BRIEF NOTES ON FUNDING OPPORTUNITIES FOR ENTOMOLOGICAL RESEARCH

by

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1. COLLECTIONS OF RECOMMENDED WEBSITES/DONORS FOR RESEARCH FUNDING, INCLUDING TRAVEL, WORKSHOP AND FELLOWSHIP GRANTS

The odds associated with sourcing for grants from government have created serious gap in carrying out research and other related scientific activities. However, an assessment of limited governmental budget for sponsoring or giving grants for conference attendance and research, resulted to competition for the limited available opportunity. This calls for sourcing from non-governmental donor agencies. Hence, the collections below are intended to provide useful information on funding source, links and associated deadlines. Consequently, if these are meticulously followed, the problem of budget constraints on conventional (governmental) sources will become a thing of the past.

S/N	Funder	Weblink		Deadline
1	West African Research Association WARC Travel grant	http://www	www.bu.edu/wara/fellowship/fund_travel/	March 15
2	SEARCA Grants Program	http://www	.searca.org/index.php/scholarship/searca-travel-grants	March 7, June 7, September 7
3	Australian Centre for International Agricultural Research Events funding***	http://aciar	.gov.au/eventsfunding/guidelines	March
4	FWO grant for conference participation	http://www	.fwo.be/en/fellowships-funding/international-mobility/outgoing/grant-for-participation-in-an-international-conference/	Anytime
5	Canon Foundation	http://www	.cfsr.co.uk/what.htm	3 months to the conference
6	Carnegie Fund for Conference attendance (institution-based)	http://www	.africanstudies.org/publications/asa-news/winter-2015/479-announcement-carnegie-fund-for-conference-attendance	
7	ANSTI Conference grants	http://www	.ansti.org/index.php/fellowships/ansti-conference-grants	3 months to the conference
8	AuthorAID	http://www	.authoraid.info/en/funding/	Next funding cycle in June 2016
9	TWAS grants for scientific meetings	http://twas	.org/opportunity/twas-grants-scientific-meetings-held-developing-countries	June 1
10	VLIR-UOS Belgium conference support (for partner countries)	http://www	.vliruos.be/en/project-finding/programdetail/international-conferences-inco_3954/	Starts March 4
11	The Emerging Nations Science Foundation travel grants	http://www	.ensf-ngo.org/new/guidelines.php	Submit at least three months before conference

2. LIST OF AVAILABLE PLAGIARISM DETECTOR LINKS AND DATABASE

There has been paucity of information dealing with the essential matter of report writing and this has led to high level of plagiarism in the academic. This background has prompted the below collection on database along with description and web address. However, to ensure coherent report and scientific article writing, use collection of relevant resources such as books, courses, presentations and other resources for the planning, style, structure and composition of your research articles. After successful compilation, plagiarism checker should be explored to verify the percentage originality of your report and article writing. Enlisted below are the links for plagiarism detector.

Plagiarism Checker - A Free Online Plagiarism Detector

https://smallseotools.com/plagiarism-checker/https://www.duplichecker.com/ *(maximum of 1000 words per search)*
https://copyleaks.com/
https://www.paperrater.com/
https://plagiarisma.net/
https://www.grammarly.com/plagiarism-checker
https://www.plagium.com/en/plagiarismchecker
https://www.plagscan.com/en/
https://www.plagtracker.com/
https://www.scanmyessay.com/plagiarism-check.php
https://www.dustball.com/cs/plagiarism.checker/
https://www.plagramme.com/ (Multilingual plagiarism check)
https://www.plagiarismchecker.com/
https://www.ithenticate.com/
https://www.turnitin.com/
https://www.qcc.cuny.edu/SocialSciences/ppecorino/Academic-Integrity-Plagiarism.html

