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Research

Rhynchophorus phoenicis(African Palm Weevil) Infestation of Elaeis guineensis(Oil Palm Tree): Research on Life Cycle and Nutritional Potential for Food Security

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Abstract: Consumption and utilization of insect food have been affected by several challenges, especially not understanding its biology and lack of nutritional insight as well as social unacceptability. The infestation and acceptability of African oil palm weevil-APW (Rhynchophorus phoenicis) was studied using standard scientific cycle analyis (biological and well structured nutritional acceptability survey) procedures that crvers percentages, averages , correlation using google analytics and excel.The life cycle was studied at their natural habitat and as well as using a controlled setting of the habitat. Accpetibility studies wer done through effective questionnaire distributed online. Results from the study showed the life cycle of palm weevil passed through the egg to larvae stage, to pupae and adults.in a life cycle of two months (8 weeks). On the survey for nutritional acceptability, the demographic information indicated that 78% of the respondents were between ages 18 - 45 years, male (56 %); 98% of the respondents (98%) had some levels of tertiary education were urban dwellers (84%) . The section which assayed the level of knowledge and perception showed that 26% were very familiar with palm weevil as source of nutrient , and further more 78% opined that it is nutrition paramount in the choice of food. The food preference and acceptability indicated that more than 32% would rank it as beef, more than 40% as Egg, more than 46% to fish, more than 28% as cricket, 22% ranks as grasshopper, more than 54% as chicken. On the factors that would influence the willingness to consume APW, Nutritional value is considered the predominant factor amongst (60%) .of the population while 70% approved it fully nutrition wise. High protein content (64 %),consumer acceptance(64%), and economic opportunities (52%) are the major concerns indicated. More than 38% would very likely include APW as complimentary diet.. Nutritional information (80%) would encourage the choice of the consumption of APW as diet. It is thus noteworthy that the commercialization of APW would be accepted as a major diet if the aforementioned factors are considered. And this would reduce nutritional problems in the region.

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Keywords: Life Cycle, Nutrition, Diet, Proteins, Assay

INTRODUCTION

The larvae of the palm weevil (*Rhynchophorus phoenicis*) is a devastating plant pest but also a cherished as snack among many communities in Nigeria and around the world, especially in those places where palms (oil, raphia and coconut) are cultivated on commercial basis Frontiers in Nutrition, 2024; Chinarak, 2023; DeFoliart, 1992; Allotey and Mpuchane, 2003; Choon-Fah *et al*., 2008). The African Palm Weevil (APW) (*R. phoenicis*) (Olivier, 1790) is a large curculionid beetle belonging to the sub-family Rhynchophorinae. It is one of two species of snout weevil known as the African palm weevil (APW), palm weevil or sago palm weevil. The adult weevil are relatively large, ranging between two and four centimeters long, and are usually a rusty red colour—but many colour variants exist and have often been classified as different species (e.g., *Rhynchophorus vulneratu*s). Males can be easily identified by the presence of thick, erect dorsal setae on rostrum whereas in females, rostrum is longer, slender, more cylindrical and lacks setae (Rochat *et al*, 2017). Weevil larvae can excavate holes in the trunk of a palm trees up to a metre long, thereby weakening and eventually killing the host plant. As a result, the weevil is considered a major pest in palm plantations, including the coconut palm, date palm and oil palm (Ezieshi *et al*., 2011). Originally from tropical Asia, the African palm weevil (APW) has spread to Africa and Europe, reaching the Mediterranean in the 1980s, other North African countries as well as in the Americas (Eyaguobor *et al*., 2023; Ekpo & Onigbinde, 2005; Steve *et al*., 2009; Stack et al., 2003; Kehat, 1999)

Insects are still the best alternatives to the increasing cost accumulating and environmental degrading insects in a globe that is encompassed with economic and climatic issues. Insects like crickets, African palm weevil, etc have been proven to be nutrient dense especially as related to protein -energy nutrition (Chen *et al*. 2024, Eyaguobor *et al*., 2023 and Ehoche et al., 2019).

1.1 Aim and Justification of Study

Larvae of palm weevil (*Rhynchophorus phoenicis*) are considered a delicacy in many African countries. In some regions, however, larvae farming is strictly prohibited to prevent the potential devastation of crops. This makes for the underutilized of this nutrient rich food source. As such the need for carry out the following study: to investigate the

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infestation of oil palm trees by palm weevil (*R. phoenicis*) in Niger Delta University, New Site Campus, Bayelsa State, Nigeria as well as study its consumption and production investigations as a potential major food source. The result would help provide a better insight on the biology, nutritional potential for consumption and production prospects of the insect.

MATERIALS AND METHODS

The work was in two phases. This included the biological assay for life cycle (both field and laboratory studies) using Hand Gloves, Safety shoes, Cutlass, Plastic containers, Petri-dish, Axe, *Rhynchophorus phoenicis*. Then the use of a well structured questionnaire was employed to assay the consumption and production potentials.

