Chapter 4
Current Status of Edible Insects in the Context of Dietary Transition in Western French Africa: A Case Study from Benin

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4.1 Introduction

The Republic of Benin, formerly known as Dahomey, is situated in West Africa between latitudes 6° and 13° N, and longitudes 0 and 4° E. The country is bordered by Togo to the west, Nigeria to the east, Burkina Faso to the northwest, and Niger to the northeast. In the surrounding countries as well as the Southern regions of Benin local inhabitants consume a variety of insect species as a planned part of their diet (Tchibozo et al. 2005; Grabowski et al. 2020; Ghosh et al. 2021).

At present days, the majority of the people of Benin like foreign foods such pasta, milk and dairy products, wine etc. Only a small population from the village depends on the Non-Timber Forest Products (NTFPs) as their livelihood including foods. The edible insects not yet accepted to a large proportion of population for the diet. I am not sure the insects will the future dietary transition in Republic of Benin. The global economic development and westernization influences the several young people.

One of the goals of the Millennium Objectives for Development (MDG) is to eradicate hunger and malnutrition worldwide. Edible insects present a viable solution as they are a traditional food source in some African countries and are part of the Non-Timber Forest Products (NTFPs). Living in proximity with nature local traditional people developed a volume of dynamic indigenous knowledge of utilizing the available ecological resources for food as well as medicines. However, with the rapid urbanization, and changing of landscape, migration, etc. are crucial drivers for the transformation of the traditional food systems and loss of indigenous knowledge system associated to it (de Bruin et al. 2021).

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4.2 Overview of Entomophagy in Africa with Special Emphasis on Benin

Worldwide about 2140 insect species have been reported as edible (Mitsuhashi 2016). As of the best of my knowledge, 31 local communities have been surveyed in 10 countries in west Africa (Fig. 4.1). In Benin, Tchibozo (2005) conducted the first study that investigated entomophagy behavior of the country. The study reported 5 edible insect species; however, as of now 22 insect species have been reported as edible or for the use of therapeutic purposes. The consumption of insect was not accidental or due to food scarcity but the insect ingestion can be well described as the cultural attribute and considered a delicacy among the local people (van Huis 2003). Table 4.1 represents a list of common edible insects in Africa. However, consumption pattern differs with different ethnic communities, belief systems, rural and urban environment etc. (Manditsera et al. 2018; Ghosh et al. 2021). In Ghana the droppings of the grasshoppers Aka Akranti, are used by the indigenous people of the region of Brong Ahafo, to give a good taste on the local fish soup (locally known as *Abunuabunu*). Figure 4.2 represents consumption of edible insects by different ethnic groups in Benin (Anii, Fon, Nagot and Wama) and other countries in West Africa.

1. Benin (Pénélan, Issaba, Kosso, Pobè, Lokoli)
2. Burkina-Faso (Kou)
3. Cameroon (Garoua-Boulaï, Bilerou Bas, Douri, Mvogbi)
4. Central African Republic (Pissa)
5. Republic of Congo (Djambala, Ankou-Okari)
6. Republic of Guinea (Serengbara, Bossou)
7. Mali (Gongasso, Sikasso)
8. Niger (Matsachi, Dankada, Sabon-Gari, Agali, Maradi)
9. Democratic Republic of the Congo (Kimpika, Londi Kavwaya, Boko, Kavwaya, Nenga, Kinzazi, Nlanga)
10. Togo (Dapaong, Agou Apégamé)

Fig. 4.1 Thirty-one local communities have been surveyed in 10 countries in Africa

Table 4.1 Some common edible insect species of Africa in Benin

Orders	Family	Scientific name	Local or vernacular name[a]
Termites	Termitidae	*Macrotermes falciger Gerstacker*	Etoutou
Orthoptera	Acrididae Cyrtacanthacridinae	*Acanthacris ruficornis citrina* (Audinet-Serville, 1838)	Tchoubou
	Acrididae Cyrtacanthacridinae	*Ornithacris turbida cavroisi* (Finot, 1907).	Tchoubou
	Acrididae Hemiacridinae	*Hieroglyphus africanus* Uvarov, 1922.	Tchoubou
	Grillydae	*Brachytrupes membranaceus* Drury	Afomon
		Brachytrupes sp.	Baka
	Oedipodinae	*Locusta migratoria migratorioides* (Reiche et Fairmaire, 1850)	Gountanta
	Acrididae Hemiacridinae	*Spathosternum pygmaeum* Karsch, 1893	Igbè
	Tettigoniidae	*Conocephalus sp.*	Igbè
	Gomphocerinae	Indéterminée (IND)	Igbè
	Pyrgomorphidae	*Zonocerus variegatus* (Linnaeus, 1758).	Alankpa
	Tettigoniidae Conocephalinae	*Pseudorhynchus sp.* 1.	Guègbelè
	Tettigoniidae Conocephalinae	*Pseudorhynchus sp.* 2.	Guègbelè
	Tettigoniidae	*Ruspolia sp.*	Guègbelè
	Acrididae	*Truxalis sp.*	Guègbelè
Coleoptera	Hydrophilidae	*Hydrophilus sp*.	Kountounnougoussiré
	Buprestidae	*Sternocera interrupta* (Olivier, 1790).	Kokouanré
		Steraspis castanea (Olivier, 1790).	Kokouanré
	Scarabaeidae, Cetoniinae	*Pachnoda cordata dahomeyana*	Pipinou
	Dynastidae	Indéterminée (IND)	Woïwo
	Curculionidae	*Rhynchophorus phoenicis* F.	Kpitran
	Dynastidae	*Oryctes spp.*	Atrandèpkometon

