniques as well as conservation and survival strategies ($p>0.05$). Picking larvae from pitfall traps had the highest mean frequency (38.3±9) among the harvesting techniques while storing briefly to defecate, parboiling and then sun-drying had the highest mean frequency (36.9±5) among the processing techniques. Delaying cultivation around the bases of host trees till after adult emergence had the highest mean frequency (31.3±2) among the conservation techniques used while jumping down of larvae from the branches was the most popular survival technique recorded (32.2±5).

Key Words: Harvesting, processing, conservation, survival, techniques, *Cirina forda*.
Running Title: Harvesting and Processing Techniques for the Larvae of the Pallid Emperor Moth, *Cirina forda* Westwood (Lepidoptera: Saturniidae), among the Tiv People of Benue State, Nigeria.

INTRODUCTION

Edible insects which are usually classified under non-timber forest products, are a very important forest resource playing crucial roles in human diets particularly making diets more balanced and palatable ((FAO, 1989; Latham 2001). Entomophagy, the practice of eating insects, is a food resource that ramifies both primitive and contemporary food traditions (De Foliart, 2002, 1990, 1989; Latham, 2001; Holden, 1991; Cherry, 1991)). There has been increasing scientific attention on entomophagy because of its importance in the context of food security, poverty alleviation and indigenous knowledge particularly among rural communities (Ramos-Elorduy, 1997). DeFoliart (2002, 1990, 1989) reported that scores of species of edible insects are prominent items of commerce in the town and village markets of Africa and tropical and

semi-tropical regions of the world. Fasoranti and Ajiboye (1993) reported the consumption and marketing of 7 edible insect species by the people of Kwara State, Nigeria while Agbidye *et al*., (2009) had reported the consumption and marketing of edible insect species by the people of Benue State, Nigeria.

The larva of the pallid emperor moth, *Cirina forda* Westwood, is heavily consumed in Nigeria (Fasoranti and Ajiboye, 1993, Amatobi, 2007, Agbidye et al., 2009). As a protein source, caterpillars from butterflies and moths are consumed by several tribes across the world. These include the Pedi of South Africa, the Bisa of Zambia, the Tiv of Nigeria, the Nanti of the Amazon, the Amacimbi of Zimbabwe and the Aka pygmy of Central African rainforest (Mbata and Chidumayo, 2003).

Insects are collected and processed in a wide variety of ways for consumption. The manner of harvesting and processing affects the nutrient content of the insect concerned (DeFoliart, 1989, 2002). The method of collection and processing depends on the insect species and where it is found. Processing, no matter how crudely done, helps in minimizing post-harvest losses, removing toxins, facilitating packaging and also conversion of a resource into forms that are acceptable to different socio-economic classes (Galadima, 2003). Akinnawo *et al.*, (2002) reported that raw extracts of *C. forda* had toxic effects on rats compared to processed extracts. The rats manifested signs of irritability and muscular tremor. They also reported that total serum protein and globulin levels were significantly higher in controls and those fed processed extracts than those fed raw extracts.

C. forda larva is collected from the shea butter tree, *Vitellaria paradoxa,* its only host in Nigeria and throughout the West African sub-region. The eggs are found on the host plant from May to June and the larvae from June to August each year. The larvae are particularly harvested from shea butter trees in July and August each year (Odeyemi and Fasoranti, 2000; Ande and Fasoranti, 1997). The larvae are either collected from the leaves on the trees or pitfall traps made round the bases of trees with the larvae and descending larvae trapped and collected (Mbata and Chidumayo, 2003, Fasoranti and Ajiboye, 1993). Caterpillars are either pushed inside out with a thin stick or punctured and the contents squeezed out. Frequently, and especially if large quantities are harvested, they are boiled and dried out in the sun and stored for later use or sold in the local markets. The insect is widely used as an ingredient in vegetable soup (Fasoranti and Ajiboye, 1993). *C. forda* (known as 'Igyô' in Tiv) is reported to be widely consumed and marketed in Benue State, Nigeria (Agbidye *et al.*, 2009). The harvesting and processing techniques for the insect have not been reported in Benue State. DeFoliart (2002, 1989) had stated that the manner of collecting and processing insects for consumption affects their nutrient content. Raw extracts of *C. forda* had been reported to contain toxins (Akinnawo *et al.*, (2002). It would therefore be necessary to find out how the insect is harvested and processed for consumption. The study was therefore carried out to investigate the harvesting and processing techniques of *C. forda* among the Tiv people of Benue State.

