

**EDIBLE INSECTS AND DIETARY CHOICES: FACTORS
AFFECTING WOMEN'S ACCEPTANCE OF PALM WEEVIL
LARVAE IN ASHANTI, GHANA**

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Abstract: For Ghanaian women of reproductive age (WRA), anemia remains a pressing issue. Currently, at the global level, anemia affects 35% of this population according to the most recent “State of Food Security and Nutrition in the World” report. In Ghana, anemia is mostly associated with iron deficiency and, if left untreated, could result in several adverse outcomes including severe fatigue and exhaustion resulting in decreased work productivity, neurocognitive impairment, and complications with chronic kidney disease. Various strategies can effectively reduce iron-deficiency anemia at the population level, including food fortification, supplementation, and dietary improvement. Unfortunately, these have failed to reach Ghanaian women adequately and equitably, resulting in many not meeting their nutritional needs. As an alternative strategy to curtail iron deficiency, edible insects, such as palm weevil larvae, have been suggested for their nutritional benefits, cost-effective rearing, and yearly availability. As such, popularizing their consumption could present an opportunity to improve WRA’s iron status in Ghana. To assess the feasibility of this strategy, formative research is needed to examine local attitudes, knowledge, and beliefs associated with the consumption of palm weevil larvae. Formative research was conducted in five peri-urban communities in the Ashanti region of Ghana that were purposefully selected for the study. These communities were separated into two clusters based on their access to palm trees. The analysis was based on 12 focus group discussions conducted with 121 female respondents, at which point data saturation was reached. Thematic analysis was used to examine the facilitators and barriers to palm weevil larvae consumption as well as WRA’s general knowledge of nutrition and anemia. Women generally had favorable perceptions of palm weevil larvae as a nutritious food in its raw, frozen, and processed forms, and were eager to be involved in its value chain. The factors positively influencing the acceptance of palm weevil larvae were its perceived nutritional and health benefits, and its taste. The main barriers to its consumption in all communities were its scarcity, difficult and inconsistent access, and fear of unauthenticity and unsafety. Finally, despite women’s general awareness of the importance of iron, persistent misinformation by health-professionals undermined their perceived seriousness of iron-deficiency anemia. Women’s clear interest in palm weevil larvae is encouraging for the community-based domestication of palm weevil larvae. Future studies should examine the feasibility and logistical requirements of such a strategy and its impact on increasing the consumption of palm weevil larvae.

Key words: formative research, palm weevil larvae, edible insects, food fortification, anemia

INTRODUCTION

Micronutrient deficiencies, also called “hidden hunger,” remain a widely prevalent threat to human health. In 2019, 1.7 billion people, including 30% of women of reproductive age (WRA), were estimated to be anemic, with sub-Saharan Africa holding one of the highest rates for WRA (40%) [1, 2]. In Ghana, despite a slight improvement in the last five years, anemia remains a major public health concern, affecting over 35% of WRA in 2019 [2].

The risk factors associated with anemia vary between countries but generally include iron and vitamin A deficiencies, inflammation, malaria, household sanitation and hygiene, and body mass index [3-5]. In Ghana, anemia in WRA is mostly associated with iron deficiency (causing iron-deficiency anemia) followed by vitamin A deficiency, and inflammation [6].

Various strategies effectively reduce iron-deficiency anemia at the population level, including food fortification, supplementation, and dietary improvement. In Ghana, the implementation of both iron supplementation and iron fortification of wheat flour and vegetable oil did not prove successful in reducing iron-deficiency anemia among WRA. Studies attribute this failure to inadequate and inconsistent fortification across the country, inequitable distribution of supplements, and low adherence to supplementation (due to forgetfulness to take the supplements, fear of side effects, and poor knowledge of iron and anemia) [7-9].

Increasing animal source food (ASF) intake, which is an example of dietary improvement, could significantly improve women's iron status, owing to consumers' acceptance of ASF, its accessibility, and its high content of bioavailable iron [10, 11]. While this strategy would benefit the nutritional adequacy of WRA, it would be detrimental to the global environment as it would require scaling up approaches to producing ASF, which currently account for 15% of all greenhouse gas emissions and are expected to double by 2050 [11, 12].

The environmental cost of increasing ASF production would be large, which necessitates alternative dietary sources of heme-iron. The United Nations' Food and Agriculture Organization suggested the use of edible insects as an alternative sustainable strategy to curtail iron-deficiency anemia, owing to their rich nutritional composition, low environmental footprint and simple rearing techniques, as highlighted in Figure 1 [13].