[a] at Benin

Cultivating edible insects in Africa is not common practice and in most of the cases edible insects are harvested from the wild environment. Insect species are known to cause seasonal damage to agricultural crops and perennial cultures, such as oil palm and other plants. The harvesting of insects responsible for destruction of crops, would equally benefit the agriculture in African countries by eliminating pests. For example in Niger, thousands of locusts are collected in the savannas annually. They are sold at local markets in Benin and represent an important revenue

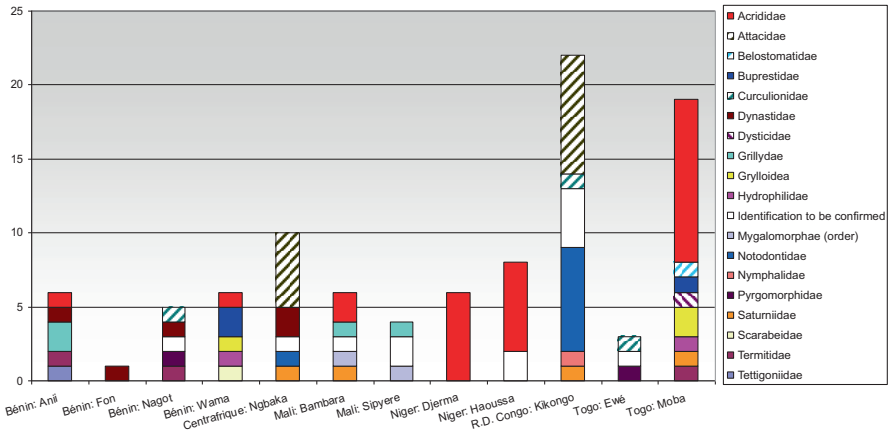

Fig. 4.2 Edible insect consumption by insect family in ethnic groups in Benin (Anii, Fon, Nagot and Wama) with comparison to other countries in west Africa. (http://gbif.africamuseum.be/lincaocnet/)

stream for local communities as well as the Nigerian diaspora in Benin. However harvest from the wild cannot ensure the continuous supply of the food item and at the same it does not ensure the safety and nutritional quality of the food insects. Moreover, harvesting from the wild does not advocate the nature conservation. Therefore, to avoid the loss of the traditional food a sustainable production facility is required to be developed.

4.3 Nutritional Potential of Edible Insects in the Context of Africa

Large volume of scientific evidences demonstrates the high nutritional quality of edible insects (Rumpold and Schlüter 2013; Meyer-Rochow et al. 2021). To cite an example, Mariod (2020) analysed the energy content of the desert-locust (*Schistocerca gregaria*) and found that 179 kcal/100 g with a protein content of 14–18 (g/100 g fresh weight). Hundred grams of cricket flour meal contained 31.8% of proteins and caterpillars meal contained 38.8% (Tchibozo et al. 2016). Mohamed (2015) analysed migratory-locusts (*Locusta migratoria*), where the preliminary results indicated the presence of (96.2%) dry matter in 100 g. Other nutritional values included: Crude protein (50.4%), crude fat (19.6%), carbohydrates (4.8%), crude-fiber (15.7%), and ash (6.2%).

Malnutrition is a severe problem in Africa and more acute than anywhere else in the world (UNICEF 2022). More than 2 billion Africans suffer from deficiency in minerals and vitamins, and nearly 30% of the child population developing countries are afflicted by malnutrition (Roudart 2016). In West and Central Africa, 11% of the

Fig. 4.3 Biscuits fortified with insect powder

child population under 5 years of age suffers from acute malnutrition (UNICEF 2013). Assuming the good bioavailability, as edible insects are rich in micronutrients, especially minerals (Rumpold and Schlüter 2013; Meyer-Rochow et al. 2021), the ingestion of them could ameliorate the micronutrient deficiencies. Several African ethic groups have a long-standing tradition of eating insects for their nutritional value. The traditions are deeply ingrained in the culture as they are part of the mythology (Seignobos 2016). Insects' high nutritional value, such as protein, iron and vitamin A promotes health and wellbeing. Between February 2022 and April 2022, the impact of drought in Africa caused the number of children facing acute hunger, malnutrition and thirst to rise from 7.25 million to at least 10 million (UNICEF 2022). Biscuits fortified with insect powder were a welcomed solution to combat the issue of malnutrition in Africa (Fig. 4.3).