DATABASE	DESCRIPTION	WEB ADDRESS	USER ID	PASSWORD
ARDI (Access to Research for Development and Innovation)	ARDI provides access to nearly 10,000 online major scientific and technical journals, books and reference works for patent offices, academic and research institutions in cooperation with 12 major publishers:	http://ardi2.wipo.int/content/en/journals.php	ardi-ng031	5qb8bx5z
AGORA (Access to Global Online Research in Agriculture)	It provides free or low-cost access to major scientific journals in agriculture and related biological, environmental and social sciences.	www.aginternetwork.org	ag-nga200	Rucukoxa
DOAJ Directory of Open Access Journal	This service covers a wide range of free full text, quality controlled scientific and scholarly journals. There are over 5000 free, **full-text available journals** in the directory.	http://doaj.org	_	_
EBSCOhost Academic Search Complete	It is a good and comprehensive scholarly, multidisciplinary full -text database, with more than 8500 full -text periodicals, including more than 7300 peer-reviewed journals	www.search.ebscohost.com	ns217100	password
ERIC (Education Resources Information Center)	is an online digital library of education research and information? It provides access to 1.5 million bibliographic records (citations, abstracts, and other pertinent data) of journal articles and other education-related materials	http://eric.ed.gov	-	_
HINARI (Health Inter Network Access to Research Initiative)	HINARI Programme set up by WHO together with major publishers, enables low - and middle-income countries to gain access to one of the world's largest collections of biomedical and health literature.	http://extranet.who.int/hinari/en/journals.php	NIE427	10637
JSTOR (Journal Storage Project)	It provides access to thousands of leading academic journals across the humanities, social sciences, and sciences, as well as select monographs and other materials valuable for academic work.	www.jstor.org	Kwasulibrary	kwasulibrary
Nigerian Virtual Library	The collection consists of online books, journals, films, videos and maps useful for teaching, research and learning in tertiary institutions	www.nigerianvirtuallibrary.com	KWASU	KWASU
OARE (Online Access to Research in t he Environment)	It enables developing countries to gain free access to one of the world's largest collections of environmental science literature.	http://oare.oaresciences.org/content/en/journals.php	NIE748	13095
Science Direct (Elsevier)	It allows users to access the contents of over 2,000 peer-reviewed academic journals.	http://www.sciencedirect.com/	library@kwasu.edu.ng	kwasulibrary

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2. https://elearningindustry.com/top-10-free-plagiarism-detection-tools-for-teachers

CONVERTING PESTS TO PROTEIN: A REVIEW OF WORLD'S MOST EDIBLE INSECTS

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ABSTRACT

Recent developments in research and development show edible insects to be a promising alternative for the conventional production of meat, either for direct human consumption or for indirect use as feedstock. Nevertheless, a tremendous amount of work still needs to be done by a wide range of stakeholders over many years to fully realize the potential that insects offer for food and feed security. This review therefore, tried to compare the capture of edible insects for human consumption to the conventional application of insecticides as a pest management strategy. It further shows that manual harvest reduces the density of most of the identified edible insects and suggests that implementation of this mechanical method of control may be substituted for chemical control. Mechanical control provides general advantages: (1) a second profitable product for the human community; (2) savings realized from reduced cost of insecticides; and (3) reduced risk of soil and water contamination by insecticides. It is therefore proposed that the manual harvest of insects is a practical method of pest control, which could be extensively applied in other crop systems in Nigeria and the world at large.

Keywords: Pest management, Pest control, Edible insect, Consumption

INTRODUCTION

The word insect derives from the Latin word insectum, meaning "with a notched or divided body", literally "cut into sections", from the fact that insects' bodies have three parts. Pliny the Elder created the word, translating the Greek word ἔντομος (entomos) or insect (as in entomology, which was Aristotle's term for this class of life), also in reference to their "notched" bodies. The term was first documented in English in 1601 in Holland's translation of Pliny (Harpe and McCormack, 2001).

Insects are a class of animals within the arthropod group that have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and two antennae. They are among the most diverse groups of animals on the planet: there are more than 1 million described species, which is more than half

of all known living organisms. The total number of species is estimated at 6–10 million, and the class potentially represents over 90 percent of the differing animal life forms on Earth. Insects may be found in nearly all environments, although only a small number of species occur in the oceans, a habitat dominated by another arthropod group, the crustaceans.