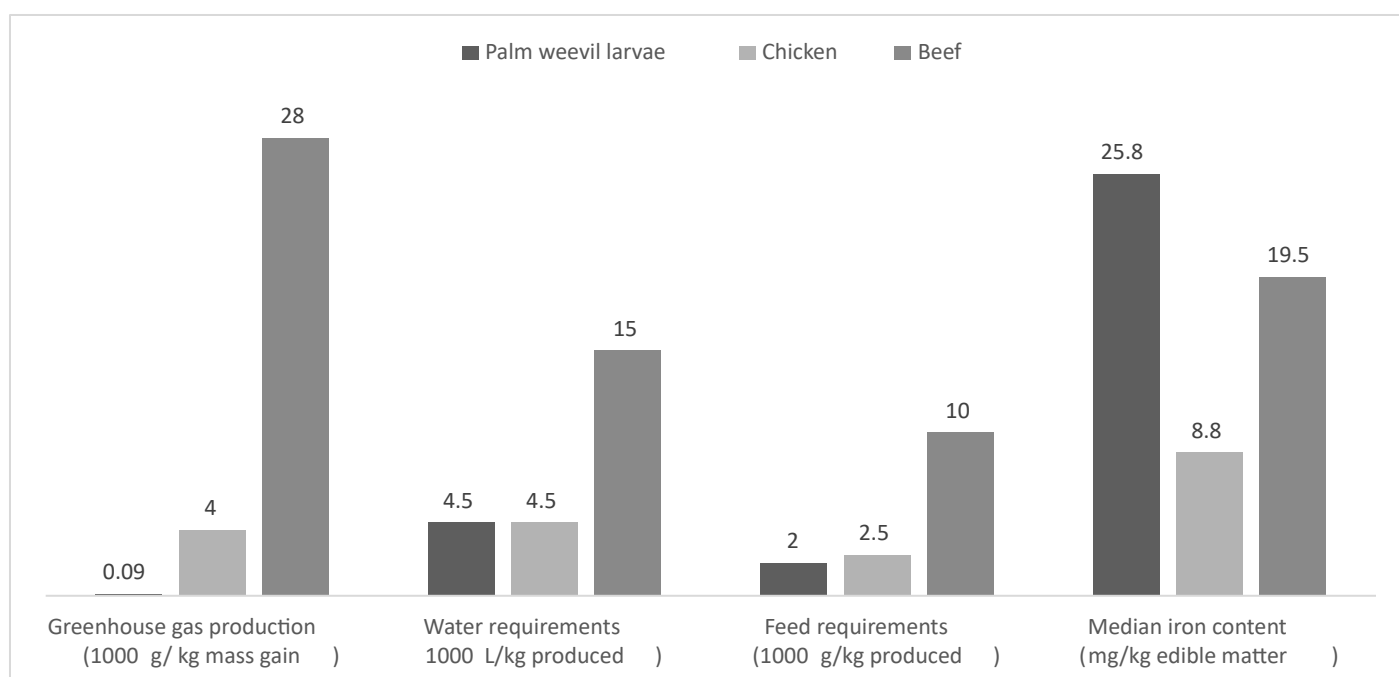


Figure 1: Comparison of greenhouse gas production, water and feed requirements, and iron content between palm weevil, chicken, beef Adapted from Smith *et al.* [11]

Edible insects have contributed to diets and livelihoods in many cultures, including Thailand, Ghana, Cameroon, Mexico, and Guatemala [13]. In Ghana, palm weevil larvae, traditionally called *akokono*, are among the most commonly consumed insects and the only ones being semi-cultivated [14]. Semi-cultivation enables the manipulation of the palm weevil's habitat such that its larva is available throughout the year in larger quantities [13]. Since *akokono* is a good source of iron [15, 16], popularizing its consumption could present an opportunity

to improve WRA's iron status in Ghana. To assess the feasibility of this strategy, formative research is needed to examine local attitudes, knowledge and beliefs associated with the consumption of *akokono*, which has yet to be evaluated in the Ashanti region in Ghana.

The objective of this study was to gain insight into Ghanaian women's acceptance of *akokono* for consumption within their communities, as well as identify the facilitators and barriers to its use.

