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Consumer Attitude toward Edible Insects in South-West Nigeria

MASTER'S THESIS

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Declaration

I hereby declare that I have done this thesis entitled “Consumer Attitude towards Edible Insects in South-West Nigeria” independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague date

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Abstract

Insects as food and feed emerge as an especially relevant issue in the 21st century due to the rise in the cost of animal protein, food and feed insecurity, environmental pressures, and population growth. This study focused on identification the most consumed insect species, analysing consumers' familiarity of insects, and examining factors influencing consumers' attitudes towards edible insects in South-Western Nigeria.

In total, 200 respondents from the rural and urban areas through purposive selection were interviewed with the use of questionnaire survey. Pearson Chi-square test was used to analyse the relationship between the factors that influence consumers' purchase decision of edible insects and the living environment of the respondents, particularly comparison between rural and urban area. Probit model was further used to determine the factors influencing attitudes towards edible insects' consumption. The results of the study showed that the most consumed insects' species were termite and palm weevil. The most significant factors that influence the purchase decision of the consumers in both rural and urban areas were taste and degree of processing of insects. The results further showed that age, educational level, living environment, nutritional value, and previous experience have a significant relationship with the consumers' attitude towards the consumption of edible insects.

This study concludes that there is a prevalent consumption of edible insects in both rural and urban areas and the respondents are willing to keep consuming edible insects if they are accessible to them. Consumption of edible insects could play a significant role in food security in Nigeria and government and stakeholders in the food industry can promote entomophagy through marketing, provision of tasty products at affordable price and nutritional value awareness.

Key words: Entomophagy, Consumer preferences, Edible insect species, Probit regression model

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1. Introduction

A recent report released by the Food and Agriculture Organization (FAO) estimated that globally, the number of people experiencing severe food insecurity is about 750 million. If moderate food insecurity is considered, this number rises to about two billion. These issues remain particularly prevalent in low-income countries, where staple foods (having low nutritional value) are relied upon because nutritious and balanced diets are widely unaffordable (FAO 2020). Edible insects consumption has the potential to combat these nutritional challenges and is already widely practiced in many parts of the world, especially among traditional communities (Dickie F et al. 2019).

Insects as food and feed emerge as an especially relevant issue in the 21st century due to the rise in cost of animal protein, food and feed insecurity, environmental pressures, population growth and increasing demand for animal protein among the middle classes (Van Huis 2013). Orkusz et al. (2020) suggests edible insects as an alternative animal protein to overcome the pressures on the demand of animal protein such as meat.

It is believed that entomophagy is heavily dependent on culture and most people view it with disgust and associate consumption of insects with primitive behaviour which has led to neglect of insects in agricultural research (FAO 2013). For cultural reasons, majority of people in the western country reject the idea of eating insects (DeFoliart GR 1999). According to Meyer-Rochow (2009) the main drivers of consumers' rejection are the presence of food taboos in terms of sociocultural and psychological barriers. Neophobia which is defined as a reluctance to eat unknown foods is seen as the most relevant factor that determines consumers unwillingness to accept insects as food (Hartmann et al. 2015).

Concerning novel foods such as insects, acceptance or rejection does not primarily depend on product-related attributes (price, taste, etc.) and rational factors but on emotional and cultural belief (Hartmann & Siegrist 2016). According to FAO (2013), about two billion people in more than 100 countries regularly consume insects with high rates in Africa, Asia and Latin America. To achieve consumers' acceptance remains the biggest challenge for the insect industry (FAO 2013; Verbeke 2015). Nevertheless, researchers have perceived a change in consumer preferences and social attitudes toward entomophagy

(the practice of eating insects) in Western societies, as people have begun to focus on healthier, natural, and more environmentally friendly diets and have sought new, more sustainable protein sources (Galati et al. 2019). Study done by (Alemu & Olsen 2018) reported that chances for insects to become a successful and viable food alternative is emerging.

In recent years, the production and consumption of insects as an substitute source of nutrition, especially protein, has been revealed since the publication 'Edible Insects: future prospects' for food and feed security' by the Food and Agriculture Organization (FAO) (FAO 2013). It highlighted the potential edible insects had in feeding a growing population and since then, entomophagy has attracted an increased interest in the media, academics and the food industry (FAO 2013; United Nations 2018).

TAO & LI (2018) postulated that rearing insects for human consumption would be key for food security as it had the potential to supply high-quality animal protein and other valuable nutrients such as fatty acids and minerals (FAO, 2013). Kelemu et al. (2015) reviewed several insect sustainability-related claims such as environmental, health and social benefit. In addition to these, insects reproduce quickly, have a fast growth rate, and are efficient in converting feed into food. More so, insect production techniques require less water; are much less dependent on land and could utilize waste organic material (Lucchese-Cheung, T. Aguiar et al. 2020).

Consumption of edible insects have played an important role as part of human nutrition in many parts of the world among which large part of it is Africa (Kelemu et al. 2015). It is interesting to know that, though there is a heavy consumption of insects in this region, there is little, or no research done about the attitude of the consumers towards edible insects.

This study brings insight and understanding of previous research done about the consumption of edible insects.

2. Literature Review

2.1 Global Consumption of Edible Insects

About 1,900 species of insects are eaten worldwide especially in low-income countries. Among main reasons for high insects consumption are quality feed, high conversion ratio and emits low levels of greenhouse gases (FAO 2013).

Insects are major part of the traditional diets of millions of people and in cases where staple foods are scarce during the rainy season edible insects serves as a major actor towards food security (Raheem et al. 2019). According to Banjo et al. (2006) the consumption of edible insects should be encouraged, insects are traditional food in most cultures and play an important role in human nutrition. Hundreds of insect species have been consumed some of the important groups include grasshopper, caterpillars, bee, wasp, cicadas as well as the winged ant and a variety of the aquatic insects (Banjo et al. 2006).

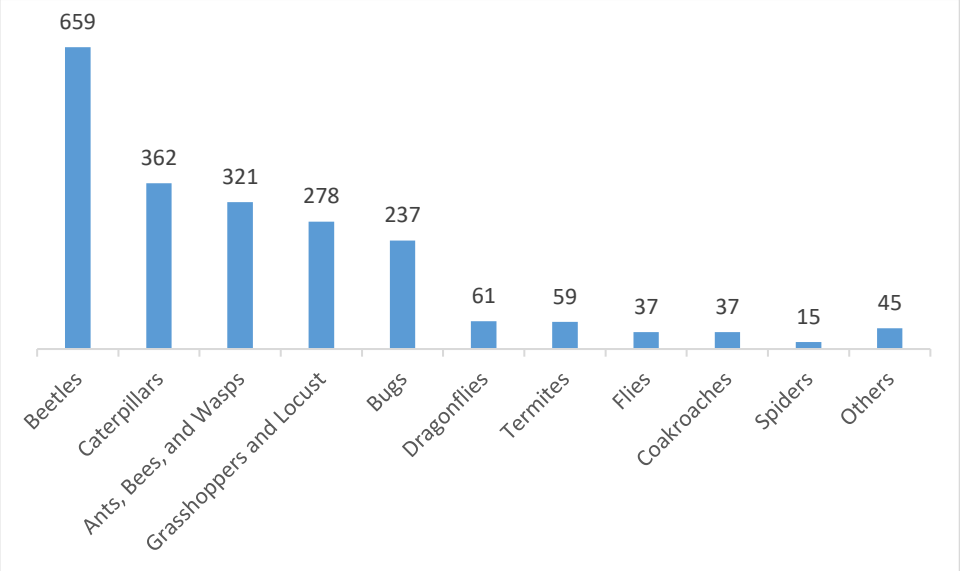

Figure 1. Number of Recorded Edible Species Per Group in the World

Source: Jongema 2017

Van Huis (2013) estimated that about two billion people worldwide consider consuming insects as food. However, in Europe and other Western countries, this practice has never been widespread and remains rare. Although the (FAO 2013) has identified several social, environmental, and nutritional benefits associated with insect consumption, Western society generally considers these insects as an emergent food source, and associates eating insects with low prestige and poverty (Sogari 2015).

According to Chen et al. (2009), there are over 20 species of insects found and consumed as food by the Chinese. The Chinese consume insects because of their palatable taste and because the supply of insects is natural. The ancient Chinese used insects for different purposes especially medicinal and this is dated back to over 2000 years which proves that consumption of insects is not a new concept (Feng et al. 2018). However, in many societies failure to accept consumption of insects is still the greatest hurdle to successful introduction of edible insects (Orsi et al. 2019), which is mainly hindered by culturally induced aversions (Hartmann & Siegrist 2017).

It is estimated that 178 insect species from 96 genera, 53 families and 11 orders are commonly consumed in China in the present day (Dobermann et al. 2017). Eggs and adults are mostly processed and prepared for snacks, while larvae and pupae are mostly consumed as a main course in restaurants (Chen et al. 2009). Preparation of edible insects includes deep frying, braising, stewing, stewing after frying, boiling, and roasting. There are 20 to 30 popular species used in restaurants year-round, including grasshoppers, silkworm pupae, wasps, bamboo insects and stink bugs (Chen et al. 2009). Most of Chinese consumers are familiar with edible insects, and so their acceptance of insects as food is generally high (Hartmann et al. 2015; Feng et al. 2018).

Human insect consumption is also popular in other Asian countries including Thailand, Japan, Laos, and Borneo. In Thailand, about 150 mostly wild-caught insect species are consumed, and they constitute a critical part of Thai people’s diets (Yhoung–Aree et al. 2010). In particular, this country has one of the most advanced cricket farming systems in the world with a total number of farms around 20,000 and an averaged production of 7,500 tons per year (Hanboonsong et al. 2013).

