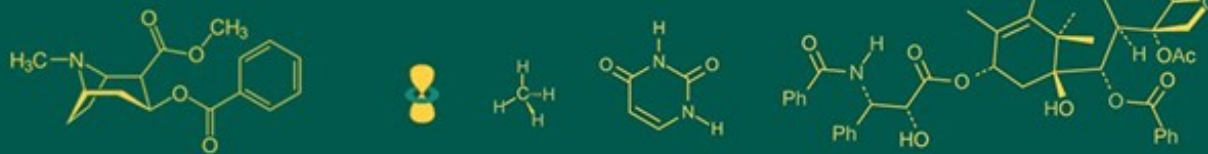


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Entomophagy as nutritional solution and food security

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ABSTRACT

Entomophagy is practiced on a large scale by the tribal communities as well as urban cities in eastern and southern states. Termites, honey bees, grasshoppers, stink bugs, aquatic insects and silk-worms are common and preferred insect species because they contain high amount of protein, fat, minerals and vitamins. Silkworms are successfully mass-reared on host plants or laboratory diets for commercial production. Generally, insects meant for food recipes are processed before consumption to improve taste, flavour, palatability and nutritional value which make them comparable with animal products. Thus, entomophagy supports nutritional security and family livelihood of tribal communities during difficult periods of the year. Regular bioprospecting revealed a few new species but needs validation of their consumption through regulatory framework. This initiative would boost not only the sale in local markets but also may open new vista for export. Holistic approach and intensive efforts are needed to promote entomophagy in regions.

Keywords: Constraints, Edible insects, Food products, Human safety, Nutritional security, Tribal communities

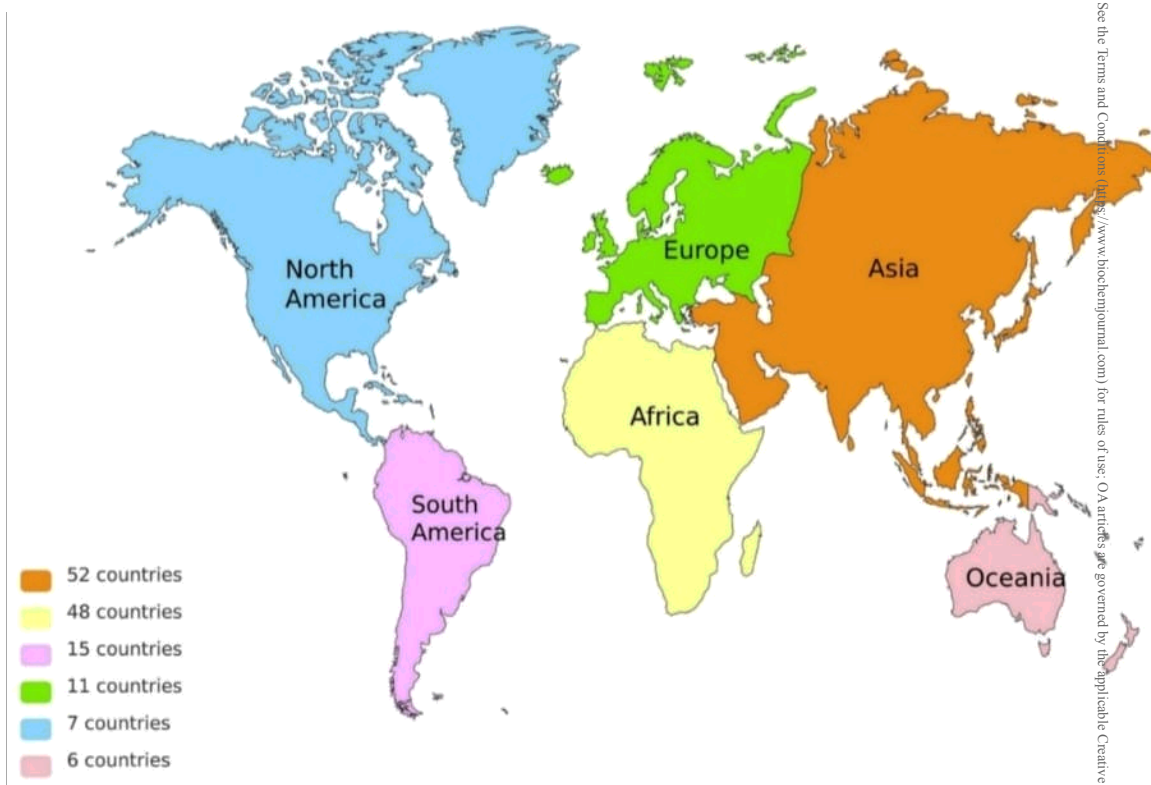


Figure 1. Worldwide consumption of edible insects.