METHODOLOGY

Study design

A descriptive study design was used to examine the acceptability of palm weevil larvae consumption by women across peri-urban communities in Ghana's Ashanti region to determine the feasibility of palm weevil larvae as a source of iron for women of reproductive age. Qualitative data were obtained through focus group discussions (FGD). As a qualitative approach to gain an in-depth understanding of social issues, focus group discussions are described as interactions between preselected participants which focus on specific issues [17].

The objectives of this study were to explore the following: women's attitudes regarding *akokono*, the factors influencing women's propensity to consume it, and women's general knowledge of iron and iron-deficiency anemia. Prior to data collection, institutional review board approval was received from McGill University's Research Ethics Board and Kwame Nkrumah University of Science and Technology's Committee on Human Research, Publication and Ethics.

Study site and participants

The study was conducted between December 2020 and January 2021 in periurban communities located in the Ashanti Region of Ghana. A list of identified periurban communities surrounding the Kumasi district was compiled using a map designed by Afrane *et al.* [18] (Figure 2).

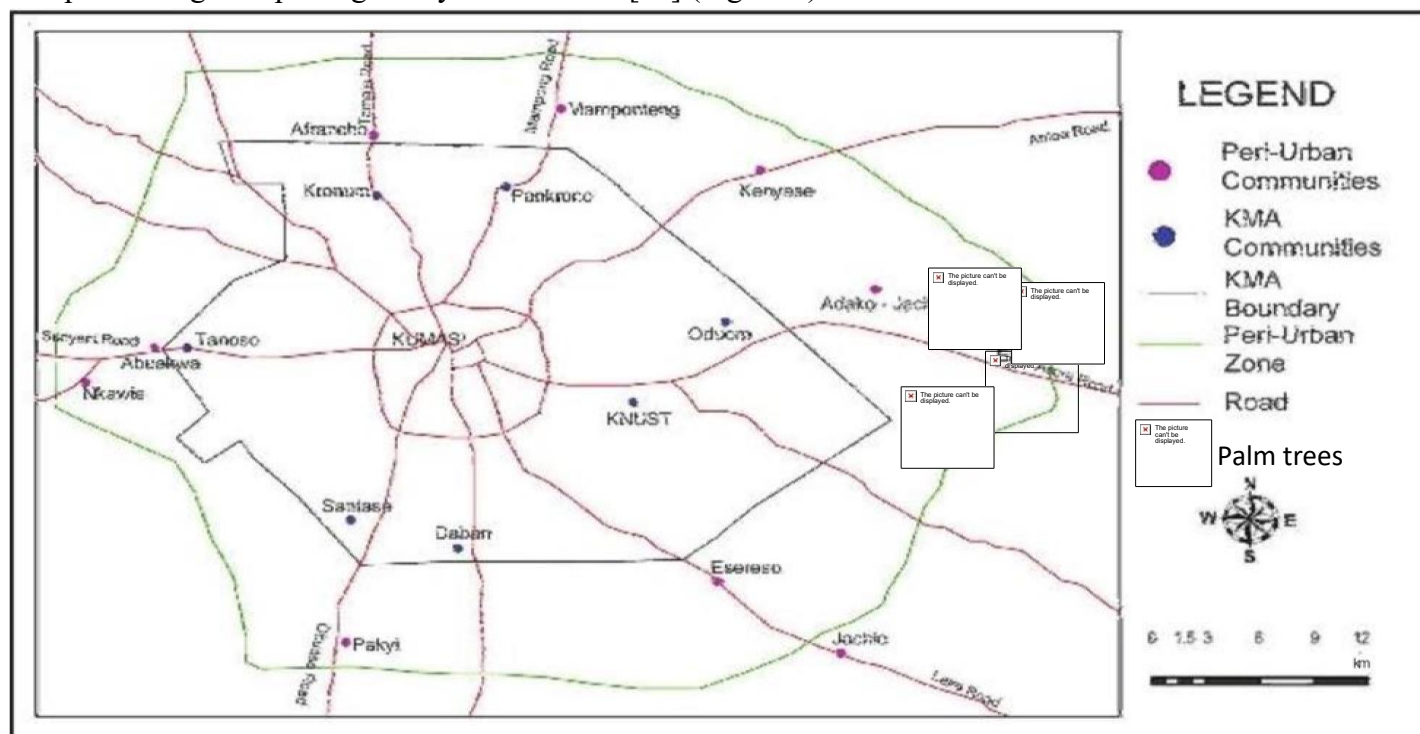


Figure 2: Map of peri-urban communities in Ghana with palm tree-rich regions, adapted from Afrane *et al.* [18]

Since entomophagy is influenced by various factors that can be location-specific, we found it informative to compare communities based on their access to palm trees. A total of five communities were purposively selected

and separated into two community groups: a) two palm-access communities (PAC), located in proximity with palm trees, and b) three non-palm access communities (NPAC). To protect their anonymity, communities were assigned letters as identifiers.

