Thematic Area 12: Agriculture and Food Production

Project Title: Mechanization of production protocol for large scale production of Insect Protein and Mushroom-Enriched Noodles as a Sustainable Solution to Mitigate Nutritional Deficiencies Among Nigerian Youths

1.1. Background of the Research

Nutritional deficiencies are a significant concern among Nigeria youths particularly undergraduate students due to poor dietary habits, financial constraints and limited access to nutrient-dense foods (Van Huis and OOnincx 2020). Apart from the problem of poor nutrient content, instant noodles are notorious for their high sodium content Adebayo-Oyetoro et al (2020), with a single serving providing between 861 to 1,200mg. Exceeding the recommended daily intake of 2,300mg can have detrimental effects on cardiovascular health. Choi et al (2014) reported the health risks posed by starchy instant noodles cherished by young Nigerians. Insect protein and mushroom flour have emerged as sustainable and nutritious ingredients that can enhance nutritional content of food products like instant noodles (Kumar and Sharma (2022) and (Lee and Kim (2020). The combination of insect protein from African Palm weevil (APW) (*Rhyncophorus phoenicis*) and mushroom (Oyster mushroom: *Pleurotus ostreatus*) flour into noodles can provide a sustainable and nutritious solution to address nutritional deficiencies among youths especially undergraduates and this aligns with three Sustainable Development Goals (SDGS) particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

Undergraduate students, the future leaders are a critical demography to target for nutritional interventions as they often experience significant lifestyle changes, including poor dietary habits leading to nutritional deficiency, susceptibility to many disease incidences and sometimes untimely death. By developing and evaluating insect protein and mushroom -enriched noodles, this study aims to provide a sustainable and nutritious solution to mitigate nutritional deficiency posed by instant noodles among this vulnerable population.

The protocols for the production of mushroom and African Palm Weevil in Nigeria are largely manual and unsustainable as they cannot support industrial scale production (Pers. Obs.). Industrial utilization of these nutrient rich resources demands process mechanization. It is on this premise that this research aims at mechanization and automation of production systems.

1.2. **Statement of Problems**

Despite the widespread popularity of instant noodles in Nigeria, attributed to the fact that they are relatively cheap, easy-to-cook, the starch –laden instant noodles often lack essential nutrients and contribute to nutritional deficiencies among youths. Besides, instant noodles have been linked to various health risks related to their high sodium content, presence of harmful chemicals and association with cardiometabolic disorders (Choi et al 2014). However, the extent of these risks

and the nutritional quality of instant noodles remain poorly understood particularly among undergraduate students. This knowledge gap necessitates an investigation into the proximate composition of several brands of instant noodles sold in Nigeria and to develop nutrient fortified instant noodles that will satisfy the young people's love for instant noodles.

Commercial scale production of insect protein and mushroom fortified instant nodules demands a paradigm shift from manual operations to high speed and high tonnage mechanized operations which is currently lacking in the industry.

1.3. Aim and Objectives of the Project

Aim

This research project is aimed at replacing at least 20% of starch-laden instant nodule in the Nigeria market with insect protein and mushroom-enriched instant noodles as a sustainable solution to mitigate nutritional deficiencies among Nigerian youths by 2026.

Specific objectives

1. To determine the nutritional composition of traditional instant noodles and identify key nutrient deficiencies.
2. To construct the African Palm weevil production farm at Agricultural Technology Teaching and Research farm Ufuma campus of Federal Polytechnic Oko for large scale production using mechanized operations (automated bagging and capping of mushroom pods using bagging and capping machine
3. To evaluate the feasibility of incorporating insect protein and mushroom flour into instant noodles without compromising their sensory attributes (taste, texture, and aroma).
4. To determine the optimal levels of insect protein and mushroom flour to be added to instant noodles to achieve significant nutritional enhancement while maintaining consumer acceptability.
5. To compare the nutritional profile of fortified instant noodles with traditional instant noodles and other commercially available noodle products.
6. To check the consumer acceptance of fortified instant noodles in terms of taste, texture, aroma, and overall satisfaction.
7. To develop guidelines and recommendations for the production and commercialization of fortified instant noodles in Nigeria.

1.4. Research Questions

1. What is the nutritional composition of traditional instant noodles and what are the nutritional deficiencies
2. What machineries and facilities do we need to upscale production capacity of African Palm weevil farm and Mushroom farms at Federal Polytechnic Oko.
3. What is the feasibility of incorporating insect protein and mushroom into instant noodles and what is the optimal ratio for maintaining consumer acceptability?
4. What is the optimal level of insect protein and mushroom flour to be added to instant noodles to achieve significant nutritional enhancement while maintaining consumer

acceptability?

5. How do fortified instant noodles compare to traditional instant noodles and other commercially available noodle products in terms of nutritional value and consumer acceptance?
6. What is the overall consumer acceptance of fortified instant noodles, and are there any specific preferences or concerns regarding the use of insect protein and mushroom flour?
7. How do I develop guidelines / manual for step-by-step production and commercialization of fortified instant noodles in Nigeria.

