A Study of Entomophagy in Mogonono in Kweneng District, Botswana

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Abstract

A study was undertaken to document insects used for human consumption in Mogonono in Kweneng District of Botswana. Thirty respondents were randomly selected and interviewed. Data were collected through informal interviews and direct observation. Results showed that 22 insects belonging to 10 families and four orders (*i.e.*, Lepidoptera, coleoptera, isoptera and hymenoptera) were used for human consumption. The order Lepidoptera was the most predominantly consumed. The eight most consumed insects in descending order were *Agrius convolvuli* L. (90.00%), *Sternocera orissa* Buq. (60.00%), *Cirina forda* Westwood (56.67%), *Imbrasia belina* Westwood (53.33%), *Carebara vidua* F. Smith (53.33%), *Acrida acuminata* Dirsh (36.67%), *lehakgala* (36.67%) and *Locusta migratoria* (33.33%). Insects are available as human food immediately after the rainy season, indicating that their availability as food is seasonal. The common methods of preparing insect specimens for human consumption were roasting, boiling and frying. These results showed that insects play an important role in nutrition security and food security of the rural poor.

KEYWORDS: Edible insects, entomophagy, Mogonono, nutrition security, sustainable utilization

INTRODUCTION

Entomophagy refers to the use of insects as food (Chakravorty et al., 2011). Insects have been used as food as far back as history of mankind. The book of law (Leviticus 11:22) in the Old Testament permits the consumption of insects such as locusts, crickets and grasshoppers by humans. Furthermore, it is reported that John the Baptist at the beginning of the first millennium lived on locusts. According to FAO (2013), there are no known cases of transmission of diseases or parasitoids to humans from consumption of insects. In many parts of the world insects are consumed as a delicacy, especially in the tropics (van Huis, 2003). Srivastava et al. (2009) also mentioned that insects and other arthropods have been eaten as a staple and/or as a delicacy in many cultures. In the opinion of Jacob et al. (2013), the consumption of edible insects by humans is a way out of protein deficiency due to the often prohibitive prices and overdependence on conventional animal protein sources which are inadequate. According to the authors, there are 250 edible insect species in Africa. Some insect species that are used as human food include grasshoppers, caterpillars, beetle grubs and sometimes adults, winged termites, bee, wasp and ant brood (larvae and pupae), winged ants, cicadas, and a variety of aquatic insects (Banjo et al., 2006). Insects are also important source of food for a wide variety of other animal species.

Insects form part of the traditional diets of at least 2 billion people (van Huis et al., 2013). Approximately 1900 insect species are eaten worldwide, mainly in developing countries (van Huis, 2013; Huis et al., 2013). Thirty-six countries in Africa are entomophagous as are 23 in Americas, 23 in Asia and 11 in Europe (National Geography, 2013). According to Niaba et al. (2012), the habit of eating insects is deeply entrenched among the African societies. Insects have high nutritive value, not only in proteins, but also in fats, minerals and vitamins (Australian Poultry CRC, 2010). Again, Melo et al. (2011) stated that insects have a good nutritional value and are high in protein with all essential amino acids. The protein content of edible insects ranges from 30% (wood worms) to 80% (some wasp species). The study by Onigbinde and Adamolekun (1998) in Zimbabwe showed that the protein, fat and mineral contents of *Imbrasia belina* Wood larvae are superior to those of beef and chicken. In addition, insects have a comparable, if not higher, amount of calories/100 g compared to cereals, vegetables, legumes and meats (Australian Poultry CRC, 2010). Edible insects also have a wide range of mineral salts such as Na, K, Ca, Zn, Fe and Mg, which are similar or in higher amounts than beef, fish, turkey, milk and eggs.

Insects as food and feed emerge as an especially relevant issue in the 21st century because of the rising cost of animal protein, food and feed insecurity, environmental pressures, population growth and increasing demand for protein among the middle classes (van Huis et al., 2013). Insects constitute quality food and feed, have high feed conversion ratios, and emit low levels of greenhouse gases (van Huis, 2013).

Despite the fact that about 80 percent of the world's population includes insects in their diets, there is a dearth of information about the consumption of insects as food around the world (Vantomme et al., 2012). In addition, the nutritional contribution of insects to diets in the traditional and informal food systems is poorly documented (FAO, 2012). Tiroesele et al. (2013) stated that there is limited information on the nutritional value of insects in Botswana. There is also little documentation of information on human consumption of edible insects in the country. Therefore, a study was undertaken to document insects used for human consumption in Mogonono in Kweneng District of Botswana.