Key contact people (assembly men and women, and town chiefs) used verbal announcements to inform their communities about the project and recruited participants a few weeks before the start of the data collection. Two FGD with 8 to 13 participants (women >18 y of age) were planned for each of the six communities, for a total of 12 FGD. Those were held in open areas within the communities. To describe the study and recruit participants, a public announcement was made the day of the data collection in each community.

A total of twelve FGD were completed with 121 women participants, allowing to reach data saturation: four FGD in Community B (n=18); one FGD in Community C (n=12); two FGD in Community D (n=23); three FGD in Community E (n=30); two FGD in Community F (n=22). Written informed consent was obtained from those who agreed to participate.

Data collection

The guide used for the FGD was pre-tested and modified as needed by Ghanaian researchers and research assistants with field experience. Each focus group facilitation team included a moderator as well as a person responsible for taking notes and setting up the video-recorder. Both research assistants were trained to moderate the discussions, engage participants, and build a judgement-free space for participants to fully express themselves. Focus group discussions were conducted in the local language, Twi, and lasted approximately an hour and a half. All participants were told that the FGD was voluntary and that they could decline to answer any questions or complete the focus group even after giving initial consent. Participants' names were kept anonymous. As a token of appreciation, participants received a bar of soap to thank them for their participation.

Data analysis

Each focus group discussion was audio recorded and transcribed verbatim. The transcripts were translated from Twi into English by Ghanaian undergraduate students and typed into an electronic copy. Qualitative data were analyzed by the student researcher using the six-stage thematic analysis process recommended by Braun and Clarke [19] and guided by the focus group questions. First, the transcripts were read repeatedly for familiarization with the data collected. Transcripts were then imported into the MAXQDA Software version 24, where they were coded. Generated codes were collated into emerging themes and subthemes, which were subsequently reviewed before being defined and refined. The final step involved writing the analysis.

RESULTS AND DISCUSSION

Focus group discussions allowed to gain an understanding of women's thoughts about *akokono*, their involvement in food preparation, as well as their knowledge of iron-deficiency anemia. An inductive analysis of the transcripts generated a total of four categories, including two nutrition-related, which will be discussed in the sections below. Previous studies have documented the consumption of *akokono* [14] as well as caregivers' perspectives regarding the acceptability of *akokono* as food for infants and young children in the Brong Ahafo region in Ghana [20]. This appears to be the first study to explore the factors influencing Ghanaian women's propensity to consume *akokono*, and their general understanding of nutrition, iron and anemia in the Ashanti region.

Perceived facilitators of *akokono* consumption

Participants were generally interested in the consumption of *akokono* for its nutritional and health benefits. Respondents from all communities described *akokono* as being a good source of adequate protein and fat to be added to soups and stews. Some participants admitted being inclined to consume *akokono* only because of its health and nutritional benefits. These findings are congruent with studies conducted in other parts of Ghana, Zimbabwe, Uganda, Burundi, India and Brazil [20-24]. Researchers found that taste, nutritional value, medicinal

properties, and availability were the main motives for insect consumption in rural and urban areas in the aforementioned countries.

Participants indicated an interest to consume *akokono* both in its frozen and processed forms as a means to increase its preservation and availability all year long, facilitate its cooking, and overcome its scarcity. Participants acknowledged no difference between the processing of *akokono* and that of other meats such as fish and chicken: “Just like me buying frozen fish and chicken in cold stores, I think I would do same if *akokono* is frozen.” (Community C). Moreover, participants admitted that adding *akokono* to staple foods would facilitate its consumption, especially among children. Some women mentioned having tried bread and cookies enriched with *akokono* and expressed their willingness to buy such products, should those be available for purchase: “I have had the opportunity to eat bread made from *akokono*; therefore, I will buy a product containing *akokono*.” (Community B).

Perceived barriers of *akokono* consumption

Respondents clearly articulated their barriers to consuming *akokono* regularly. The main challenges that came up were disgust, scarcity and challenging access, insalubrity, doubt about *akokono*'s authenticity, and medical discouragements.

