Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics

Bachelor Thesis

Insect Consumption in Zambia

Edith Tembo

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

BACHELOR THESIS ASSIGNMENT

Edith Tembo

Economics and Management

Thesis title

Insect Consumption in Zambia

Objectives of thesis

The aim of the bachelor thesis is to determine and to evaluate consumption of insect and consumers behaviour in Zambia.
The aim will be fulfilled based on the partial aims. Then, several hypotheses will be defined and verified. Based on the results of empirical analysis the final conclusions will be introduced.

Methodology

The bachelor thesis will cover both, theoretical and empirical part. Theoretical part will contain theoretical background of the selected topic as well as the methodological framework. Scientific literature will be used to prepare the literature overview. Based on the empirical analysis the results will be presented and some recommendations will be suggested.

The aim of the thesis will be fulfilled based on own survey of cunsumers' behaviour and hypothesis testing.

The proposed extent of the thesis

40 – 50 pages

Keywords

Consumption, consumers behaviour, insect, Zambia, survey.

Recommended information sources

DE VAUS, D A. *Surveys in social research.* London: Routledge, 2014. ISBN 978-0-415-53018-7.

FRANK, R H. – BERNANKE, B. – ANTONOVICS, K L. – HEFFETZ, O. *Principles of microeconomics.* New York: McGraw-Hill Education, 2016. ISBN 978-1-259-25410-9.

HATCHER, L. *Advanced statistics in research : reading, understanding, and writing up data analysis results.* Saginaw, MI: ShadowFinch Media, LLC, 2013. ISBN 978-0-9858670-0-3.

MONTGOMERY, D C. – PECK, E A. – VINING, G G. *Introduction to linear regression analysis.* Hoboken, N.J.: John Wiley and Sons, 2012. ISBN 978-0-470-54281-1.

SCHIFFMAN, L G. – KANUK, L L. – WISENBLIT, J. *Consumer behavior.* Boston: Pearson Prentice Hall, 2010. ISBN 978-0-13-700670-0.

Expected date of thesis defence

2022/23 SS – FEM

The Bachelor Thesis Supervisor

Ing. Lenka Rumánková, Ph.D.

Supervising department

Department of Economics

Electronic approval: 15. 6. 2022

prof. Ing. Miroslav Svatoš, CSc.

Head of department

Electronic approval: 27. 10. 2022

doc. Ing. Tomáš Šubrt, Ph.D.

Dean

Prague on 08. 03. 2023

Declaration

I declare that I have worked on my bachelor thesis titled "Insect Consumption in Zambia" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on 08.03.2023 _____

Edith Tembo

Acknowledgement

I would like to thank my supervisor Ing. Lenka Rumánková, Ph.D. who made this work possible.

Insect Consumption in Zambia

Abstract

The global population is growing rapidly, and it is necessary to maintain agricultural production. The food system will be put under pressure as a result of this growth. Edible insects are rich in proteins and other nutrients and hence are presented as a prospective food and protein source. Over two billion people worldwide are estimated to consume insects. Globally, over 2100 insect species are currently consumed by humans as food. Consumer behaviour of edible insects have been the subject of numerous studies in the Western world. Despite Zambia's long history of eating insects, not much is known about the factors that influence consumer attitudes towards edible insects. A survey was conducted with 173 Zambian consumers to examine the factors influencing their consumption and the consumer behaviour of edible insects. The results show that the main motivations for insect consumption are taste and nutritional value. Availability and price are the major criteria used by respondents when purchasing edible insects. Additionally, the findings indicate that there is a significant relationship between insect consumption and age.

Keywords: Insects, consumption, food, edible, consumer behaviour, factors, consume, Zambia

Konzumace hmyzu v Zambii

Abstrakt

Světová populace velmi rychle roste a je nutné udržovat zemědělskou produkci. Potravinový systém bude čelit mnoha výzvám. Jedlý hmyz je dobrým zdrojem bílkovin a dalších živin, a proto je považován za budoucí zdroj potravy. Odhaduje se, že na světě konzumují hmyz přes dvě miliardy lidí. V současné době existuje více než 2100 druhů hmyzu, které lidé konzumují jako potravu. Existuje mnoho studií o spotřebitelském chování jedlého hmyzu v západním světě. Přestože má Zambie dlouhou historii konzumace hmyzu, není mnoho známo o faktorech, které ovlivňují chování spotřebitelů vůči jedlému hmyzu. Průzkum byl proveden se 173 zambijskými spotřebiteli s cílem prozkoumat faktory ovlivňující jejich spotřebu a spotřebitelské chování jedlého hmyzu. Výsledky ukazují, že hlavní motivací pro konzumaci hmyzu je chuť a nutriční hodnota. Hlavními kritérii, která respondenti při nákupu jedlého hmyzu používají, jsou dostupnost a cena. Kromě toho zjištění ukazují, že existuje významný vztah mezi spotřebou hmyzu a věkem.

Klíčová slova: Hmyz, spotřeba, potraviny, jedlý, spotřebitelské chování, faktory, spotřebovat, Zambie

Table of Contents

1. Introduction

As the global population increases, it is essential that agricultural production keeps up. In order to ensure that humanity has access to food of sufficient quality and quantity, agricultural emissions will rise by approximately 60% over the next 40 years. Numerous studies project rapid population growth within the next 30 years (Fróna et al., 2019). According to Serraj et al. (2019), the world population is expected to grow to more than 9 billion by 2050. The food system will be put under pressure as a result of this growth, which comes with rising prosperity, shifting dietary patterns in low and middle-income countries, and rising demand for a more wide-range, high-quality diet. This would require more resources to be produced. The meat industry worldwide may face challenges due to increased demand for meat and limited agricultural land (Van Huis, 2016).

Alternative protein sources, such as insects, are beneficial because conventional meat protein sources may not be able to meet the demands of a growing global population (Caparros Megido et al., 2014). In the year 2021, the global market value of edible insects was 3.2 million U.S. dollars and is expected to grow to about 17.6 billion U.S. dollars by 2032 (Shahbandeh, 2022). According to the Food and Agricultural Organization (FAO), edible insects have many benefits for the environment. For example, insect rearing releases significantly fewer greenhouse gases than majority of other animal protein sources. In addition, it requires considerably less water compared to livestock rearing (FAO, 2022).

This thesis adds to the existing body of literature in two different ways. Firstly, research on the consumption of edible insects has primarily focused on developed nations and this study brings something new in that it examines the factors that influence consumer behaviour in a developing country such as Zambia. Secondly, this study contributes to the existing body of knowledge by providing some recommendations for insect businesses and marketers that are keen on promoting insect consumption.

There are five parts in this thesis. The first part is the objectives and methodology which will address the aims of investigation and analysis and the research methods used. The second part is the literature review which will give a comprehensive overview of existing knowledge. The third part is the practical part which will be about presentation and analysis of the data. The fourth and fifth parts are the discussion and conclusion respectively.

2. Objectives and Methodology

2.1 Objectives

The main aim of this thesis is to examine insect consumption and the factors that influence consumer behaviour in Zambia. The partial aims are:

- To investigate whether a relationship exists between insect consumption and personal factors such as gender, age, occupation, educational level, and monthly income.
- To provide recommendations for insect businesses and marketers that seek to promote the consumption of edible insects.

2.2 Methodology

This section deals with four main parts. These are: questionnaire design, hypothesis testing (i.e., decision on the null hypothesis based on the p-value and general process of hypothesis testing), categorical data analysis, and contingency tables (i.e., analysis in a 2x2 contingency table along with suitable tests and analysis in a classical contingency table including appropriate tests).

2.2.1 Questionnaire design

The questionnaire was created using google forms and consisted of 11 questions. It was sent to respondents mainly via social media platforms and utilised the snowball sampling technique. A total of 173 people took part in the questionnaire survey. The first part of the questionnaire contains background information about the respondents i.e., gender, age, occupation, educational level, and monthly income. The second part consists of questions related to insect consumption.

2.2.2 Hypothesis testing

A hypothesis is a proposed logical statement derived from existing factual knowledge that can be tested for accuracy through research. Hypothesis testing is done to find out the accuracy of the proposed hypothesis. This involves using sample data to find out whether the assumptions for the sample data are true for the whole population.

During hypothesis testing, two opposite hypotheses are formulated. These are the null hypothesis which is denoted by H_0 and the alternative hypothesis which is denoted by H_1. The null hypothesis is an assumption that there is no relationship between the variables, in contrast to the alternative hypothesis, which asserts that there is a relationship between the variables. A decision must be made after the sample data have been gathered and the null and alternative hypotheses have been stated (Hlavsa, 2016).

Decision on the null hypothesis based on the p-value

When taking into consideration the test of the null hypothesis, there is a commonly used approach. **The probability value**, also known as the **p-value**, is the minimal level of significance whereupon the null hypothesis is rejected.

The p-value is compared to the significance level α (typically 0.05 or 5%).

The decision rule is as follows:

$p \geq \alpha \rightarrow$ do not reject null hypothesis

$p < \alpha \rightarrow$ reject null hypothesis (Corotto, 2020)

General process of hypothesis testing

1.) Set the null and alternative hypothesis
2.) Choose the level of significance α (alpha)
3.) Select the appropriate test
4.) Calculate the test statistic or test criterion
5.) Decision
6.) Interpret the result (Hlavsa, 2016)

Proposed Hypotheses

To find out the relationship between insect consumption and personal factors, the following hypotheses are proposed:

H_0: There is no significant relationship between gender and insect consumption.

H_0: There is no significant relationship between age and insect consumption.

H_0: There is no significant relationship between occupation and insect consumption.

H_0: There is no significant relationship between educational level and insect consumption.

H_0: There is no significant relationship between monthly income and insect consumption.

2.2.3 Categorical data analysis

Categorical variables are made up of four kinds of measurement scales. These are the nominal, ordinal, interval, and ratio scales. In a nominal scale, the variables are named and have no particular order e.g., female or male, yes or no. In the ordinal scale, the variables are named and come in a particular order e.g., educational degree which consists of elementary, high school, undergraduate, and graduate degree. However, the distance between the categories is not equal. In an interval scale, the variables are named, are in a particular order and the distance between the categories is equal e.g., temperature on a thermometer. The difference between 30 and 40 degrees Celsius is the same as the difference between 50 and 60 degrees Celsius. However, interval scales have no absolute zero. A temperature of 0 degrees Celsius does not necessarily mean that there is no temperature. In a ratio scale, the variables are named, come in a particular order, have equal distances between the variables and have absolute zero e.g., weight. The difference between 15 kg and 20 kg is equal to that between 45 kg and 50 kg. Ratio scales have absolute zero i.e., if the weight of an object is 0 kg, then that means there is no weight (Stevens, 2022; Hlavsa & Pacáková, 2020).

The requirement to analyse data produced in research studies in both the social and biomedical sciences sparked the development of categorical variable methods. In the social sciences, categorical scales are often used to gauge attitudes and beliefs whereas in the biomedical sciences, categorical scales are used to evaluate outcomes, including the effectiveness of a given medical procedure (Agresti, 2013).

2.2.4 Contingency tables

Contingency tables are matrix-style tables that show the observed counts of categorical variables. They are usually used to find out whether there is a relationship between categorical variables. Contingency table is used interchangeably with cross-tabulation (Fagerland et al., 2017). The categories that make up a categorical variable do not overlap, so categorical data are counts, that is, the frequencies with which each category of the variable appears. When all the variables involved in a particular problem are categorical, a contingency table is used to represent them (Kateri, 2014). There are two kinds of contingency tables:

- 2x2 contingency table (two rows and two columns)
- Classical contingency table (2x3, 3x2, 4x4, 3x5, etc)

Analysis in a 2x2 contingency table

Table 1 below shows a 2x2 contingency table of observed frequencies:

Table 1. 2x2 contingency table of observed frequencies

A \ B	B1	B2	Σ
A1	n_{11}	n_{12}	$n_{11} + n_{12}$
A2	n_{21}	n_{22}	$n_{21} + n_{22}$
Σ	$n_{11} + n_{21}$	$n_{12} + n_{22}$	**N**

Source: Fagerland et al., 2017 (created by author)

To analyse the relationship between two categorical variables, hypothesis tests are used e.g.,

H_0: There is no significant relationship between variables.

H_1: There is a significant relationship between variables.

The two types of tests that can be utilized are the Chi-Square test or the Fisher's factorial test. The following conditions must be met in order to use these tests:

1. If the sample size N > 40, then the Chi-Square test (χ^2) of independence is used.
2. If the sample size N < 20, then the Fisher's factorial test is used.
3. If 20 < N < 40, then the expected frequencies must be checked. If all the expected frequencies are greater than 5, then the Chi-Square test is used. If at least 1 expected frequency is less than 5, then the Fisher's factorial test is used.