For most people living in rural areas, especially the poor, forests and trees are important sources of food and cash income. Some 350 million of the world's poorest people – including 60 million indigenous peoples – depend on forests for their daily subsistence and long-term survival (FAO, 2012a). Insects are a major source of animal protein in many communities and are critical for diet diversification but, in most countries, eating insects is not a matter of survival but a question of personal choice. In fact, the vast majority of insect consumption is by choice, not necessity, and insects are a part of local culture. Nevertheless, insects do provide valuable buffers against seasonal shortages of food (Dufour, 1987). As well as acting as important food items, insects provide additional cash for basic expenditure, including on food, farming inputs and education (Agea *et al.*, 2008; Hope *et al.*, 2009).

The practice of eating insects is known as entomophagy. Many animals, such as spiders, lizards and birds, are entomophagous, as are many insects. People throughout the world have been eating insects as a regular part of their diets for millennia. Although this practice should be specified as human entomophagy, throughout this paper entomophagy refers to human entomophagy. The earliest citing of entomophagy can be found in biblical literature; nevertheless, eating insects was, and still is, taboo in many westernized societies.

The unconventional nature of entomophagy has meant that farming insects for food and feed has largely been absent from the great agricultural innovations in livestock farming that emerged in past centuries – with a few exceptions, such as bees, silkworms and scale insects (from which a red colorant is derived).

Insects have also failed to feature on the agendas of agricultural research and development agencies worldwide, including at FAO. Until recently, references to insects for food and feed have been largely anecdotal. It is therefore unsurprising that insects are still lacking from the diets of many rich nations and that their sale for human consumption remains part of a niche food sector of novelty snacks. Nevertheless, insect consumption is not a new concept in many parts of the world. From ants to beetle larvae – eaten by tribes in Africa and Australia as part of their subsistence diets – to the popular, crispy-fried locusts and beetles enjoyed in Thailand, it is estimated that insect-eating is practised regularly by at least 2 billion people worldwide. More than 1 900 insect species have been documented in literature as edible, most of them in tropical

countries. The most commonly eaten insect groups are beetles, caterpillars, bees, wasps, ants, grasshoppers, locusts, crickets, cicadas, leaf and planthoppers, scale insects and true bugs, termites, dragonflies and flies.

The importance of sedentary agriculture may have also resulted in the perception of insects as a nuisance and threat to food production. In short, undomesticated food sources in general became less important (DeFoliart, 1999). In modern agriculture, agro-ecosystems are greatly simplified: biodiversity is minimal and the potential to harvest from nature is generally low. Urbanization, which is more extensive in Western countries, has left people out of touch with nature, contrary to many tropical settings where people live a more rural life, although this is changing (UN, 2012).

Increasing urbanization will change insect consumption in developing regions of the world if supply to cities remains small and unreliable and urban areas westernize. For example, locust consumption in the Fertile Crescent has disappeared in areas characterized by strong westernization (Amar, 2003). People in most Western countries view entomophagy with feelings of disgust (Rozin and Fallon, 1987). It is safe to say that most are reluctant to even consider eating insects and, moreover, that they perceive the practice to be

associated with primitive behaviour (Vane-Wright, 1991; Ramos Elorduy, 1997; Tommaseo Ponzetta and Paoletti, 1997).

Disgust forms a basis of moral judgement and plays a major role in people's rejection of food (Fessler and Navarette, 2003), although it is an innate reaction (Rozin and Vollmecke, 1986; Herz, 2012). Feelings of disgust are mostly triggered by questions such as: What is it? or Where has it been? (Rozin and Vollmecke, 1986). Aside from basic human emotions, the origins of disgust are rooted in culture (i.e. "taste is culture"), which undoubtedly has a major effect on food habits. Culture, under the influence of environment, history, community structure, human endeavour, mobility and politico-economic systems, defines the rules on what is edible and what is not (Mela, 1999). In short, the acceptance or rejection of entomophagy is a question of culture (Mignon, 2002).

Why eat insects?