In Japan, insect food consumption has generally declined in most places. People who live in mountainous areas are the primary consumers of insects in Japan, and they eat species such as the long-horned beetle caterpillar and wasps (Nonaka 2010). Eating wild-caught insects is very common among the Laotian people and the percentage of the Laotian population that consumes insects on a regular basis is the highest in the world (Hanboonsong & Durst 2014). In Borneo, a country with 80 commonly consumed insect species, the local population collects insects at various life stages, including eggs, larvae or nymphs, and pupae or adults (Chung 2010).

Several studies conducted in European countries (e.g. Belgium, Italy, and the Netherlands) have reported that consumers feel fear and disgust about edible insects, but are also curious to try these novel products (Sogari et al. 2017).

Surprisingly, consumption of edible insects is decreasing in Eastern countries where insects have long been a part of the traditional diet, and this decrease has been even more marked in urban areas. This is primarily due to globalization, which has made available new food varieties and improvements in food technology and has allowed Western culture's contributions to gastronomy to diffuse worldwide (Yen 2010; Hartmann et al. 2015).

2.2Edible Insects Species

There are about 2,000 species of edible insects consumed by humans globally (Jongema 2017), however the total number of edible species suitable for human consumption is still unknown (Yen 2015). Ramos-Elorduy et al. (2011) identified 524 species of edible insects in Africa, 549 in Mexico, 349 in Asia, 679 in America, 152 in Australia and 41 in Europe, 170 edible insect species were identified in China.

The most consumed insects are beetles (Coleoptera, 31 %), caterpillars (Lepidoptera, 18 %) and bees, wasps and ants (Hymenoptera, 14 %) grasshoppers, locusts and crickets (Orthoptera, 13 %), cicadas, leafhoppers, planthoppers, scale insects and true bugs (Hemiptera, 10 %), termites (Isoptera, 3 %), dragonflies (Odonata, 3 %), flies (Diptera, 2 %) and other orders 5 % (FAO 2013).

The popular edible beetle in the tropical regions is the palm weevil, *Rhynchophorus* and varieties of the specie is seen in South Asia, South America and Africa, for instance, *Rhynchophorus phoenics* is found in equatorial and tropical Africa, *Rhynchophorus ferrugineus* is found in Indonesia, Japan, Malaysia, Papua New Guinea, Thailand and the Philippines, with *Rhynchophorus palmarum* found in tropical Americas (Raheem et al. 2019).

Table 1. List of the most common species in the world

Common Name	Scientific Name	Order	Consumption Stage	Regions
Bamboo Caterpillar	*Omphisa fuscidentalis*	Lepidoptera	Larvae and Adult	Asia
Beetle/Palm Weevil	*Rynchophorus phoenicis*	Coleoptera	Larvae	Tropical and equatorial Africa
Beetle/Palm Weevil	*Rynchophorus ferrugineus*	Coleoptera	Larvae	Asia
Black weaver Ant	*Polymachis dives*	Hymenoptera	Larvae and Pupae	Subtropical southeast China
Bogong Moth	*Agrotis infusa*	Lepidoptera	Larvae and Adult	Indigenous Australians
Cicada Species	*Ioba*, *Platypleura*, and *Pycna*	Hemiptera (sub-order: Homoptera)	Adults	Malawi
Crickets	*Gryllus bimaculatus, Teleogryllus occipitalis, and T. mitratus*	Orthoptera	Adults	Asia, Africa
Grasshopper	*Zonocerous variegatus*	Orthoptera	Adults	Africa, Latin America
Hawkmoths	*Daphnis spp. and Theretra spp.*	Lepidoptera	Larvae and Adult	Lao People's Democratic Republic
House Cricket	*Acheta domesticus*	Orthoptera	Adults	Thailand
Leafcutter Ant Species	*Atta mexicana* and *A. cephalotus*	Hymenoptera	Larvae	Mexico
Lesser Mealworm	*Alphitobius diaperinus*	Coleoptera	Larvae	Netherlands
Locust/Migratory Locust	*Migratis migratus*	Orthoptera	Adults	Africa, Kuwait
Mopane Caterpillar	*Imbrasia belina*	Lepidoptera	Larvae and Adult	Angola, Botswana, Mozambique, Namibia
Pentatomid	*Agonoscelis versicolor*	Hemiptera (sub-order: Heteroptera)	Adults	Sub-Saharan Africa and Mexico
Psyllid	*Arytaina mopane*	Hemiptera (sub-order: Homoptera)	Adults	South Africa and Australia
Short-tail Cricket	*Brachytrupes portentosus*	Orthoptera	Adults	Thailand
South American Palm Weevil	*Rynchophorus palmarum*	Coleoptera	Larvae	Tropical Americas
Superworm	*Zophobas morio*	Coleoptera	Larvae	Netherlands
Termites	*Macrotermes spp. and Syntermes spp.*	Isoptera	Adults	Africa and Amazon
Weaver Ant	*Oecophylla spp.*	Hymenoptera	Larvae and Pupae	Asia, Thailand
Yellow jacket Wasps	*Vespula and Dolichovespula spp.*	Hymenoptera	Larvae	Japan
Yellow Mealworm	*Tenebrio molitor*	Coleoptera	Larvae	Netherlands

Source: Temitope et al. 2014

2.3 Benefits of Insects Consumption

Insects present a food source rich in amino acids, mono- and polyunsaturated fatty acids, and several important micronutrients (Rumpold & Schlüter 2013). Edible insects are rich in essential nutrients, but their nutritional value varies greatly and this depends on the species, life stage (higher protein content of adults compared to stages of development between successive larval linings), habitat, and the diet of insects (Belluco et al. 2013). Due to the high nutritional value of insects, in countries where malnutrition is diffuse, insects may represent a potential solution to deficiencies in minerals such as zinc and iron (Christensen et al. 2006).

Generally, insects are rich in fat, particularly caterpillars, palm weevil larvae and termites and high amounts of Calcium and Phosphorus 61.28mg/100g and 136.4mg/100g were found in *Analeptes trifasciata*, Iron, Phosphorus and Vitamin A were 27-29mg/100g, 136mg/100g and 2.56-2.89μg/100g respectively for *Macrotermes spp* and 85mg/100g Iron for *O.monoceros* (Banjo et al. 2006). Study by Banjo et al. (2006) concludes that insects provides high quality of protein and supplement, species with high nutritional content should be cultivated to increase its consumption and availability.

Depending on the species of the insect, the protein content in various edible insects ranges from 13%–81% (FAO 2013) and this usually exceeds that of beef and poultry as well as fish and seafood, which ranges from 19–26% and 13–28% of protein respectively (Kinyuru et al. 2015). Insects are a suitable alternative food source, which can aid in the management of nutrient deficiency and overall food security if used on a wide scale (Kinyuru et al. 2015). According to Rumpold & Schlüter (2013) insects are very high in energy and protein.

Insects are reported to require significant less land and water than cattle rearing and they emit fewer greenhouse gases and less ammonia than cattle or pigs (FAO 2013). The clearing of land for agricultural purpose has a role in devastating biodiversity and insects rearing requires small space which helps the efficiency of land utilization and environmental conservation (Jansson, 2019).

In addition, rearing of insects on organic side-streams (human and animal waste) can help reduce environmental contamination (FAO 2013). Insects have high feed conversion ratio which makes rearing of insects beneficial to the environment, for example, crickets requires just 2 kilogram of feed for every 1 kilogram of weight gain (FAO 2013).

Insect farming can translate to employment opportunities and increase in cash income to farmers, households and industries at large (FAO 2013). In developing countries such as South Africa, Central Africa and South-east Asia where demand for edible insects exists and bringing insects to the market is quite easy (FAO 2013), it shows clearly the economic benefits of edible insects (Dobermann et al. 2017). Insect farming can provide stable income for farmers given that the market value of insects often exceed that of other protein sources, for instance, Thailand insect market produce about 500-700kilogram of crickets around four-five times in a year and that yields a net income of $4270-9970 (Dobermann et al. 2017).

In South-Korea, market value of insects is approximately $145 million in 2019 and expected to increase to $420 million in 2020 which shows that increase in acceptance of consumption of edible insects plays a vital role in future increase of market value of insects (Han et al. 2017). The market value of insects in some other countries like Belgium, UK, USA, France, China is placed at $25.1 million in 2015 and predicted growth of about $398 million by 2023 (Dobermann et al. 2017).

2.3.1 Consumption of Edible Insects in Africa

Insect consumption is in abundance in countries such as Africa, Asia and Latin America. (DeFoliart 1989) reported that scores of specie of edible insects are prominent items of commerce in town and village market of Africa, tropical and semi-tropical regions of the World. In Africa, insects are an important source of staple foods especially when hunting of game or fish become problematic during the rainy seasons (FAO 2013).

The African diet contains a variety of wild foods which edible insects is one, there are over 1,500 identified species of edible insects across Africa as the price and demand of other animal sources of protein is increasing across the world and edible insects has emerged to meet the need of animal protein for all humans now and in the nearest future

(Raheem et al. 2019). The demand for consumption of edible insects in Africa is fast growing since animal protein source of food such as meat, fish is becoming scarce and expensive (Raheem et al. 2019).

Highest edible insects species in Africa is found in the orders of Lepidoptera, Orthoptera, Coleoptera with Central Africa having about 526 species, Southern-Africa having 164 species, Eastern Africa having 100 species, Western Africa having 91 species and Northern Africa having 8 species (Kelemu et al. 2015). In Central Africa, several caterpillar species, *Imbrasia oyemensis* are eaten and in Southern Africa the mopane caterpillar (*Imbrasia belina*) is a common seasonal food item (van Huis 2020). *Acanthacus ruficorus* and *Ruspolia differens* are common grasshoppers species mostly consumed in Uganda, some parts of West Kenya and Tanzania (Kinyuru et al. 2015). In Nigeria, edible moths, *Anaphe veneta* butler are widely consumed (Ashiru 1989; Agbidye et al. 2009a), *Zonocerus variegatus* is widely consumed in West Africa especially in Nigeria, Liberia and Ghana (Banjo et al. 2006). However, every country has its own peculiar culture and ethnic differences in consumption of edible insects, for instance, the people of Mofu-Gudur in Cameron consume a number of grasshoppers species such as *Aceoypha picta*, *Acorypha glaucopsis* which are not consumed by the Hausa people in Niger (Raheem et al. 2019) and likewise in Nigeria it was reported that blacksmiths in Ire clan do not eat crickets because of religious reasons (Fasoranti & Ajiboye 1993).