Expected frequencies are artificial frequencies that are calculated for each cell in the contingency table and represents a situation where independency between variables is expected (Hlavsa, 2022; Nowacki, 2017). The calculations for expected frequencies are given below:

$$e_{ij} = \frac{(row\ total)(column\ total)}{grand\ total} \quad (1.1)$$

$$e_{11} = \frac{(n_{11} + n_{12})(n_{11} + n_{21})}{N} \quad (1.2)$$

$$e_{12} = \frac{(n_{11} + n_{12})(n_{12} + n_{22})}{N} \quad (1.3)$$

$$e_{21} = \frac{(n_{21} + n_{22})(n_{11} + n_{21})}{N} \quad (1.4)$$

$$e_{22} = \frac{(n_{21} + n_{22})(n_{12} + n_{22})}{N} \quad (1.5)$$

Table 2 below shows the contingency table of expected frequencies:

Table 2. Contingency table of expected frequencies

A \ B	B1	B2	Σ
A1	e_{11}	e_{12}	$e_{11} + e_{12}$
A2	e_{21}	e_{22}	$e_{21} + e_{22}$
Σ	$e_{11} + e_{21}$	$e_{12} + e_{22}$	**N**

Source: Fagerland et al., 2017 (created by author)

Chi-Square (χ^2) test statistic

The formula for the χ^2 test statistic is given by:

$$\chi^2 = \sum\sum \frac{(n_{ij} - e_{ij})^2}{e_{ij}} \qquad (1.6)$$

Where:

n_{ij} = matrix notation for observed frequencies

e_{ij} = matrix notation for expected frequencies

i = rows

j = columns (Hlavsa & Pacáková, 2020; Serra et al., 2019)

The Chi-Square alpha table value is denoted by $\chi^2 \alpha$ [(r - 1) (c - 1)] and for a 2x2 table, this is $\chi^2 \alpha$ (1). The Chi-Square test statistic χ^2 is then compared to the Chi-Square alpha table value $\chi^2 \alpha$ and a decision is made.

- If $\chi^2 > \chi^2 \alpha$, then null hypothesis is rejected and there is a significant relationship between the two variables.
- Alternatively, if p-value < α, then null hypothesis is rejected and there is a significant relationship between the two variables (Hlavsa, 2022; Bolboacă et al., 2011).

Fisher's factorial test

The following steps are taken when Fisher's factorial test is used:

1. Locate the cell which has the lowest value.

2. The value is then gradually reduced by 1 until final value is zero. All marginal frequencies are the same. The number of steps depends on how large the absolute frequency in the cell is.
3. The probability for all the tables is calculated using the formula shown below.

$$p_i = \frac{(n_{11}+n_{12})!(n_{21}+n_{22})!(n_{11}+n_{21})!(n_{12}+n_{22})!}{n!(n_{11})!(n_{12})!(n_{21})!(n_{22})!} \quad (1.7)$$

Since the p-value is directly calculated, a decision can be made.

If $\Sigma p_i > 0.05$, then null hypothesis is accepted, and this means there is no significant relationship between the variables (Nowacki, 2017; Hlavsa, 2022).

Analysis in a classical contingency table

Table 3 below shows the classical contingency table of observed frequencies:

Table 3. Classical contingency table of observed frequencies

A \ B	B1	B2	…	Bj	Total
A1	n_{11}	n_{12}	…	n_{1j}	$n_{1.}$
A2	n_{21}	n_{22}	…	n_{2j}	$n_{2.}$
…	…	…	…	…	…
Ai	n_{i1}	n_{i2}	…	n_{ij}	n_i
Total	$n_{.1}$	$n_{.2}$	…	$n_{.j}$	N

Source: Hlavsa, 2022 (created by author)

To analyse the relationship between categorical variables in a classical contingency table, hypothesis tests are used e.g.,

H_0: There is no significant relationship between variables.

H_1: There is a significant relationship between variables.

The type of test that can be utilized is the Chi-Square test. Note that: The Fisher's factorial test is not used for tables larger than 2x2. The following conditions must be met in order to use the Chi-Square test:

1. Expected frequencies < 5 can only be maximum 20%. If there will be more expected frequencies less than 5 that are more than 20%, then the conditions of a chi-Square test have not been met. If 20% or less of expected frequencies are less than 5, then it

is not a problem, and it is possible to proceed with Chi-Square test. If the conditions are not met, the contingency table must be adjusted accordingly. This adjustment is usually done by merging similar rows or columns.

2. None of the expected frequencies is less than 1. If any of the expected frequencies is less than one, then similar categories must be merged (Hlavsa & Pacáková, 2020).

The calculations for expected frequencies are given below:

$$n_{Oj} = \frac{n_{\cdot j} \cdot n_{i\cdot}}{N} \tag{1.8}$$

$$n_{O1} = \frac{n_{\cdot 1} \cdot n_{1\cdot}}{N} \tag{1.9}$$

Chi-Square test (χ^2) statistic

The formula for the test statistic χ^2 is given by:

$$\chi^2 = \sum_{i=1}^{k} \sum_{j=1}^{m} \frac{(n_{ij} - n_{oj})^2}{n_{oj}} \tag{1.10}$$

Where:

n_{ij} = matrix notation for observed frequencies

n_{oj} = matrix notation for expected frequencies

i = rows

j = columns

The Chi-Square alpha table value is denoted by χ^2 α [(r - 1) (c - 1)]. The Chi-Square test statistic χ^2 is then compared to the Chi-Square alpha table value χ^2 α and a decision is made.

- If $\chi^2 > \chi^2$ α, then null hypothesis is rejected and there is a significant relationship between the variables.
- Alternatively, if p-value < α, then null hypothesis is rejected and there is a significant relationship between the variables (Hlavsa, 2022).

3. Literature Review

3.1 Insect consumption

Insects are small six-legged animals that are part of the arthropod group. More than 90% of all animal species belong to the class of insects, with approximately 2 to 3 million species worldwide. The term used to describe the action of consuming insects by humans is known as entomophagy. The term entomophagy originates from the Greek words *éntomon* which means insect, and *phagein* which means to eat (Jansson et al., 2019). The following section is a literature review on previous related studies of entomophagy.

3.1.1 History of edible insects

In ancient times, it was common to consume the eggs, larvae, pupae and adults of insects. Insects, to a great extent, were part of the diet of early man seeing as he was an omnivore. Before the discovery of tools for hunting, people included insects as an essential part of their diet. Furthermore, most people lived in warm climates where a variety of insects were present all year long. If meat was scarce, insects would suffice as a source of protein (Kouřimská & Adámková, 2016). The Bible, a book that was written in about the 10th century BCE, mentions in the book of Leviticus what type of insects were ought to be consumed. Locusts, grasshoppers, crickets, katydid were considered clean whereas four-legged winged insects were unclean (New International Version Bible, n.d.). Diodorus of Sicily in the 1st century BC referred to Ethiopians as Acridophagi which translates to eaters of locusts and recalls that during times of scarcity, the locusts were preserved in salt (Van Huis, 2003).

In Africa, insect consumption has been practised for many years except in Ethiopia, where people seem to value insects much less than they do in other parts of Africa (Dürr & Ratompoarison, 2021). For example, in South Africa, it has been reported that entomophagy dates back to prehistoric times. There are reports that show that South Africans ate insects in the early 100, 000 BCE. In the 1950s, there were reports that the baPedi people of South Africa practised entomophagy (Hlongwane et al., 2020). In Zambia, the earliest written records of edible caterpillars date back to the 1950s. At the household level, caterpillars were enjoyed as a delicacy and occasionally exchanged for other food or sold for cash (Mwanza, 2021).

3.1.2 Types of edible insects

According to estimates, over two billion people practise entomophagy worldwide. Currently, over 2100 species are eaten by humans as food globally (Jansson et al., 2019). In Africa, Australia, Latin America, and Asia, edible insect consumption is common, with about 1000 insect species being consumed in Africa alone (Matandirotya et al., 2022). A variety of edible insects are harvested in the wild and consumed or used as feed for animals (Mutungi et al., 2019). Edible insects are consumed as a delicacy, staple food, or even as a temporary source of nutrition in times of food shortages in Africa (Matandirotya et al., 2022). Beetles, caterpillars, bees, wasps, and ants are the most commonly consumed insect species on a global scale. Grasshoppers, locusts, crickets, cicadas, leafhoppers, flies, termites, and dragonflies follow after. In Africa, Asia, and Latin America, insects are consumed in the greatest quantities (Kouřimská & Adámková, 2016). According to Van Huis, there are about 470 recorded edible insects in Africa and caterpillars are the most eaten and grasshoppers, beetles and termites follow after (Van Huis, 2020). There are 33 edible insect species in Zambia. Since there hasn't been much research on human insect consumption in sub-Saharan Africa, this estimate is most likely conservative. The numbers are remarkable where thorough research has taken place (Van Huis, 2003). Nevertheless, there are 4 commonly eaten insects, and Table 4 below shows the names of common edible insects found in Zambia, their edible stage as well as their availabilities.

Table 4. Common edible insects, edible stage, and availability

Scientific name	**Common name**	**Local name**	**Edible stage**	**Availability**
Gonimbrasia belina	Caterpillar/Mopane worm	Ifinkubala	Larvae	Aug, Sept, Oct
Gynanisa maja	Caterpillar	Ifinkubala	Larvae	Aug, Sept, Oct
Macrotermes falciger	Termite	Inswa	Winged adults	Mar, Apr, May
Ruspolia differens	Grasshopper	Nshonkonono	Adults	Jan, Nov, Dec

Source: Siulapwa et al., 2014 (created by author)

3.1.3 Collection and processing

In African nations, the majority of insect species are collected in the wild by women. The way insects are collected from the wild in traditional areas is largely determined by the insects' behaviour. Light can be used as traps to attract some night flyers like grasshoppers and termites. Applying glue to branches, stems or twigs can be used to trap some insects that live in bushes or trees (Raheem et al., 2019). In Zambia, caterpillars are collected from trees and processed before being sold to big city markets in Lusaka, Livingstone, and the Copperbelt. This is mainly done by people from Mporokoso, Mpika, and Luwingu districts in the Northern Province of Zambia (Siulapwa et al., 2014). The following procedure is used to process caterpillars in order to keep them for a long time or for sale:

(a) The live caterpillars are removed by hand from the tree and immediately degutted or eviscerated.
(b) Large fires are set up in the woodlands. The degutted caterpillars are then boiled in salty water for 20 to 60 minutes until the caterpillars harden.
(c) The caterpillars are then sun-dried until crispy. This could last anywhere between two to four days.
(d) The sun-dried caterpillars are then packaged in sacks or any other material (Mbata et al., 2002; Illgner & Nel, 2000).

In the southern part of Africa, mopane caterpillar collection is predominantly carried out by women and children. Women do the processing, which, despite being less physically demanding, can result in finger cuts due to the caterpillar's spiky bodies. Women prepare the insect for consumption in the home, while men typically do the trading. Women are able to harvest a 20-litre bucket of caterpillars in one day and in just one week, they can fill a 30-kilogram sack with caterpillars. During harvesting season, women and sometimes entire families migrate to the collecting areas to build temporal houses (Illgner & Nel, 2000).

There are many ways to collect winged termites. In urban areas, they are trapped in a water-filled receptacle under or next to a light source because they are drawn to electric light. In rural areas, they are frequently captured at the termite mound (Van Huis, 2003). These termites are consumed in their adult stage and killed by boiling or roasting them for a few minutes and then they are finally sun-dried or smoke-dried (Mutungi et al., 2019).

Grasshoppers are processed by removing the parts that are not edible such as wings. They are then boiled in salty water, sun-dried, smoked, toasted or deep fried (Mmari et al., 2017).

3.1.4 Benefits of edible insects

There are many health, environmental, and economic benefits that result from insect consumption. For instance,

Health benefits

- The amount of nutrients present in an insect is dependent on their stage of life, diet, and habitat. It is generally agreed upon that insects are rich in high-quality protein that is comparable to fish and meat (Halloran & Vantomme, 2013). The nutritional value of edible insects is dependent on the stage of metamorphosis i.e., egg, larvae, pupa, or adult. The value of nutrition is also affected by the methods of processing and preparation e.g., roasting, boiling, and frying (Kauppi et al., 2019). The nutritional value varies as well according to the species (Dobermann et al., 2017). In Africa, it is culturally and traditionally acceptable for people with low incomes to consume edible insects as a source of protein (Siulapwa et al., 2014).
- They provide fibre and micronutrients like zinc, iron, copper, selenium, phosphorus, manganese, and magnesium (Van Huis, 2013; Dobermann et al., 2017). The amount of micronutrients present differs among insect species. Some insect species have higher amounts of particular micronutrients (Dobermann et al., 2017).
- Zoonotic infections are on the rise and present serious risks to human health. In terms of taxonomy, insects are a lot more distant from humans than usual livestock and as a result, such risks are anticipated to be extremely low (Van Huis, 2013).