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1.Introduction

By 2050, the world is heading for a population of around nine billion people. That's going to demand twice as much food as we produce now. Already we are running out of land and resources for farming and livestock. At the same time global hunger isn't getting any better. Over 2 billion people face food insecurity. Just in 2020, about 811 million people went hungry a jump from 690 million in 2019, thanks in part to the covid-19 pandemic. The number are even worse in some places, in Africa, for instance about 21% of people deal with under-nourishment. The global goal is to end hunger by 2030, but honestly things are moving in the wrong direction. So we need better and more

efficient ways to ahrdly a new idea. People have been doing it for centuries all around the world especciaaly in regions where it already a cultural norm. Insects are sustainable, environment friendly and nutrient dense and some call it as "Food of the Future".

This article highlight edible insects can help fight food insecurity, especially where hunger is worst and eating bugs is already part and parcel of life. Sure, in most western countries, insects are seen as pest,not dinner. But experts and entrepreneurs have begun to pitch edible insects as high quality, eco-friendly protein that could help feed a fast growing population.

Thus, considering the practice of eating insects as a practical and viable solution to food security.

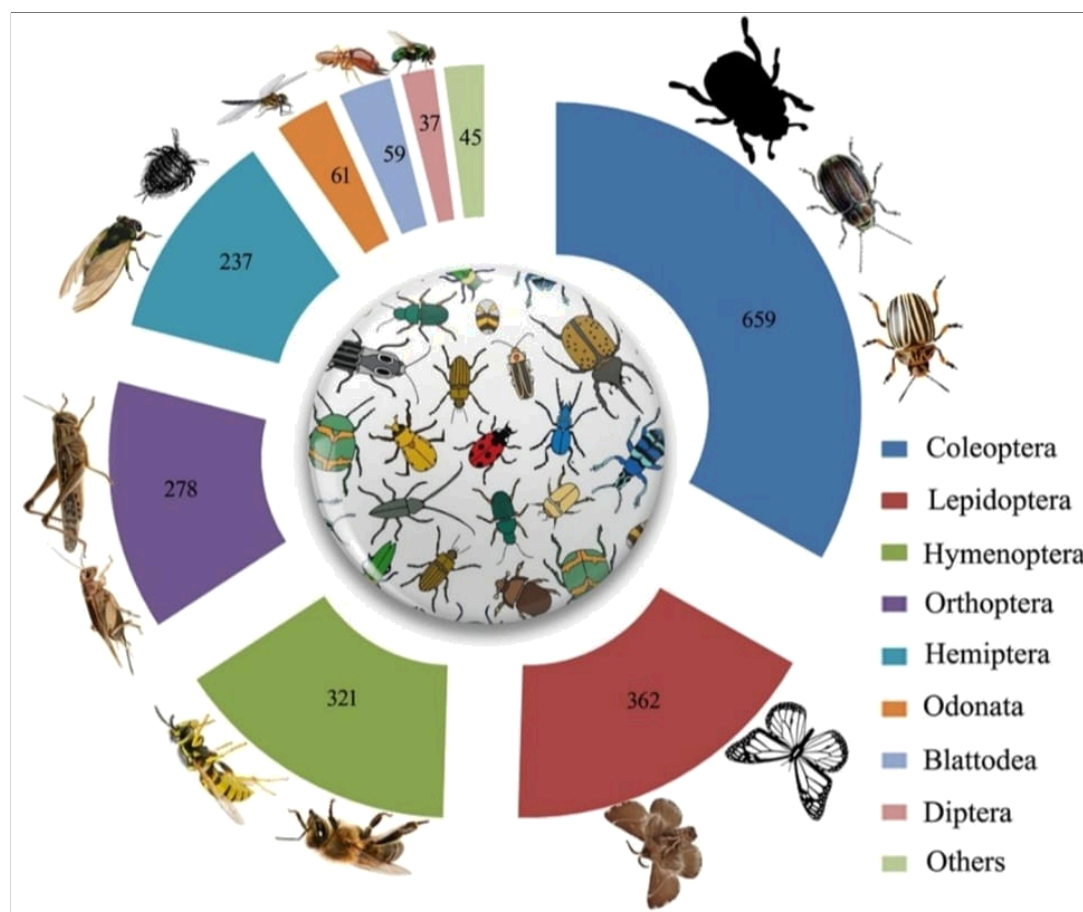


Figure 2. Order wise Distribution

2.Insect as food and feed as overview

2.1.Human entomophagy

A global standpoint Experimenters at Wageningen University in the Netherlands have estimated that further than 1,900 nonentity species features in mortal diets around the world, although it's delicate to be precise about the figures. The most generally devoured insects worldwide go to Coleoptera(beetles),Lepidoptera(butterflies, moths, substantially devoured as caterpillars), Hymenoptera(notions, wasps and ants), Orthoptera(grasshoppers, locusts and justices) and Hemiptera(cicadas,leafhoppers, planthoppers, scale insects and true bugs). The favoured species differ regionally. Insects are devoured by people in dozens of nations, especially in Southeast Asia, Oceania, southern Africa, Central America and the northern portion of South America(van Huis *et al.* 2013 9-10).

2.2 Nutritional profiles of edible insects

The nutritive composition of comestible nonentity species varies, but in general insects are set up to be good sources of protein, some redundancy and some fibre. The proportion of protein per 100g of colorful nonentity species compares favourably with that from mammals,