1.5. Literature Review

Instant noodles have become a popular and affordable food option in Nigeria, particularly among young people and students. Their convenience and low cost make them attractive to those with limited cooking facilities or time. The World Instant Noodles Association in its report ranked Nigeria 11th in the global demand for noodles, putting Nigeria among the largest consumers of instant noodles with 1.92 million servings as at May, 2020. These noodles are sold precooked, in dried long strips in block forms with seasoning are called instant noodles. Adebayo-Oyetoro et al (2020) noted that instant noodles are low in calories, fibre and protein with higher amount of fats and monosodium glutamate (MSG) in the seasoning pack. Thus, high rate of instant noodle consumption poses a challenge of nutritional deficiency with associated health risks due to poor immune defense.

Fortification of noodles with vegetables like dried carrot and spinach practiced by some industries in response to the clarion call from various quarters to improve on the nutrient content of noodles, though laudable, still fails in the area of crude protein and mineral content. Thus, the need for protein inclusion. The use of plant protein is limited by deficiency of some essential amino acid, insect protein like Africa palm weevil (APW) becomes useful in this regard. APW, a cream-coloured larva found in the rotting stem of raffia palms, often around riverine areas are rich in protein and essential fatty acids (Kumar and Sharma (2022) discussed the nutrient composition of insect proteins while Lee and Kim (2020) described the nutritional composition of mushroom. substrates and protocols for mass production of APWL in captive management has been developed in Nigeria and other countries of the world, thus the research aims at utilizing these two nutrient rich ingredients in the development of nutrient rich instant noodles and also to evaluate its usefulness in mitigating deficiency problems associated with young peoples' over consumption of instant noodles.

However, mechanized production line for mushroom and African Palm weevil is not available in many production centers. This research is aimed at introducing some level of mechanization into mushroom and African Palm Weevil production systems to enhance industrial scale of production as a strategy to sustain noodle fortification with these nutrient rich ingredients,

1.6. Theoretical Framework

The proposed research on fortifying instant noodles with insect protein and mushroom flour can be grounded in the following theoretical frameworks:

1. Food Systems Theory

Food systems theory provides a holistic framework for understanding the complex interactions between food production, distribution, consumption, and waste. This theory can be applied to analyze the factors influencing the consumption of instant noodles in Nigeria and the potential impact of fortification on the overall food system.

2. Nutrition Transition Theory

Nutrition transition theory explains the shift in dietary patterns from a traditional diet rich in unprocessed, nutrient-dense foods to a more Westernized diet high in processed foods and energy-dense nutrients. This theory can be used to understand the reasons for the increasing popularity of instant noodles in Nigeria and the potential health implications of their consumption. Other theories that will form the frame work for this study include: Consumer behaviour, Sustainable theory and Health Promotion Theory

Research Methodology

The first phase of the project will be itemizing, costing, procurement of facilities required for upscaling of APW (*Rhyncophorus phoenicis*) farm at the Teaching and Research farm of the Department of Agricultural Technology Ufuma campus of the Federal Polytechnic Oko. A total of 3000 APW larvae will be purchased from Brave Farms in Port Harcourt. The insects will be fed with known ingredients to adult stage when male and female characteristics will be used for their selection. The adult male and female APW will be paired in containers for 48 hours for copulation to take place. Thereafter the fecundated females will be monitored for egg laying to continue the cycle thus production of large quantities of larvae. The larvae produced will be defatted, milled into powder and proximate composition determined before incorporation into noodles.

Similarly, large quantity of mushroom (*Pleurotus ostreatus*) will be produced using standard production protocols that involve mechanized bagging machine, capping machine, spawn inoculation and air conditioned incubation room. The mushroom will be milled into powder and nutrient composition determined before incorporating into noodles.

Various wheat, APW larvae and mushroom flour mixing ratios will be tested to determine the graded quantities that will yield optimum results. The APW and Mushroom-enriched noodle will be compared nutritionally by chemical composition assessment and feeding to white rat. Thereafter, a ten-man taste panelist will be used to evaluate the sensory perception of the noodle and its acceptability.

Expected Results

- APW and Mushroom-enriched instant noodles will be developed to replace starch-laden instant noodles in Nigerian market by at least 20%
- At least two investors will be attracted to large scale production of nutrient-rich instant noodles
- Malnutrition of young people will be reduced by at least 10%
- Two MSc. will be produced
- Job opportunities for young people in APW and mushroom production

Innovation

In this research lies novel combination of insect protein and mushroom flour as fortification agents for instant noodles. This approach offers several innovative aspects:

1. Nutritional Enhancement: Provides a unique and balanced nutritional profile, addressing multiple nutrient deficiencies common in instant noodles.

2. Sustainability: Both insect protein and mushroom flour are considered more sustainable alternatives to traditional animal protein sources

3. Consumer Acceptance: The research aims to explore innovative ways to present these ingredients to consumers, making them more appealing and acceptable.

4. Product Development: The development of fortified instant noodles represents a new product category, potentially offering a healthier and more sustainable option for consumers.

Budget: **Forty seven million, seven hundred and ninety two thousand, three hundred and three Naira, nine kobo (N47, 792, 303.09)**

References

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