Environmental benefits

- Being cold-blooded allows insects to possess a high feed conversion efficiency. Feed-to-meat conversion rates, which refers to the amount of feed required to increase an animal's weight by one kilogram, differ greatly from animal to animal and production methods used. However, insects are highly efficient. In contrast to cattle, which need 8 kilograms of feed to gain 1 kilogram of body weight, insects can typically convert 2 kilograms of feed into 1 kilogram of insect mass (Halloran & Vantomme, 2013).
- Most insects are more favourable in terms of greenhouse gas emissions and ammonia production compared to typical livestock (Van Huis, 2013). There is a general agreement that greenhouse gas emissions, primarily nitrous oxide, carbon dioxide,

and methane from fossil fuels and agricultural processes are the major contributors of global climate change. The agricultural industry is the largest contributor to greenhouse gas emissions, with livestock making up 18% of all carbon dioxide equivalents (Dobermann et al., 2017).

- Bio-waste like animal slurry, compost, human waste, and food can be consumed by insects, and can turn this waste into high-quality protein that can be used as animal feed (Halloran & Vantomme, 2013).
- In contrast to conventional livestock, insects consume less water (Halloran & Vantomme, 2013). A study investigated the water footprint of insects that are produced commercially while taking into consideration the whole production system. The study discovered that the water footprint per ton for producing mealworms in a commercial system was higher than that of producing chickens and pigs (Dobermann et al., 2017).
- The pressure on meat producers to raise more livestock, which requires extra land, is growing with increasing demand for meat. Approximately 70% of all accessible agricultural land in the world is currently used by the livestock industry (Dobermann et al., 2017). Less land is needed for insect farming than for traditional livestock farming (Halloran & Vantomme, 2013).

Economic benefits

- Insect collection can provide significant livelihood diversification strategies and can be done in the wild without capital expenditure (Halloran & Vantomme, 2013). This eventually offers households numerous opportunities to generate income (Van Huis et al., 2013).
- Another benefit is that even the poorest members of society can better their diets and raise income via production and selling of insects (Halloran & Vantomme, 2013). In Zambia, trading of insects is one of the many ways of generating income for both urban and rural areas (Niassy et al., 2022). Furthermore, the surplus collected insects can be bartered or readily sold for cash in food stands on the streets or at the market by their family members or the gatherer. In addition, insects can also be sold to wholesalers and middlemen at the farm gate. The outcome of their interaction and the presence or absence of middlemen will determine the final cost of the insect product for the consumer (Van Huis et al., 2013).

3.1.5 Challenges in the edible insect industry

Despite the many benefits of insect consumption, there are some challenges too. The challenges are listed below:

- **Consumer acceptability**: Studies have shown that the main reasons people do not consume insects are that they find them disgusting or they are not culturally acceptable. The other reason consumers are reluctant to consuming edible insects is due to food neophobia (Ruby & Rozin, 2019). In Africa, edible insects are rejected because of unawareness and negative thoughts regarding insects (Abdullahi et al., 2021).
- **Health issues**: In terms of food safety, the way insects are traditionally processed are often times considered substandard. The consumption of insects such as cicadas, grasshoppers, caterpillars, and silkworms have been associated with food allergies (Niassy et al., 2022).
- **Availability**: Insect availability is the main factor that leads to consumption. Certain edible insects are only available during certain seasons. As a result, this hinders regular consumption of edible insects (Abdullahi et al., 2021).
- **Affordability**: This is the most important constraint regarding the promotion of insect consumption. In general, edible insects are not always available throughout the year. Consequently, they may be pricey even in areas that have plenty of wild insect species (Abdullahi et al., 2021).
- **Environmental issues**: Insect farming is uncommon in Africa and most edible insects are usually harvested in the wild which may lead to overexploitation of edible insects (Niassy et al., 2022). Over 90% of edible insects are collected from the wild. Random harvesting of insects can be harmful to some insect species as well as the environment. The random collection of edible insects can have environmental and ecological impacts by lowering the population of insects and changing the ecological relationship between plants and insects (Abdullahi et al., 2021).
- **Legislative constraints**: Many countries that consume insects do not have the proper regulatory policies regarding the food and feed sector which could possibly be beneficial to insects. In spite of having a wide range of edible insects, Zambia does not have any particular regulations with regard to insects as food and feed (Niassy et al., 2022).

3.2 Overview of consumer behaviour

Consumer behaviour embodies viewpoints from various fields of study such as psychology, economics, marketing etc. This section deals with the definition of consumer behaviour, decision-making process as well as the influences on the decision-making process.

3.2.1 Definition of consumer behaviour

There have been numerous definitions of consumer behaviour. Consumer behaviour can be defined as the actions people take when they purchase, consume, and discard goods and services (Blythe & Sethna, 2019). According to Ngugi et al. (2020), consumer behaviour is concerned with the actions and decision-making of both individuals and organizations or groups who buy goods and services for their own use. Kardes et al. (2014) defined consumer behaviour as all the activities of a consumer related to purchasing, using, and disposing of goods and services, as well as the consumer's mental, emotional, and behavioural responses that come before, determine, or come after these activities.

There are many benefits to studying consumer behaviour. Businesses stay in business by attracting and keeping consumers. As a result, it is likely that the company will be able to attract and keep consumers more effectively if it has a solid understanding of consumers and how they behave. Both for-profit and non-profit organizations can benefit from having an understanding of consumer behaviour. It is beneficial in any job where the goal is to satisfy human needs and wants. Additionally, it is significant for organizations and groups attempting to influence public policies that impact consumer's rights. It is important to remember that everyone buys things and as a result, being aware of consumer behaviour makes one a well-informed consumer (Ngugi et al., 2020).

3.2.2 Consumer decision-making process

The simplified model of the decision-making process consists of five stages. These are the well-known stages that a consumer experiences when purchasing and consuming goods and services. If marketers seek to attract consumers to purchase a product, have effective communication and finally make a sale, they need to be aware of these steps (Stankevich, 2017). The model of the five stages is shown in Figure 1:

Figure 1. Simplified model of consumer decision-making process

Source: Ngugi et al., 2020 (created by author)

Need/problem recognition: This is basically the first stage in the process of consumer decision-making. At this point, the consumer recognises that there is a problem that needs to be fixed or a need that must be met (Ngugi et al., 2020). There are two stimuli involved at this stage. These are internal and external stimuli. An internal stimulus refers to an emotion the consumer is experiencing or an immediate basic impulse (Stankevich, 2017). When a person is hungry, they understand that they must eat in order to put a stop to their hunger. A consumer realizes they need to drink when they become thirsty in order to help satisfy their thirst (Ngugi et al., 2020). An external stimulus occurs when external influences have an impact on a person. External influences could be advertisements and sales promotions (Stankevich, 2017).

Information search: This is the second stage in the consumer decision-making process. The consumer is looking for a solution to their problem at this stage. A consumer performs a memory check and looks at his/her surrounding areas to determine what options might be available to address his/her problem (Solomon, 2009). Can they fix the problem that is already there or find another way to solve it, or will they just buy something new? Consumers frequently seek guidance from family, friends, or co-workers. These people are bound to have honest reviews and describe any issues they had with a service, product, or company. They might also consider appropriate newspapers, magazines, company webpages, or supermarkets etc., with the aim of searching for information, such as availability and prices that is relevant in order to make a decision on where to purchase a product or service (Ngugi et al., 2020). When consumers search for information externally in this way, it is called external information search (Stankevich, 2017). Naturally, individuals also use their own experiences to make decisions (Ngugi et al., 2020). This is referred to as internal information search (Stankevich, 2017). It could be that they had awful takeout food or terrible customer service at a restaurant. The consumer will either act on their own recommendations or they will give a company another try. When trying to figure out how to make the most of their money, some people will rely on reviews posted online (Ngugi et al., 2020).

Evaluation of alternatives: This is essentially the third stage in the process of consumer decision-making. This stage may be regarded as the most significant since the consumer attempts to select one option out of many (Ngugi et al., 2020). The consumer typically selects one of the most important factors and they will reach a decision based on these factors. Moments that matter might be emotional ties to products/interactions with them or giving in to marketing or advertising efforts. This is an individual process in which the consumer evaluates his/her options based on characteristics such as brand, store's location, quality, and price (Stankevich, 2017).

Purchase: This is essentially the fourth stage in the process of consumer decision-making. After deciding what to buy, a consumer must carry out their decision and actually make the purchase. There is usually a time delay between making a decision to buy and actually doing so. For more complicated purchases, like cars, personal computers, etc., the time delay might be longer. The time delay is shorter for nondurable goods like daily necessities (Stankevich, 2017).

Post-purchase behaviour: In this final step of the decision-making process, the consumer assesses how good of a decision they made. This assessment leads to either satisfaction or dissatisfaction. The general attitudes or feelings a consumer has about a particular product after buying and using it determines whether they are satisfied or dissatisfied. Consumers are satisfied with their purchase when the product meets their expectations and dissatisfied when they express regret (Solomon, 2009). There is a possibility of cognitive dissonance following the purchases (Ngugi et al., 2020). Cognitive dissonance is the mental tension that arises when a person holds two psychologically opposing ideas or beliefs (Olsen, 2008). It can be difficult for a consumer to determine whether their decision was correct or whether they should have chosen a different option. When cognitive dissonance occurs, people experience feelings of discomfort as well as opposing attitudes, beliefs, and behaviours. The consumer might ask questions such as " Should I have taken the negative review I read more seriously?", " Could I have saved more?" etc. During cognitive dissonance, people consider the following factors (Ngugi et al., 2020):

a) Permanence in one's life: Will this purchase last for a long or short period of time? For instance, a bag of dried cereal may last longer than takeout food one buys during lunch which they'll only keep for about an hour.
b) Importance: Is this purchase necessary to continue living one's daily life?

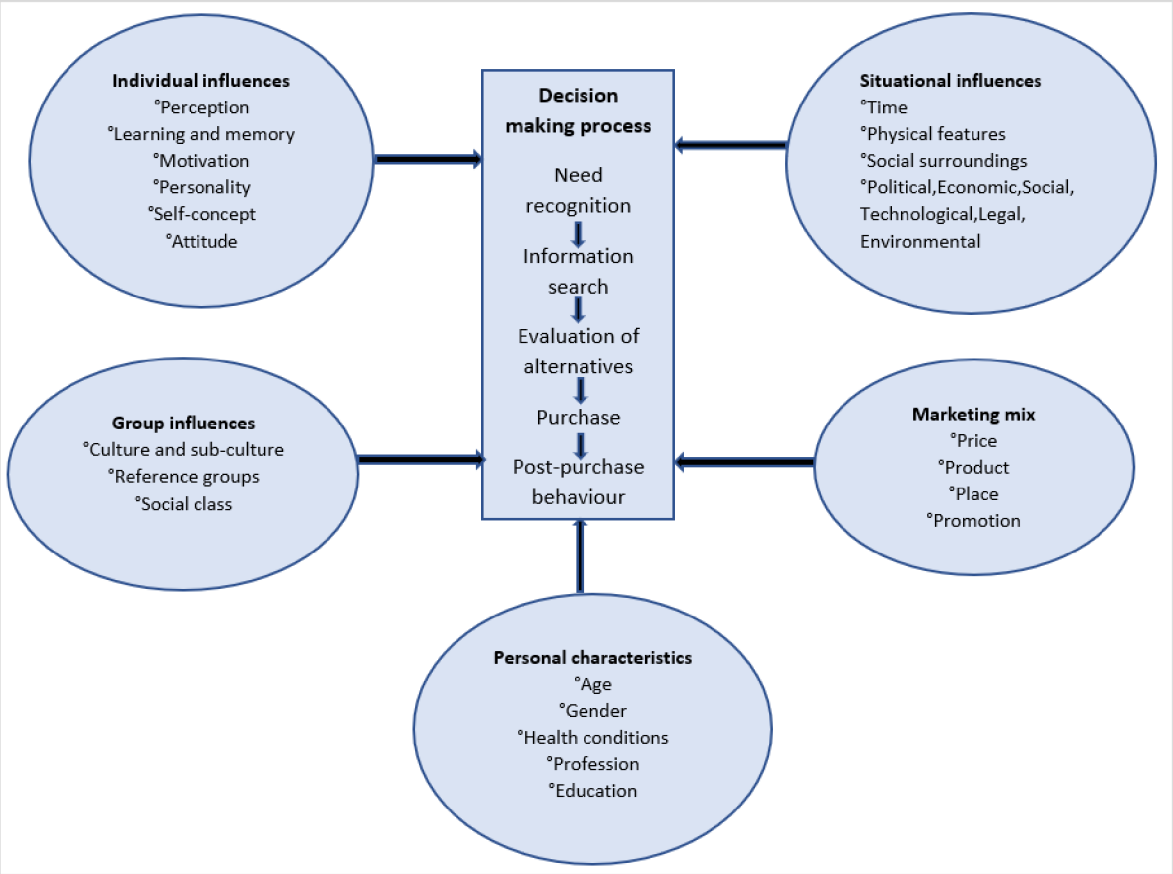
c) Cost: Is this purchase going to cost a lot of money, or will it only cost a small amount? A consumer is more likely to experience cognitive dissonance if the purchase is expensive.
d) Availability of good options: If the consumer had to make a decision between two or more options, they may ask themselves whether they should have picked the other option (Ngugi et al., 2020).