2.3.2 Consumption of Edible Insects in South-West Nigeria

Nigeria is a country rich in forest edible insects because of its ecological and climatic diversity (Raheem et al. 2019). Commonly consumed insects in Nigeria can be found in the following order, Isoptera (termites), Lepidoptera (moths), Orthoptera (grasshoppers and crickets), Coleoptera (beetles) and Hymenoptera (bees) (Temitope et al. 2014).

In Nigeria, insect eaters are found in most region of the country, especially in several parts of South-western Nigeria (Banjo et al. 2006). Fasoranti & Ajiboye (1993) reported some kinds of Nigeria edible insects are available most period of the year and can be collected in forested area and in the wild. Though a number of species are available all year round, some can easily be obtained for a short season depending on the weather and other natural circumstances (Ashiru 1989). DeFoliart (1989) also reported that edible

insects are usually included as part of the diet during season or all through the year if available.

Most edible insects in Nigeria rely on forest for survival and every region has its own consumption habits (Raheem et al. 2019). Seven edible insects species were reported to consumed by people in Kwara State (Fasoranti & Ajiboye 1993) and in Benue State, termites *Macrotemes natalensis* is found to be prevalently consumed by the people followed by the large African Cricket *Brachytrupes membranacens* and palid emperor moth *Crinia forda* (Agbidye et al. 2009a). The variegated grasshopper, which has a large dry season population in Southwestern Nigeria is reported eaten in the Akoko area of Ondo State (Fasoranti & Ajiboye 1993) and the African Silkworm *Anaphe venata* was reported as well (Ashiru 1989). The winged termites are locally known and consumed in various parts of Nigeria by different names such as 'aku' in Ibo, 'chinge' in Hausa and 'Esusu' in Yoruba and are regarded as traditional delicacies (Fasoranti & Ajiboye 1993). *Macrotermes spp (Macrotermes nigeriensis* and *Macrotermes bellico-sus)* are enjoyed in all parts of Nigeria, due to its presence at the beginning of the rainy season when live-stock production is low, new crops are not yet harvested, and store produced from previous growing season is running low (Banjo et al. 2006). Table 2 shows the list of some edible insects in Nigeria.

Table 2. Commonly consumed edible insects in South-West province, Nigeria

Common Name	Scientific Name	Local Name	Consumption Stage
Caterpillar	*Anaphe venata*	Yoruba: Ekuku	Larvae
Cricket	*Brachytrupes membranaceus* Drury	Yoruba: Ire	Adults
Emperor moth	*Bunaea alcinoe* Cram	-	Larvae
Grasshopper	*Zonocerous variegatus*	Yoruba; Tata, Igbo: Abuzu, Ukpana	Adults
Grasshopper	*Cytacantharis naeruginosus unicolor*	Yoruba; Tata, Igbo: Abuzu, Ukpana	Adults
Honeybee	*Apis mellifera*	Yoruba: Oyin	All stages
Mole cricket	*Gryllotalpa Africana*	Yoruba: Ire	Adults
Pallid Emperor moth	*Cirina forda* Westwood	Yoruba: Kani munimuni	Larvae
Palm weevil	*Rhynchophorus Phoenics*	Yoruba: Ipe, Itun	Larvae
Rhinoceros beetle	*Analeptes trifasciata*	Igbo: Ebe	Larvae
Snout beetle	*Oryctes boas* *Oryctes monocerus* Oliver	Yoruba: Ogongo	Larvae
Termites	*Macrotermes belliscosus* *Macrotermes notalensis* Haviland	Yoruba: Esunsun Igbo: Aku	Winged-adult, Queen
Yam beetle	*Heteroligus meles Billberger*	Yoruba: Kokoro inu isu	Adults

Source: Temitope et al. 2014

2.3.3 Harvesting and Processing of Edible Insects in Nigeria

Majority of edible insects are harvested in the wild (Van Huis 2013) and women are seen to mostly do the harvesting (Raheem et al. 2019). Traditionally method of harvesting of edible insects from the wild mostly depends on the behaviour of the insect, for instance, the Palm beetle grubs are harvested from a palm stem (Raheem et al. 2019). In the South-eastern part of Nigeria, Ebenebe et al. (2017) reported that the caterpillar a particular specie of the moth is harvested by standing at the base of the host tree called the 'ngwu tree' by singing a song 'wee wee' and as you sing the insects fall from the tree top and are captured. Another collection method reported Ebenebe et al. (2017) is the use of sound to detect the presence of the African palm weevil *Rhynchophorus phoenics* whereby harvesters will place their ears close to the trunk of the tree which is sequential

to the report that in Cameroon harvesters used sound to harvest the *Rhynchoporus* larva from the palm tree (Van Huis 2003).

The study on Eco-diversity of edible insects in Nigeria by Temitope et al. (2014) reported that *Macrotermes spp* also known as winged termites are attracted to electric and harvesters trap them in a receptable and place water near or under the source of light, the *Oryctes boas* and *Rhynchophorus phoenics* are harvested by hand-picking from their host plants, the *Zonocerous variegatus* are harvested with the use of sweep net. Harvesting is done in the urban areas such as Lagos by the palm wine tappers who then sell directly at road side markets or re-sell to insect marketers (Temitope et al. 2014).

Edible insects are sometimes seasonally available and due to this they are often processed and dried for later consumption, though some are not cooked or processed but consumed raw (Van Huis 2003). Nigerians in the rural areas have cooked edible insects species in their local ways for a very long time either by deep frying, roasting or cooked with spices and they are eaten as side dishes or served with staple food (Temitope et al. 2014). Also cooked edible insects are commercially sold on roadside food shops and several markets in different cities in Nigeria (Agbidye et al. 2009b).

Edible insects in Nigeria do not only serve as a source of food but they reflect rich cultural conditions and can serve as a good means of generating income and there is likely to be an increase in edible insects harvesting (Temitope et al. 2014).

2.4 Factors Influencing Consumers Attitudes Towards Edible Insects

a. Gender

The role of gender in consumption and purchase power is a very important one which brings about adoption of different marketing strategies adopted by companies when its target is based on gender (Perju-Mitran & Budacia 2015). The style of communication differs in this gender, women tend to tune more to messages that gives them assurance that is relevant to their interest and ask more questions for further information while men prefer a more direct approach, they accept the information and show strong intention to be loyal customers (Perju-Mitran & Budacia 2015).

The study by Hartmann et al. (2015) showed the influence of demographic factors such as sex on consumer attitudes towards edible insects, the male consumers were more likely to try eating insects than the female which supports previous study done by (Verbeke 2015) that women have higher aversion towards edible insects while men see edible insects less disgusting.

b. Age

Tri- city study in Poland showed that respondents below 20 years demonstrated a negative attitude towards consumption of insects, not even availability and low price of insects make them consume insects, age group 21-40 indicated highest motivating factors to insect consumption than the older generation, (Bartkowicz 2017) which is in contrast with study by Wilkinson et al. (2018) which shows that the younger and older generation have the same level of positive attitudes towards consumption of edible insects.

Study according to Lensvelt & Steenbekkers (2014) found a certain openness of young consumers to including insects in their diet, which supports the assumption from previous research that younger people have more positive attitudes toward entomophagy (Schösler et al. 2012). This is actually in contrast to a study carried out by Sethi (2018) on Chinese consumers which showed that older generation have a higher potential to consume edible insects compared to the younger generation.

c. Price

Price is one of the elements that attracts the purchase of food products. For example, functional food and dietary supplements among Czech consumers and conventional food in the Western World (Chaloupkova et al. 2020). If we focused more on educible insects, there are many studies underlying the effect of price.

The study done by House (2016) showed that insect-based products are higher in price than meat products which affected the purchase behaviour of consumers, which supports the report by Pambo et al. (2016) that price is one of the important factors that influence making food choice. This is also in firm agreement with a study carried out by Zhang (2018) that found out that price exerts a major influence on Swedish laypeople's decision to consume edible insects.

d. Taste

The study on Australian consumers acceptance of insects as food by Wilkinson et al. (2018) shows that taste is a major factor influencing the consumption of insects. Consumers were willing to consume flavoured insects because of the taste and did not mind the appearance, which is in contrast with the study in Germany that showed that people will not consume unprocessed insects because of its appearance (Hartmann et al. 2015). The study by House (2016) in Netherlands showed that consumers have a positive perception towards taste of edible insects as the participants were willing to consume edible insects because of its palatable taste.

e. Nutritional Value

A study on Indigenous Knowledge about Consumption of Edible Insects in South Africa found that nutritional value is one of the main reason why edible insects is consumed (Hlongwane et al. 2020)**.** Manditsera, F.A. et al. (2018) in his study of consumption patterns of edible insects in rural and urban areas of Zimbabwe found out that (74.4%) of respondents in urban areas see nutritional value as an important motivation for consuming edible insects whereas (51.0%) of respondents in rural areas also consumed edible insects because of its nutritional value.