reptiles and fish. In tours of protein quality, comestible insects can supply a range of essential amino acids.Some nonentity species are respectable amounts of healthy unsaturated superfluity and essential adipose acids.Insects usually also have important micronutrients, similar as iron and zinc, for illustration, while some also contain useful quantities of certain vitamins(DeFoliart 1989; vanguard Huis 2013; vanguard Huis *et al.* 2013). The food value of comestible insects depends to some place on what the insects themselves have eaten, which leads to the supposition that the diets of insects expressed for mortal or beast consumption could be modified to ameliorate or optimise their nutritive value(van Huis 2013; vanguard Huis *et al.* 2013). Numerous insects are scavengers and enterprises about their practicable part as vectors for the transfer of pathogens to beast and humans. Nonentity pathogens are regarded as of veritably low implicit threat to invertebrates; fungi, contagions or poisons(similar as cadmium and lead) that are ingested by insects might accumulate in their bodies and be passed on to consumers. To reduce this threat, some nonentity species are 'degutted'(have their gut contents removed) before being reused as victuals. This can be done mechanically(as it's with mopane worms) or by starving the insects for the last day or two of the parenting circle. Processing styles similar as washing, boiling and desiccating can exclude some pathogens. As with any other food

product, usual aseptic preventives need to be observed to help(re) impurity during processing and storehouse(vanguard Huis *et al.* 2013 118 – 21). Some people witness antipathetic responses to nonentity proteins. Termites and caterpillars yield a high dynamism value. Content of protein is significantly advanced than or equal to beast victuals similar as, funk. When five insects were assimilated for nutritional value, high protein content was set up in dragon cover, *Crocotermis servilla*(Drury) naiad(70.48) 25, short- horned grasshopper.

Mulberry silkworm(*Bombyx mori* L.) nymphs contained protein 55.6, redundancy 32.2 and high situations of essential amino acids similar as valine, methionine and phenylalanine 31. Eri silkworm nymphs contained protein (16.), redundancy 8.0), Ca 24 mg, P 175 mg, Mg 54 g, Zn. Status of marketable nonentity husbandry presently, utmost of the comestible insects are collected in nature and tamed insects, especially silkworms are considered for out-of-door and inner parenting on marketable scale. Silkworm naiads and nymphs are devoured as food whereas in other places mulberry silkworms are fated for husk product. In Arunachal Pradesh, two stag beetles, *Dorcus* sp. and *Odontolabis gazella*(Fb.), termite, *Odontotermes* sp., beetle, *Odontotaenius* sp. and cabochon beetle, *Polyphylla* sp. have been reported as regular crop pests. There's want for an intertwined food network to conciliate and exploit the huge eventuality of comestible insects for mortal nutrition. In fact, demand for healthy victuals or those codified as health- promoting particulars is adding in the market. Thus, nonentity- grounded victuals can be pro moted by involving them in the marketing chain. The mindfulness, knowledge and perception of pastoral and civic population can make the selling of comestible insects as a marketable exertion which boost profits.