In an effort to lessen cognitive dissonance, consumers defend their decisions. They may look for new information that supports their beliefs about the purchase, avoid information that is not in line with their choice, or even change their minds and return the item. Consumers who are not satisfied occasionally depend on word of mouth to lessen cognitive dissonance by telling family and friends about their dissatisfaction. Marketing managers who communicate well with consumers can aid in reducing dissonance. For example, they can include a note in the package of the buyer that congratulates them on making the right decision (Lamb et al., 2020).

3.2.3 Influences on the decision-making process

Consumers are subjected to numerous influences on their behaviour daily. These influences can be psychological, sociological, and situational factors like the weather or a company's marketing strategies like huge discounts. Consumption of food and beverages is driven by physiological needs like hunger and thirst. Situational factors like the weather encourage specific food items to be consumed. Ice cream, for example, is in high demand during hot weather. There are five major influences on consumer behaviour: individual influences (the factors that are intrinsic in a consumer); group influences (caused by other members of the society); situational influences (such as time pressure and moods, which are temporary circumstances that influence consumer behaviour), the marketing efforts of a company (based on variables that can be controlled, parts of the marketing mix), and individual characteristics like age and gender. These factors can have an influence on one or more stages of the consumer decision-making process (Ngugi et al., 2020). The main factors that influence consumer behaviour are outlined in Figure 2.

Figure 2. Influences on consumer decision-making process



Source: Ngugi et al., 2020 (created by author)

3.3 Factors influencing food choices and insect consumption

Food choice is an intricate phenomenon that is influenced by a variety of factors that each have a different impact on the human psyche. Considering such influence, some products are selected while others are passed over. Many attempts have been made to categorize the factors that impact consumers' behaviour. In general, all factors fall under one of the following three categories: (1) Consumer-related factors: physiological factors (thirst, hunger), psychological factors (attitudes, personality, motives); demographic factors; (2) Product-related factors: nutrient contents, sensory attributes, and functionality (durability, availability, packaging, convenience), and (3) Environmental factors: social factors (habits, social group, family patterns), cultural factors (religions, traditions), economic factors, and context (company associated with eating, place, time) (Babicz-Zielińska, 2006). This section deals with the factors that influence consumer behaviour in terms of food choices and insect consumption.

3.3.1 Consumer-related factors

(a) Physiological factors: This refers to all the chemical reactions taking place in our bodies to stay alive. This includes, but not limited to,

   i. Hunger: The discomfort or pain resulting from a lack of food. The ongoing, uncontrollable inability to access food (Kulick, 2002).

   ii. Thirst: The sensations that signal the identification of and intake of fluids to meet hydration requirements (McKiernan et al., 2008). For example, one may choose to either drink water, coffee, or juice when thirsty.

(b) Psychological factors: These factors pertain to the way in which the mind works. Psychological factors have been shown to significantly influence nutritional behaviour (Babicz-Zielińska, 2006). As rational beings, consumers are influenced by numerous external factors that can alter their emotional, cognitive, volitional, as well as their automatic actions. Scientific literature has extensively examined and described the impact of psychological factors on people's behaviour, particularly in relation to the decision to choose and purchase particular goods, services, or experiences (Font-i-Furnols & Guerrero, 2014). Psychological factors are:

   i. Motives: In a broader sense, motives are defined as conscious or unconscious influences in behaviour that focus an individual's efforts on a particular objective (Kuntsche et al., 2005). Motives play a key role in food choice. Rational motivations do not always lead to the right eating habits. For instance, wanting to be healthy, slim, or preserve youth can lead to improper food behaviour known as "food faddism" (Babicz-Zielińska, 2006).

   ii. Personality: Studies have shown that personality affects eating styles and food choices. In addition to this, personality traits were found to be linked to (over-) eating behaviours like eating in response to stress and a bad mood (Keller & Siegrist, 2015). According to Gajjar (2013), a person's personality can change according to the time or place and hence can influence his/her purchasing behaviour.

   iii. Attitudes and Beliefs: Gajjar (2013) stated that consumers have certain attitudes and beliefs towards different products. Attitudes are one of the important psychological factors that influences food behaviour and choice (Babicz-Zielińska, 2006).

iv. Values: The food values are a collection of considerations that are taken into account when making food choices. These values take into account personally developed interpretations and meanings concerning food including emotional attachment. Values include taste, convenience, cost, health, managing relationships, quality, variety, symbolism, ethics, safety, and waste (Shepherd & Raats, 2006).

v. Perception: To select, organize, and interpret in order to achieve understanding of the world is called perception (Gajjar, 2013).

(c) Demographic factors:

i. Age: Studies suggest that sensory-specific satiety decreases with age. When the pleasantness of food being consumed is reduced, this is called sensory-specific satiety. This decrease of pleasantness often drives food choices and thus a varied diet (Elmadfa, 2005). According to Ramya et al. (2016), a person's age has an influence on purchasing behaviour. People will buy certain products at different stages in their lives.

ii. Gender: Men and women's food preferences differ significantly, according to numerous studies. Women are consistently reported to consume more fruits and vegetables, more dietary fibre, and less fat than men. Women typically place a higher value on healthy eating as a result of their preference for healthier foods. Women are also more likely to diet or restrict their eating and have a stronger motivation to control their weight. Men's less nutritious food choices may also be linked to their lower nutritional knowledge (Elmadfa, 2005).

iii. Occupation: A person's occupation plays an important role in their buying behaviour (Gajjar, 2013). The profession or occupation of a consumer influences his/her purchasing decisions. Depending on the type of occupation, there are significant differences in lifestyles and purchasing behaviours as well as decisions (Ramya & Ali, 2016).

iv. Education: The level of one's education is strongly correlated with their food choices. People with higher educational level have more cultural capital and hence choose healthier foods than people with lower educational levels (Enriquez & Archila-Godinez, 2022).

3.3.2 Product-related factors

(a) Nutrient and health beliefs: Many people focus on and select particular foods that they believe are good for them. Diet and food choices can be strongly influenced by consumer health beliefs, perceptions of disease susceptibility, and wanting to prevent or delay the start of a disease (Insel et al., 2018).

(b) Sensory attributes: These are characteristics that are easily identified by human senses. Sensory attributes include appearance, taste, flavour, odour, and texture of foods. They are often used to assess food quality and may be used when making food choices (Chumngoen & Tan, 2015).

(c) Functionality:

i. Convenience: This plays a role in food choices. Consumers prefer food that is easy to prepare and saves time (Pieniak et al., 2009).

ii. Availability: This refers to how accessible a product is. This is one of the most important factors that influences food choices (Mela, 2001).

iii. Packaging: When it comes to food choices, packaging plays a crucial role. Characteristics of a package, such as its colour, shape, size, images, and text, have an impact on the consumer's perception of the product. Numerous studies with unpackaged foods have shown variations in neural responses to high and low hedonic foods (Van der Laan et al., 2012).

iv. Durability: Consumers may purchase food based on how long it will last. For example, a bag of cereal is likely to last longer than takeout food (Ngugi et al., 2020).

3.3.3 Environmental factors

(a) Social factors: They are defined as factors that are deep-rooted relationships that affect food choices (Shepherd & Raats, 2006).

i. Social group: The majority of eating occurs in groups where an individual negotiates and manages their own food choices in synchrony with those of others (Shepherd & Raats, 2006).

ii. Family patterns: Family plays a key role in food choices. The member of a family strongly influences purchasing behaviour. As a result, marketers are attempting to determine the roles and influence of the family unit. Marketers

will attempt to target women in their advertisements if a product's purchase decision is influenced by the wife (Jisana, 2014).

iii. Habits: This is an acquired manner of behaviour that has become nearly or entirely unconditioned. According to Insel et al. (2018), it is likely that one's cooking and eating habits are influenced by their parents. In most cases, people learn to eat three meals per day at roughly the same times without worrying as much about when and what to eat because of this routine, which makes life easier.

(b) Cultural factors: Culture has a significant impact on the kinds of foods and drinks that people consider suitable to consume. When choosing food, people take into account cultural and subcultural norms that dictate which foods are acceptable and preferred by larger cultures and ethnic groups within cultures (Shepherd & Raats, 2006).

i. Traditions: The individual's preferences regarding food are influenced by factors such as tradition. Many people view food as cultural rather than nutritional. In some societies, certain plants or animals are considered edible, while in others, they may not (Reddy & Anitha, 2015).

ii. Religions: The person's religious upbringing is also thought to have a significant impact on the foods they choose to eat (Mak et al., 2012). While some religious guidelines pertain to special occasions, others apply to everyday eating. For instance, Christianity, Buddhism, Hinduism, Judaism, and Islam all have specific dietary laws. However, each religion has its own dietary customs based on how these laws are interpreted (Insel et al., 2018).

(c) Economic factors:

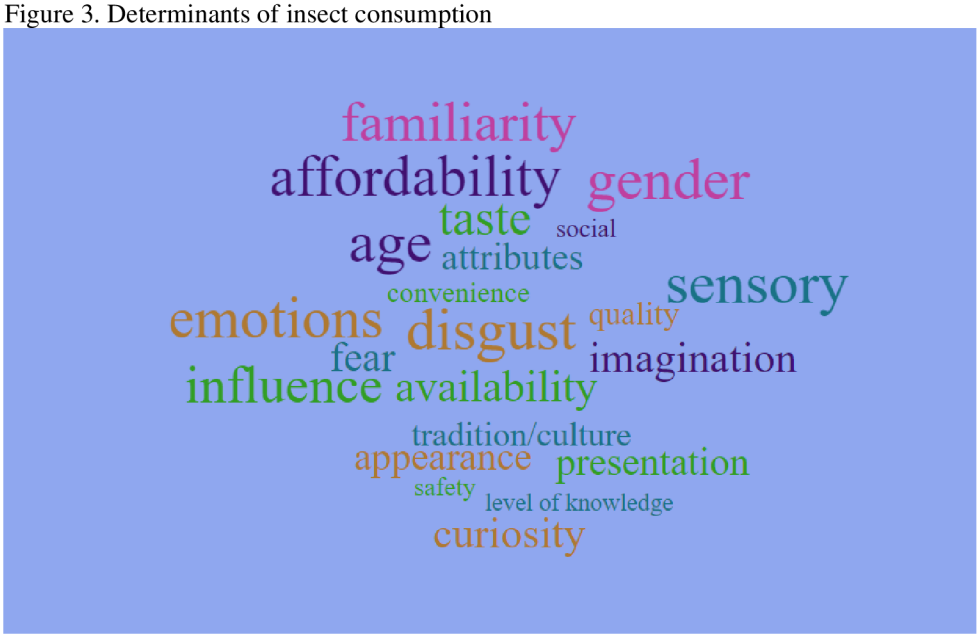
i. Price: Pricing has been shown to influence food choices, and consumers with low incomes may face financial obstacles to healthy eating due to limited resources (Steenhuis et al., 2011).

ii. Income: One's income has an impact on the types of foods purchased and the amount spent on food (Insel et al., 2018). According to Ramya et al. (2016), income is a significant source of buying power. Therefore, consumption patterns of people are different depending on their various income levels.

3.3.4 Determinants of insect consumption

The determinants influencing insect consumption according to several studies are shown in Figure 3 below (Florença et al., 2022).

Figure 3. Determinants of insect consumption



Source: Florença et al., 2022 (created by author)

According to Dobermann et al. (2017), there are two different psychological responses regarding the consumption of insects as food. In cultures where eating insects is common, they are valued as a source of protein, and the older generations pass down the knowledge of which insects should be consumed to the younger generations. In contrast, insects can induce innate negative responses in Western cultures. It is deeply ingrained in the Western mind that insects are dangerous, dirty, and also disgusting. Familiarity, neophobia, and meat attachment appear to be the main determining factors of insect consumption. The more neophobic and attached to consuming meat a person is, the less willing they are to consume edible insects. Nonetheless, if the presentation of insects is done in a familiar and convenient form, a person may be more willing to try it (Dobermann et al., 2017).

A study done in a Mexican village revealed that the amount of edible insects consumed varies depending on the presence of particular species, personal preferences, and weather conditions (Dürr & Ratompoarison, 2021).

It is not accurate to believe that people only consume insects because they are hungry or that there are no other options. Insects, particularly termites, crickets, palm larvae, and edible grasshoppers, are considered delicious by Africans (Van Huis, 2003).

The acceptance level of insects as food is affected by the environment in which a person lives and whether or not they have been exposed to edible insects. In addition to this, determinants such as price, educational level, age, gender, ethnicity, disgust, and food neophobia have been identified as determinants that can affect insect consumption (Lim et al., 2022).