The most obvious barrier identified by a few participants in both PAC and NPAC groups was their general disgust for insects. For some participants, this barrier completely dissuaded them from potentially trying *akokono*: “I don't eat *akokono*. I can't even stand the sight of them. Their movements make them look disgusting” (Community B). Disgust is a reaction that has typically been associated with entomophagy in the Westernized world [13] and can usually be overridden by incorporating insects in popularly consumed food products and masking their taste and appearance with processing steps and the addition of spices.

Scarcity was perceived as a major barrier for respondents from NPAC and a moderate barrier for respondents from PAC. Participants from NPAC stated that the irregular availability of *akokono* could make them lose interest in consuming *akokono*. Multiple respondents from PAC highlighted an increase in *akokono*'s scarcity over time which they associated with the erosion and decrease of palm trees caused by the use of chemicals and pesticides. They also mentioned that living close to palm trees did not ensure access to *akokono* as its harvesting is strenuous, unpredictable, and not fruitful. Scarcity due to seasonality, ease of access, and difficulties in collection were also described as main challenges in the utilization of insects in Uganda, Burundi, Nigeria and Cote d'Ivoire [24-26]. The increasing scarcity of edible insect species has been assessed by researchers and in Zambia, the local extinction of mopani worms has been linked to droughts and the overexploitation of forests making their harvesting non-viable [27]. Similar results were found in Cameroon where the harvesting of palm weevil larvae, either from naturally infested raffia stems or by cutting and preparing healthy raffia stems for larvae production, has been proven unsustainable and damaging to the forests [28].

Akokono access can be limited by forest ownership and management in Ghana. Although over 95% of forests are publicly owned in Ghana, they are either jointly managed by local communities and the government, or for most cases, are under the management of “unknown” holders [29, 30]. The latter could be explained by forests where ownership is disputed or in transition [29]. A study looking at oil palm production in Ghana also identified land access as being a critical barrier in shaping farmers' ability to benefit from the cultivation of oil palm [31], thus supporting the ambiguity of land and forest management in Ghana.

Although participants expressed a willingness to process *akokono* into food products to make it more available, accessible, and attractive to children, they had concerns regarding the authenticity of *akokono*, its sourcing (naturally harvested versus farmed), the hygienic conditions in which it would be processed, and the possible detrimental changes that the processing could cause to its nutritional and organoleptic properties. Several

respondents revealed their willingness to consume *akokono* only if it was harvested from the palm tree, as they felt more reluctant to do so if *akokono* was being manipulated and farmed under controlled conditions in a facility. Findings about participants' fear of food insalubrity and unsafety concur with a study conducted in Ghana that highlighted consumers' increased concerns about the safety of processed foods due to distrusting public institutions' competence in ensuring food safety [32].

In addition, participants expressed poor knowledge about where to access *akokono* and how to cook and store it. These comments arose mostly from PAC residents which was surprising considering they lived in close proximity with palm trees and would expectedly be more familiar with *akokono*. With the complex forest tenure system in Ghana, however, physical closeness to palm trees does not ensure access nor utilization of these trees.

With less exposure to *akokono* comes the loss of conversation and knowledge transfer highlighting the importance of educating Ghanaians about the traditional and nutritional values of *akokono*. Another way to raise awareness and contribute to knowledge preservation about *akokono* is by implementing cooking demonstrations within communities. The interest in *akokono*-based food products and nutrition education on *akokono* resurged in a study conducted in other parts of

Ghana, namely in the Upper Manya Krobo district, Kumasi Metropolitan, LaNkwantanang-Madina and Ho municipality [33] pointing to the importance of educating residents on the benefits of *akokono* and *akokono*-based products. This is especially important among children as they greatly influence women with certain household food-related decisions as seen below.

Household decision-making around food and nutrition

While most women reported deciding what to cook based on what their children want to eat, some attributed their decisions to the amount of money and resources available to them. Nutrition did not seem to guide respondents' decisions except for one who mentioned: "I decide what to cook on a particular day based on what I ate the previous day because I like to keep my meals balanced" (Community B).

In all cases except for a few (n=8, participants who either share the responsibility of purchasing food for the household with their husband or leave it to their husbands, the breadwinners), women acknowledged being in charge of purchasing the food for the household. This data showed that in addition to financial limitations, women's food purchases and preparations were influenced by their children's food choices. This finding is supported by a study conducted in Accra which highlighted family members' (such as mothers, wives, siblings and children) influence on household members' food choices [34]. As women and children play a fundamental role in household food-related decisions, it is crucial to design interventions centered on them.