2.3 Edible insect fauna of India

Over 2,000 nonentity species belonging to 18 orders are devoured worldwide. In India, biodiversity is the symphonious concurrence between ethnical communities and natural coffers. Despite this fact, methodical check on comestible insects has not been accepted by any government division. Chakravorty *et al.* reported 298 comestible insects belonging to coleoptera(34), orthoptera 24), Hemiptera(17), Hymenoptera(10), odonata(8), lepidoptera(4), *Isoptera*(2) and Ephemeroptera(1). Chakravorty also stated nonentity diversity in Arunachal Pradesh(158 species), Manipur and Nagaland(41 species each), Assam(38 species), Meghalaya(16 species), Kerala(5 species) and *Karnataka*, Tamil Nadu, *Odisha* and Madhya Pradesh(1 species). In one check in Assam, Ronghang and Ahmed) tried 30 nonentity species and reported 36.6 coleoptera followed by Hymenoptera(23.3) and the least was *Isoptera* with 3.3. In another check, Chakravorty *et al.* studied 81 nonentity species in Arunachal Pradesh. Ultimate number of 24 insects(29.6) was from coleoptera followed by orthoptera(20.9) and hemiptera(19.7), and minimal number of 9 species(11.1) odonata. Bioprospecting is usually intended for contriving new comestible insects and for attesting current status of insects which are consumed. There's critical want of bio prospecting to see biodiversity of comestible insects in countries other than North East region. This is because it's practicable that several insects are comestible but are yet unknown or unidentified. For partner bountiful, after removing bodies, grasshoppers are fried in oil painting and eaten after adding swab. Bamboo caterpillars are stuffed in bamboo tube, smoked dry for 3 days, mixed with chilli/ red pepper and swab and devoured with rice. else, dehydrated substance is crushed and mixed with chilli, swab and bamboo shoots to make a mucilage 'chutney'. This largely accelerated medication is generally eaten in North East region. utmost of the insects are degutted/defatted before recycling as insects may contain poisonous substances. The reused insects can also be saved safely without microbial impurity. In an dissection of insects devoured in Assam and Arunachal Pradesh, it was caught on that a maturity of insects are devoured only after having reused them with colorful styles. A fantastic pleasure by fragile figures of rich consumers dining at caffs , cafés and carnivals. But this is a formerly in-a-while, episodic experience for a fragile slice of the population. To

make bounds meet, a many people from lower rich sections of society haunt to producing their own foods. Domestic nonentity parenting proves to be an seductive option to some of these people because a useful protein supplement can be grown at home without taking a lot of room.

3. Entomophagy and global food security

Entomophagy, the consumption of insects, offers a sustainable solution to global food security by providing a highly nutritious, low-emission, and resource-efficient alternative protein source. Insects require significantly less land and water than traditional livestock, serving as a key strategy to address malnutrition and agricultural strain as the global population grows.

3.1 Implications for global food security

Insects are reared consequently and reused into victuals in important the same expressway as in the ' advanced' world – largely as general proteins for mass consumption. Fat elites in these nations have cultures preferably like those of fat people in metropolises each over the world.. Encyclopedically, the evolution of indispensable protein sources has allowed the aggregate force of salutary protein to remain plentiful, while the ecological footmark of protein product has dropped. The specialized effectiveness of food product systems has greatly swelled, at the cost of a physical reduction in crop, beast and natural biodiversity. Huge, ferocious stock- fostering installations have faded, displaced by a fragile number of granges that supply elite, niche requests with high quality, sustainably reared rubric types. grim cost competition within the comestible nonentity region threatens the sustainable nature of this protein volition. still, the global request for rarer species of entire insects remains veritably fragile and does n't pose imminent pitfalls of over-harvesting. Tropical regions have a erected- in competitive advantage in nonentity- parenting because of their climatic conditions. adding substance in profitable hotspots of the global South means that original investors established prosperous nonentity- parenting and nonentity processing companies. They've some specialized know- style and artistic vantages that enable them to serve the sapient palates of nonentity consumers in their regions. Western directors tend to concentrate on bulk nonentity proteins that are extensively devoured in unnoticeable forms, while the fragile volumes of epicure nonentity constituents needed to meet demand in Europe and North America are generally imported. Civic nonentity parenting has helped reduce food long hauls and created value from waste aqueducts. Access to protein around the world has bettered since 2015, due in respectable portion to the comestible nonentity region. Consumers are suitable to take between a wide range of protein druthers , involving fresh and nutritionally and packaged nonentity- grounded victuals with long force progressions and extended shelf life. The usual beast assiduity has greatly refused around the world, especially the voluminous- scale ferocious missions that were rendered unviable by stricter regulations. nonentity- grounded beast feeds have helped with cost edge but, for utmost people, usual flesh consumption is an episodic pleasure. Some environmentalists have expressed enterprises about the carbon copy footmark of nonentity force progressions, and also the traceability of certain species. nonentity exports from Asian companies are one source of company, while nonentity product in colder Western countries is criticised for its reliance on dynamism-empty climate- ruled product installations.