Overall, entomophagy can be promoted for three reasons:

- **Health:** Insects are healthy, nutritious alternatives to mainstream staples such as chicken, pork, beef and even fish (from ocean catch). Many insects are rich in protein and good fats and high in calcium, iron and zinc. Insects already form a traditional part of many regional and national diets.

- **Environmental:** Insects promoted as food emit considerably fewer greenhouse gases (GHGs) than most livestock (methane, for instance, is produced by only a few insect groups, such as termites and cockroaches).

necessarily a land-based activity and does not require land clearing to expand production. Feed is the major requirement for land. The ammonia emissions associated with insect rearing are also far lower than those linked to conventional livestock, such as pigs. Because they are cold-blooded, insects are very efficient at converting feed into protein (crickets, for example, need 12 times less feed than cattle, four times less feed than sheep, and half as much feed as pigs and broiler chickens to produce the same amount of protein). Insects can be fed on organic waste streams.

- **Livelihoods (economic and social factors):** Insect harvesting/rearing is a low-tech, low-capital investment option that offers entry even to the poorest sections of society, such as women and the landless. Mini-livestock offer livelihood opportunities for both urban and rural people. Insect rearing can be low-tech or very sophisticated, depending on the level of investment.

A Handful of Edible Insects

There are definitely quiet a great species of edible insects around the world and specifically to the area where one lives, but not in the same variation and abundance as other bioregions. Literatures abound on the accounts of Paiute food gatherers burning a field of grass to expose (and roast) large quantities of

grasshoppers, and indigenous Peruvians harvesting large amounts of edible tarantulas (with large, fatty butts) from caves. However, this review will be looking at some major agricultural insect pests that are edible and instead of targeting them as pests, they should be converted into protein as shown subsequently.

1. Eating Ants

Ants are insects. They are related to bees and wasps. But thousands of different kinds of ants live all over the world (except in the Arctic and Antarctic where it is too cold), There are Amazon ants and wood ants, safari ants and Australian bulldog ants. Scientists have collected at least 20 species of ants locally on the Fitzner/Eberhardt Arid Lands Ecology Reserve.

Most ant species are edible, their flavor is pleasantly sour. This is because ants secrete an acid when threatened, giving them a vinegar-like flavor. In Colombia ants are roasted with salt (crunchy salt-and-vinegar ants!) and eaten at feasts. The queen ants are preferred there, having big juicy butts (more fat). In Colombian folk culture, queen ants are said to boost libido. Ant larvae are also fantastic, having no sour flavor. They can often be found in clumps under rocks, or on top of anthills when they are being moved or kept warm.

To harvest ants, one can put a stick on an anthill, wait for it to get covered with ants, and then shake it off into a container. A lid on the container will suffocate them, but this death may allow them to secrete more acid. Roasting them right away will kill them more quickly and prevent this.

2. Eating Crickets

Inhabitants of open meadows, grassland, fields and some forests, crickets also have a continuous tradition as human food. They are sold by the pound, dried, in Mexican markets and fried or roasted before eating. Crickets are excellent pan-fried or oven toasted, with a bit of oil and salt if you like. The legs can be removed before eating as they are sometimes irritating. They can also be dried and stored for future use.

A simple trap for crickets can be set with nothing other than a Mason jar and some bait. Dig a small hole in the ground of a cricket-inhabited area, put the jar into this hole and move the soil back into place around it or simply put the jar on its side on the ground. A piece of bait is then placed in the jar (a slice of apple, oats, bread, carrot, lettuce, a bit of stale beer, try what you have). In the morning there should be some crickets enjoying themselves in there. Put the lid on the jar, with holes poked in if you want to keep them alive, and without if you

want them to die.

As a variation, put water in the jar along with the bait and the crickets will drown. Often people use a solution of molasses and water or stale beer for this; other sweeteners or foods mixed with water may also work.

3. Eating Grasshoppers

Locusts are a group of grasshopper species that become gregarious and migratory when their populations are sufficiently dense. During the swarming phase, locusts destroy or severely damage crops. They are a major pest of historical importance, notably in Africa (North, West, Sahelian, Madagascar), Australia and the Middle-East. A locust swarm can represent a considerable amount of biomass, containing up to 10 billion insects and weighing approximately 30,000 t (DeFoliart, 1989; Ramos-Elorduy, 1997; van Huis et al., 2013).