Field Procedure Biological Assay

A forest in Niger Delta University close to the new site (campus) in Amassoma, Bayelsa State was visited withpersonal safety fears and observational tools for sestructive monitoring from the pupal stage of palm weevil was using an average hieght palm tree. The palm tree was cut at the leaf scars in a bit to make it open for the adult palm weevil to arrive at the breeding site. It was cut to a point where the palm tree became soft. Six days after, the prepared oil palm was visited to assess the level of decomposition. The number of adult palm weevils present at the decomposing site of the palm were counted and then sexes were identified. The next visitation to the prepared oil palm was done after one month and two weeks (six weeks) when the infested oil palm was cut down to count the numbers of adults, pupae and larvae found in the palm. The various stages of the palm were put in separate plastic containers, labeled and taken to the laboratory for further observations.

After on month and three (3) weeks, the forest was visited for the third time and it was observed that the adult females of the palm weevil (*Rhynchophorus phoenicis*) had laid eggs which was the first generation of the life cycle in palm weevil. After two (2) months, eight (8) larvae stages of the palm weevil and palm tissues were collected and placed in plastic containers having holes for the purpose of ventilation and taken to the laboratory.

Breeding Trials for the Larval Stages of the Palm Weevils in the Laboratory

Four plastic buckets were used in the breeding of the larvae of the palm weevil (Rhynchophorus phoenicis). Perforations were made on the lid of the buckets to allow oxygen into the buckets. Oil palm tissue was used as feed to breed the larvae. The moisture level of the palm tissue was moderate. The eggs of the oil palms weevil (*Rhynchophorus*

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phoenicis) was first observed but after a period of two (2) months it was found that the larvae stage of the palm weevil (*Rhynchophorus phoenicis*) was fully formed.



Plate 1: Oil Palm cut open for palm weevil infestation in Niger Delta University New Site Campus, Bayelsa State



Plate 2: Oil Palm damaged due to palm weevil infestation

The Well-Structured Questionnaire

A well-structured questionnaire was administered to 50 randomly selected internet users in the Nigerian internet space using the link https://forms.gle/d3SFnuA4LfGsWzea7 . The questionaire contained five sections for a non-subjective but comprehensive analysis.

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These include the demographic information, the level of knowledge and perception, food preference and acceptability with respect to production/ farming of APW and the desire to farm APW as a major diet. Both internal and external validt was done comparing with standards and by engaging the imput of senior specialists in nutrition and survey.

Statistical analysis was done using googlr analytics for percentages, means and correlations at 5% probability

RESULTS AND DISCUSSION

Life Cycle Studies

Results from the study on the infestation by palm weevils (*Rhynchophorus phoenicis*) larvae in oil palm trees. From the study, the larval stage of the oil palm weevils were seen after the eggs stage of the palm weevils. Eggs were found in the oil palm tree which later metamorphosed into the larval stage after a period of two weeks. Observations of the infestations of palm trees by palm weevils (*R. phoenicis*) showed that palm weevil infestation begins from the laying of eggs (plate 3) which hatched to form the larvae stage of palm weevil (*R. phoenicis*) (plate 4 and 5) and metamorphoses to pupal stage of the palm weevil. It took 2-3 month for the life cycle to be completed in the palm trees in Niger Delta University, New Site Campus, and Bayelsa State, Nigeria. Meanwhile it took 3-4 weeks to get to the larvae while the larvae took 8 weeks to develop to the pupae stage which later develops to adult stage. This life cycle outcomes is similar to findings by Chinarak, P. (2023).

The are reports on about high 17 amino acid rich proteins and olieic and palmitic fatty rich acid content (at the early and middle) larva stages respectively as high as 53.87% by weight and 67.95 % by weight.larvas are also rich in minerals like K and P``````````(Chen *et al*., 2024 and Zhou, 2023). these values are in par and even higher than reports for beef, chicken,pork, fish , crayfish, soya beans and fish , all traditional protein and fat sources(Promwee *et al*., 2023; Mensah *et al*., 2023; Ekpo & Onigbinde, 2007)

There is still more possibilities of higher nutrients accumulating in them by inculcating them in their feeds during farming. These nutrient dense stages coupled with the short turnover time of less than 2 months indicates a cheaper and quick source of food when compared to conventional protein sources with respect to sustainability and by inference, environmental impact (Adebiyi *et al*., 2024).