4. Climate shift factor – resilience and adaptation

Endangers mortal health, while aggravating food instability in numerous corridor of the world and directly contributing to the spread of contagious conditions(McMichael *et al.*, 2007). Flesh product comes with serious impacts similar as acid rain, climate revise due to hot-house gas emigrations(GHGs), deforestation, soil corrosion, desertification, loss of factory biodiversity, and water toxin(Dopelt *et al.*, 2019; vanguard Huis and Oonincx, 2017). Exploration indicates that without revolutionary revise in the food assiduity, the environmental jolt of beast product will remain to boost.

The global agrarian accounts for roughly a fifth of grand GHGs, 80 of which can be attributed to beast product (McMichael *et al.*, 2007). The beast assiduity is responsible for 35 to 40 of grand methane (CH₄) emigrations and 65 of nitrous oxide (N₂O), both of which have much lesser global warming eventuality (GWP) (McMichael *et al.*, 2007); 23 moments and 296 moments the GWP of carbon copy dioxide (CO₂), independently (Steinfeld *et al.*, 2006) [1]. (FAO) indicated that global flesh product has closely quadrupled from 1961 to 2018 with a 380 boost from 71 million tonnes to over 340 million tonnes (Ritchie and Roser, 2019). It's apparent that a reduction of flesh consumption could contribute to the reduction of GHGs and climate revise mitigation (González *et al.*, 2020) [2].

4.1 Environmental benefits of entomophagy

Environmental benefits of substituting meat protein with comestible insects have been demonstrated in once studies on entomophagy (Belluco *et al.*, 2013 [3]; Guiné *et al.*, 2021; Imathiu, 2020; Ooninx and de Boer, 2012 [4]; Rusconi and Romani, 2018 [5]; van Huis and Ooninx, 2017). Four areas high feed conversion effectiveness (van Huis) dropped land use, reduced water use, and lower GHGs. Compared to that of mealworms, the GWP per kilogram of comestible protein of funk (32 - 167 advanced), pork (51 - 287 advanced), and beef (452 - 1151 advanced) are much larger. In comparison, for 1 kg of comestible insects compared to the same quantum of meat from animal, produce 100 times lower GHGs (Ooninx *et al.*, 2010).

Entomophagy presents a sustainable strategy to dwindling the environmental detriment of people's food choices; exploration set-up if meat consumption was halved and replaced with insects, this alone would free up roughly 1,680 million hectares of land, original to 70 times the size of the United Kingdom (Rusconi *et al.*, 2018) [5].

5. Insect collection and rearing

5.1.1 Coleoptera

Coleoptera The slaveys of *R. phoenicis* and the coconut rhinoceros beetles *Oryctes rhinoceros* L. and *O. boas* F. (Scarabaeidae) are a common food in the Democratic Republic of Congo (DRC) (Onyeike *et al.*, 2005; Onzikou *et al.*, 2010) [6] and Nigeria (Ekpo *et al.*, 2005) [7]. soil beetles including *Heliocopris* (Scarabaeidae) are collected generally in morning by digging them out from cattle soil, placed into a vessel filled with water to soak for 12h or until no further food remains in their bowel before they can be cooked (Hanboonsong, 2010) [8].

5.1.2 Diptera

Lake flies, *Chaoborus edulis* Edwards, *Chaoborus* spp. (Chaoboridae) rise like clouds from Lake Victoria in East Africa. Natives sweep them off from bushes and rocks and collect them by whirling baskets. Cake is prepared by grinding the flies, which is then sun-dried (van Huis, 2003).

5.1.3 Heteroptera

Collecting water bugs around lights at night near water sources is an age-old practice in Mexico where bug eggs are well known for their taste. Two rice bugs, *Leptocoris oratorius* F. (Coreidae) and *Nezara viridula* L. (Pentatomidae), are relished by farmers in Borneo. They mash the bugs with chillies and salt and cook them in hollow bamboo stems.