MATERIALS AND METHODS

A semi-structured questionnaire was used to

survey the harvesting and processing techniques for *Cirina forda* larvae among the Tiv people of Benue State, Nigeria. Three (3) Local Government Areas (LGAs), Gboko, Katsina-Ala, and Tarka were used for the study. Using purposive sampling, forty (40) respondents (consumers) each were interviewed in Aye Gber village (Katsina-Ala LGA), Akaa Pila village (Gboko LGA), and Wannune village (Tarka LGA). *Cirina forda* consumers were first identified and thereafter interviewed at random (Osuala, 1986; Anonymous, 2003). Altogether 120 respondents were interviewed. The interview was conducted on the harvesting and processing techniques for the insect among the Tiv people of Benue State. Information was also gathered on the conservation strategies employed by the consumers to ensure sustainability of the edible caterpillar species. Apart from the interviews, personal observations were carried out in these three locations accompanied with snapshots of harvesting and processing techniques used. The questionnaire were collated and coded to aid statistical analysis of the data. Data obtained (frequencies) were subjected to log transformation (Log_{10}). The transformed data were then analyzed using one-way ANOVA with mean separation by Duncan's new multiple range test (Akindele, 1996).

RESULTS

Harvesting techniques for *C. forda* larvae

There were significant differences among the harvesting techniques for *C. forda* larvae employed by the Tiv people of Benue State. Picking larvae from pitfall traps was significantly highest ($P>0.05$) compared to the other techniques employed (Table 1). The natives excavated the soil round the bases of infested *V. paradoxa* trees prior to descent of the mature larvae for pupation in the soil (Plate 1). When the larvae descended for pupation in the soil, they became trapped in the pits (pitfall traps) (Plates 2). The trapped larvae were then collected.

Table 1: Frequencies of responses on the harvesting techniques for *Cirina forda* larvae in Benue State, Nigeria.

Harvesting Technique	Mean frequency
Picking from pitfall traps (dug pits)	38.3 ± 9^{a}
Picking from tree directly	14.7 ± 5^{b}
Picking from soil surface	12.4 ± 6^{bc}
Picking from cut tree branches	6.2 ± 4^{cd}
Picking from inside soil	3.1 ± 3^{d}

Values are mean frequency + SEM of responses on harvesting techniques for *C. forda* larvae by the Tiv people of Benue State. Means with the same superscripts in the same column are not significantly different ($p>0.05$).

Plate 1: Excavated pit (pitfall trap) at the base of an infested *V. paradoxa* tree to trap descending *C. forda* larvae.

Plate 2: Trapped *C. forda* larvae in a pit dug around the base of *V. paradoxa* tree

Processing techniques for *C. forda* larvae

Processing techniques employed for the larvae of *C. forda* in the study area showed significant differences (Table 2). Storing briefly to defecate, parboiling and sun-drying had the highest mean frequency (P>0.05). There was however no significant differences among the other processing techniques used. *C. forda* larvae were removed from pitfall traps and placed in pits filled with loamy soil (Plate 4). The larvae were then removed from the pits and parboiled in a pot (with potash added). After parboiling, the larvae were then rinsed and then sun-dried (Plate 5).

Table 2: Frequencies of responses on the processing techniques for *Cirina forda* larvae by the Tiv people of Benue State, Nigeria.

Processing Technique	Mean frequency
Storing briefly to defecate, parboiling and sun-drying	36.9 ± 5^{a}
Evisceration and singeing/frying or heat drying	21.7 ± 5^{b}
Storing briefly to defecate, parboiling and cooking (soup or snacks)	17.4 ± 1^{b}
Singeing/frying or heat drying	15.1 ± 2^{b}

Values are mean frequency + SEM of responses on processing techniques for *C. forda* larvae by the Tiv people of Benue State. Means with the same superscripts in the same column are not significantly different (p>0.05).