Knowledge of iron-deficiency anemia

While a few respondents (n=8) had no or wrong knowledge of iron and iron-rich foods (exempli gratia: stating plantain as being rich in iron), most of the participants were able to name iron-rich foods. The most common responses were cocoyam leaves (kontomire), turkey berries, beans, fish and groundnut. When asked more specifically about iron-deficiency anemia, women described their doctor's recommendations on how to treat it. These included: increasing their consumption of green leafy vegetables (mainly kontomire) and turkey berry as well as mixing turkey berry into their Milo (Nestle chocolate drink). Only one respondent mentioned increasing their meat consumption. A few participants highlighted the importance they give to their doctors' recommendations, stating that if doctors were to ever discourage the consumption of *akokono*, they would stop eating it: "It will only take a medical advice from a doctor to stop me from eating them" (Community B), noticed that respondents held some wrongful beliefs and myths about nutrition and healthy cooking approaches. Those included reducing the use of pepper and spices and substituting vegetable oil with palm oil. Though reducing pepper and spices are not harmful to one's health, those wrongful assumptions raise concerns about other possible

myths that could negatively impact women's health. For instance, though the negative effects of palm oil consumption have been contested, two meta-analyses conducted in developed and developing countries found a significant relationship between an increased palm oil consumption and higher ischemic heart disease mortality rates [35, 36]. In addition, doctors' recommendations to alleviate iron-deficiency anemia appeared to be incomplete. They advised anemic patients to include turkey berries and cocoyam (kontomire) in their diets as these are good sources of iron [37-39]; however, in vivo studies have shown that turkey berry and cocoyam have poor iron bioavailability due to their high content of anti-nutritional factors (such as phytates, oxalates). Their consumption is therefore not very effective in combating iron deficiency unless consumed with non-heme iron absorption enhancers such as Vitamin C, which doctors did not promote [40]. This finding highlights once again the importance of nutrition education and health literacy about iron, iron-deficiency anemia and nutrition among Ghanaian women and health practitioners.

The current study has some weaknesses. Due to the COVID-19 pandemic, fewer participants than initially planned for were reached; however, the point of data saturation was attained with the number of focus groups conducted. In addition, a community that was initially interested in participating dropped out from the study during data collection due to having experienced "helicopter researcher" with another researcher working on *akokono*, and associated us with them. This loss was unfortunate as we could have benefited from this community's residents' knowledge. This study, however, has many strengths: 1) dividing the communities based on their access to palm trees allowed to detect a lack of differences in perceptions between both groups; 2) conducting focus groups where women felt open to share their experiences and knowledge on *akokono*, food preparation and nutrition; 3) inquiring about sensitive topics such iron-deficiency anemia.

CONCLUSION

This study found that women generally viewed palm weevil larvae as a tasty and nutritious food and were mostly in favor of its processing (freezing, product development) as a means to increase its availability and accessibility. Scarcity, unhygienic conditions, and mistrust were perceived as major barriers to palm weevil larvae consumption. Some barriers could be overcome through adequate nutrition education pertaining to the importance of iron, the dangers of anemia and the benefits of palm weevil larvae. The need for nutrition education is all the more important as doctors' nutrition-related recommendations to alleviate iron-deficiency anemia seemed incomplete and misleading. Women's interest in palm weevil larvae and involvement in household food purchasing and preparation make palm weevil larvae's domestication a promising strategy to increase its access and consumption among Ghanaian women and their families. This strategy, if proven successful, could also increase dietary diversity and livelihood options for Ghanaian women, as well as overcome their fears of food unsafety and insalubrity.

Further investigation of the logistics and costs associated with the domestication of palm weevil larvae should be conducted. In addition, future studies should quantify the frequency and use of palm weevil larvae while focusing on its contribution to the total iron consumed in Ghanaian women's diets.

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REFERENCES

Gardner W and N Kassebaum Global, Regional, and National Prevalence of Anemia and Its Causes in 204 Countries and Territories 1990–2019. *Current Developments in Nutrition*. 2020; 4(Supplement_2): 830-830.