5.1.4 Hymenoptera

Larvae and pupae (and rarely adults) of honeybees and social wasps are roasted/grilled over a fire and eaten, whereas adult wasps are canned or rice is cooked with wasps or honeybees in Japan, China and Java (Edwards, 1998; Feng *et al.*, 2010) [9]. Larvae and pupae of the social honeybee *Apis cerana* F., the giant honeybee *A. dorsata* F., the dwarf honeybee *A. florea* F. and the stingless bee *Trigona biroi* Friese

(Apidae) are boiled with porridge or rice, stir-fried or drunk together with honey.

5.1.5 Isoptera

Large colonies of termites are set up in thirsty and sticky areas of Central Africa and Australia. Eating of the queen and the reproductive forms is common encyclopedically, whereas dogfaces are preferred in Vene zuela (Paoletti *et al.*, 2003). Roulon-Doko (1998) and van Huis (2003) reviewed colorful styles termite collection in Africa.

The most popular and easy way used in the tropics is to collect them during the evening hours by placing a receptacle of water right under the light source. As light is reflected on the water, termites are attracted and trapped on the water face (Chung, 2010). The lines of Africa, especially those in Zambia, the Central African Republic, Angola and the DRC, collect winged sexual forms at the time of matrimonial flights of termite species, *Macrotermes falciger* Gerstaecker and *M. subhyalinus* (Isoptera Termitidae), when grown-ups crop in large figures from the termitaria after the first rains (Mbata, 1995; Malaisse, 2005) [10, 11].

5.1.6 Orthoptera

Grasshoppers, justices and locusts are eaten by Africans as delectables (Mbata, 1995) [10]. Grasshoppers (Acrididae) including *Acanthacris ruficornis* Fb., *A. nigrovariegata* Bolivar, *Locusta migratoria migratoria* L., *Nomadacris septempunctata* Serville, *Cyrtacanthacris tatarica* Linn., *Lamarckiana cucullata* Stoll and other jumping insects are collected in the early morning and evening when insects gather and inactive. Townies use brooms made of leaves or branches of original trees to chase grasshoppers from trees and hooches (Mbata, 1995; Nonaka, 1996; Roulon-Doko, 1998) [10]. Grasshopper are collected when drawing the fields for planting accepted (Chung, 2010). Small grasshoppers are first smoothly interspersed, boiled in a little water.

Conservation and collection
Banded colorful styles of collection and prisoner of comestible insects. Harvesting of insects is frequently done by women, nonentity husbandry can be a low-input sustainable form. The way of collecting depends on the insects'. For illustration, low temperatures in the morning make insects comparatively inactive and catching them is easy; nightly insects (termites and grasshoppers) can be caught in light traps as they're attracted to light; artificial parentage spots are useful for attracting win weevils, whereas justices and cicadas can be traced by the sound they make (van Huis, 2003).

5.2 Insect mass rearing

Development economically doable ways of mass parenting in unrestricted surroundings is pivotal since utmost insects are only seasonally available in nature (Callavo *et al.*, 2005; Feng *et al.*, 2009; Sileshi and Kenis, 2010) [12]. Rearing of insects in prison (coops, potted shops and embedded food shops) at village position can allow a non-stop force rather than counting on natural harvesting. For illustration, the hepialid caterpillar *Wiseana copularis* Meyrick (Lepidoptera Hepialidae) (Allan *et al.*, 2002) [13] and the South American win weevil

Rhynchophorus be reared on indispensable host shops or artificial diets. Inner parenting by growers of the eri silkworm and mulberry silkworm in houses in India (Sathe *et al.*, 2008; Chakravorty *et al.*, 2011; Sarmah, 2011) [14], the giant hornets (*Vespula* spp.) in woodenhive boxes in Japan (Nonaka, 2010) and the eri silkworm on cassava leaves in Thailand (Sirimungkarakat *et al.*, 2010) [15] has been relatively successful.

Thailand, growers use cement tanks and plastic distance for justice husbandry (Hanboonsong, 2010) [8]. A subcaste of flaxen gault soil is added and is covered with dry meadows, bamboo shoots. An artificial diet, containing chickfeed along with meadows or weeds, and water are handed. After 4 - 6 weeks, adult justices are ready to be gathered (Jamjanya *et al.*, 2001). It's possible that the trade of insects yields further profit for growers than millets.