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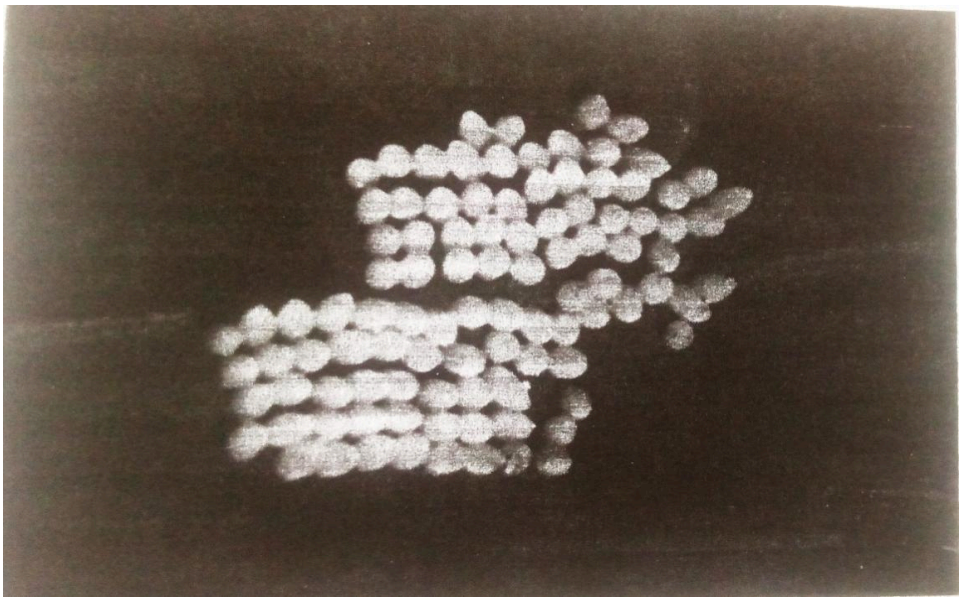


Plate 3: Laying of Eggs



Plate 4. Larvae stage of Rhynchophorus phoenicis

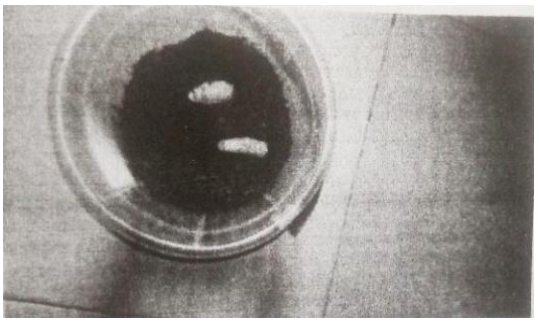


Plate 5. Larvae stage of palm weevil

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Survey Analysis

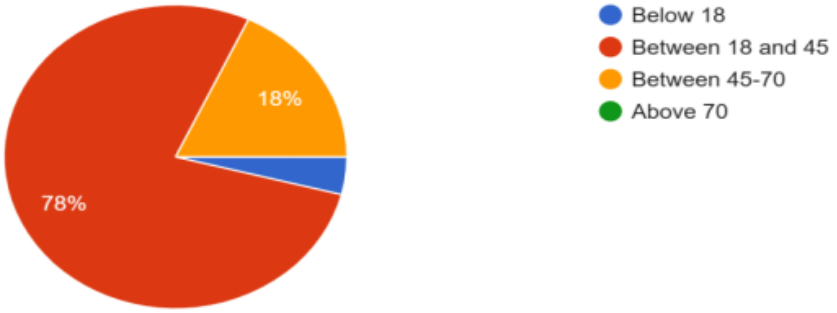


Figure 1. Ages(years) of respondents

The demographic information indicated that 78% of the respondents were between ages 18 - 45 years(Figure 1). This represents significant youth population.Male (Figure 2)respondents were a little above average (56 %). Figure 3 showed that 98% of the respondents had some levels of tertiary education which indicates increased level of literacy by internet users. More of the respondents were urban dwellers (84% , Figure 4) suggesting wide acceptance of a supposed to be rural diet. Naomesi et al (2023) added that a robust health awareness drive across the populations can encourage approval and uptake of the food. These demographic representation would reflect in the opinions the that follows.