However, Obopile & Seeletso (2013) in their study in Botswana showed that nutritional value was not one of the major reasons why edible insects is consumed. The results from the study showed that only 5% of respondents consumed edible insects because of nutritional value. It is good to note that although respondents consume insects for its nutritional value, they only do so because of the perception that insects contain high nutritional value. Many are ignorant of the exact nutritional values that insects contain.

f. Level of Education

Study by Orsi et al. (2019) the level of education had no significant effect on consumers acceptance towards edible insects which is contrary to study by (Fischer & Steenbekkers 2018) that observed 45% of students of Wageningen university in Dutch had already eaten insects before and are willing to eat insects again.

g. Degree of processing/appearance

In a study carried out by Hartmann et al. (2015) in Germany, it was found that people will not consume edible insects because of its appearance. This actually not in tandem with the study carried out by Wilkinson et al. (2018) where it was observed that Australians do not mind the appearance of edible and that its appearance has no influence on its consumption.

h. Social perception (because others consume)

The adoption of Western values in many countries that are traditionally known to consume insects is known to have led to a decrease in the consumption of edible insects (BJ 1997; DeFoliart GR 1999; Yen 2010). As a resultant effect, Western cultures took advantage of cultural differences and this led to what is now seen as disgust for insect consumption among traditional peoples (Looy H, Dunkel FV 2014).

i. Previous experience

Van Thielen et al. (2019) in his study of consumer acceptance of edible insects in Belgium found out that 11.2% had already eaten foods with processed insects; 31.8% had no experience but were willing to try, and 57% had no experience or interest in tasting such products. Some studies have also shown that people who have previous experience of eating insects are more likely to accept eating insects again particularly those who have lower neophobia (Hartmann & Siegrist 2016; Laureati, M., Proserpio C. 2016; Megido. et al. 2016).

j. Availability of Purchase

Manditsera, F.A. et al. (2018) in his study of consumption patterns of edible insects in rural and urban areas of Zimbabwe found out that availability of edible insects has an influence on its consumption in both urban (64.0%) and rural (83.0%) respondents. This is agreement with (House 2016) showed in a study done in Netherlands on factors influencing consumer attitudes towards edible insects found that availability is one of the factors that influences the consumption of edible insects. Zhang (2018) found out in his

study of the consumption of edible insects by Swedish laypeople that if edible insects is not readily available, they will be less likely to purchase it.

2.5 Theory of Consumer Behavior

This study postulate that consumers rank preferences over all goods, make consumption choices based on these rankings use them in such a way that utility is maximized. The problem of consumption both as an individual process significant for daily living, and as a collective process significant for its economic results, is fundamentally a problem of choice of selection between values. The theory plays two roles in welfare economics. Firstly, it is a positive theory of how individuals respond to changes in economic environment. Secondly, the normative theory of household is based on the maximization of utility. It is measured by per capita income, per capita expenditure, and utility (these are usually used as measure of economic development) (Kant A. 1996). The household utility is maximized as a measure of welfare through different sources of income.

Budget constraint gives a straight line on the indifference map that shows all the possible distributions between goods; the point of maximum utility is then the point at which an indifference curve is tangent to the budget line. The budget line defines the consumption or income opportunity available to the household. The slope of the indifference curve (marginal rate of substitution) indicates the rate at which consumers are willing to give up one good in exchange for more of the other good. Increase in income through more sources shifts the indifference curve to the right, consumer operate at higher level of utility when income increases, every additional income is addition to household resources.

Consumers are likely to go for the option of edible insects if they have a budget constraint and if they have a larger household size to feed. The choice of edible insect can be due to the low cost, and the nutritional value they derive from the consumption of edible insects. The choice of edible insects is a better alternative especially for rural dwellers because of the availability of edible insects since they can easily be harvested from the wild (Meyer-Rochow, & Chakravorty 2013). Manditsera et al. (2018) in their study found that taste and nutritional value remains the main reasons for the consumption of edible insects.

3 Aims of the Thesis

Previous studies show that insect consumption is high in Africa, Latin America, and in Asian countries. However, civilization has continued to threaten the consumption of insects. Furthermore, civilization has also forced some young people who previously ate insects while growing up because their family members ate them to stop eating insects.

The United Nations Sustainable Development Goals (SDGs) 1 and 2 is focused on no poverty and zero hunger. Unfortunately, in Nigeria, poverty and hunger is rife. Moreover, the rising cost of food prices in Nigeria is likely to force people especially those in the rural areas to seek alternative means of food, with edible insects being a good substitute.

Therefore, the main aim of this study is to assess consumers' attitudes towards edible insect consumption in the South-Western Nigeria. The specific objectives include the following:

1. To describe the reasons for consuming edible insects among rural and urban consumers,
2. To analyse the factors consumers consider before they make purchase decision on consumed insect species,
3. To compare the the level of familiarty of consumed insect species among rural and urban consumers,
4. To examine factors influencing consumers attitudes towards edible insects.

Table 3. Overview of factors that influence consumption of insects

Factors	Findings	Country	Author(s)
Gender	Men are likely to eat insects more than women	Poland	(Bartkowicz 2017)
Age	Young and older generation have the same positive attitudes towards insect consumption	Australia	(Wilkinson et al. 2018)
	Younger people have positive attitudes towards insect consumption than the older people	Poland	(Bartkowicz 2017)
Price	Price exerts a major influence on lay people's decision to consume edible insect	Sweden	(Zhang 2018)
Taste	Consumers were willing to consume insects because of the taste and did not mind the appearance	Australia	(Wilkinson et al. 2018)
	Consumers have a positive perception towards the taste of edible insects	Netherlands	(House 2016)
Nutritional Value	Nutrients in edible insects is one the main reason for consumption	South Africa	(Hlongwane et al. 2021)
Degree of Processing	People will not consume unprocessed insects because of its appearance	Germany	(Hartmann et al. 2015)
	Appearance of edible insect had no effect on consumption of edible insects	Australia	(Wilkinson et al. 2018)
Previous Experience	People who have consumed insect before are likely to consume again than those who had never consumed insects before	Germany	(Hartmann & Siegrist 2016)
Availability of Purchase	If edible insects are not readily available for purchase, people will less likely purchase	Sweden	(Zhang 2018)

From the above literature reviews, this study has the following hypothesis.

- $H_{1:}$ Those with previous experience on edible insects are more likely to have a favorable attitude towards edible insects than those without previous experience (Hartmann & Siegrist 2016).
- H_2: Younger consumers have more positive attitude towards edible insects than older consumers (Bartkowicz 2017).

4 Methods

4.1 Conceptual Framework

Consumer attitudes and behaviour towards consumption of edible insects is influenced directly and indirectly by three major factors, firstly factor related to cultural beliefs and attitude which includes previous experience and social perception. The cultural beliefs and attitude influence the two other factors which are the socio-economic characteristics of consumers and factors related to the characteristics of the product. The socio-economic characteristics variables include age, gender, household size, level of education, while product related variables include price, availability of purchase, and degree of processing of edible insects (Kelemu et al. 2015).

According to Siegrist (2008) tangible and intangible benefits such as living environment (location) among others should be look into to increase the level of acceptance of consumption towards edible insects.

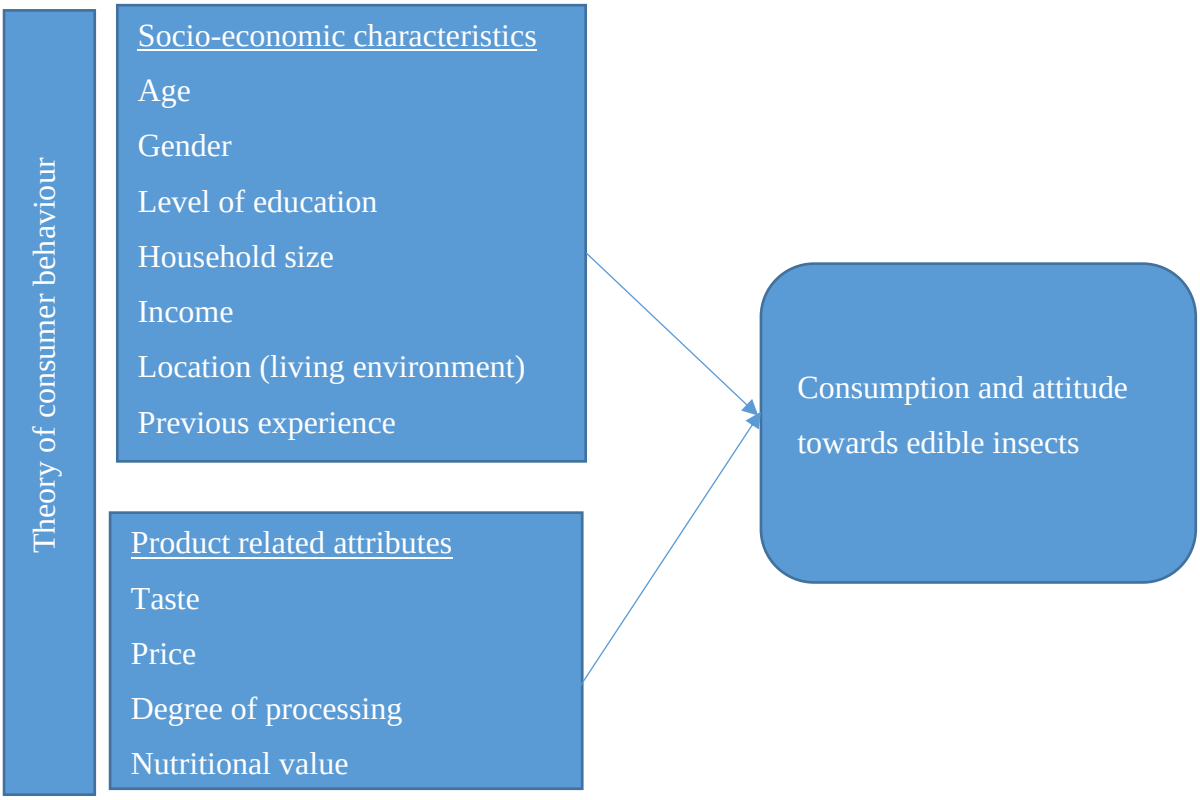

Figure 2. Conceptual model of consumer acceptance of edible insects.
Source: Adopted and modified from (Siegrist 2008; Kelemu et al. 2015).