The swarming behaviour makes locusts relatively easy to harvest for food. In Africa, the desert locust (*Schistocerca gregaria*), the migratory locust (*Locusta migratoria*), the red locust (*Nomadacris septemfasciata*) and the brown locust (*Locustana pardalina*) are commonly eaten. In Japan, China and Korea, rice field grasshoppers (including *Oxya yezoensis*, *Oxya velox*, *Oxya sinuosa*, and *Acrida lata*) are harvested for food (van Huis et al., 2013). The grasshopper *Ruspolia differens*, which is actually a katydid, is a common food source in many parts of eastern and southern Africa. Crickets are a common food in South East Asia, particularly in Thailand: the house cricket *Acheta domestica*, *Gryllus bimaculatus*, *Teleogryllus occipitalis*, *Teleogryllus mitratus*, the short-tail cricket *Brachytrupes portentosus* and *Tarbinskiellus portentosus* are edible cricket species (van Huis et al., 2013).

Harvesting and farming

Grasshoppers, locusts and crickets are usually collected in the wild, preferably at night (using artificial light) or in the morning when the temperature is cooler and the insects are less active and easier to catch. Due to the demand, commercial farming of locusts, grasshopper and crickets for the food and feed market is developing in South East Asia. As of 2012, there were about 20,000 cricket farmers in Thailand, raising the species *Acheta domestica* and *Gryllus bimaculatus*. Orthoptera, and particularly locusts, are commonly raised to feed pets and zoo animals (van Huis et al., 2013).

Grasshoppers inhabit similar terrain to the cricket and are similarly prepared and esteemed. They can be harvested by hand in the early morning before they are fully awake, using the same type of traps as described above for crickets, or using more ambitious methods.

In modern-day Uganda, there is a booming trade in grasshoppers; locals set up extensive grasshopper traps using tall, standing sheets of galvanized tin roofing, their ends stuffed into old oil drums and powerful lights shining on them at night. With the tin roofing reflecting light into the darkness, grasshoppers are attracted en masse to them, land on the upright, glowing roofing and slide into the old oil drums where they are captured.

In order to harvest grasshoppers in large quantities, a group of people hold hands to formed a human wall and walked across a field of tall grass, herding grasshoppers into a tarp on the other end of the field. A good method to try if you have enough people. A Mexican study recently compared the insect management strategies of several farms. Some of them used modern insecticides; others allowed locals to harvest grasshoppers for local markets.

The two methods were equally effective in controlling grasshoppers, but one approach required money and poisoned the land, water and food being grown, while the other avoided those costs, providing healthy wild food and income.

4. Eating Maggots

Maggots are not just edible, they are a traditional super-food in some cultures. They are also probably the most revolting insect one could imagine. Traditionally, many cultures have relished maggots, leaving fish or meat out to become saturated with them and then eating the maggots raw. There is logic to this: a diet of exclusively lean meat causes severe health problems, eventually leading to kidney failure and death. This condition has traditionally been called "rabbit starvation." White trappers living in the north would often be afflicted as they attempted to live entirely off lean meat like rabbit, easily trapped in the northern forests, without sufficient fat or carbohydrates to balance the protein.

They would get a kind of protein poisoning, diarrhea and malnutrition would ensue, and despite eating as much lean meat as possible, they would "starve" to death. What does this have to do with maggots? They are capable of transforming lean meat into fat. Maggots are extremely fatty and a rich source of essential amino acids, making them nutritionally far more valuable than lean meat.

They don't have internal digestive systems of their own, so they secrete gastric juices directly onto meat, causing it to degrade or spoil (or "predigest" if you have a taste for it). That is why there is so much hysteria around maggots on meat, not because they make it unsafe to consume, but because they alter its flavor, texture and palatable shelf life. Maggots will taste different depending on their food source. Their ability to transform lean meat into essential fats is both magical and potentially life-saving under certain conditions.