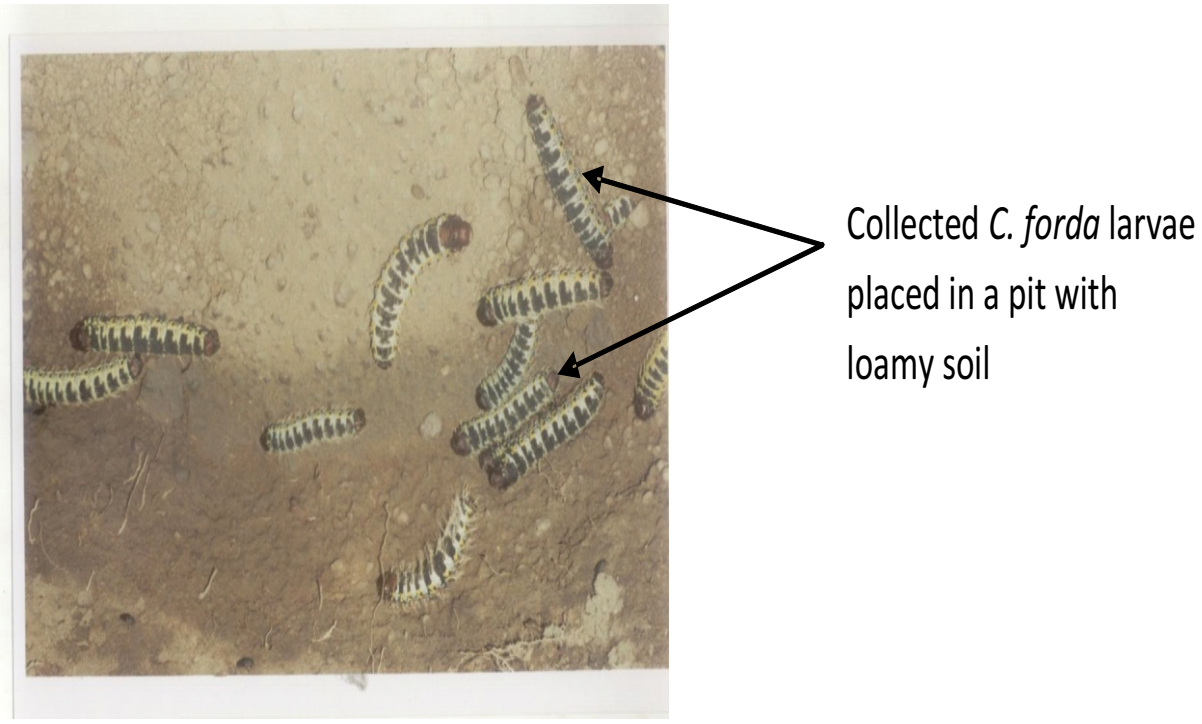

Plate 3: *Cirina forda* larvae in a pit with loamy soil awaiting processing

Plate 4: Parboiling of *C. forda* larvae

Plate 5: Sun-drying *C. forda* larvae

Conservation strategies for *Cirina forda* larvae

The study showed that the Tiv people of Benue State usually delayed cultivation around the bases of *V. paradoxa* trees until adults of C. forda had emerged from the soil. The mean frequency for this practice was significantly highest (P>0.05). There was no significant difference among the other conservation strategies used (Table 3).

Table 3: Frequencies of responses on the conservation strategies employed by the Tiv people of Benue State, Nigeria for *Cirina forda* larvae

Conservation Strategy	Mean frequency
Delaying cultivation around the bases of *V. Paradoxa* trees till after adult emergence	31.3±2[a]
Deliberately not making pitfall traps around some *V. Paradoxa* trees so as allow larvae to enter the soil to pupate.	18.7±4[b]
Leaving some *C. forda* larvae to enter the soil after much collection	15.4±3[b]
Stopping cultivation activities around the bases of V. Paradoxa Trees that were infested with *C. forda larvae*	14.4±2[b]

Values are mean frequency + SEM of responses on conservation strategies for *C. forda* larvae by the Tiv people of Benue State. Means with the same superscripts are not significantly different ($p>0.05$).