According to Halloran & Vantomme (2013), Western diets are having an impact on food preferences in nations where insect consumption was once common. As a result, eating insects may now be despised or avoided. Hlongwane et al. (2020) stated that in developing nations, entomophagy has significantly declined over time, especially in urban areas. The younger generation knows very little or nothing about the consumption of edible insects. This is believed to be a result of people embracing modern/western food culture and abandoning traditional practices like insect consumption. People's diets have changed as a result of westernization and globalization. Consequently, people are more dependent on Western cuisine and less willing to try traditional foods like edible insects because they are now viewed as taboo or dirty. Many people have become hesitant to consume insects or have even distanced themselves from doing so as a result of this (Hlongwane et al., 2020). Furthermore, there is a notion that insect consumption is starvation food or a primitive man's peculiar habit (Van Huis, 2016).

In Zambia, grasshoppers are frequently harvested and eaten as a traditional snack. Grasshoppers and other edible insects are commonly thought to be very nutritious and to have particular medicinal properties (Mmari et al., 2017). In some cultures, consumption of insects is thought to make up for the lack of protein in primarily vegetarian diets. When there is a low supply of food from November to February, insects are the most significant source of nutrients for the Lala tribe in Zambia (Mutungi et al., 2019).

A great opportunity for insects to meet the current and future needs of people and livestock for animal protein has arisen as the price of fish, chicken, and beef continues to rise globally. In Africa, there is a growing demand for edible insects, primarily due to the rising cost and scarcity of animal protein (Raheem et al., 2019).

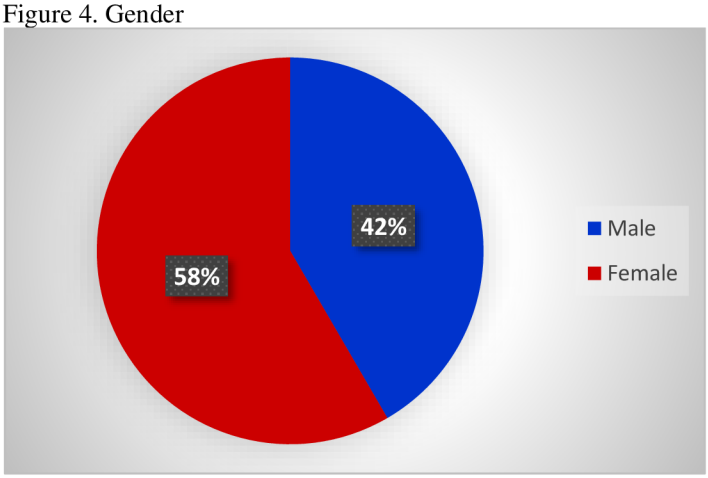
4. Practical Part

The practical part deals with the evaluation of the survey. This is done in three main sections. The first section evaluates the background information of the respondents, including their age, occupation, educational level, and monthly income. The second section includes insect-related questions about insect consumption, types of preferred insects, frequency of insect consumption, motivations, criteria when purchasing insects as well as expenditure on insects. The third section is hypothesis testing and analysis.

4.1 Evaluation of background information

Figure 4 shows the gender of respondents. There were 173 samples obtained from the questionnaire of which 101 were females accounting for 58% and the males were 72 accounting for 42% of the total samples. The questionnaire had more females than males, therefore, the questionnaire is more representative of females than males.

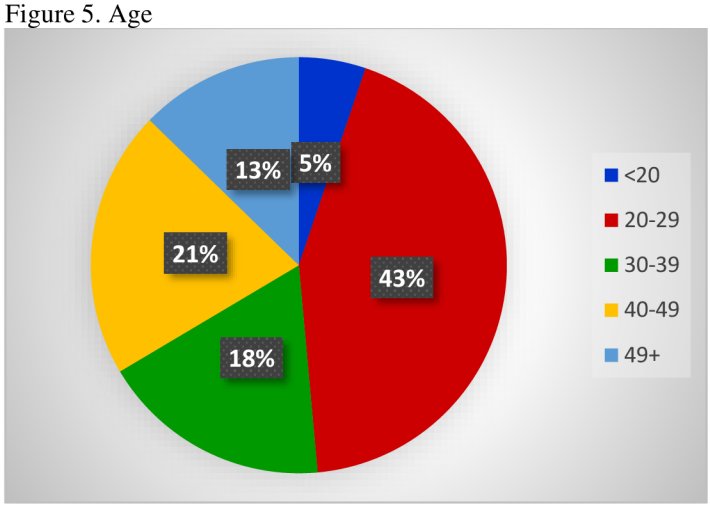
Figure 4. Gender



Source: Own source

Figure 5 shows the pie chart of the age range of the respondents from the questionnaire. There were 75 respondents between 20 and 29 years old, accounting for 43%. There were 36 respondents between 40 and 49 years old, accounting for 21%. There were 31 respondents between 30 and 39 years old, accounting for 18%. There were 22 respondents over 49 years old, accounting for 13%. Finally, there were 9 respondents below 20 years old, accounting for 5%. As depicted in Figure 5, majority of respondents from the survey were people aged between 20 and 29 years old. The age group below 20 years old is the least represented.

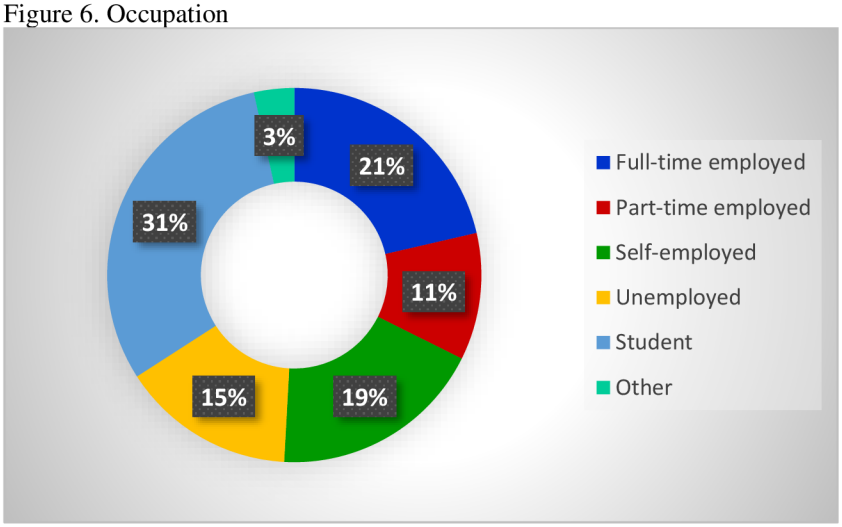
Figure 5. Age



Source: Own source

The occupation of the respondents is represented in and is shown in Figure 6. There were 53 students, accounting for 31%. There were 37 respondents with full-time jobs, accounting for 21%. There were 32 self-employed respondents, accounting for 19%. There were 26 unemployed respondents accounting for 15%. There were 19 respondents with part-time jobs, accounting for 11%. There were 6 respondents with other occupations, accounting for 3%. The majority of respondents were students, while the group with other occupations is the least represented.

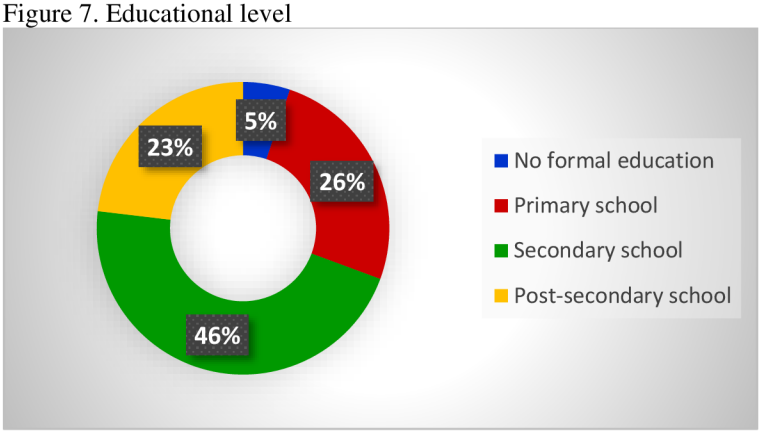
Figure 6. Occupation



Source: Own source

Figure 7 shows the educational level of the respondents. There were 80 respondents with secondary education, accounting for 46%. There were 44 respondents with primary education, accounting for 26%. There were 40 respondents with post-secondary education, accounting for 23% and finally there were 9 respondents with no formal education, accounting for 5%. The majority of respondents in this survey had secondary education and respondents with no formal education are the least represented.

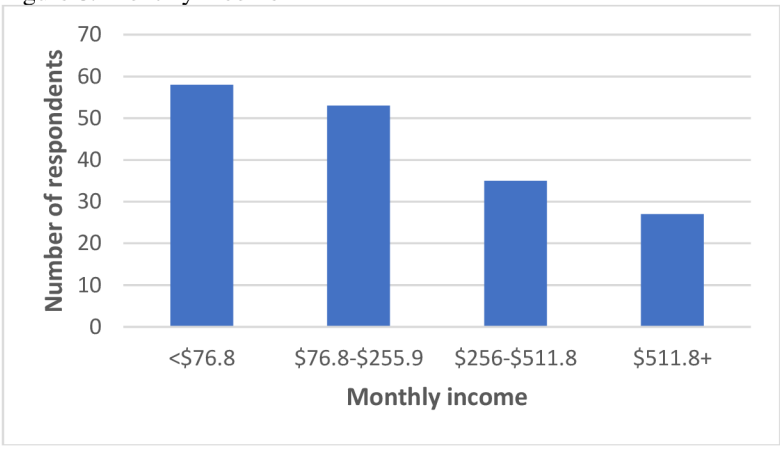
Figure 7. Educational level



Source: Own source

Figure 8 is a chart showing the monthly incomes of the respondents. There are 58 respondents with an income below $76.8, accounting for 33%. There are 53 people with an income between $76.8 and $255.9, accounting for 31%. There are 35 respondents with an income between $256 and $511.8, accounting for 20%. There are 27 respondents with an income above $511.8, accounting for 16%.

Figure 8. Monthly income

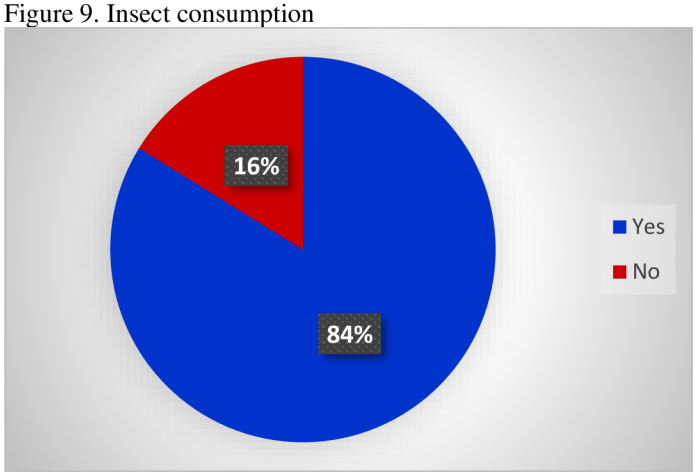


Source: Own source

4.2 Evaluation of insect-related questions

Figure 9 shows the responses to the question 'Do you consume insects?' Among the 173 respondents, 145 answered yes to the question 'Do you consume insects?' and thereby accounting for 84%. The number of respondents that answered no was 28, accounting for 16%. Majority of respondents in this survey eat insects.

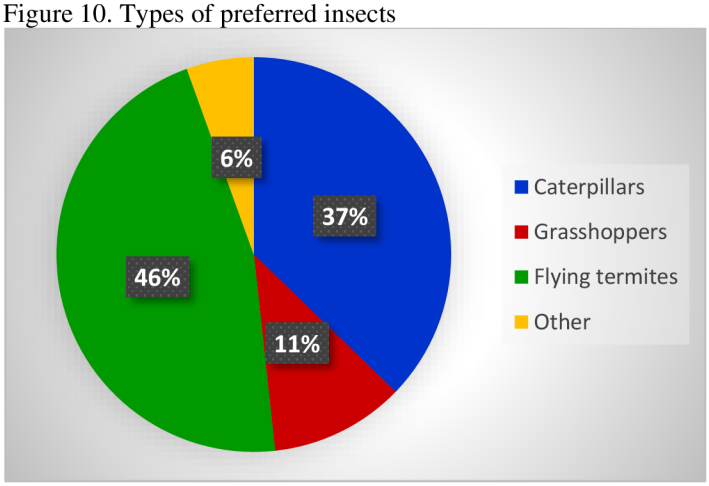
Figure 9. Insect consumption



Source: Own source

Figure 10 shows the most preferred types of insects of the 145 respondents that consume insects. The chart shows that 67 respondents prefer flying termites, accounting for 46%. There are 54 respondents who prefer caterpillars, accounting for 37%. There were 16 respondents who prefer grasshoppers and therefore accounts for 11%. Finally, 8 respondents prefer other types of insects accounting, for 6%.