Materials and Methods

Study site

This study was conducted in Mogonono, a rural village situated about 16 km north-east of Molepolole (the capital of Kweneng District) from December 2013 to January 2014. Mogonono is located at coordinates 24°22′48″S, 25°28′1″E.

Data collection and analysis

A total of 30 respondents were randomly selected and interviewed in this study. Data were collected through informal interviews and direct observation. Secondary sources of data were also reviewed. The interviews were conducted individually in the local language, *i.e.*, Setswana. Data on sex, age and educational level of respondents; names of insects consumed, time of availability and how they were prepared (processed) for human consumption were gathered during the investigation. Qualitative and quantitative data were analyzed using Microsoft Excel. Tables and figures were used to present summary statistics.

RESULTS AND DISCUSSION

Socio-economic data

Table 1 gives data on socio-economic background of the respondents. The majority (31.03%) of the respondents were aged >60 years followed by 20-30 years (24.14%). Fifty percent of the respondents said they never attended school while a large proportion of those that attended school had primary education (Table 1). Contrary to the finding by Obopile and Seeletso (2013) no respondents in the current study had tertiary education.

Edible insects

A total of 22 insects were identified as human food in Mogonono (Table 2). The majority of insects in Table 2 derive their local names from the tree leaves they feed on. The eight most consumed insects in descending order were *Agrius convolvuli* L. (90.00%), *Sternocera orissa* Buq. (60.00%), *Cirina forda* Westwood (56.67%), *Imbrasia belina* Westwood (53.33%), *Carebara vidua* F. Smith (53.33%), *Acrida acuminata* Dirsh (36.67%), *lehakgala* (36.67%) and *Locusta migratoria*(33.33%) (Table 2). It is apparent that the consumption pattern of insects is based on their availability. van Huis et al. (2013) observed that people in Africa, Asia and Latin America eat insects not only because conventional meats such as beef, fish and chicken are unavailable but because they are considered important food items, often delicacies.

Seasonal availability and harvesting of insects

As shown in Table 3, most insects are available immediately after the rainy season, *i.e.*, October to January. This indicates that insects' availability as human food is seasonal. In agreement with the present finding, Chakravorty et al. (2011) in India observed that although edible insects generally occur throughout the year, their densities and diversities are determined by their food plants, as well as, by seasonal conditions. It has been observed (Mello et al., 2011) that although some species of insects are seasonally reproduced they are preserved in urban cities by different techniques in order to have them available throughout the year. Of all the insects shown in Table 2, *Cirina forda* Westwood and*Locusta migratoria* were said not to occur anymorein Mogonono. The extinction of *monato*trees (*Burkea africana*) in Mogonono has rendered *C. forda* caterpillar to be unavailable for human consumption. On the other hand, the disappearance of*L. migratoria* could be attributable to the use of pesticides in croplands and possibly climate change.

The two harvesting methods in the present study are hand-picking and digging. The digging method applied only to scarab larvae (*Oryctes boas* Fabr.) which are usually harvested from the cattle enclosures (kraals). *Oryctes boas Fabr*.alsoforms an important feed resource for family chickens that are usually seen scratching cattle enclosures in search of these caterpillars. Obopile and Seeletso (2013) in Botswana reported insect collection methods to be hand-picking, digging and trapping with the commonly used method being hand-picking. Hand-picking was also found to be the common harvesting method in the current study.

The majority (93.33%) of the respondents mentioned that edible insects were collected or harvested mainly by women and children, whereas the remainder said men were also involved. It, however, appears that children were solely responsible for the harvesting of *S. orissa* Buq. About 93% of the respondents mentioned that they harvested

insects mainly for family use while the remainder said they harvested insects for sale in the Mogonono, Molepolole and urban centres such as Gaborone where they fetch a higher price. In Mexico, Mello et al. (2011) reported that for urban population insects represent a wide amount of gourmet dishes highly demanded by consumers. van Huis et al. (2013) stated that some insects are commercialized and transported within countries or beyond national borders for sale in distant markets; this being common between the Lao People's Democratic Republic and Thailand. In this study, only *phane* (*Imbrasia belina* Westwood) and *monakamongwe* (*Agrius convolvuli* L.) appeared to be commercialized with *phane* being the most commercialized. *Phane* is often sold in large villages and urban centres across Botswana and exported to the Republic of South Africa for use in both human and livestock diets.