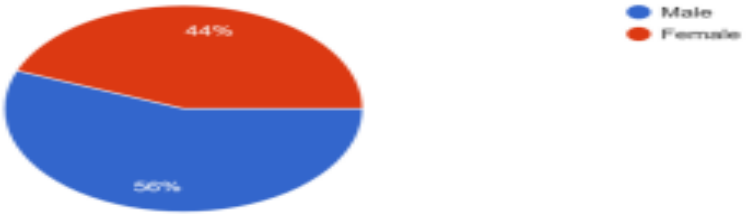


Figure 2 . Gender

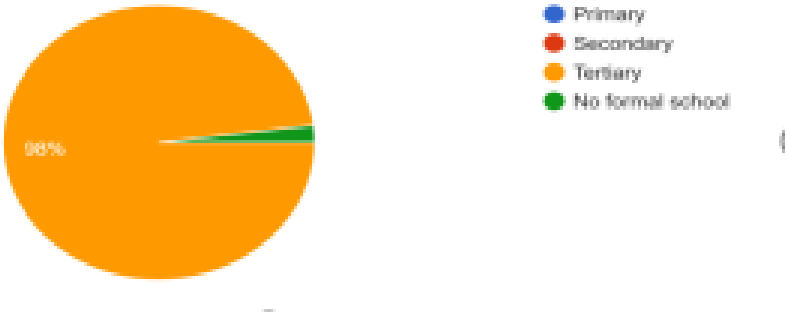


Figure 3. Educational level

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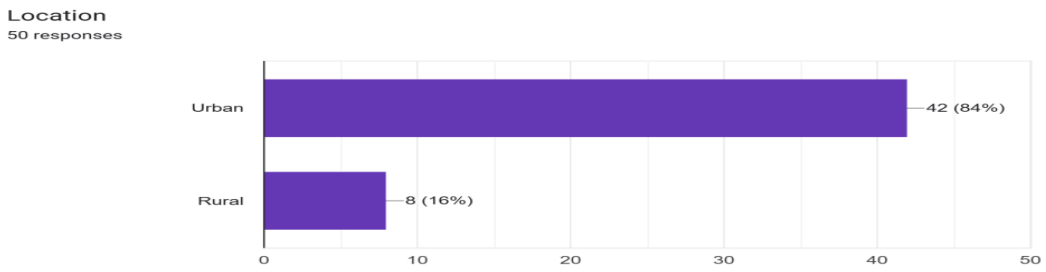


Figure 4. Location of residence

The section 2 which assayed the level of knowledge and perception showed that 26% were very familiar and 18% were not familiar at all. The remain percentages had some level of familiarity(Figure 5). While 78% opined that nutrition paramount in the choice of food,10% of the population did not consider it important(Figure 6). this is also inline with review of Siddiqui *et al*. (2024) recommending APW as sustainable protein source and they further added the need for standardization.

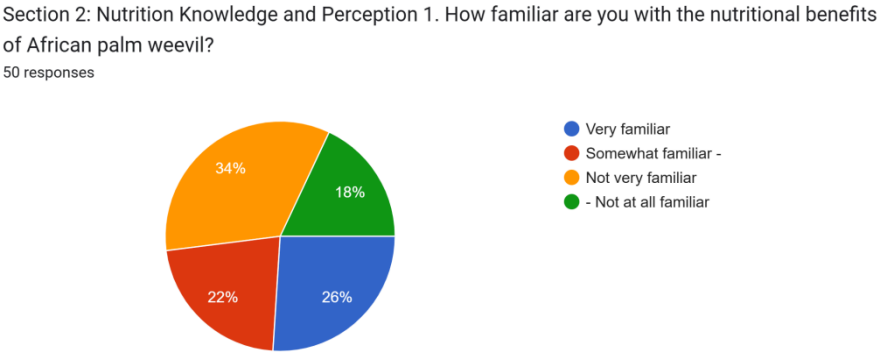


Figure 5.Knowledge and perception

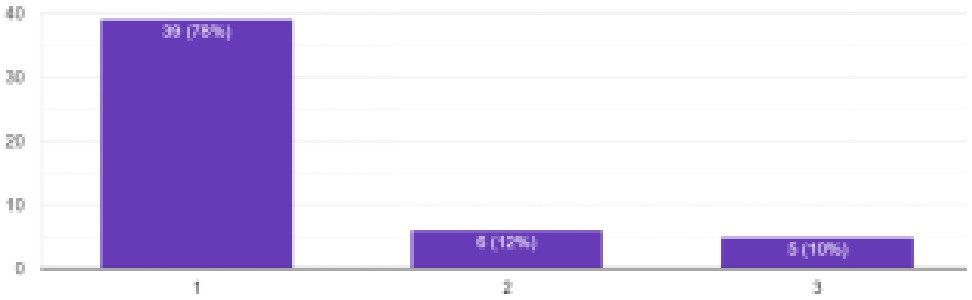


Figure 6.Importance of nutrition in food choice

The third section of the survey considered food preference and acceptability . this compares the ranking perception of African palm weevil with well acceptable traditional food. Of these, 32% would ran it as beef, 24% would not(Figure 7), 40% ranks it as

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Egg,32% would not consider it so(Figure 8),46% compares it to fish, 32% would not,28% as cricket,14% and 54% would not place it the same rank as cricket.while 22% ranks the meal as grasshopper,58% do not.54% ranks them as chicken. This suggests a high acceptance value from the poles as compared to traditionally consumed protein foods.(see Figures 9-11). This contributes to the reports presented by Noamesi and Oppong (2023)