4.4 Past and Present in Benin

In a recent study conducted in Southeast Benin with the local communities of the Kétou and Pobé populations, we reported the current perception of entomophagy in the rural and urban population (Ghosh et al. 2021). We administered a semi-structured questionnaire to understand how these communities relate and understand to entomophagy, which is part of the local food culture. The study results showed that the majority of population is familiar with the use of insects as food source and a majority of the people is interested in insect consumption. No gender differences were found. As the most influential factor we identified the food tradition as determinants for the eating or rejecting the consumptions of insects. We found that knowledge of how to identify and select insect species, as well as

different forms of preparation were not homogenous across the sample. Differences were depending on ethnicity, cultural traditions, age group and educational background. Awareness and promotion of edible insects throughout society will preserve the practice of entomophagy. It would further lead to the provision of much needed nutritional supplements to the poorer and disadvantaged sections of the society (Ghosh et al. 2021).

The rapid increasing of population, unanticipated climate change, higher environmental footprint of conventional livestocks and meat production systems have led to the search for alternative sustainable protein sources to meet the protein requirements in humans without negative impact on environment. In this regard, edible Insects are seen a major alternative protein source. A study in three ecological zones in North Benin investigated the diversity of edible insect species and the proximate properties of selected common insects used in traditional local diets. In total 20 edible insects belonging to 4 orders *Orthoptera, Coleoptera, Isoptera* and *Hymenoptera* were identified to be consumed throughout the year. It was also observed that each species was harvested with different methods. The quality attributes of consumption were distinguished according to the traditional technology-processing of insects collected: as boiling, sun drying, frying and smoking. These insects were found to be rich in protein (25.2–64.4 g/100 g dry matter), fat (16.4–46.8 g/100 g dry matter) and minerals (1.0–4.8 g/100 g dry matter). Not only general preservation of edible insect culture can act as economic incentive and to provide nutritional source, but also the safeguarding of the processing methods should be included in these local communities. This would greatly assist in reducing rural poverty and malnutrition (Hongbété and Kindossi 2017).

The production of edible insects had drawn much attention in developing countries to cope with the increasing demand for sustainable proteins in human and animal food consumption and reduce pressure on natural resources. In order to highlight the importance of edible insects, a study on the growth and food value of *Oryctes monoceros* larvae were conducted at the Faculty of Agricultural Sciences of the University of Abomey Calavi in Benin. The larvae were collected from rotten stems of palm oil (*Elaeis guineensis*) and the nutritional value was investigated. Analysis exhibited comparable, if not superior, nutritional quality of *Oryctes monoceros* larvae with other edible insect species and meat products (Gbangboche et al. 2016).

Food security is a critical issue for many low GDP countries across the African continent. In areas not suitable for for intensive agricultural production, local natural resources can play an important role, particularly those which are sustainable and on which people have relied on for centuries. In many regions of the world insects have been consumed for generations, and represent a reliable source of animal proteins among populations that otherwise have limited access to meat. The research conducted in Benin was motivated by the attempt to understand how edible insects could contribute to an area where food-security is a significant issue. Initially, our work focused on a case study of an insect-eating-community in Northern Benin, in the Atakora region. Not every community has the entomophagous tradition. Data on edible insects in the Wama-communities of the district of Tanguieta were

collected administering interviews to focus groups and observing insect collections in two Wama settlements, Kosso and Cotiakou. Eighteen edible insect species were recorded, predominantly Coleoptera (52%) and Orthoptera (29%). Our project has found nine arthropod species eaten in the region, including new groups of arthropods, such as Hemiptera (family: Coreidae) and Acari (family: Ixodidae). Interestingly, collecting insect and their consumption was found to be an ancestral tradition in the Wama-community, mostly carried out by children. In light of malnutrition in North Benin being a major problem in young-age groups, promoting this tradition as well as exploring the potential of implementing small scale captive rearing of selected species could be a promising opportunity to further develop food-security in the region and beyond (Riggi et al. 2014).

Insects always have been, and still are, consumed in South Benin. They are a very important source of animal protein, able to successfully substitute some meats and improve the health of malnourished children. Various aspects have been investigated that include the species eaten, techniques of gathering, culinary usages, community consumption, and their economic importance (Tchibozo et al. 2005).