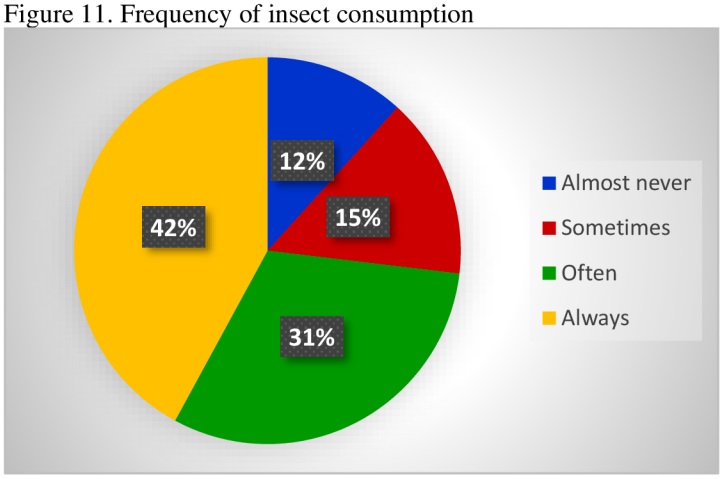
Figure 10. Types of preferred insects



Source: Own source

Figure 11 shows the insect consumption frequency of the 145 respondents that consume insects. The chart shows that 61 respondents consume edible insects always accounting for 42%. There are 45 respondents that consume edible insects often, which accounts for 31%. This is followed by 22 respondents who consume insects sometimes, accounting for 15%. Lastly, there are 17 respondents who almost never consume insects, which accounts for 12%.

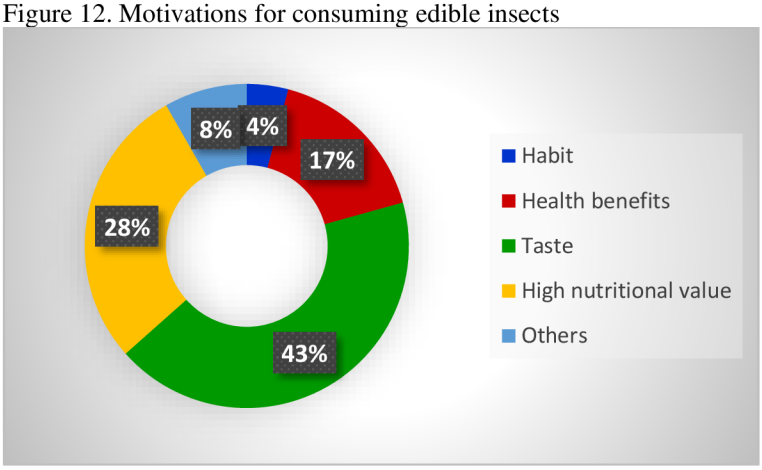
Figure 11. Frequency of insect consumption



Source: Own source

Figure 12 is a chart that shows what motivates the 145 respondents to consume insects. The chart shows that 62 respondents consume insects because of taste, accounting for 43%. This is followed by 41 respondents who consume insects for their high nutritional value, accounting for 28%. There were only 6 respondents who consume insects as a habit, accounting for 4%. Taste is the main motivational factor for consuming edible insects for most people.

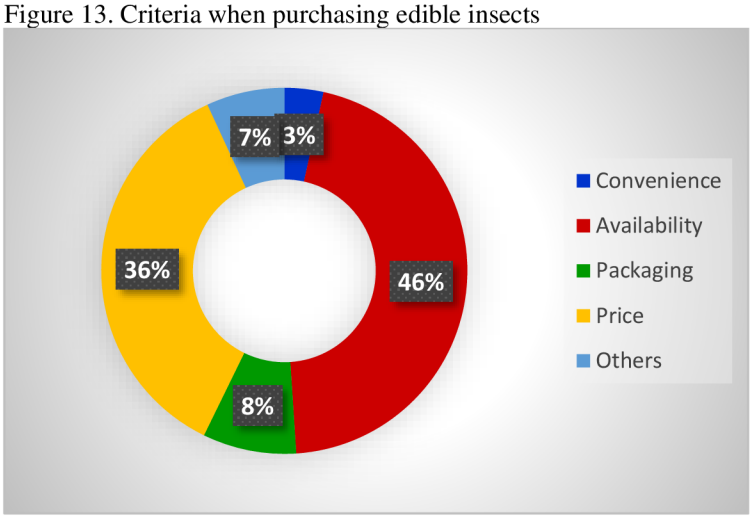
Figure 12. Motivations for consuming edible insects



Source: Own source

Figure 13 shows the criteria used when purchasing edible insects by the 145 respondents who consume insects. The chart shows that 66 respondents chose availability as an important criterion when purchasing edible insects, accounting for 46%. This is followed by 52 respondents who chose price as a criterion which accounts for 36%. There were only 5 respondents who chose convenience as a criterion, accounting for 3%.

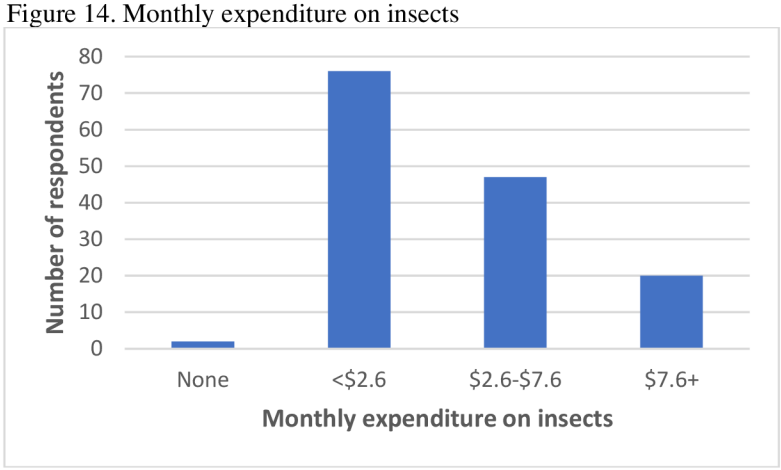
Figure 13. Criteria when purchasing edible insects



Source: Own source

Figure 14 shows the monthly expenditure on insects of the 145 respondents that consume insects. The chart shows that 76 respondents spend less than $2.6, accounting for 52%. This is followed by 47 respondents who spend between $2.6 and $7.6 on edible insects which accounts for 32%. There were 20 respondents who spend more than $7.6 on edible insects, accounting for 14%.

Figure 14. Monthly expenditure on insects



Source: Own source

4.3 Analysis and hypothesis testing

Five hypotheses are put forth to test the factors that are assumed to influence insect consumption.

H_0: There is no significant relationship between gender and insect consumption.

H_0: There is no significant relationship between age and insect consumption.

H_0: There is no significant relationship between occupation and insect consumption.

H_0: There is no significant relationship between educational level and insect consumption.

H_0: There is no significant relationship between monthly income and insect consumption.

4.3.1 Gender and insect consumption

H_0: There is no relationship between gender and insect consumption.
H_A: There is a relationship between gender and insect consumption.
Let α=0.05

Table 5. Contingency table: gender and insect consumption

Table of Gender by insect consumption			
Gender	**Insect consumption**		
	No	**Yes**	**Total**
Female	19 16.347	82 84.653	101
Male	9 11.653	63 60.347	72
Total	28	145	173

Source: Own work, SAS Studio

Table 6. Statistics for table of gender and insect consumption

Statistic	**DF**	**Value**	**Prob**
Chi-Square	1	1.2345	0.2665
Likelihood Ratio Chi-Square	1	1.2640	0.2609
Continuity Adj. Chi-Square	1	0.8131	0.3672
Mantel-Haenszel Chi-Square	1	1.2274	0.2679
Phi Coefficient		0.0845	
Contingency Coefficient		0.0842	
Cramer's V		0.0845	

Source: Own work, SAS Studio

The conditions for a Chi-Square test are satisfied. The p-value is greater than α, otherwise known as alpha and therefore the null hypothesis is accepted. In conclusion, there is **no significant relationship between gender and insect consumption**.

4.3.2 Age and insect consumption

H_0: There is no relationship between age and insect consumption.
H_A: There is a relationship between age and insect consumption.
Let α=0.05

Table 7. Contingency table: age and insect consumption

Table of age and insect consumption			
	Insect consumption		
Age	**No**	**Yes**	**Total**
Below 20	1 1.4566	8 7.5434	9
20-29	11 12.139	64 62.861	75
30-39	9 5.0173	22 25.983	31
40-49	1 5.8266	35 30.173	36
Over 49	6 3.5607	16 18439	22
Total	28	145	173

Source: Own work, SAS Studio

Table 8. Statistics for table of age and insect consumption

Statistic	DF	Value	Prob
Chi-Square	4	10.8341	0.0285
Likelihood Ratio Chi-Square	4	12.0990	0.0166
Mantel-Haenszel Chi-Square	1	0.1623	0.6870
Phi Coefficient		0.2502	
Contingency Coefficient		0.2428	
Cramer's V		0.2502	

Source: Own work, SAS Studio

The conditions for a Chi-Square test are satisfied. The p-value is less than α, otherwise known as alpha and therefore the null hypothesis is rejected. In conclusion, there is **a significant relationship between age and insect consumption**.

4.3.3 Occupation and insect consumption

H_0: There is no relationship between occupation and insect consumption.
H_A: There is a relationship between occupation and insect consumption.
Let α=0.05

Table 9. Contingency table: occupation and insect consumption

Table of occupation by insect consumption			
Occupation	**Insect consumption**		
	No	**Yes**	**Total**
Full-time	7 5.9884	30 31.012	37
Part-time	4 3.0751	15 15.925	19
Self-employed	2 5.1792	30 26.821	32
Unemployed	3 4.2081	23 21.792	26
Student	10 8.578	43 44.422	53
Other	2 0.9711	4 5.0289	6
Total	28	145	173

Source: Own work, SAS Studio

Table 10. Statistics for table of occupation and insect consumption

Statistic	**DF**	**Value**	**Prob**
Chi-Square	5	4.8598	0.4332
Likelihood Ratio Chi-Square	5	5.1990	0.3921
Mantel-Haenszel Chi-Square	1	0.6862	0.4075
Phi-Coefficient		0.1676	
Contingency Coefficient		0.1653	
Cramer's V		0.1676	
WARNING: 25% of the cells have expected counts less than 5. Chi-Square may not be a valid test.			

Source: Own work, SAS Studio

Table 10 shows that 25% of the cells have expected counts less than 5. Expected frequencies < 5 can only be maximum 20%. Since there are more expected frequencies less than 5 that are more than 20%, the conditions of a chi-Square test have not been met. This is due to the

insufficient responses in the ‘part-time’, ‘self-employed’, ‘unemployed’ and ‘other’ groups. The contingency table should therefore be adjusted appropriately. This adjustment is done by merging similar rows. In order to meet the criteria for a Chi-Square test, ‘full-time’, ‘part-time’, and ‘self-employed’ were merged, whereas ‘unemployed’ was merged with ‘other’ as shown in Table 11.

Table 11. Merged contingency table: occupation and insect consumption

Table of occupation by insect consumption			
	Insect consumption		
Occupation	**No**	**Yes**	**Total**
Employed	13 14.243	75 73.757	88
Unemployed	5 5.1792	27 26.821	32
Student	10 8.578	43 44.422	53
Total	28	145	173

Source: Own work, SAS Studio

Table 12. Statistics for merged table of occupation and insect consumption

Statistic	**DF**	**Value**	**Prob**
Chi-Square	2	0.4180	0.8114
Likelihood Ratio Chi-Square	2	0.4097	0.8148
Mantel-Haenszel Chi-Square	1	0.0814	0.7754
Phi Coefficient		0.0492	
Contingency Coefficient		0.0491	
Cramer’s V		0.0492	

Source: Own work, SAS Studio

After adjusting the contingency table accordingly by merging similar rows together, none of the cells have expected counts less than 5. The conditions for a Chi-Square test are therefore satisfied. The p-value is greater than α, otherwise known as alpha and therefore the null hypothesis is accepted. In conclusion, there is **no significant relationship between occupation and insect consumption**.

4.3.4 Educational level and insect consumption

H_0: There is no relationship between educational level and insect consumption.
H_A: There is a relationship between educational level and insect consumption.
Let α=0.05

Table 13. Contingency table: educational level and insect consumption

Table of Educational level by insect consumption			
	Insect consumption		
Educational level	**No**	**Yes**	**Total**
No formal education	1 1.4566	8 7.5434	9
Primary	5 7.1214	39 36.879	44
Secondary	10 12.948	70 67.052	80
Post-secondary	12 6.474	28 33.526	40
Total	28	145	173

Source: Own work, SAS Studio

Table 14. Statistics for table of educational level and insect consumption

Statistic	DF	Value	Prob
Chi-Square	3	7.3533	0.0615
Likelihood Ratio Chi-Square	3	6.5948	0.0860
Mantel-Haenszel Chi-Square	1	2.7347	0.0982
Phi Coefficient		0.2062	
Contingency Coefficient		0.2019	
Cramer's V		0.2062	

Source: Own work, SAS Studio

Expected frequencies < 5 can only be maximum 20%. Table 13 shows that less than 20% of expected frequencies are less than 5. Therefore, the conditions for a Chi-Square test are satisfied and the Chi-Square test can be used. The p-value is greater than α, otherwise known as alpha and therefore the null hypothesis is accepted. In conclusion, there is **no significant relationship between educational level and insect consumption**.