4.2 Study Area

The study was carried out in two states in South-western Nigeria: particularly in Akoko North-East Ondo state and Epe, Lagos state. Akoko North-East is a local government area in Ondo State, Nigeria. Its headquarters is in the town of Ikare. The city has an area of 372 km² and a population of 175,409 according to Federal Republic of Nigeria (2009). Akoko NorthEast local government area is one of the eighteen serving local government councils of the state, domiciled in the town of Ikare, comprising the towns of Ikado, Okela, Okorun, Eshe, Odo, Ilepa, Okoja, Iku, Odeyare, Odoruwa, Okeruwa and others.

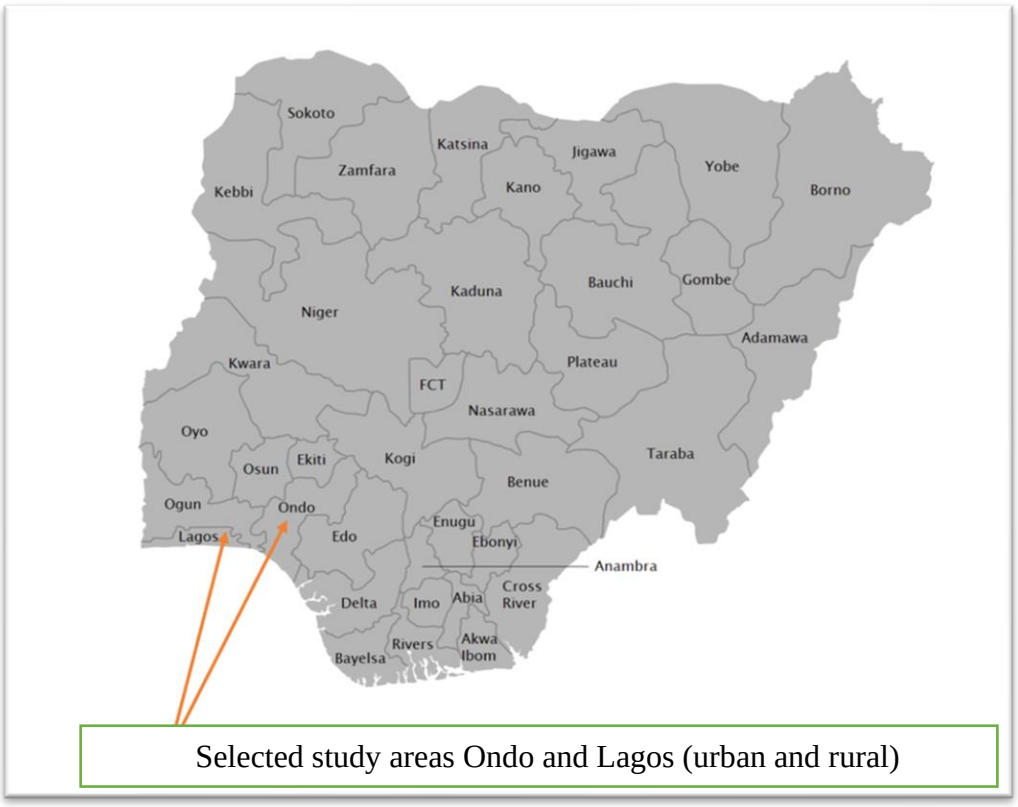

Figure 3. Map of study areas

Epe is a town and local government area in Lagos state, Nigeria. It is located on the north side of the Lekki lagoon. The 2006 Census (Federal Republic of Nigeria 2009) estimated the population of Epe to be approximately 181,409**.** The notable festivals mostly celebrated in Epe land include Kayo-kayo Festival, Ebi day, Ojude-Oba, and Epe day.

As a result of its proximity to the lagoon, many dwellers earn their livelihood through fishing. Thus, Epe is well-known for its fish market. Epe also serve as a collecting point for the export of fish, cassava, firewood, and many other goods to Lagos.

4.3Sampling Strategy

This study was carried out through self-administration of questionnaire to the respondents. Multi-stage sampling was used. It was broken down to two stages; the first stage involved the use of purposive sampling i.e purposive selection of Akoko North-East local government in Ondo State, Nigeria because of the prevalent consumption of edible insects by the rural dwellers and good concentration of variegated grasshopper (*Cytacantharis naeruginosus unicolor, Zonocerus variegatus*) and purposive selection of an insect road-side market in Epe local government in Lagos State due to the consumption of insects by the Urban dwellers.

The second stage involved the use of snow-ball sampling which is a chain-referral sampling that relies on a reference sample. This study got responses from 200 respondents from the rural and urban dwellers (100 responses from each) and with snow-ball sampling, referral was gotten from the first respondent to the 199th respondent.

This sampling strategy was adopted for effective comparison of consumption of edible insects in both rural and urban households in South-Western Nigeria.

4.4 Questionnaire structure

The sample size for this study was 200 respondents among rural and urban dwellers that consume edible insects in Akoko North-East local government of Ondo State and Epe local government of Lagos State. This study used primary data only whereby questions was administered through oral face-to-face interview with the respondents.

Data was collected on the socio-demographic characteristics of the consumers such as age, gender, occupation, marital status, level of education among others to describe consumers' attitudes towards consumption of edible insects. Secondly, data was collected

on the consumed insect species in both regions to identify and compare the most preferred and most consumed insects among the rural and urban dwellers. Data was also collected on psychological factors, knowledge, and taste.

4.5Data Analysis

The study employed several analytical tools and models based on the objective of the study. The tools used include descriptive statistics, Pearson Chi Square test, and Probit regression model. Descriptive statistics such as percentages, measures of central tendencies, measures of dispersions, etc. were employed to summarize the data.

The objective 1 which highlights the reasons for the consumption of consumed insects was analysed by adopting descriptive statistics such as percentages and mean.

The second and third objectives of this study were analysed using Pearson Chi Square test. The Pearson Chi Square was used to analyse the association between the various factors affecting consumers' purchase decision of insects and living environment (rural and urban). Also, we adopted the Pearson Chi Square to analyse the association between consumers' familiarity of consumed insect species and living environment (rural and urban).

The last objective was to examine factors influencing the consumers' attitude towards the consumption of edible insects. The Probit regression model was used to analyse these factors. The Probit regression model was specified as follows:

$$Y = \begin{matrix} 1 \\ 0 \end{matrix} \left\{ \begin{matrix} Y^* > 0 \\ otherwise \end{matrix} \right\} = \begin{matrix} 1 \\ 0 \end{matrix} \left\{ \begin{matrix} X^T \beta + \varepsilon > 0 \\ otherwise \end{matrix} \right\}$$

Where Y*= the latent dependent variable i.e consumer attitude (1 for positive or more embracing attitude, 0 otherwise)

X_1= Gender (Male=0, Female=1)

X_2= Ordered Age (<18 years =1, 18-30=2, 31-40=3, 41-50=4, >50=5)

X_3= Educational Level (Non-formal education=0, High School=1, Bachelor's degree=2, Postgraduate=3)

X_4= Living Environment (Rural=0, Urban=1)

X_5= Taste (Pleasant/Palatable=1, Otherwise=0)

X_6= Price (High=1, Otherwise=0)

X_7= Nutritional Value (Nutritious=1, Otherwise=0)

X_8= Degree of Processing (Less Processed/Whole=0, Highly Processed 1)

X_9= Ease of Purchase/Availability (Available=1, Otherwise=0)

X_{10}= Previous Experience (Positive/Encouraging/Good Experience=1, Otherwise=0)

β= Coefficient of Independent Variable

ϵ = The Random Error Term

Table 4. Variables used in the model

Variable	**Description**	**Measurement Type**	**A Priori Expectation +/-**
Gender	Sex of respondents (Male=1, Female=2)	Dummy	+/-
Age	Age of respondents in years (18-30=1, 31-40=2, 41-50=3, 51-60=4, >60=5)	Continuous	+/-
Price	Perception of edible insect's price (Expensive=1, cheap=2)	Dummy	+
Taste	Attitude to insect consumption (tasty=1, unpleasant=2)	Dummy	+/-
Nutritional value	Reasons of insects' consumption by nutrients (yes=1, no=2)	Dummy	+/-
Educational Level	Number of formal education years (No formal education=0, High School=1, Bachelor's Degree=2, Postgraduate=3)	Continuous	-
Degree of Processing	Form of insect consumption (Whole=1, highly processed=2)	Dummy	+/-
Previous Experience	Experience respondent have had eating edible insects (Previous experience=1, no previous experience=2)	Dummy	+
Availability of Purchase	Access to edible insects (Easily available=1, not easily available=2)	Dummy	+
Living Environment	Location of respondent (Rural=1, Urban=2)	Dummy	-

5. Results

5.1 Characteristics of the respondents

For Ondo state (rural) most of the respondents were female while Lagos state (urban), most of the consumers were male. Table 5 shows that greater percentage of the respondents age ranges between 18 to 50 years. In terms of educational level, Ondo state had majority of the consumers belonging to the non-formal education category and majority of the Lagos state had at least university education. In the rural area (Ondo state), most of the consumers had more than 5 family members and in the urban area (Lagos), most of the consumers had between 3 to 5 household members.

Table 5. Socio-demographic characteristics of the respondents

	Ondo %	Lagos %
Gender (Male)	46	52
Age		
18-30 years	11	32
31-40 years	30	24
41-50 years	13	19
51-60 years	17	10
Above 60 years	29	15
Educational level		
No formal education	46	16
High School	30	30
Bachelor's Degree	21	39
Postgraduate	3	15
Household size		
1-2 members	4	13
3-5 members	36	46
More than 5 members	60	41

It is evident that most of the respondents obtained the consumed insects from the wild (Figure 4). 97% of the rural consumers from Ondo and 89% of the urban consumers from Lagos get access to the insects from the wild. The next channel which the consumers get access to the insects is the market (19% from Ondo and 19% from Lagos).