6. Processing, safety and food technology

Studies have shown that traditional insect consumption is higher at lower latitudes, that is, in tropical regions of the world. Around the world, insects are consumed in 11 European countries, 14 countries in Oceania, 23 American countries, 29 Asian countries, and 35 countries.

Processing technologies

The edible insect industry is moving ahead at staggering speed, and the demand for new products, both in recognizable form and as ingredients, is growing (Van Thielen *et al.*, 2018) [16]. The manufacturing processes start with the post-harvesting of raw insects and ends with production of foodstuffs and wastes, some of which are recovered and reused as by-products (Raheem *et al.*, 2018).

Blanching

Blanching is a process wherein a food is placed in boiling water for a short period, removed, and then plunged into ice water or placed under cold running water to stop the thermal process (Xiao, Bai, Sun, & Gao, 2014). It is used as a pretreatment for most commercialized edible insects, at both the industrial and artisanal scales, to reduce microbial counts and to inactivate degradative enzymes responsible for food spoilage and poisoning. Blanching significantly reduces total counts of mesophilic bacteria and of yeast and molds; however, it is ineffective at eliminating, or even reducing, mesophilic bacterial spores. Blanching has also been reported to reduce counts of lactic acid bacteria and total psychrotrophic bacteria (Vandeweyer *et al.*, 2017) [17].

Drying

Drying is the most widely used technology for increasing the shelf-life of foods. Drying techniques range from traditional methods (for example, roasting, frying, and sun-drying) to modern methods (for example, freeze-drying, microwave-assisted drying). Drying can reduce the total water content and, therefore, its availability for degradative reactions, including enzymatic reactions and reactions initiated by spoilage microorganisms. Microbial growth depends directly on water activity (a_w). The vast majority of microorganisms stop growing at $a_w < 0.65$. When a_w is low, microorganisms show slowed growth, and when water conditions are appropriate, they can start growing again (Grabowski & Klein, 2016, 2017) [18]. A reduction of free water increases the dry matter concentration significantly without damaging the tissues or the physical appearance of foods and is an important step for food ingredient extraction (Lamidi *et al.*, 2019) [19].

6.2 Processing technologies for extraction

New processing technologies for edible insects have been used mainly for protein, fat, and chitin extraction as shown in Table 5. Protein extraction can be carried out using water, organic solvents, and enzymes to facilitate industrial processes. The extraction rate and characteristics are species dependent and could influence the extraction yield and the physicochemical, functional, and bioactive properties, depending on the solvent used (Bußler *et al.*, 2016) [20].

6.2.1. Enzymatic hydrolysis

It has been studied mainly with a view to gaining a better understanding of the bioactivity of edible insects' hydrolysates after simulated gastrointestinal digestion (Nongonierma & FitzGerald, 2017), in particular angiotensin-converting enzyme inhibition (Dai, Ma, Luo, & Yin, 2013; Stal-janssens *et al.*, 2011) [21], and antioxidant capacities (Zielin'ska *et al.*, 2017) [22].

6.2.2. Ultrasound-assisted aqueous

Extraction was used to extract oil from *Clanis bilineata*, an edible *Lepidoptera* species consumed in China, and compared with Soxhlet extraction (Sun *et al.*, 2018). The highest oil yield (19.47%) was obtained with the ultrasound technique at 400 W ultrasonic power, 40 °C extraction temperature, and 2 s intervals for 50 min of extraction.

6.2.3. Chitin and chitosan are extracted from the exoskeletons of a variety of edible insects. This is the case for the beetle *Holotrichia parallela* Motschulsky that is captured for the control of pests in fields. This insect's chitin was compared with the commercial α -chitin extracted from shrimp. The beetles' chitin showed similar characteristics to the chitin obtained from shrimp. A similar extraction was performed on exoskeletons of *Pimelia* spp. The extracted chitin and chitosan were found to be nontoxic and showed antimicrobial activity against *C. albicans* and *L. monocytogenes*, and therefore has potential for use in food preservation.