Someone once shared his story to his grand kids that, during the Depression of the 1930s, he would take maggots that grew on a hunk of meat he kept in the cellar and spread them on toast like butter.

5. Eating Aphids

Aphids are another edible insect. Depending on what foliage they are feeding on, they can range from slightly bitter to sweet. Upon finding an infested plant or patch of plants, simply collect the aphids and eat them fresh or incorporate them into a meal as a nutritious supplement.

6. Eating Termites

These little ones are another big player in traditional human cuisines. They are harvested either individually or in small groups and then toasted in a hot pan. They have high oil content relative to the size of their body and are quite tasty, with a slightly nutty flavour. Those with wings (called alates) are larger and fattier. In many areas where these alates are prolific, they are harvested using a lamp with netting around it. They are attracted to the light and will collect on the netting. The wings are shed easily, which you may have noticed if one has ever landed on you, and can be removed by winnowing after they have been toasted. A candle next to a mirror at dusk at the right time of year can yield some fantastic snacking. In old wooden homes infested with termites, this may be an excellent coping strategy. Sitting around with a friend and talking on the porch at sunset while catching some food in the warm summer night can be quite delightful.

7. Eating Sowbugs

Sow bugs, also known as pillbugs and rolly pollies, are

those little grey, pill-shaped mini-shrimp that you find when you lift up a rotten piece of wood, rock or anything that has been sitting on soil for a while. They are another nutritious bug to know, and are tastiest toasted and eaten crispy, though in a pinch you can eat them fresh.

8. Eating Earwigs

Earwigs are edible and tasty too. Prepare them the same as termites or sowbugs. A couple of tactics for gathering them come from gardeners who disdain these little fellas. Fill low-sided cans with a half inch of vegetable oil (or other liquid, food-grade oil) and place them on the ground. Earwigs will find their way in and drown. Or, alternatively, a beer bottle with a bit of stale beer left in it will attract earwigs. Strain, toast and serve.

Different types of consumable products from Insects

After being wild-harvested or reared in a domesticated setting, insects are killed by freeze-drying, sun-drying or boiling. They can be processed and consumed in three ways: as whole insects; in ground or paste form; and as an extract of protein, fat or chitin for fortifying food and feed products. Insects are also fried live and consumed.

In countries where edible insects are traditionally eaten, food habits have shifted towards Western diets. To counter this, initiatives have been undertaken, for example, in Mexico, where tortillas are being enriched with yellow mealworm (Aguilar-Miranda et al., 2002). This section gives examples of innovative projects that have developed promising edible insect products.

a. **Whole insects:** In tropical countries, insects are often consumed whole, but some insects, such as grasshoppers and locusts, require the removal of body parts (e.g. wings and legs). Depending on the dish, fresh insects can be further processed by roasting, frying or boiling. In the Lao People's Democratic Republic, among other countries, insects can be found in markets as ready-to-eat snacks or fried with lime leaves.

b. **Granular or paste form:** Grinding or milling is a common method for processing a large variety of foods. Soybeans, for example, are often transformed into 'awara', 'tofu' or other meat analogues. Meat is processed into products such as hamburgers and hot dogs, and fish into popular foods such as fish fingers. In much the same way, edible insects can also be processed into more palatable forms. They are often ground into paste or powder and added to otherwise low-protein foods to increase their nutritional value. An easy way to obtain powder is by drying and grinding the insects. In Thailand and the Lao People's Democratic Republic, chilli paste with crushed and ground giant waterbugs (*Lethocerus indicus*) is very popular as a main ingredient (and is known locally as jaew maeng da in the Lao People's Democratic Republic and nam phik in Thailand). The flavour of giant water bug is now reproduced artificially and is readily available. In societies where consumers are not accustomed to eating whole insects, granular or paste forms may be better accepted.

c. **Extracted insect proteins**: Western consumers may be reluctant to accept insects as a legitimate protein source because insects have never played a substantial role in their food culture. Extracting insect proteins for human food products – a process already being carried out – could be a useful way of increasing