Recently, insects such as *phane* have been incorporated in livestock diets as protein sources. In Nigeria, Ojewola et al. (2005) fed Anak broiler chickens three animal protein sources (*i.e.*, Danish fish meal, locally processed fish meal (fish waste meal), crayfish waste meal and grasshopper meal) and observed that the replacement of Danish fish meal with either local fish meal, crayfish waste meal, or grasshopper meal did not hamper productive performance in broilers. The authors concluded that locally processed fish meal, crayfish waste meal, and grasshopper meal can serve as a natural substitute for the imported, expensive and unavailable Danish fish meal without negatively effecting performance and economic returns on broiler production. Similarly, Hassan et al. (2009) investigated the effect of replacing graded levels of fishmeal (100% fishmeal: 0% Grasshopper meal) with grasshopper meal at two inclusion levels (50% and 100%) in broiler diets and found that 100% grasshopper meal diet resulted in higher weight gain (1.02 kg) and feed intake (1.48) but lower feed conversion efficiency (69%).

Stages and modes of insect consumption

The common methods of preparing edible insects for human consumption were boiling, roasting and frying (Table 4). This finding is consistent with Chakravorty et al. (2011). According to van Huis et al. (2013), traditional processing methods such as boiling, roasting and frying are often applied to improve the taste and palatability of edible insects and these have the added advantage of ensuring a safe food product. Cultural preferences and organoleptic aspects play key roles in chosen preservation methods. In this study, only the giant jewel beetle (*Sternocera orissa* Buq) was consumed raw, roasted or fried. The respondents mentioned that the wings and heads are removed prior to eating *S. orissa* Buq. Also, *S. orissa*Buq was said to be consumed together with its delicious eggs. For roasting, the wings and heads of *S. orissa* Buq may or may not be removed, whereas wings and heads are removed before frying. The respondents consumed only the adult stage of *S. orissa* Buq. All insects in this study except *S. orissa* were boiled in salt and thereafter sun dried to prolong their shelf life. The study by Dube et al. (2013) showed that most of the respondents that consumed insects in Zimbabwe preferred them in the dried form.

CONCLUSION

Entomophagy is a common practice in Mogonono. A list of 22 edible insects has been compiled and most of the edible insects belong to the order, Lepidoptera. Edible insects have a great potential as a supplier of protein, especially to the rural poor. As a

consequence, there is a need to raise awareness of the contribution of edible insects to human nutrition amongst policy-makers in order to promote and guide future development. There is also a need for countrywide studies on edible insects and their contribution towards improving livelihoods. Hence, the financial support of Government and private sector in undertaking research initiatives into such areas as sustainable harvesting practices, food safety and international trade is of utmost importance. Promoting appropriate preservation techniques will contribute to insects being important sources of protein and income, especially for the rural poor.

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Table 1: Sex, age and educational level of respondents in Mogonono

Attributes	**Number of responses**	**Percentage**
Sex:		
Female	15	50
Male	15	50
Age (years):		
20 – 30	7	23.33
31 – 40	5	16.67
41 – 50	3	10.00
51 – 60	5	16.67
>60	10	33.33
Education level:		
Never attended school	15	50
Primary	7	23.33
Junior certificate	3	10.00
O' level	5	16.67

Table 2: A list of edible insects in Mogonono

Scientific name	English name	Tswana name	No. of responses	Percent response
Agrius convolvuli L.	Hawk moth	Monakamongwe	27	90.00
Sternocera Orissa Buq.	Giant Jewel beetle	Kakanatswii/lebitse	18	60.00
Cirina forda Westwood	Pallid emperor moth	Nato	17	56.67
Imbrasia belina Westwood	Mophane worm (phane)	Phane	16	53.33
Carebara vidua F. Smith	African thief ant	Ntlhwa	16	53.33
Acrida acuminata Dirsh	Common stick grasshopper	Lentloro	11	36.67
*	*	Lehakgala	11	36.67
Locusta migratoria	Locust	Tsie	10	33.33
Amyops sp.	Scarab larvae	Kgonono	4	13.33
Hodotermes mossambicus (Hagen)	Silver striped hawk	Kokobele/korobele	4	13.33
Imbrasia tyrrhea Cramer	Willow emperor moth	Leshokgole	3	10.00
Sphingomorpa chlorea Cramer	Sundown emperor moth	Senatwana/nyitana	3	10.00
Hippotion celerio L.	Silver striped hawk	Morweerwee	3	10.00
Bunaea alcinoe Stoll	African thief ant	Phata	4	13.33
*	Harvester termite	Ngudu	3	10.00
Oryctes boas Fabr.	Locust	Thethe	1	3.33
*	*	Khommana	1	3.33
		Sekwakwalla	1	3.33
Cyriacanthacris tataria L.	Brown-spotted locust	Tsiakgope	1	3.33
*	*	Segotlhwana	1	3.33
*	*	Konkocha	1	3.33
*	*	Mmamowe/komoko	1	3.33