6.3 Storage

In many parts of the world, "ready-to-eat" insects are sold in local markets after sun-drying, roasting, or frying in bulk without appropriate hygienic handling. When insects have not previously been subjected to a thermal treatment, such as boiling, they may contain a high microbiological load and they can be recontaminated and/or cross-contaminated. necessary to process, pack, and store them properly to minimize the bacterial loads. Since blanching does not eliminate bacterial spores (Belluco *et al.*, 2013; Caparros Megido *et al.*, 2018) [3], to completely sterilize insect flours, thermal treatment at a temperature between 120 -140 °C needs to be applied for 15 min (Bußler *et al.*, 2016) [20].

A modified atmosphere consisting of 60% CO₂ and 40% N₂ was used to store minced meat-like products from *T. molitor* and *Alphitobius diaperinus* larvae under refrigeration. A significant reduction in microbial growth was observed relative to samples stored in normal atmospheric conditions. The *T. molitor* aerobic count remained low (1.0 log CFU/g) after 28 days when stored under modified atmosphere; however, the total aerobic count was 6.9 log CFU/g for samples stored under ambient conditions.

7. Socio economic and cultural barriers

Edible insects face significant barriers to mainstream adoption, primarily driven by cultural stigma, "disgust" factors, and food neophobia in Western societies, where they are often wrongly viewed only as a poverty food. Socioeconomic hurdles include limited market availability, high processing costs, and regulatory gaps, hindering the transition from traditional, local consumption to commercial, global food systems.

Cultural barriers

Disgust and Food Neophobia: Many people, especially in Western cultures, perceive insects as dirty, disease-carrying pests, causing strong psychological aversion.

Lack of Tradition: Insects are not part of the standard diet in many regions, making their consumption seem strange or unnatural.

Stigma of Starvation: There is a misconception that eating insects is only done in times of famine, causing people in developing areas to abandon them when economic status improves, despite their high nutritional value.

Religion and Customs: Cultural traditions and religious laws can influence the acceptability of certain insects, with different groups having varied beliefs about safety and appropriateness.

Socioeconomic barriers

Availability and Price: While abundant in some areas, the lack of commercial farming and processing facilities makes processed insects more expensive than conventional meat in some markets, limiting access.

Lack of Processing: Insects are often eaten whole, which is a major turn-off for many consumers. Lack of products where insects are masked—such as powder in biscuits—hinders acceptance.

Regulatory Inconsistency: In many regions, there is a lack of clear legal frameworks, food safety standards, and labeling regulations, which complicates commercialization.

Generational and Social Differences: Younger people or urban populations might have different, often lower, acceptance levels compared to rural communities with traditional ties to entomophagy.

8. Current challenges and perspectives

The gap in information can be filled by attestation of pastoral livelihoods depending on entomophagy. Also, ecological knowledge can give an occasion for nonentity conservation and eventually food security (DeFoliart, 2005). Creating awareness in the Western world and nutrition supporter important food for numerous lines may increase pride in ethnical roots and traditions, and raise concern about a healthy terrain and overuse of fungicides; and may foster communication among scientists who are interested in the subject. Therefore, now studied to see whether further sustainable crop will affect in enhanced profitable stability and conservation becomes stable (Frears, 1995). This artistic bias against eating insects is still unclear (DeFoliart, 1999; Ratcliffe, 2006) [23]. On the negative, in certain African countries similar as Botswana, South Africa and Zimbabwe, both beast husbandry and eating of mopane worms and other insects have co-existed for centuries. This perspective has to be studied for long-term provident and ecological benefits, and eternalized by original traditions.

9. Conclusion

People need to pay attention to how we practice entomophagy, both as consumers and entrepreneurs who aren't directly involved in raising insects themselves (Nonaka, 2005). Take food safety sometimes, people gladly spend more for edible insects if they know they have been prepared, stored, and sold in clean, safe condition (Akinbode *et al.*, 2011). Back in 2010, for example the Southern Institute for Appropriate Technology put together a big international forum called "The Potential of Edible Insects" in Linville, Alabama. A couple of years earlier in 2008 a factory in Chiang Mai, Thailand joined forces with the FAO to organize an event focused on edible insects. Both gatherings went well.

Large scale efforts like these can really help push entomophagy forward, especially in places where people don't have enough to eat. We need to see more collaboration between developed and developing countries forward. Doing through research into different insect species, how we gather them and their nutrition and taking a hard look at the economic benefits and whether people actually want to eat them opens up new opportunities for solving food security issues. That's why we need to focused global strategy something that brings everyone together for a focused global strategy. Entomophagy isn't just about food either it ties into fields like forestry, traditional medicines, livestock farming and animal husbandry.

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