4.3.5 Monthly income and insect consumption

H_0: There is no relationship between monthly income and insect consumption.
H_A: There is a relationship between monthly income and insect consumption.
Let α=0.05

Table 15. Contingency table: monthly income and insect consumption

Table of monthly income by insect consumption			
Monthly income	**Insect consumption**		
	No	**Yes**	**Total**
< $76.8	7 9.3873	51 48.613	58
$76.8 - $255.9	6 8.578	47 44.422	53
$256 - $511.8	7 5.6647	28 29.335	35
$511.8 and more	8 4.3699	19 22.63	27
Total	28	145	173

Source: Own work, SAS Studio

Table 16. Statistics for table of monthly income and insect consumption

Statistic	DF	Value	Prob
Chi-Square	3	5.6220	0.1315
Likelihood Ratio Chi-Square	3	5.1807	0.1590
Mantel-Haenszel Chi-Square	1	0.5501	0.4583
Phi Coefficient		0.1803	
Contingency Coefficient		0.1774	
Cramer's V		0.1803	

Source: Own work, SAS Studio

The conditions for a Chi-Square test are met. The p-value is greater than α, otherwise known as alpha and therefore the null hypothesis is accepted. In conclusion, there is **no significant relationship between monthly income and insect consumption**.

5. Results and Discussion

5.1 Main results

There were 173 samples collected from the questionnaire. There were 101 females accounting for 58% and the males were 72 accounting for 42% of the total samples. The questionnaire had more females than males, for that reason, the questionnaire is more representative of females than males. Among the respondents, 145 of them answered yes to the question 'Do you consume insects?' and this accounted for 84%. There were 28 respondents that answered no, accounting for 16%. Most respondents in the survey eat insects. The type of insects most preferred were flying termites that accounted for 46%. This was followed by caterpillars, accounting for 37% of respondents. During seasonal availability, majority of people consume edible insects always accounting for 42%. This is followed by people who consume insects often, accounting for 31% and 15% consume insects sometimes. Most respondents consume insects because of taste, and this accounts for 43%. High nutritional value then follows, accounting for 28%. Many respondents chose availability as the criterion used when purchasing insects which accounted for 46%. The criterion of price then follows which accounted for 36%. When it comes to the monthly expense on edible insects, most respondents chose the less than $2.6 category accounting for 52%.

This thesis uses a contingency table to analyse whether a relationship exists between personal factors and insect consumption in Zambia. Five hypotheses had to be evaluated. The results from SAS Studio revealed that four out of the five null hypotheses were accepted. The following outcomes were obtained after testing the hypotheses:

- There is no significant relationship between gender and insect consumption.
- There is a significant relationship between age and insect consumption.
- There is no significant relationship between occupation and insect consumption.
- There is no significant relationship between educational level and insect consumption.
- There is no significant relationship between monthly income and insect consumption.

5.2 Discussion of the results

The main types of insects consumed were flying termites and caterpillars. Van Huis (2020) reported that caterpillars and flying termites were among the most common insects consumed in Africa. Additionally, a study carried out by Hlongwane et al. (2020) found that caterpillars and flying termites were the insects that were most preferred by respondents. This study revealed that most respondents consume edible insects because of taste and high nutritional value. A report by Van Huis (2003) stated that edible insects are considered tasty by Africans. Dobermann et al. (2017) reported that in cultures where edible insect consumption is a norm, they are valued as a source of protein. Mmari et al. (2017) and Mutungi et al. (2019) also reported that nutrition played an important role in the consumption of edible insects. In this study, most respondents chose availability and price as the criteria used when purchasing edible insects. According to Abdullahi et al. (2021), insect availability is crucial to the consumption of edible insects. Because insects are only available during certain seasons, this hinders the regular consumption of edible insects. Edible insects are not always available throughout the year. As a result of this, they tend to be pricey in seasons of availability (Abdullahi et al., 2021).

In this study, the factor influencing insect consumption is age. The results obtained are similar to the studies conducted in South Africa by Hlongwane et al. (2020) and in Ghana by Anankware et al. (2017). The studies found that there is a significant impact between age and insect consumption. The younger generation do not know much or completely unaware of edible insect consumption. This is a consequence of young people adopting modern/western food culture and giving up traditional customs like eating insects. Westernization and globalization have changed people's diets. Because traditional foods like edible insects are now seen as taboo or dirty, younger people are less inclined to try them and opt for a western cuisine instead. Because of this, many younger people have started to be wary of eating insects or have even shifted away from this practice. A study of People in Botswana, carried out by Obopile & Seeletso (2013) showed a difference in knowledge about edible insects among different age groups. The study discovered that older people are more knowledgeable about unusual edible insects than younger people.

5.3 Recommendations and limitations of study

Majority of respondents in this study eat insects. The most consumed insects were flying termites and caterpillars. These findings can help marketers focus more on promoting flying termites and caterpillars to consumers in Zambia.

The motivations for insect consumption in this study are taste and high nutritional value. These findings are useful for marketers and businesses in the insect industry. Promoting the nutritional value of insects and developing tasty insect products could not only improve insect consumption but enhance sales too.

In this study, the criteria used when purchasing insects are availability and price. Insect rearing is an approach that can be used so that seasonal insects are available for even longer periods. Insect farming allows for businesses to keep running and make profits all year round. Prices of insects could be made more affordable in order to attract more customers.

This study revealed that there was a significant relationship between age and edible insect consumption. Businesses that deal with insects can target different age groups in a way that is appropriate for each group by using generational marketing techniques.

By educating people about the nutritional advantages of insects, the acceptance of edible insects by the general public can be increased. When processing edible insects traditionally, safety precautions like good hygiene procedures should be followed to guarantee food safety and quality in an effort to address health issues. Producing edible insects on a large scale will increase their availability. This will make it possible to produce more edible insects without having to rely on the common, established techniques of collecting them from the wild. Edible insects can be made more affordable in order to draw in more customers. How to gather and prepare edible insects more cheaply needs to be made more widely known. By doing this, the overharvesting of edible insects can be avoided. Last but not least, appropriate regulatory policies need to be established.

This study had some limitations. The sample size of 173 is only representative of a small group of people in Zambia, thus, the results could not be confirmed precisely. A larger sample size would be recommended for future research to get more generalised results that are representative of the whole country. The survey mainly consisted of respondents aged between 20 and 29. It is also important to note that majority of respondents had a secondary school level of education. Furthermore, majority of responses were from students. In future research, a sample with more variety would be recommended.

6. Conclusion

This thesis primarily focuses on investigating insect consumption and the factors that influence consumer behaviour in Zambia. There are discussions in the literature review about insect consumption in Zambia, consumer behaviour and factors influencing consumption of edible insects as food. The practical part deals with results obtained from the survey and the discussion part provides recommendations for insect businesses and marketers on how to promote the consumption of edible insects based on the results.

Edible insects have been consumed by Zambians for a very long time and even today, this practice is still ongoing. A variety of insects are consumed in Zambia. Nevertheless, other insects are enjoyed more than others. Most insects are harvested from the wild in rural areas whereas in urban areas, insects such as winged termites are usually captured near light sources since they are attracted to light.

Insects have numerous health, environmental, and economic benefits. They provide nutrients such as protein and many other micronutrients. Insects are more favourable compared to typical livestock when it comes to greenhouse gas emissions. Another benefit is that people can raise income from selling insects thereby improving their livelihoods.

In spite of the many benefits, the edible insect industry also faces some challenges such as consumer acceptability, health issues, availability, affordability, environmental issues, and legislative constraints. Consumer acceptability of edible insects can be enhanced by informing people about the nutritional benefits of insects. In order to combat health issues, safety precautions such as good hygiene practices should be followed during traditional processing of edible insects to ensure food safety and quality. Edible insects can be made more available by producing them on a massive scale. This will allow for more edible insects to be produced without relying on the usual traditional methods of collection in the wild. To attract more consumers, edible insects can be made more affordable. There should be more education regarding how to harvest and process edible insects in a more economical way. This could prevent the overexploitation of edible insects. Lastly, proper regulatory policies need to be put in place when it comes to the food and feed sector.

It is necessary for insect businesses to understand the concept of consumer behaviour. This is important not only for attracting but keeping their customers too. Insect businesses also need to understand the factors that affect insect consumption. It is important to examine

the factors that influence the choices made by consumers in order to create a product that is successful and to keep that success in the long run.

The practical part dealt with the results obtained from the questionnaire. Respondents who were female outnumbered those who were male. Most respondents consumed insects which means that there is a market for edible insects. Flying termites and caterpillars were the most preferred types of insects. These findings may assist marketers in concentrating more of their efforts on promoting caterpillars and flying termites to Zambian consumers. In this study, taste was the biggest motivation to consume insects and high nutritional value was the second biggest motivation. Marketers and insect-related businesses can develop insect products that taste good and also promote the nutritional value of insects. This could increase insect consumption and significantly improve sales. When it comes to criteria used when purchasing insects, majority of respondents chose availability. This was followed by the criterion of price. Insect rearing can be looked into so as to improve the availability of seasonal insects and to ensure businesses are running throughout the year. Affordable prices of insects can attract more customers.

In order to analyse whether there is a relationship between personal factors and insect consumption in Zambia, a contingency table was used. This was achieved by using the data analysis platform called SAS Studio. The results revealed that there was no significant relationship between insect consumption and gender, occupation, educational level as well as monthly income. The results however, confirmed that there was a significant relationship between insect consumption and age. Insect businesses can use generational marketing strategies to reach various age groups in a way that is specific to each age group.

There are, however, a few limitations to this research. The sample size was small, consequently, the results cannot be accurately confirmed. A larger sample size would be recommended for research that will be done in the future. The reason for this is to attain more generalised results that are representative of Zambia. Most of the respondents were between the ages of 20 and 29. In addition to this, most respondents were students and people with secondary school level of education. A sample with more variety would be recommended for future research.

7. References

Abdullahi, N., Igwe, E.C., Dandago, M.A. and Yunusa, A.K., 2021. Consumption of Edible-Insects: The Challenges and the Prospects. *Food ScienTech Journal*, 3(1), pp.1-24.

Agresti, A., 2013. *Categorical Data Analysis*. 3rd ed. New Jersey: John Wiley & Sons.

Anankware, P.J., Osekre, E.A., Obeng-Ofori, D. and Khamala, C.M., 2017. Factors that affect entomophagical practices in Ghana. *Journal of Insects as Food and Feed,* 3(1), pp.33-41.

Babicz-Zielińska, E., 2006. Role of psychological factors in food choice–a review. *Polish Journal of Food and Nutrition Sciences,* 15(56), pp.379-384.

Blythe, J. and Sethna, Z., 2019. *Consumer behaviour*. 4th ed. Los Angeles: SAGE.

Bolboacă, S.D., Jäntschi, L., Sestraş, A.F., Sestraş, R.E. and Pamfil, D.C., 2011. Pearson-Fisher chi-square statistic revisited. *Information,* 2(3), pp.528-545.

Caparros Megido, R., Sablon, L., Geuens, M., Brostaux, Y., Alabi, T., Blecker, C., Drugmand, D., Haubruge, É. and Francis, F., 2014. Edible insects acceptance by Belgian consumers: promising attitude for entomophagy development. *Journal of Sensory Studies,* 29(1), pp.14-20.

Chumngoen, W. and Tan, F.J., 2015. Relationships between descriptive sensory attributes and physicochemical analysis of broiler and Taiwan native chicken breast meat. *Asian-Australasian journal of animal sciences,* 28(7), p.1028.

Corotto, F.S., 2020. *Understanding Null Hypothesis Tests and Their Wise Use*. s.l.:s.n.

Dobermann, D., Swift, J.A. and Field, L.M., 2017. Opportunities and hurdles of edible insects for food and feed. *Nutrition Bulletin,* 42(4), pp.293-308.

Dürr, J. and Ratompoarison, C., 2021. Nature's "Free Lunch": The Contribution of Edible Insects to Food and Nutrition Security in the Central Highlands of Madagascar. *Foods,* 10(12), p.2978.

Elmadfa, I. ed., 2005. *Diet diversification and health promotion (Vol. 57).* Basel: Karger Medical and Scientific Publishers.

Enriquez, J.P. and Archila-Godinez, J.C., 2022. Social and cultural influences on food choices: A review. *Critical Reviews in Food Science and Nutrition,* 62(13), pp.3698-3704.

Fagerland, M., Lydersen, S., & Laake, P., 2017. *Statistical Analysis of Contingency Tables*. 1st ed. New York: Chapman and Hall/CRC.

FAO (Food and Agriculture Organization), 2022. *'Worm' up to the idea of edible insects: Four reasons why edible insects are good prospects for food security and livelihoods*. [online] Available from: https://www.fao.org/fao-stories/article/en/c/1603016/ [Accessed 13 09 2022].