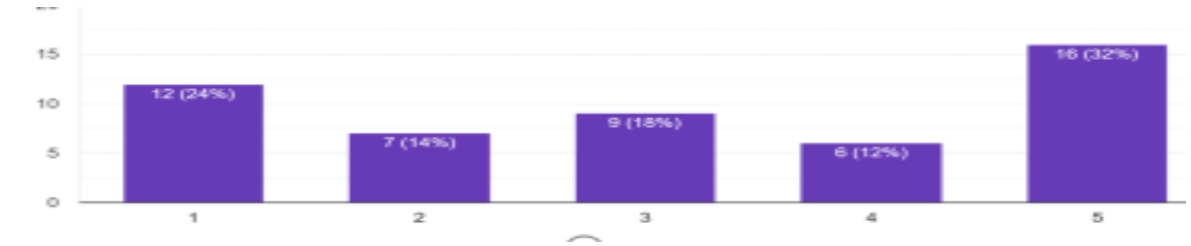


Figure 7. Perception on Food preference and acceptability rank as Beef

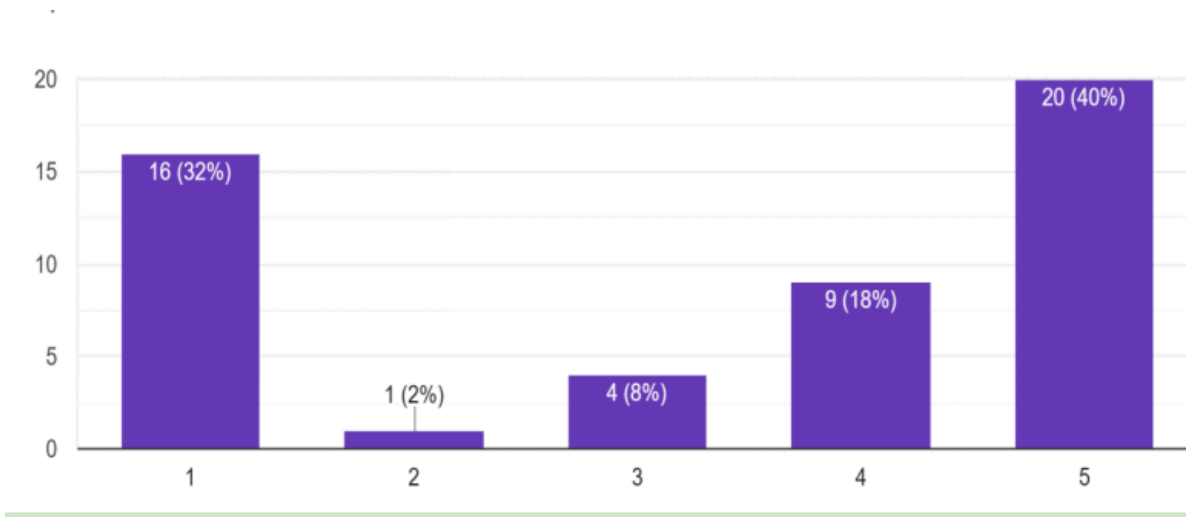


Figure 8. Perception on Food preference and acceptability rank as Egg

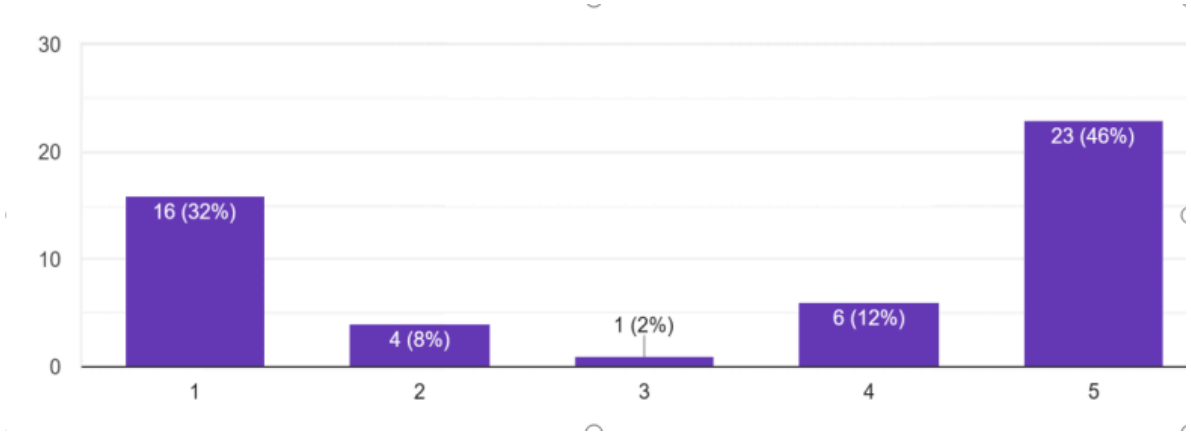


Figure 9. Perception on Food preference and acceptability rank as fish

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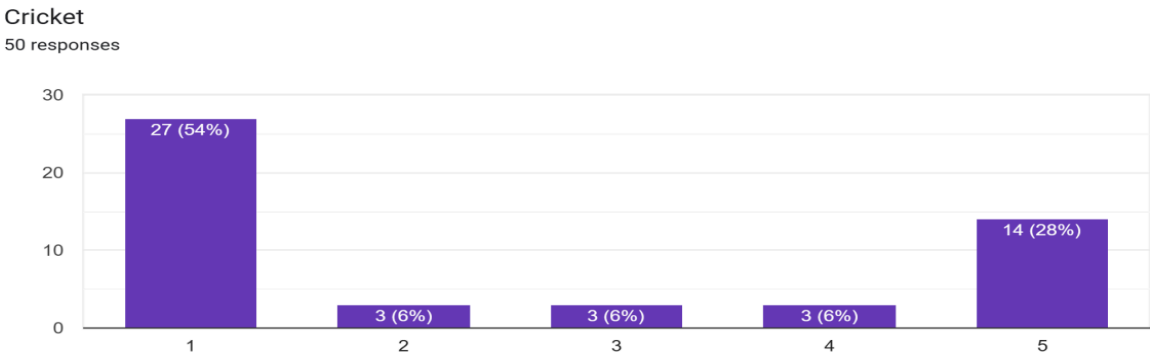


Figure 9. Perception on Food preference and acceptability rank as Cricket

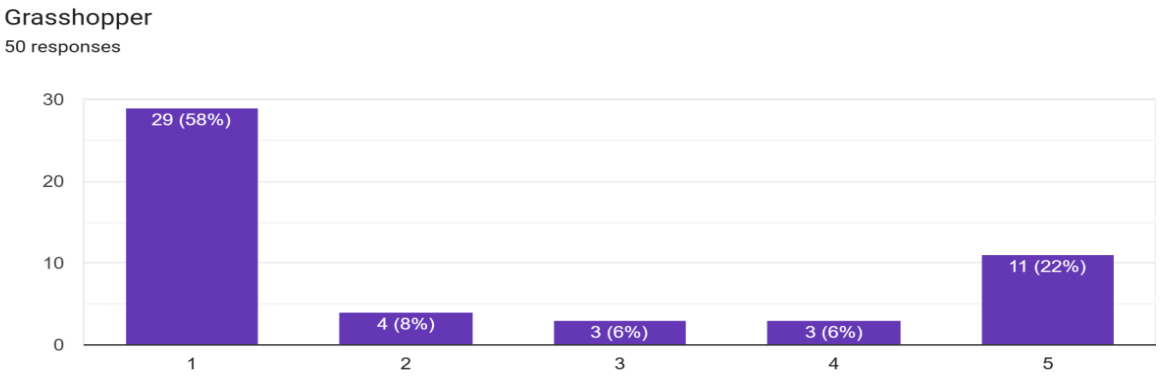


Figure 10. Perception on Food preference and acceptability rank as Grasshopper

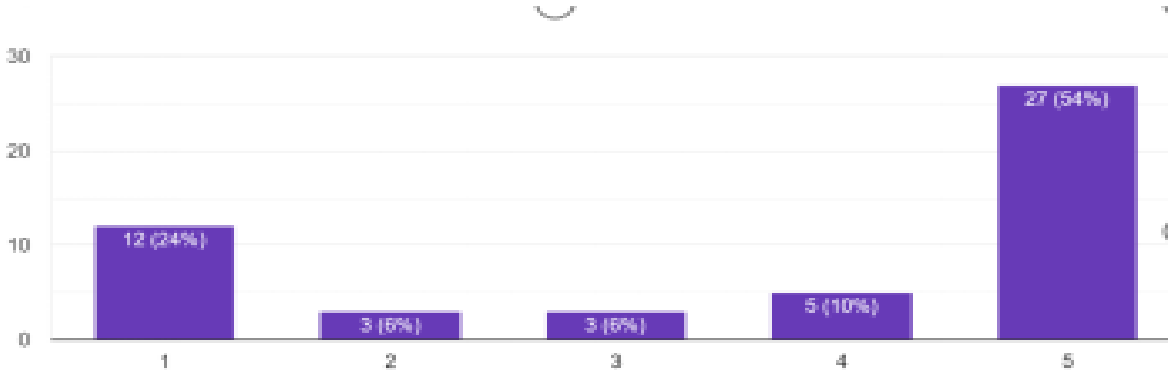


Figure 11. Perception on Food preference and acceptability rank as Chicken

On the factors that would influence the willingness to consume APW,there response were as follows: taste(32%),Nutritional value (60%),Environmental

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sustainability(20%),cultural acceptance(22%)and other factors(30%). Correlation between benefits and concern showed to be positively correlated , Nutritional value is the predominant factor. Various reports have established the rich nutrient composition and digestibility studies of APW(Frontiers in Nutrition 2024, Chinarak, 2023, Eyaguobor *et al* 2023), Adeparusiet al 2023, Ekpo & Onigbinde2005).

