CERTIFICATION

I, hereby declare that this research project titled **EVALUATION OF NEEM LEAVE POWDER AS AN ALTERNATIVE PRESERVATION FOR COWPEA** was carried out by **AJIBADE, Musa Oladoja** ND/23/ABE/PT/0029, is my own work and has not been submitted by any other person for any degree or diploma in any higher institution. I also declare that the information provided therein are mine and those that are not mine are properly acknowledged.

Babatunde, S.O (Project Supervisor)	25/08/2025 Date
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Engr. Dr. Mrs. Yusuf, Risikat , O (External Examiner)	8th Sept, 2025 Date

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cowpea (Vigna unguiculata) is an important food legume widely grown and consumed in many parts of sub-Saharan Africa, especially Nigeria. It serves as a rich source of plant protein, vitamins, and essential amino acids, which are especially important in regions where animal protein is scarce or expensive. In rural communities, cowpea is a critical dietary component and contributes significantly to the livelihoods of smallholder farmers who rely on it for both subsistence and income generation.

However, despite its importance, cowpea production and consumption are severely hampered by post-harvest losses. These losses, often caused by insect pests during storage, result in significant reductions in both quantity and quality of the stored grains. The most notorious storage pest of cowpea is the cowpea weevil (Callosobruchus maculatus), an insect capable of destroying stored grains within a short period, especially under poorly managed storage conditions. The insect burrows into the seed, reducing its market value and nutritional quality.

To mitigate these storage losses, synthetic chemical insecticides have become the most commonly used preservation method. Although effective, these chemicals pose several threats to human health, the environment, and economic sustainability. Frequent use can lead to the accumulation of toxic residues in food products, pest resistance, and contamination of soil and water. Moreover, for many smallholder farmers, these chemicals are either too expensive or unavailable, especially in rural areas.

Given these drawbacks, there is an urgent need to identify safer, more sustainable, and cost-effective alternatives for preserving cowpea during storage. In this context, the use of botanicals—natural plant-derived substances with insecticidal properties—has attracted attention as a promising solution. One such botanical is neem (Azadirachta indica), a plant renowned for its broad-spectrum insecticidal, antifungal, antibacterial, and repellent properties.

Neem is widely available in tropical and subtropical regions, including Nigeria. It has been traditionally used in folk medicine and agricultural practices. The active compounds in neem, such as azadirachtin, nimbin, and salannin, are known to interfere with the growth, feeding, and reproduction of a wide range of insects. Neem leaves, in powdered form, have been reported to repel or kill storage pests and preserve grains with minimal impact on grain quality.

The potential use of neem leaves powder as an alternative preservative offers a more affordable and environmentally friendly solution to cowpea preservation, especially for farmers with limited access to chemical pesticides. Despite anecdotal success, scientific evidence and standardized evaluation of neem powder's effectiveness under local storage conditions are still limited.

This study is designed to evaluate neem leaves powder as an alternative preservation method for cowpea by investigating its effect on pest infestation, grain quality, and overall storage performance, with the goal of providing a reliable and sustainable storage strategy for local farmers.

1.2 Problem Statement

Cowpea is a major dietary staple in Nigeria, but its preservation after harvest poses significant challenges due to pest infestation during storage. The cowpea weevil (Callosobruchus maculatus) is particularly destructive, capable of reducing grain viability, quality, and quantity within a matter of weeks. Infested grains become riddled with holes, discolored, and powdery, rendering them unfit for human consumption or commercial use. To control this problem, many farmers and traders depend on synthetic chemical preservatives, including fumigants and insecticide dusts. While these chemicals can reduce pest infestation, they come with several drawbacks: This study seeks to fill that gap by evaluating neem leaves powder as a natural preservative for cowpea, providing scientific data that can support its wider adoption as a sustainable storage practice.

1.3 Aim and Objectives of the Study

Aim

The main aim of this research is to evaluate the efficacy of neem leaves powder as an alternative preservative for cowpea storage, with a focus on its ability to control insect infestation, maintain grain quality, and provide a cost-effective alternative to synthetic preservatives.

Specific Objectives

The study is guided by the following specific objectives:

1. To determine the insecticidal effects of neem leaves powder on cowpea weevils (Callosobruchus maculatus) during storage.

2. To compare the effectiveness of neem leaves powder with commonly used synthetic chemical preservatives in controlling cowpea storage pests.

3. To assess the impact of neem leaves powder on the physical and sensory quality of

stored cowpea grains (e.g., color, texture, odor, and taste).

4. To establish the optimal quantity or dosage of neem leaves powder required for effective cowpea preservation.

1.4 Scope of the Study

This study is limited to the evaluation of neem leaves powder as a preservative for cowpea under storage conditions. The scope includes the following:

1.4.1 Geographical Scope

The research will be conducted within a local agricultural context, preferably in Nigeria, where both neem trees and cowpea production are abundant. This ensures relevance to the local farming system and environmental conditions.

1.4.2 Botanical Scope

Only neem (Azadirachta indica) leaves powder will be studied. Other parts of the neem plant, such as seeds, oil, and bark, are not included in the scope of this research. The focus is on the leaf due to its availability and ease of processing.

1.4.3 Crop Scope

Cowpea (Vigna unguiculata) is the sole crop considered in this research. The study does not cover other legumes or cereals. The choice is based on the importance of cowpea in local diets and its susceptibility to storage pests.