- FAO, UNICEF, WFP and WHO. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, Italy; 2021: 240.
- Wirth JP, Woodruff BA, Engle-Stone R, Namaste SM, Temple VJ, Petry N, Macdonald B, Suchdev PS, Rohner F and GJ Aaron Predictors of anemia in women of reproductive age: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA) project. *American Journal of Clinical Nutrition*. 2017; 106(Suppl 1): 416-427.
- Chaparro CM and PS Suchdev Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. *Annals of the New York Academy of Sciences*. 2019; 1450(1): 15-31.
- Petry N, Olofin I, Hurrell RF, Boy E, Wirth JP, Moursi M, Angel MD and F
- Rohner The Proportion of Anemia Associated with Iron Deficiency in Low, Medium, and High Human Development Index Countries: A Systematic Analysis of National Surveys. *Nutrients*. 2016; 8(11).
- Petry N, Wirth JP, Adu-Afarwuah S, Wegmuller R, Woodruff BA, Tanumihardjo SA, Bentil H, Donkor ES, Williams TH, Shahab-Ferdows S, Selenje L, Mahama A, Steiner-Asiedu M and F Rohner Risk factors for anaemia among Ghanaian women and children vary by population group and climate zone. *Maternal & Child Nutrition*. 2021; 17(2):e13076.
- Nasir BB, Fentie AM and MK Adisu Adherence to iron and folic acid supplementation and prevalence of anemia among pregnant women attending antenatal care clinic at Tikur Anbessa Specialized Hospital, Ethiopia. *PLOS ONE*. 2020; 15(5): e0232625.
- Appiah PK, Nkuah D and DA Bonchel Knowledge of and Adherence to Anaemia Prevention Strategies among Pregnant Women Attending Antenatal Care Facilities in Juaboso District in Western-North Region, Ghana. *Journal of Pregnancy*. 2020: 2139892-2139892.
- Osendarp SJM, Martinez H, Garrett GS, Neufeld LM, De-Regil LM, Vossenaar M and I Darnton-Hill Large-Scale Food Fortification and Biofortification in Low- and Middle-Income Countries: A Review of Programs, Trends, Challenges, and Evidence Gaps. *Food and Nutrition Bulletin*. 2018; 39(2): 315-331.
- Creed-Kanashiro HM, Bartolini RN, Fukumoto MN, Uribe TG, Robert RC and ME Bentley Formative research to develop a nutrition education intervention to improve dietary iron intake among women and adolescent girls through community kitchens in Lima, Peru. *The Journal of Nutrition*. 2003; 133(11 Suppl 2): 3987s-3991s.
- Smith MR, Stull VJ, Patz JA and SS Myers Nutritional and environmental benefits of increasing insect consumption in Africa and Asia. *Environmental Research Letters*. 2021; 16(6): 065001.
- Zhai P, Shukla P, Buendia E and S Luz Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. Food Security. 2019.
- van Huis A Prospects of insects as food and feed. *Organic Agriculture*. 2021; 11(2): 301-308.
- Anankware J, Osekere EA, Obeng-Ofori D and C Khamala Identification and classification of common edible insects in Ghana. *International Journal of Entomology Research*. 2016; 1: 2455-4758.