*Scientific and common names could not be found

Table 3: Edible insects and their time of availability

		Months of the year											
Scientific name	**Tswana name**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Agrius convolvuli L.	Monakamongwe	X	X	X							X	X	X
Sternocera Orissa Buq.	Kakanatswii/lebitse	X	X								X	X	X
Cirina forda Westwood	Nato	X											
Imbrasia belina Westwood	Phane	X		X	X								X
Carebara vidua F. Smith	Ntlhwa											X	
Acrida acuminata Dirsh	Lentloro										X	X	
	Lehakgala	X	X										
Locusta migratoria	Tsie**												
Amyops sp.	Kgonono	X	X										
Hodotermes mossambicus (Hagen)	Kokobele/korobele										X		
Imbrasia tyrrhea Cramer	Leshokgole	X	X										
Sphingomorpa chlorea Cramer	Senatwana/nyitana	X	X										
Hippotion celerio L.	Morweerwee	X	X	X								X	X
Bunaea alcinoe Stoll	Phata	X	X										
*	Ngudu	X	X										
Oryctes boas Fabr.	Thethe	X	X	X						X	X	X	X
	Khommana										X	X	
	Sekwakwalla	X	X	X	X	X	X	X	X	X	X	X	X
Cyriacanthacris tataria L.	Tsiakgope	X	X	X	X	X	X	X	X	X	X	X	X
*	Segotlhwana	X										X	X
*	Konkocha	X	X	X	X	X	X	X	X	X	X	X	X
*	Mmamowe/komoko							X	X	X			

*Scientific name not found; X = time of availability; **Have not occurred for a long time

Table 4: Edible insects and their methods of preparation for human consumption

Order	Family	Scientific name	English name	Local name	Method of preparing insects for the table
Lepidoptera	Sphingidae	*Agrius convolvuli* L.	Hawk moth	Monakamongwe	Roasting, boiling and frying
Lepidoptera	Saturnidae	*Imbrasia belina* Westwood	Mophane worm	Phane	Roasting, boiling and frying
Lepidoptera	Saturnidae	*Imbrasia tyrrhea* Cramer	Willow emperor moth	Leshokgole	Roasting, boiling and frying
Lepidoptera	Saturnidae	*Cirina forda* Westwood	Pallid emperor moth	Nato	Roasting, boiling and frying
Lepidoptera	Erebidae	*Sphingomorpha chlorea* Cramer	Sundown emperor moth	Senatwana/nyitana	Roasting or boiling
Lepidoptera	*	*	*	Lehakgala	Roasting, boiling and frying
Lepidoptera	Saturniidae	*Bunaea alcinoe* Stoll	Common emperor moth	Phata	Roasting, boiling and frying
Lepidoptera	*	*	*	Ngudu	Roasting, boiling and frying
Coleoptera	Dynastidae	*Oryctes boas* Fabr.	Scarab larvae	Thethe	Roasted and frying
Lepidoptera	*	*	*	Khommana	Roasting, boiling and frying
Lepidoptera	Notodontidae	*Amyops sp.*	*	Kgonono	Boiling or frying
Lepidoptera	Sphingidae	*Hippotion celerio* L.	Silver striped hawk	Morweerwee	Boiled or fried
Coleoptera	Buprestidae	*Sternocera Orissa* Buq.	Giant Jewel beetle	Kakanatswii/lebitse	Raw or frying. Wings are discarded.
Hymenoptera	Formicidae	*Carebara vidua* F. Smith	African thief ant	Ntlhwa	Roasting or frying
Isoptera	Hodotermitidae	*Hodotermes mossambicus* (Hagen)	Harvester termite	Kokobele/korobele	Roasting or frying
Orthoptera	*	*Locusta migratoria*	Locust	Tsie	Roasting and boiling
*	*	*	*	Sekwakwalla	Roasting and boiling
Orthoptera	Acridoidea	*Acrida acuminata* Dirsh	Common stick grasshopper	Lentloro	Roasting
Orthoptera	Acrididae	*Cyrtacanthacris tatarica* L.	Brown-spotted locust	Tsiakgope	Roasting
*	*	*	*	Segotlhwana	Roasting or boiling
*	*	*	*	Konkocha	Boling or frying
*	*	*	*	Mmamowe/komoko**	Honey is eaten

*Name could not be found; **The insect is not eaten but the honey it produces.