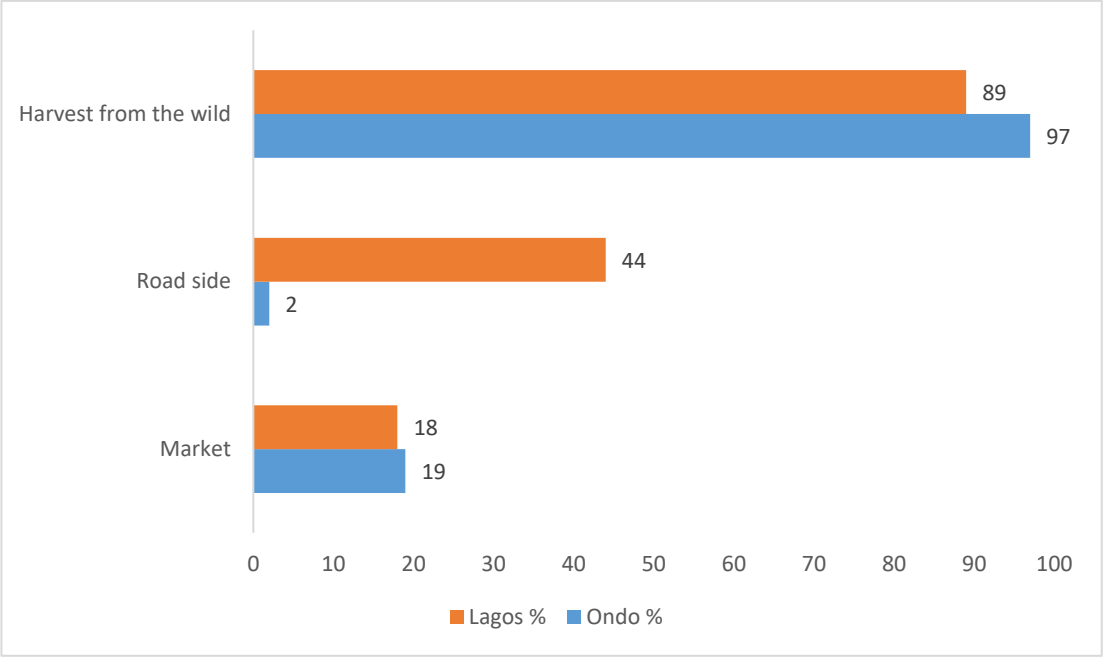

Figure 4. Source of edible insects in rural and urban environment

In terms of the consumption how the consumers prefer to consume the insects (figure 5), majority of the consumers from both the rural and urban areas indicated that they prefer to eat the insects as either fried (98% from Ondo and 97% from Lagos) or cooked (80% from Ondo and 78% from Lagos).

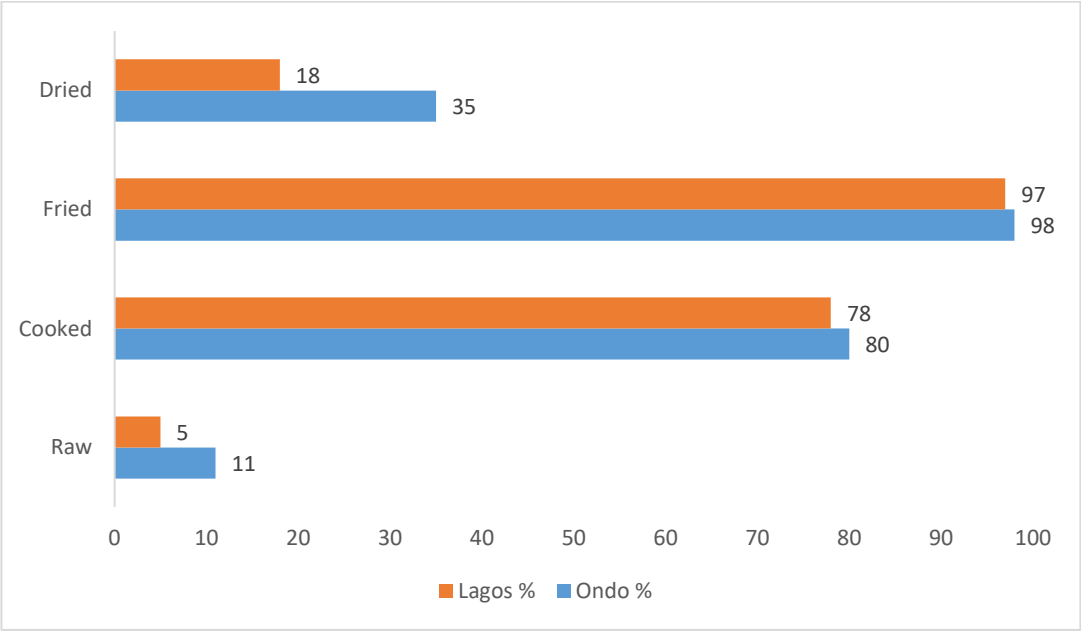

Figure 5. Comparison of degree of processing preferences by the respondents from rural and urban areas

5.2 Reasons for Consuming Insects among Rural and Urban Consumers

Table 6 shows the reasons for consuming insects among both rural (Ondo) and urban (Lagos) consumers. Among the reasons, the greater percentage of the consumers highlighted that they consume insects because their family members eat them. Another important reason for the consumption is because their friends consume the insects which influence their decision to consume insects.

Table 6. Reasons for consuming insects by the respondents from rural and urban areas

	State	
Reasons	Ondo %	Lagos %
I ate them out of curiosity	3	9
I do not remember why	3	4
I eat them because my family members eat them	90	74
I eat them because my friends eat them	3	13
I was not aware they were insects	1	0

5.3 Factors that Affect the Decision to Purchase Insects Among Rural and Urban Consumers

The Pearson Chi-square analysis showed (figure 6) that there is significant association between taste and the degree of processing of insects and the living environment (rural-Ondo and urban Lagos). Consumers who live in Lagos considers the degree of processing as key factor they will consider before they purchase insects than those in the rural area (Ondo state). On the contrary, the consumers in the Ondo state place emphasis on the taste of insects as the major factor they will consider when purchasing insects as compared to the urban consumers (Lagos). Both consumers in the rural and urban areas believe that nutritional status and social perception about the consumption of insects are key factors that will influence their decision to purchase insects. As a results of that there is no statistical effect between the association between living environment of the consumer, nutritional status, and social perception about the consumption of insects. Both consumers in the rural and urban areas do not consider previous experience and price as key factors when deciding to purchase insects and Pearson Chi-square for the two associations were not statistically significant.

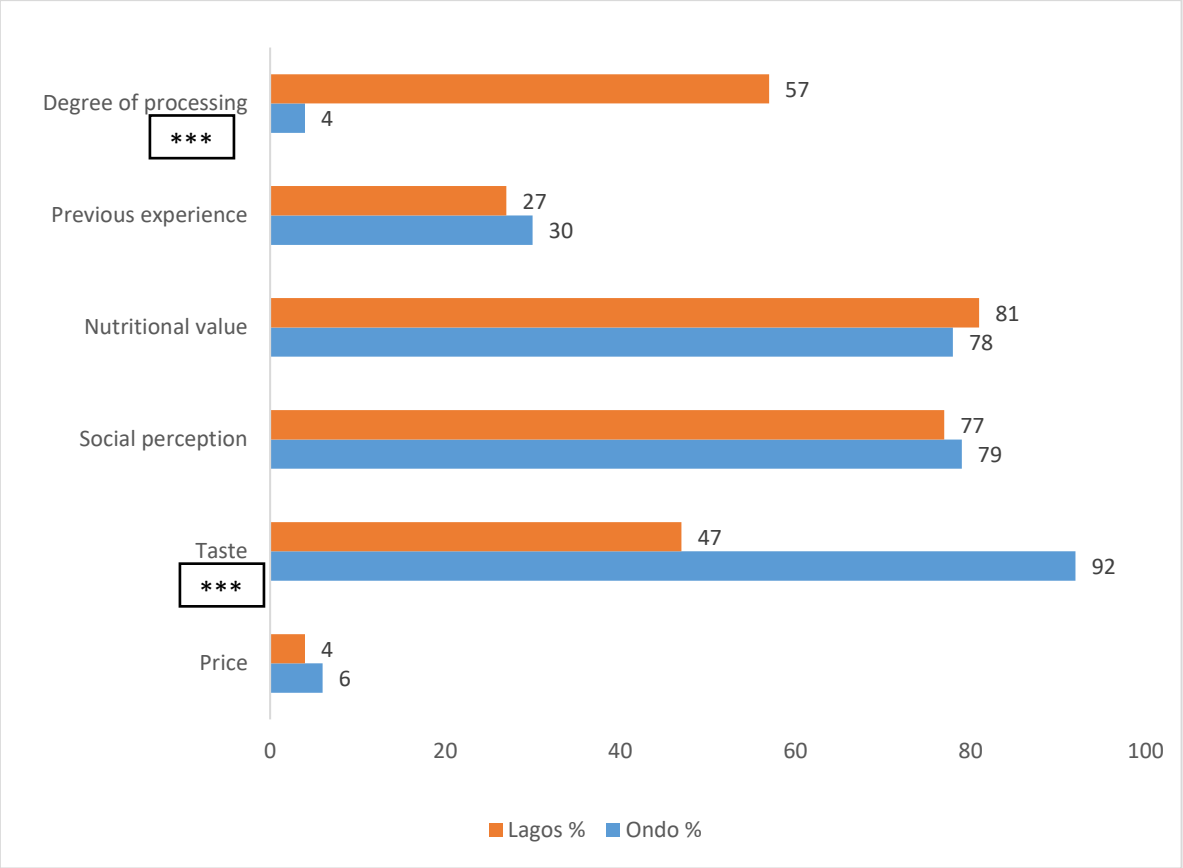

Figure 6. Determinants of insects purchasing decision by the respondents from urban and rural environment

Note: *** represents 1% level of probability and the level of probability was estimated with Pearson Chi-square.