- Mwangi MN, Oonincx DGAB, Stouten T, Veenenbos M, Melse-Boonstra A, Dicke M and JJA van Loon Insects as sources of iron and zinc in human nutrition. *Nutrition Research Reviews*. 2018; 31(2): 248-255.
- Parker M, Zobrist S, Mansen K, Soor S, Laar A, Asiedu C and H
- Lutterodt Nutrient Analysis of Farmed Palm Weevil Larvae for the Advancement of Edible Insects in Ghana. *The FASEB Journal*. 2017; 31(1_supplement): 639.36-639.36.
- Hennink MM Focus group discussions. Oxford University Press, New York. 2014.
- Afrane S and C Amoako Peri-Urban Development in Kumasi. 2011: 92110.
- Braun V and V Clarke Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006; 3(2): 77-101.
- Laar A, Kotoh A, Parker M, Milani P, Tawiah C, Soor S, Anankware JP, Kalra N, Manu G, Tandoh A, Zobrist S, Engmann C and G Pelto An Exploration of Edible Palm Weevil Larvae (*Akokono*) as a Source of Nutrition and Livelihood: Perspectives from Ghanaian Stakeholders. *Food and Nutrition Bulletin*. 2017; 38(4): 455-467.
- Manditsera FA, Lakemond CMM, Fogliano V, Zvidzai CJ and PA Luning Consumption patterns of edible insects in rural and urban areas of Zimbabwe: taste, nutritional value and availability are key elements for keeping the insect eating habit. *Food Security*. 2018; 10(3): 561-570.
- Lucchese-Cheung T, De Aguiar LK, Da Silva RFF and MW Pereira Determinants of the Intention to Consume Edible Insects in Brazil. *Journal of Food Products Marketing*. 2020; 26(4): 297-316.
- Chakravorty J, Ghosh S and VB Meyer-Rochow Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). *Journal of Ethnobiology and Ethnomedicine*. 2011; 7(1): 5.
- Ayieko M and V Oriaro Consumption, indigenous knowledge and cultural values of the lakefly species within the Lake Victoria region. *African Journal of Environmental Science and Technology*. 2008; 2: 282-286.
- Ebenebe C, Amobi MI, Udegbala C, Ufele AN and BO Nweze Survey of edible insect consumption in south-eastern Nigeria. *Journal of Insects as Food and Feed*. 2017; 3(4): 241-252.
- Niaba KPV, Atchibiri OA, Gbassi G, Beugre AG, Adou M, Anon AB and D Gnakri Consumption survey of edible winged termites in Cote d'Ivoire.
- International Journal of Agricultural and Food Science*. 2012; 2: 149-152.
- Ghaly AE The Use of Insects as Human Food in Zambia. *OnLine Journal of Biological Sciences*. 2009; 9(4).
- Muafor F, Ayemele Gnetegha A, Le Gall P and P Levang Exploitation, trade and farming of palm weevil grubs in Cameroon. *CIFOR Working Paper*. 2015; 178: 54.
- Romano F and D Reeb Understanding Forest tenure in Africa: opportunities and challenges for forest tenure diversification. Forestry Policy and Institutions. Rome, Italy. 2008.
- FAO. Global Forest Resources Assessment 2020: Main Report. Rome, Italy. 2020: 184

- Khatun K, Maguire-Rajpaul V, Asante E and C McDermott from Agroforestry to Agroindustry: Smallholder Access to Benefits from Oil Palm in Ghana and the Implications for Sustainability Certification. *Frontiers in Sustainable Food Systems*. 2020; 4(29).
- Omari R, Arthur W and GK Frempong Competence of Public Institutions in Food Safety Control: A Consumer Perception Survey in Ghana. *Journal of Food Quality and Hazards Control*. 2018; 5: 102-108.
- Agbemaflle I, Francis S, Jensen H and M Reddy Drivers of Perceptions About Turkey Berry and Palm Weevil Larvae Among Ghanaian Women of Reproductive Age: A Mixed Methods Approach. *Current Developments in Nutrition*. 2020; 4(Supplement_2): 1284-1284.
- Boatema S, Badasu DM and AG Aikins Food beliefs and practices in urban poor communities in Accra: implications for health interventions. *BMC Public Health*. 2018; 18(1): 434.
- Chen BK, Seligman B, Farquhar JW and JD Goldhaber-Fiebert MultiCountry analysis of palm oil consumption and cardiovascular disease mortality for countries at different stages of economic development: 1980-1997. *Globalization and Health*. 2011; 7: 45-45.
- Sun Y, Neelakantan N, Wu Y, Lote-Oke R, Pan A and RM van Dam Palm Oil Consumption Increases LDL Cholesterol Compared with Vegetable Oils Low in Saturated Fat in a Meta-Analysis of Clinical Trials. *The Journal of Nutrition*. 2015; 145(7): 1549-1558.
- Amagloh F and E Nyarko Mineral nutrient content of commonly consumed leafy vegetables in northern Ghana. *Afr. J. Food Agric. Nutr. Dev*. 2012; 12: 1684-5374.
- Wada E, Feyissa T and K Tesfaye Proximate, Mineral and Antinutrient Contents of Cocoyam from Ethiopia. *International Journal of Food Science*. 2019; vol 2019: 8965476.
- Akoto O, Borquaye LS, Howard AS and N Konwuruk Nutritional and Mineral Composition of the Fruits of *Solanum torvum* from Ghana. *International Journal of Chemical and Biomolecular Science*. 2015; 1(4): 222-226
- Agbemaflle I, Hanson N, Bries AE and MB Reddy Alternative Protein and Iron Sources from Edible Insects but Not *Solanum torvum* Improved Body Composition and Iron Status in Malnourished Rats. *Nutrients*. 2019; 11(10): 2481.