Insects are mostly consumed in the rural areas, mostly by the children for the taste from April to November, when the insects are widely proliferated. After the rainfalls the children put insects with joy into their basin under the lamps to collect winged termites. They also enjoy hunting crickets and grasshoppers. They grill them and eat them with the other insects that had been collected (Fig. 4.4). Specific insects, like the termite queen, are eaten raw because of their energy content. But mostly they are grilled or fritted. However, the consumption varies by region. Some people consume them discreetly because they don't want to be seen eating creepy-crawlies, yet others eat them openly. We have prepared biscuits to make insect eating attractive for everyone (Tchibozo et al. 2016; Fig. 4.3). The biscuits have a level of 8.88% to 10.6% of total raw protein content, 390 to 446 kcal/100 g energy. Their consumption would be an expected solution, at least to a certain extent, to reduce child malnutrition in Benin (Tchibozo et al. 2016).

There is an urgent need to breed insects to help the community to consume insect species and to reduce the collection of insects in the wild. Insects suffer from extinction due deforestation and urbanization of the areas, where insects have no longer access to host plants.

4.4.1 Benin Has Several Awards About Edible Insects

- 2015: Hoyrou SIGEF (Social Innovation and Global Ethics Forum) 2015, biscuits to reduce child malnutrition in Africa, https://www.sigef2015.com/portfolio-item/enhanced-biscuits-for-malnourished-children-in-africa/
- 2013: African Forum – 100 innovations pour un développement durable – Paris – 5 décembre 2013 catégory: *SAN – Bénin – Transformation des insectes comestibles,* (transformation of edible insects) https://hermannreports.mondoblog.org/2014/03/12/distinction-des-laureats-beninois-du-forum-afrique-pour-linnovation

Fig. 4.4 Different photographs of edible insects and preparations; (**a**–**b**) *Orytes* larva that have been grilled from man from Benin; and man come from Costa Rica fried *Orytes* larva's in rural locality in Benin (Photo credit: S. Tchibozo 2009); (**c**–**d**) The author on a field trip in East Benin. Palm weevil larva cooking in a pot cooking (Photo credit: R. Kok, Benin 2012); (**e**–**f**). Grilled orthoptera in West Benin (Photo credit: S. Tchibozo 2004 and 2012); (**g**) Cricket legs, whole termites, scrambled eggs and rice cooking by author (Photo credit: S. Tchibozo 2012); (**h**) Therapeutic consumption of a raw termites queen (Photo credit: S. Tchibozo 2003)

- 2012: First price in the competition 'Parlons développement durable!'(let us talk about sustainable development), catégory: 'Information Scientifique' (scientific information): Les insectes alimentaires de la République du Bénin (edible insects in the Benin Republic. French Embassy in Bénin, IFB, MEHU, MESRS, ORTB, RFI, etc. https://fr.horyou.com/member/severin-tchibozo-1/action/les-insectes-alimentaires-de-la-republique-du-benin

4.4.2 The Past and Present Project

- 2021–2023: Insects-food & Tour, https://www.reseau-ulysse.be/insects-food-tour. This project aim to promote the edible insects in Benin: by tourism together with the cooperation from researchers from Benin in Belgium.
- 2016–2018: Valuation for edible insects in the food. Concern the cricket breeding in Benin with two NGO. The first idea for this project come author and CRGB in 2015. The French NGO has fly and to develop with others local NGO in Benin. The aim is to breeding local insects and combat malnutrition in Benin.
- 2009–2012: The edible insects online in West and Central French Africa (Les insectes comestibles d'Afrique francophone de l'Ouest et du Centre sur Internet: LINCAOCNET), http://gbif.africamuseum.be/lincaocnet/https://biogov.uclouvain.be/Besafe-Biomot-Conference-June2015/posters/Tchibozo-Mergen-June%202015final.pdf
- 2008–2011: Collaboration between, Benin, Bhutan and Costa Rica in Sustainable Biodiversity Knowledge and Use. People, coming from Costa Rica, discover the edible insects in Benin and will promote them.

To outsiders it may seem unusual, but in Benin, insects are common snack. South-South cooperation is allowing Costa Rica to new experiences, https://www.youtube.com/watch?v=TQHq1kKRV_s.

4.5 Conclusion

Insect consumption belongs to traditional food culture for many different societies in the world. It is not only a matter of taste, but also a viable alternative for meat in the rural, peri-urban and urban areas. The breeding of potential edible insects and development of farming facilities is necessary for sustainable conservation. In 2050, there will be nearly 10 billion humans on earth, and the promotion of the consumption of insects could be a potential solution to feed people with animal proteins. Sustainable breeding or farming is strongly recommended to sustain consumption, as well as to preserve the natural ecosystems.

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