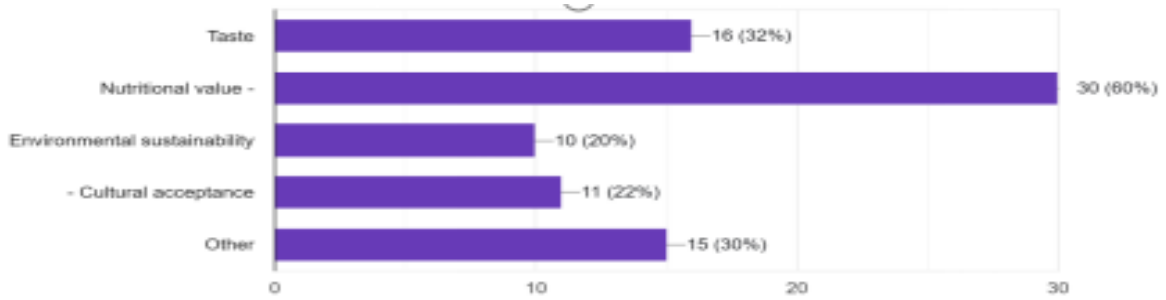


Figure 12. Factors influencing willingness to consume APW

With respect to production/ farming of APW(Figures 13-15),70% of the population approved it. The following benefits from farming the insect was responded to: high protein content (64 %),economic opportunities (52%) and food security (20%). With respect to concerns, the following apply : food safety (52%), Scalability(20%),consumer acceptance(64%),and regulatory frame work (26%).

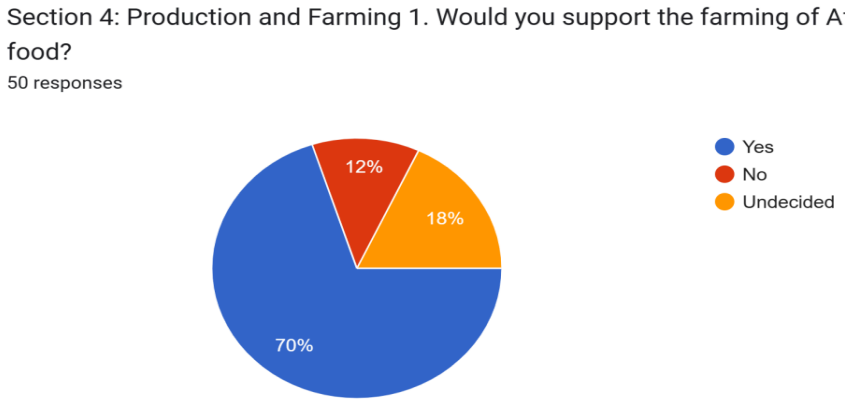


Figure 13. Support for African weevil for food

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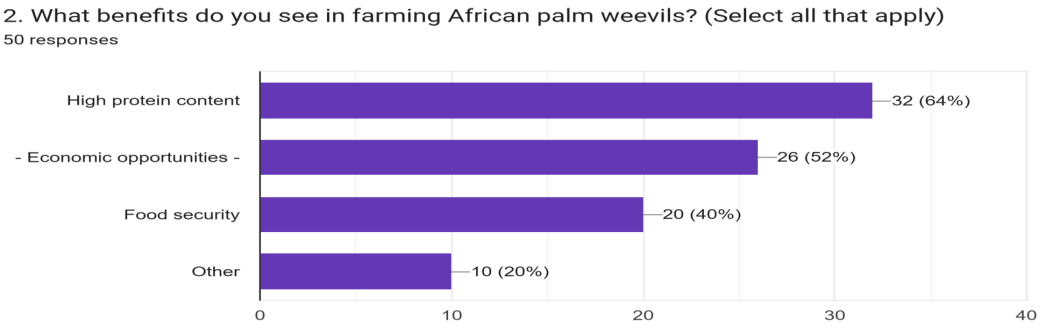