5.4Familiarity of Consumed Insect Species among Rural and Urban Consumers

The chart below (figure 7) shows the different types of insects and the percentage of familiarity in both rural and urban environments. From the analysis of the study, different kinds of insect showed different levels of either familiarity or consumption or both at different living environment that is, urban and rural environments.

In the urban case, Snout beetle has the highest percentage (23%) of "do not know them" among others. Grasshopper in its own case is known but not eaten among the insects with 92%. However, in the urban region, Mole cricket is consumed occasionally (36%) while

Termite is consumed regularly (71%) among others. Whereas, observing the rural area, people are familiar with as well as consume the insects. The highest percentage for “do not know them” was just four (4%) recorded by Mole cricket among the insects. For “know them but do not eat them”, Honeybee surpassed the others having the highest value of 100%. Both Palm weevil and Rhinoceros beetle have the largest percentage (70%) of occasional consumption while Termite still show the highest percentage (88%) of being consumed regularly among the edible insects. The main reasons of termites’ consumption can be linked to the nutritional value flavour and aroma, food habit and curiosity.

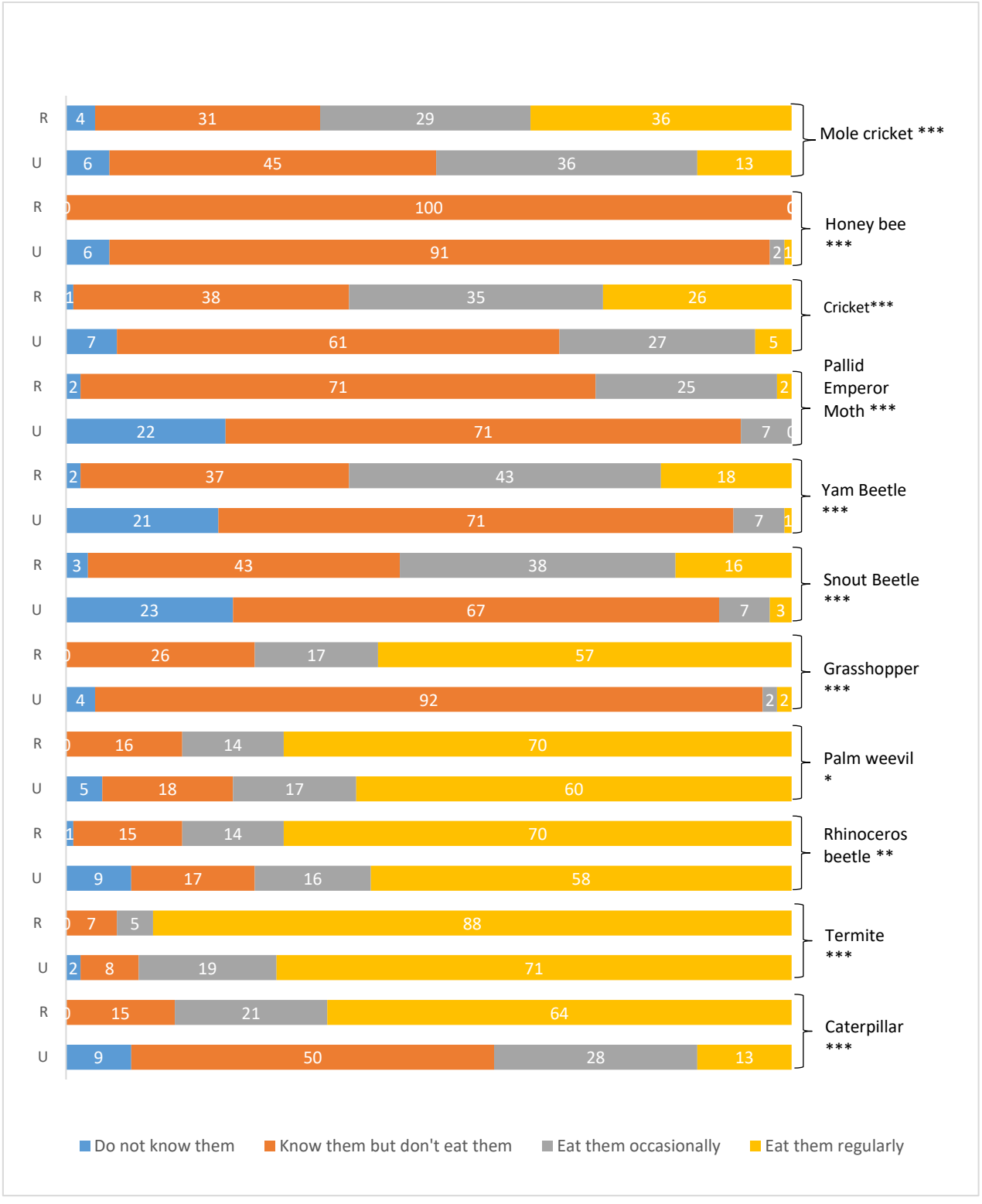

Figure 7. Edible insect familiarity and consumption by the respondents from urban and rural environment

Note: U= urban, R=rural. ***, ** and * represents 1%, 5% and 10% levels of probability and the levels of probability was estimated with Pearson Chi-square.

5.5 Factors influencing Consumers Attitude towards Edible Insects' Consumption

The Table 7 below shows the Probit regression results of the factors influencing consumers' attitude towards edible insects' consumption. The model was statistically significant at 1% (Prob > chi^2 = 0.000), have a log likelihood of -67.744 and chi-square log ratio of 141.75. The model also has an acceptable moderate fit with Pseudo R^2 of 0.511 (51.1%) which means that the level which the independent variable can explain the dependent variable is 51.13%. Out of the ten variables used, five were statistically significant at 1% ($p < 0.05$).

Age of the consumers is statistically significant and is positively related with the consumers' attitude towards edible insects' consumption. This shows that as people get older, they develop more embracing attitude towards inclusion of edible insects in their diets or consumption habits with the marginal effect of 0.092.

The educational level also is statistically significant but has a negative relationship with the consumer' attitude towards the consumption of edible insects. This denotes that as the educational level tends backward towards non-formal education, attitude towards more consumption of edible insects will increase with the marginal effect of 0.064. This is so because as educational level of people increases, they appear to be more civilized and go for the so called modern or luxury items thereby having a sense of disgust or an unpleasant view of insect consumption.

Living environment is statistically significant and shows a negative relationship with consumers' attitude towards the consumption of edible insects. The negative effect means that urban consumers are less likely to have positive attitude towards the consumption of insects whereas rural farmers are more likely to have a positive attitude towards the consumption of insects. A consumer who is from the urban area (Lagos) is 0.280 less likely to have a positive attitude towards the consumption of insects.

The nutritional value is statistically significant and is positively related to consumers' attitude towards edible insects' consumption. Nutritional value or content in a food/diet plays a very significant role in embracing, purchase decision as well as the consumption

of a particular consumer goods as it is a major factor in consumer satisfaction. This denotes that as the nutritional value of edible insects increases and is being considered, a more embracing and positive attitude would be generated in the attitude of the consumers with a marginal effect of 0.245.

The previous experience of consumers is statistically significant and has a positive significant relationship with the consumers' attitude towards edible insects' consumption. This shows that a positive previous experience by the consumer will induce more embracing or positive attitude towards edible insects' consumption. A consumer with a satisfying experience in time past would responsively develop an embracing attitude towards the consumption of edible insects. Therefore, from the exhibition of a positive previous experience, the probability that the consumers would have a more embracing attitude towards edible insects' consumption would increase by 0.239.

Table 7. Factors influencing consumers' attitudes towards edible insects' consumption

Variables	Coefficients	Standard Error	z-value	p > |z|	Marginal Effect
Gender	-0.039	0.250	-0.160	0.874	-0.007
Age	**0.493**	**0.102**	**4.820**	**0.000**	**0.092**
Educational level	**-0.345**	**0.145**	**-2.380**	**0.017**	**-0.064**
Living environment	**-1.495**	**0.340**	**-4.390**	**0.000**	**-0.280**
Availability of purchase	0. 421	0.509	0.830	0.409	0.079
Taste	0.064	0.315	0.200	0.838	0.012
Nutritional value	**1.307**	**0.409**	**3.190**	**0.001**	**0.245**
Price	-0.065	0.696	-0.09	0.925	-0.012
Previous experience	**1.276**	**0.309**	**4.130**	**0.000**	**0.239**
Degree of processing	-0.022	0.328	-0.070	0.945	-0.004
_constants	-0.221	0.765	-0.290	0.772	
Number of obs.	200	Prob >chi^2	0.000		
LR chi^2	141.75	Pseudo R^2	0.511	Log likelihood	-67.744

Note: bold means statistically significant factors

Based on the results provided in the Table 7, the following hypothesis can be analysed:

H_1: Those with previous experience on edible insects are more likely to have a favorable attitude towards edible insects than those without previous experience (Hartmann & Siegrist 2016). For H_1 we accept the hypothesis, as the study also concludes that respondents with previous experience with consumption of edible insects had more embracing attitude towards consumption of edible insects.

H_2: Younger consumers have more positive attitude towards edible insects than older consumers (Bartkowicz 2017). For H_2 we reject the hypothesis, from the study it shows that the older respondents get, the more embracing attitude they have towards consumption of edible insects.

6 Discussion

6.1 Reasons for Consumptions and Purchase Decision of Edible Insects

The results show that family and friends consumptions of edible insects are the main reasons why the people consume insects. The influence of family on consumption of a product is significant because of how the family help their members to develop religious beliefs, consumer preferences, and lifestyle choices. A family creates first perceptions about brands and consumer habit (Kotler & Armstrong 2010; Khan 2006). From the results of this study, both the rural and urban consumers indicated that they consume edible insects mainly because of their family (90% in rural area Ondo and 74% in urban area of Lagos).