Survival Strategies adopted by *Cirina forda* larvae

Jumping down of C. forda larvae from V. paradoxa tree branches without descending from the stems and thereby evading the pitfall traps had the highest mean frequency ($P>0.05$) among the survival strategies employed by the insect. There were no significant differences among the other survival strategies used by the insect (Table 4).

Table 4: Frequencies of responses on the survival strategies adopted by *Cirina forda* larvae as observed by the Tiv people of Benue State, Nigeria.

Survival Strategy	Mean frequency
Jumping down of *C. forda* larvae from the branches without descending from the stems thereby evading the pitfall traps.	32.2±5[a]
Climbing onto the backs of other *C. forda* larvae to get out of the pitfall traps.	17.3±2[b]
Making use of weeds (grasses) that extend into the pitfall traps to escape and enter the soil.	16.1±1[b]
Escaping inside the pitfall traps in-between the Roots of *V. paradoxa* trees.	16.4±2[b]

Values are mean frequency + SEM of responses on the survival strategies adopted *C. forda* larvae as observed by the Tiv people of Benue State. Means with the same superscripts are not significantly different ($p>0.05$).

DISCUSSION

The harvesting techniques used by the Tiv people of Benue State, Nigeria in collecting C. *forda* larvae from *V. paradoxa* trees in all the locations surveyed were similar to those of Mbata and Chidumayo (2003), DeFoliart (2002) and Latham (2001). The preponderance of the use of pitfall traps in collecting *C. forda* larvae from *V. paradoxa* trees in the study area should be encouraged as this method does not destroy the host tree. In some cases tree branches were cut down before collecting larvae. This is destructive harvesting and should be discouraged by all means. Larval collections in large harvests were pre-stored in a pit filled with loamy soil before processing. Minor harvests of *Cirina forda* larvae were processed for consumption by evisceration of gut contents by puncturing or pushing inside out and then frying. Pre-storing could be done mainly to get enough quantity for processing and also for the larvae to empty their gut contents. The larvae were then parboiled, rinsed and sun-dried. This method of processing caterpillars was also reported by Mbata and Chidumayo (2003). Part-boiling kills and toughens the larvae and in addition improves the taste. It also increases shelf life. Sun-drying reduces the moisture content of the larvae thereby increasing the shelf life.

The adoption of conservation strategies for *C. forda* larvae by the Tiv people of Benue State shows that they are fully aware that *C. forda* larvae do not come from nowhere (i.e. from "heaven") but that larvae from the previous generation give rise to the offspring in the next generation. In some cultures, edible caterpillars were believed to be God-sent or from spirits (Mbata and Chidumayo, 2003). The most popular conservation strategy adopted by the natives was delaying cultivation around the bases of *V. paradoxa* trees till after adult emergence. This implies that soil tillage before adult emergence could destroy the insect pupae since the insect pupates inside the soil thereby reducing harvests in the next generation. Latham (2001) had reported that cultivation and bush burning reduces the availability of edible caterpillars in the Bas Congo.

It was gathered during the survey that *C. forda* larvae themselves have devised survival strategies to prevent being exploited to extinction by man. Notably among the survival strategies is the fact that some of the larvae drop down straight from the tree branches without descending through the stems thereby evading the pitfall traps made. This practice is not strange since any organism that is being heavily exploited would adopt survival strategies to avoid going into extinction.

CONCLUSION AND RECOMMENDATION

Information provided by this study has shown that *C. forda* is part and parcel of the biodiversity of Benue State where it is exploited as a food resource. The insect is harvested in a variety of ways and processed before marketing or consumption. This further suggests that *C. forda* larvae offered for sale or consumed in Benue State is to some extent safe for consumption since it is processed. Since this edible forest insect had been playing important roles in the economic well-being of the people of Benue State, something has to be done to preserve the habitat of the insect which is *V. paradoxa*. This is necessary to ensure conservation of

this forest resource. The rural populace should be educated to preserve *V. paradoxa* trees and control bush burning. Benue State government should enforce the legislation against indiscriminate bush burning and illegal tree felling to preserve the habitats of these insects. It will not be out of place to establish plantations of *V. paradoxa* to promote large scale the production of *C. forda*. Cutting down branches of *V. paradoxa* trees in order to harvest *C. forda* larvae should be discouraged since it destroys trees and causes environmental degradation.

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