Florença, S.G., Guiné, R.P., Gonçalves, F.J., Barroca, M.J., Ferreira, M., Costa, C.A., Correia, P.M., Cardoso, A.P., Campos, S., Anjos, O. and Cunha, L.M., 2022. The motivations for consumption of edible insects: A systematic review. *Foods,* 11(22), p.3643.

Font-i-Furnols, M. and Guerrero, L., 2014. Consumer preference, behavior and perception about meat and meat products: An overview. *Meat Science,* 98(3), pp.361-371.

Fróna, D., Szenderák, J. and Harangi-Rákos, M., 2019. The challenge of feeding the world. *Sustainability,* 11(20), p.5816.

Gajjar, N.B., 2013. Factors affecting consumer behavior. *International Journal of Research in Humanities and Social Sciences,* 1(2), pp.10-15.

Halloran A. and Vantomme P., 2013. *The Contribution of Insects to Food Security, Livelihoods and the Environment*. [online] Available from: https://www.fao.org/3/i3264e/i3264e00.pdf [Accessed 27 01 2023].

Hlavsa, T., 2016. *Statistics I*. Prague: s.n.

Hlavsa, T., 2022. *Statistics II*. Lectures & Seminars of bachelor's programme Economics and Management, FEM CULS Prague, from 07.02.2022 to 25.04.2022. Professor from CULS (Prague).

Hlavsa, T. and Pacáková, Z., 2020. *Statistics II*. Prague: s.n.

Hlongwane, Z.T., Slotow, R. and Munyai, T.C., 2020. Indigenous knowledge about consumption of edible insects in South Africa. *Insects,* 12(1), p.22.

Illgner, P. and Nel, E., 2000. The geography of edible insects in sub-Saharan Africa: A study of the mopane caterpillar. *Geographical Journal,* 166(4), pp.336-351.

Insel, P., Ross, D., McMahon, K. and Bernstein, M., 2018. *Discovering Nutrition*. Loose Leaf ed. Burlington: Jones & Bartlett Learning.

Jansson, A., Hunter, D. and Berggren, Å., 2019. *Insects as food–an option for sustainable food production?*. Uppsala: Swedish University of Agricultural Sciences, the research platform Future Food.

Jisana, T.K., 2014. Consumer behaviour models: an overview. *Sai Om Journal of Commerce & Management,* 1(5), pp.34-43.

Kardes, F., Cronley, M. and Cline, T., 2014. *Consumer Behavior*. 2nd ed. Stamford: Cengage Learning.

Kateri, M., 2014. *Contingency table analysis. Methods and Implementation Using R.* Basel: Birkhäuser.

Kauppi, S.M., Pettersen, I.N. and Boks, C., 2019. Consumer acceptance of edible insects and design interventions as adoption strategy. *International Journal of Food Design,* 4(1), pp.39-62.

Keller, C. and Siegrist, M., 2015. Does personality influence eating styles and food choices? Direct and indirect effects. *Appetite,* 84, pp.128-138.

Kouřimská, L. and Adámková, A., 2016. Nutritional and sensory quality of edible insects. *NFS journal,* 4, pp.22-26.

Kulick, R., 2002. *A measure for ending hunger in the United States*. s.l.:s.n.

Kuntsche, E., Knibbe, R., Gmel, G. and Engels, R., 2005. Why do young people drink? A review of drinking motives. *Clinical psychology review,* 25(7), pp.841-861.

Lamb, C.W., Hair, J.F. and McDaniel, C., 2020. *MKTG*. 13th ed. Boston: Cengage Learning.

Lim, S.M., Thien, C.N., Toure, A.K. and Poh, B.K., 2022. Factors Influencing Acceptance of Grasshoppers and Other Insects as Food: A Comparison between Two Cities in Malaysia. *Foods*, 11(20), p.3284.

Mak, A.H., Lumbers, M., Eves, A. and Chang, R.C., 2012. Factors influencing tourist food consumption. *International Journal of Hospitality Management*, 31(3), pp.928-936.

Matandirotya, N.R., Filho, W.L., Mahed, G., Maseko, B. and Murandu, C.V., 2022. Edible insects consumption in Africa towards environmental health and sustainable food systems: a bibliometric study. *International Journal of Environmental Research and Public Health*, 19(22), p.14823.

Mbata, K.J., Chidumayo, E.N. and Lwatula, C.M., 2002. Traditional regulation of edible caterpillar exploitation in the Kopa area of Mpika district in northern Zambia. *Journal of Insect Conservation*, 6, pp.115-130.

McKiernan, F., Houchins, J.A. and Mattes, R.D., 2008. Relationships between human thirst, hunger, drinking, and feeding. *Physiology & behavior*, 94(5), pp.700-708.

Mela, D.J., 2001. Determinants of food choice: relationships with obesity and weight control. *Obesity Research*, 9(S11), pp.249S-255S.

Mmari, M.W., Kinyuru, J.N., Laswai, H.S. and Okoth, J.K., 2017. Traditions, beliefs and indigenous technologies in connection with the edible longhorn grasshopper Ruspolia differens (Serville 1838) in Tanzania. *Journal of ethnobiology and ethnomedicine*, 13, pp.1-11.

Mutungi, C., Irungu, F.G., Nduko, J., Mutua, F., Affognon, H., Nakimbugwe, D., Ekesi, S. and Fiaboe, K.K.M., 2019. Postharvest processes of edible insects in Africa: A review of processing methods, and the implications for nutrition, safety and new products development. *Critical Reviews in Food Science and Nutrition*, 59(2), pp.276-298.

Mwanza, A., 2021. *Consumption or profit? edible caterpillars collection in Northern province of Zambia, 1950-2019* (Master's thesis). Lusaka: University of Zambia.

Ngugi, I.K., O'Sullivan, H. and Osman, H., 2020. *Consumer Behaviour in Food and Healthy Lifestyles: A Global Perspective*. Wallingford: Centre for Agriculture and Bioscience International (CABI).

New International Version Bible. *New International Version Bible*. [online] Available from: https://web.mit.edu/jywang/www/cef/Bible/NIV/NIV_Bible/LEV+11.html#:~:text=%22%60All%20flying%20insects%20that%20walk,%2C%20katydid%2C%20cricket%20or%20grasshopper. [Accessed 05 02 2023].

Niassy, S., Omuse, E.R., Roos, N., Halloran, A., Eilenberg, J., Egonyu, J.P., Tanga, C., Meutchieye, F., Mwangi, R., Subramanian, S. and Musundire, R., 2022. Safety, regulatory and environmental issues related to breeding and international trade of edible insects in Africa. *Scientific and Technical Review*, 41(1), pp. 117-131.

Nowacki, A., 2017. Chi-square and Fisher's exact tests. *Cleve Clin J Med*, 84(9 suppl 2), pp.e20-5.

Obopile, M. and Seeletso, T.G., 2013. Eat or not eat: an analysis of the status of entomophagy in Botswana. *Food security*, 5, pp.817-824.

Olsen, R.A., 2008. Cognitive dissonance: the problem facing behavioral finance. *Journal of Behavioral Finance*, 9(1), pp.1-4.

Pieniak, Z., Verbeke, W., Vanhonacker, F., Guerrero, L. and Hersleth, M., 2009. Association between traditional food consumption and motives for food choice in six European countries. *Appetite*, 53(1), pp.101-108.

Raheem, D., Carrascosa, C., Oluwole, O.B., Nieuwland, M., Saraiva, A., Millán, R. and Raposo, A., 2019. Traditional consumption of and rearing edible insects in Africa, Asia and Europe. *Critical reviews in food science and nutrition*, 59(14), pp.2169-2188.

Ramya, N.A.S.A.M. and Ali, S.M., 2016. Factors affecting consumer buying behavior. *International journal of applied research*, 2(10), pp.76-80.

Reddy, S. and Anitha, M., 2015. Culture and its influence on nutrition and oral health. *Biomedical & Pharmacology Journal*, 8(SpecialOct), p.613.

Ruby, M.B. and Rozin, P., 2019. Disgust, sushi consumption, and other predictors of acceptance of insects as food by Americans and Indians. *Food Quality and Preference*, 74, pp.155-162.

Serraj, R., Krishnan, L. and Pingali, P., 2019. Agriculture and food systems to 2050: a synthesis. *Agriculture and Food Systems to 2050*, pp.3-45.

Serra, N., Rea, T., Di Carlo, P. and Sergi, C., 2019. Continuity correction of Pearson's chi-square test in 2x2 Contingency Tables: A mini-review on recent development. *Epidemiology Biostatistics and Public Health*, 73(3), pp.822-834.

Shahbandeh, M., 2022. *Forecast market value and volume of edible insects worldwide from 2032 to 2032*. [online] Available from: https://www.statista.com/statistics/882321/edible-insects-market-size-global/ [Accessed 06 02 2023].

Shepherd, R. and Raats, M. eds., 2006. *The psychology of food choice (Vol. 3)*. Wallingford: CABI.

Siulapwa, N., Mwambungu, A., Lungu, E. and Sichilima, W., 2014. Nutritional value of four common edible insects in Zambia. *International Journal of Science and Research*, 3(6), pp. 876-884.

Solomon, M.R., 2009. *Marketing: Real people, real decisions*. 1st European ed. Harlow: Pearson Education.

Stankevich, A., 2017. Explaining the consumer decision-making process: Critical literature review. *Journal of international business research and marketing*, 2(6), pp. 7-14.

Steenhuis, I.H., Waterlander, W.E. and De Mul, A., 2011. Consumer food choices: the role of price and pricing strategies. *Public health nutrition*, 14(12), pp.2220-2226.

Stevens, E., 2022. *4 Levels of Measurement: Nominal, Ordinal, Interval & Ratio*. [online] Available from: https://careerfoundry.com/en/blog/data-analytics/data-levels-of-measurement/ [Accessed 04 02 2023].

Van der Laan, L.N., De Ridder, D.T., Viergever, M.A. and Smeets, P.A., 2012. Appearance matters: neural correlates of food choice and packaging aesthetics. *PloS one*, 7(7), p.e41738.

Van Huis, A., 2003. Insects as food in sub-Saharan Africa. *International Journal of Tropical Insect Science*, 23(3), pp.163-185.

Van Huis, A., 2013. Potential of insects as food and feed in assuring food security. *Annual review of entomology*, 58, pp.563-583.

Van Huis, A., 2016. Edible insects are the future? *Proceedings of the Nutrition Society*, 75(3), pp.294-305.

Van Huis, A., 2020. Importance of insects as food in Africa. *African edible insects as alternative source of food, oil, protein and bioactive components*, pp.1-17.

Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. and Vantomme, P., 2013. *Edible insects: future prospects for food and feed security (No. 171)*. Rome: Food and Agriculture Organization (FAO) of the United Nations.

8. List of Tables, Figures, and Abbreviations

8.1 List of tables

8.2 List of figures

8.3 List of abbreviations

Apr: April
Aug: August
BC: Before Christ
BCE: Before Common Era
Dec: December
FAO: Food and Agricultural Organization
Jan: January
kg: kilogram
Mar: March
Nov: November
Oct: October
SAS: Statistical Analysis System
Sept: September
U.S.: United States

9. Appendix

Questionnaire

Part 1: Background information

1. What is your gender?

- ○ Male
- ○ Female

2. What is your age group?

- ○ Below 20
- ○ 20-29
- ○ 30-39
- ○ 40-49
- ○ Over 49

3. What is your current occupation?

- ○ Full-time employment
- ○ Part-time employment
- ○ Self-employed
- ○ Unemployed
- ○ Student
- ○ Other

4. What is your highest level of education?

- ○ No formal education
- ○ Primary school
- ○ Secondary school
- ○ Post-secondary

5. What is your estimated average monthly income?

- ○ Below 1500 Kwacha ($76.8)
- ○ 1500 - 4999 Kwacha ($76.8 – $255.9)
- ○ 5000 - 9999 Kwacha ($256 – $511.8)
- ○ Above 9999 Kwacha (Above $511.8)

Part 2: Experience with edible insect consumption

6. Do you consume insects?

- ○ Yes
- ○ No

7. What's your preferred type of insect?

- ○ None
- ○ Caterpillars
- ○ Grasshoppers
- ○ Flying termites
- ○ Other

8. How often do you eat insects during seasonal availability?

- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Often
- ○ Always

9. Which of these best describes why you consume insects?

- ○ None
- ○ Habit
- ○ Health benefits
- ○ Taste
- ○ High nutritional value
- ○ Others

10. What criteria do you follow when purchasing edible insects?

- ○ None
- ○ Convenience
- ○ Availability
- ○ Packaging
- ○ Price
- ○ Others

11. What is your monthly expense on insects?

- ○ None
- ○ Less than 50 Kwacha ($2.6)
- ○ 50 Kwacha - 149 Kwacha ($2.6 – $7.6)
- ○ More than 149 Kwacha ($7.6)