In terms of the factors that influence the purchase decision of edible insects by the consumers, the consumers in the rural areas place more emphasis on taste whereas the consumers in the urban areas pay more attention to the degree of processing. The significant relationship between taste as product attribute and purchase decision of insects can be linked to the fact that the consumers in the rural areas are more familiar with edible insects so they can differentiate between the taste of the insects as compared to the urban consumers. The relationship between taste and purchase decision was analysed by Andrianto (2019) and found a significant positive relationship between taste and purchase decision. On the other hand, the consumers in the urban areas focus on degree of processing and can be linked to the quality of the product which is a key determinant of modern consumers. This shows that consumers have the stability to buy edible insects because they believe that processed edible insects has good quality and benefits. This result means that the higher the quality of the product (edible insects) that is given the higher the level of consumer confidence in buying edible insects (Hartmann et al. 2015)

6.2 Familiarity of Edible Insect Species Among Rural and Urban Consumers

Termites has the highest percentage of consumption among respondents in both rural and urban areas and this can be confirmed from the study by Banjo et al. (2006) that the winged termite is enjoyed in various parts of the country. The variegated grasshopper, which has a large dry season population in Southwestern Nigeria is reported eaten in the

Akoko area of Ondo State by (Fasoranti & Ajiboye 1993) but the results of the study states otherwise as just 57% of the respondents in Ondo State consume this insect.

6.3 Determinants of Consumers Attitude towards Edible Insects

Age of the consumers is statistically significant which shows that as people get older, they develop more embracing attitude towards inclusion of edible insects in their diets Liu A.J. (2019) results showed that age has a significant positive effect on edible insect purchase and older people are more likely to eat insects than younger people. Though studies by Schösler et al. (2012); Bartkowicz (2017) concluded that younger people have more positive attitudes towards edible insects' consumption.

The educational level also is statistically significant but has a negative relationship with the consumer' attitude towards the consumption of edible insects. This is so because as educational level of people increases, they appear to be more civilized and go for the so called modern or luxury items thereby having a sense of disgust or an unpleasant view of insect consumption. This is however, contrary to the study by Orsi et al. (2019) that showed educational level had no significant effect with the acceptance and consumption of edible insects.

Living environment is statistically significant and shows a negative relationship with consumers' attitude towards the consumption of edible insects which means that respondents from the rural areas are likely to consume insects more than the urban respondents. This is confirmed by (Meyer-Rochow, V. B.& Chakravorty 2013) that rural dwellers have the choice of consumption of edible insects more than urban dwellers because of availability of edible insects.

The nutritional value is statistically significant and is positively related to consumers' attitude towards edible insects' consumption. This denotes that as the nutritional value of edible insects increases and is being considered, consumers will have a more embracing and positive attitude. This agrees with the findings of Belluco et al. (2013) that concluded that edible insects are rich in essential nutrients. Study by Banjo et al. (2006), also concludes that insects provide high quality of protein and supplements and its consumption could be increased by cultivating insect species with high nutritional contents.

Our result showed that the previous experience of consumers is statistically significant and has a positive significant relationship with the consumers' attitude towards edible insects' consumption. This shows that a consumer with a satisfying experience in time past would responsively develop an embracing attitude towards the consumption of edible insects. This result is in agreement with the study by Hartmann & Siegrist (2016) that people who have consumed insect before are likely to consume again than those that had never consumed insects before.

Our results showed that factor gender is not statistically significant, but it shows a negative relationship with consumers' attitude towards the consumption of edible insects denoting a tendency towards the male gender. The findings of Verbeke (2015); Bartkowicz (2017); Joanna B. (2017) agrees that men are more likely to consume insects than women. The study of Gere et al. (2017) is also in alignment and agrees that men are likely to consume insects that women. In his study, Olarewaju T.O et al. (2020) agrees with this that gender has no significant relationship with edible insects consumption. Meludu and Onoja (2018) who researched on a similar study found the gender to be positive and significant.

According to our results, taste also is not statistically significant but has a positive relationship with consumers' attitude towards edible insects' consumption. This is in accordance with the finding of House (2016) done in Netherland that consumers have a positive perception or attitude towards taste of edible insects as the participants were willing to embrace edible insects' consumption because of its pleasant taste. Availability of purchase is not statistically significant, but it is positively related to the consumers' attitude towards edible insects' consumption

The findings showed that price also is not statistically significant, and it is negatively related to consumers' attitude towards the consumption of edible insects' consumption. The study done by House (2016) revealed that insect-based products (for those purchasing) have high prices which affected purchase behaviour of consumer. In essence, if the price is low and/or harvesting it freely from the bush, consumers would likely want to embrace edible insects' consumption more. The degree of processing is not statistically

significant, and it has negative relationship with consumers' attitude towards edible insects' consumption.

6.4 Limitation of the Study

Some difficulties were encountered in reaching respondents who consumed edible insects especially in the urban areas because of the busy activities of respondents in urban areas. Data collected from most of the respondents were based on memory recall because most of them do not keep adequate records of the food they consume. Some of the respondents were unwilling to give information based on previous encounters with government officials who had interviewed them, and nothing had been done about their situation.

7. Conclusions

This study reported the consumer attitudes towards edible insect consumption and their preferences among various edible insects. Specifically, the study aimed at describing the reasons for consuming edible insects among rural and urban consumers, factors affecting consumers purchasing decision of edible insects, compare the familiarity of the respondents in rural and urban areas towards edible insects and estimate the determinants of consumers' attitude towards edible insects. The result revealed a high familiarity among the respondents in the study areas. Termites, grasshopper, and palm weevil were highlighted to be the most familiar with among the insect species in both the rural and urban areas while termites, palm weevil and rhinoceros beetle were seen to be the most consumed insect species by the respondents.

The results further showed that the age of consumers, education, living environment (rural area Ondo and urban area Lagos), consumers consideration of nutritional status and previous edible insect consumption experience have a statistically positive effect on the attitude towards the consumption of insects. On the other hand, educational level of consumers and living environment has a statistically significant negative effect on the consumers attitude towards the consumption of edible insects.

Consequently, government and stakeholders in the food industry can take advantage of this research to advocate insect-product diversifications and availability for ease of acquisition. Doing so will encourage and promote entomophagy through marketing, provision of tasty products at affordable price and nutritional value awareness.

Although the research identified specific areas consumers' patterns among others and provided insights into the consumers' attitudes, many aspects of consumer attitudes and preferences related to edible insects' consumption and insect-based foods remain unknown. Therefore, further research should extend the scope of this research to cover a more diverse consumer sample, inspect larger study area and further investigate the influence of culture and beliefs differences on consumption and consumers' purchase behaviour in accepting this cost-friendly protein source.

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Appendix

QUESTIONNAIRE

Consumer Attitude towards Edible Insects in Nigeria

I am a student at the Czech University of Life Sciences pursuing a master's degree in International Development and Agricultural Economics. My name is Elegbede Deborah Oluwakemi. The purpose of this survey is to assess Nigerians consumers' attitudes towards Edible Insect consumption in Nigeria. This research would enable me to complete my studies as it is a requirement for the study programme. Your contribution is voluntary and the information you give will be treated confidentially. Your lack of participation or participation itself will not have any adverse consequences on you. The questionnaire will take approximately 15 minutes to complete.

Part 1: Edible insect consumption

1. How familiar you are with these edible insects?

	I know them but I don't eat them	I eat them regularly	I eat them occasionally	I do not know them
Mole Cricket				
Cricket				
Yam beetle				
Snout beetle				
Grasshopper				
Palm weevil				
Rhinoceros beetle				
Termites				
Caterpillar				

2. What were the reasons for eating them?
   a. I was forced to eat.
   b. I ate them out of curiosity.
   c. I do not remember why
   d. I eat them because my family members eat them.
   e. I eat them because my friends eat them.
   f. I was not aware they were insects.
   g. Other.

3. In what form do you eat the insects?

   a. Raw
   b. Cooked
   c. Fried
   d. Dried

4. Which degree of processing do you prefer the most?

a. Whole form

b. Mixed/cut

c. Processed products

5. Where do you get your insects?

a. Buy them in the market

b. Buy them from the roadside sellers

c. Harvest them from the bush/wild

Part 2: Consumer attitude towards edible insects

5. What factors do you consider when making purchase decisions about edible insects?

a. Price

b. Taste

c. Availability of purchase

d. Social Perception (because others consume)

e. Nutritional value

f. Previous Experience

g. Degree of processing

6. How do you view edible insect consumption?

a. Disgusting (negative)
b. Not disgusting (positive)

Part 3: Background Information

7. What is your gender?

a. Female
b. Male

8. What is your age?

a. 18-30 years
b. 31-40 years
c. 41-50 years
d. 51-60 years
e. Above 60 years

9. What state do you live in?

a. Lagos
b. Ondo

10. What is your level of education?

a. No formal education
b. High School
c. Bachelor's Degree
d. Postgraduate

11. What is your household size?

a. 1-2 members
b. 3-5 members
c. 5+

12. What is your living environment?

a. Rural
b. Urban

13. What is your estimated average income per month?

a. Below 30,000 naira
b. 31,000 – 100,000 naira
c. 110,000 – 150,000 naira
d. Above 150,000 naira

Appendix 1: Questionnaire used in the study

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Yam beetle				
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Grasshopper				
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Rhinoceros beetle				
Termites				
Caterpillar				

2. What were the reasons for eating them?

h. I was forced to eat.
i. I ate them out of curiosity.
j. I do not remember why
k. I eat them because my family members eat them.
l. I eat them because my friends eat them.
m. I was not aware they were insects.
n. Other.

3. In what form do you eat the insects?

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f. 31,000 – 100,000 naira
g. 110,000 – 150,000 naira
h. Above 150,000 naira