Figure 14. Benefits of farming APW

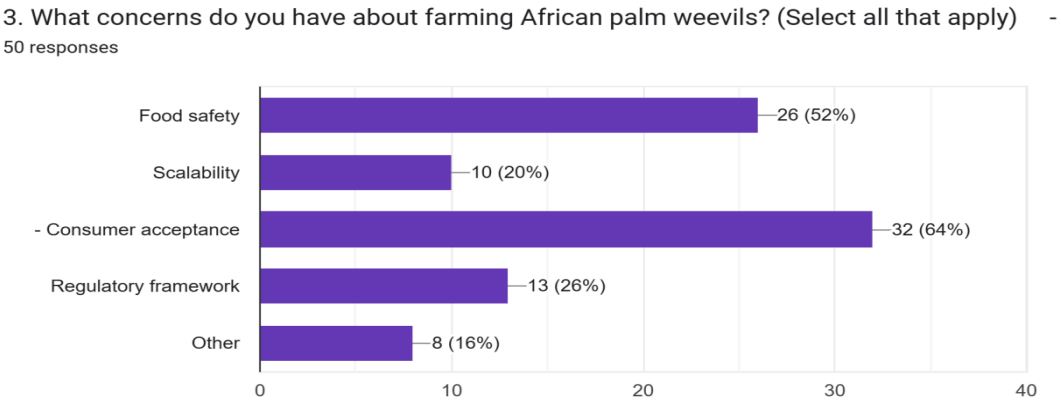


Figure 15. concerns about farming APW

As to the desire to farm APW as a major diet(figures 16-17), 38% would very likely include it in their major diet, 22% would not and the rest had some degree of likelihood. Recipe and cooking demonstration(24%), nutritional information(80%),Environmental benefits(24%) and celebrity endorsement(16%) would encourage the choice of the consumption of APW as diet. Again nutritional information tops the list. This along with environmental concerns are essential in the considerations as APW for food or feed(Adebiyi *et al*,, 2024).

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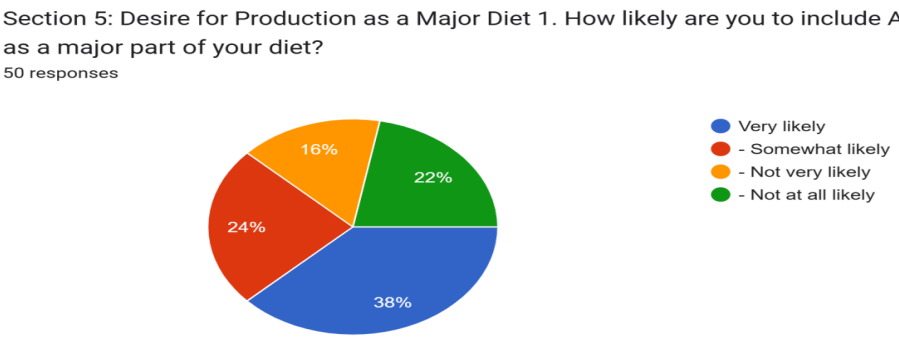


Figure 16. APW as major Diet

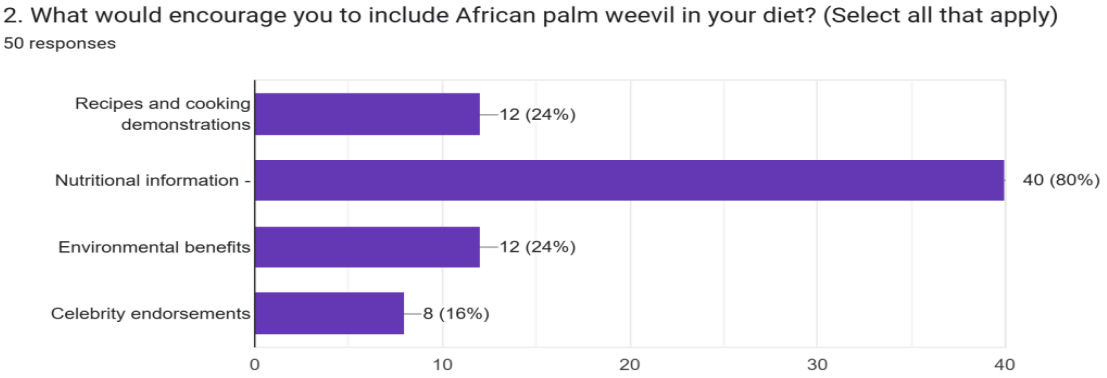


Figure 17. Factors on including APW in diet

The comments reflect a positive perception towards the consumption and farming of APW. These are shown below

CONCLUSION AND RECOMMENDATION

In conclusion, from this project, it was observed that the life cycle of palm weevil (*Rhynchophorus phoenicis*) took 2-3 months (8-12 weeks) from laying of eggs by the adult to form larvae which develop to pupae and finally adult emerged. It took 2-3 months for the life cycle to be completed in palm trees in Niger Delta University, New Site Campus, and Bayelsa State, Nigeria. While it lasted for 3-4 weeks to get to the larvae to pupae; 8 weeks from the pupa to adult stage. APW is an accepted source of nutrient and is recommended for commercial farming to meet the increasing global nutrient demands. Organoleptic scoring and pilot commercial farming is recommended for further studies.

CONFLICT OF INTEREST

Authors declare there are no conflicts of interest.

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