1.4.4 Comparative Agents

The study will compare neem leaves powder with a synthetic chemical insecticide commonly used for cowpea storage (e.g., phostoxin or permethrin) and a control group with no treatment. This enables a comprehensive understanding of neem's relative effectiveness.

1.4.5 Parameters for Evaluation

The study will focus on:

Mortality and reproduction rates of Callosobruchus maculatus

Degree of grain damage (percentage weight loss and holes)

Changes in physical characteristics of the cowpea (color, smell, texture)

Storage duration (short-term preservation period of 30–90 days)

Economic cost analysis (cost of neem vs. synthetic preservatives)

1.4.6 Time Frame

The research will be conducted over a three-month storage period, which is sufficient to evaluate pest infestation trends and preservation efficacy.

1.4. Limitations

This study does not evaluate the long-term nutritional or toxicological effects of consuming neem-treated cowpea. Also, it does not cover large-scale commercial applications or mechanized treatment systems. The study is based on small-scale, traditional storage methods applicable to rural farmers.

CHAPTER TWO

LITERATURE REVIEW

2.1 Background to the study

The increasing concern over post-harvest losses of legumes, especially cowpea, necessitates the search for safer, eco-friendly, and cost-effective preservation methods. Synthetic insecticides, though effective, raise several issues ranging from environmental degradation to health hazards and the development of pest resistance. This has led to an exploration of botanical alternatives, among which neem (Azadirachta indica) has gained significant attention. This chapter presents a review of relevant literature on the agronomy, economic value, processing, and nutritional content of cowpea, as well as the agronomy and benefits of the neem plant. It seeks to lay a foundational understanding of how neem leaves powder can serve as an alternative method of preserving cowpea seeds post-harvest.

2.2 Agronomy of Cowpea

Cowpea (Vigna unguiculata) is an annual herbaceous legume widely cultivated in tropical and subtropical regions of the world, especially in West Africa. It thrives in semi-arid conditions and is remarkably tolerant to drought, making it suitable for cultivation in regions with low rainfall (Ehlers & Hall, 1997).

2.2.1 Climate and Soil Requirements

Cowpea requires warm temperatures (20°C–35°C) for optimal growth. It grows well in well-drained sandy loam soils with a pH range of 5.5 to 6.5. Although it tolerates low fertility soils, growth and yield are significantly improved with modest applications of phosphorus and potassium fertilizers.

2.2.2 Planting and Growth

Cowpea is propagated through seeds and typically planted at the onset of the rainy season. Plant spacing varies depending on the variety, but on average, seeds are sown 20–30 cm apart in rows 60–75 cm apart. It matures within 60 to 100 days depending on the cultivar.

2.2.3 Pests and Diseases

Cowpea is susceptible to numerous pests including Callosobruchus maculatus (cowpea weevil), aphids, thrips, and pod borers. Diseases such as bacterial blight and fusarium wilt can also impact productivity. Post-harvest pests like weevils significantly reduce the seed quality during storages

2.3 Economic Importance of Cowpea

Cowpea is a vital staple crop, especially in Sub-Saharan Africa, due to its adaptability, high protein content, and versatility. It is sometimes referred to as the "poor man's meat" due to its affordability and rich protein profile (Langyintuo et al., 2003).

2.3.1 Income Generation

For many rural farmers, cowpea cultivation is a significant source of income. It is sold in local and international markets in various forms: whole dry seeds, flour, canned, or as processed foods like akara and moi-moi.

2.3.2 Food Security

As an early maturing crop, cowpea provides food during the hunger gap period in many farming communities. Its ability to thrive in poor soils and low rainfall areas makes it essential for ensuring food security.

2.3.3 Soil Improvement

Cowpea is a nitrogen-fixing plant, contributing to improved soil fertility. The crop residues are used as livestock feed or green manure, contributing to integrated farming systems

2.4 Processing of Cowpea

Cowpea processing involves a series of steps that improve its shelf-life, edibility, and market value. Common processing methods include drying, dehulling, milling, fermenting, and cooking.

2.4.1 Traditional Processing

Traditionally, cowpea is dried under the sun to reduce its moisture content before storage. It is then dehulled manually or mechanically. In households, cowpea is often soaked, boiled, or ground into flour for various dishes.

2.4.2 Industrial Processing

On an industrial scale, cowpea is processed into canned beans, cowpea flour, and protein concentrates. Advances in food technology have improved the nutritional and functional properties of processed cowpea products.

2.4.3 Preservation Challenges

The major post-harvest challenge is infestation by C. maculatus which can lead to 30–60%

seed loss if not properly managed. Chemical insecticides are commonly used but raise concerns regarding residue, safety, and sustainability.

2.5 Nutritional Composition of Cowpea

Cowpea is nutritionally rich, making it a crucial component of diets in developing countries. It provides essential macro and micronutrients.

2.5.1 Macronutrients

Cowpea seeds contain about 22–28% protein, 1–2% fat, and 60–65% carbohydrates. The proteins are predominantly globulins and albumins, which are rich in lysine but deficient in sulfur-containing amino acids like methionine.

2.5.2 Micronutrients

Cowpea is a good source of B-vitamins (especially folate), iron, calcium, magnesium, and potassium. The bioavailability of these nutrients can be improved through processing techniques such as fermentation and germination.

2.5.3 Anti-nutritional Factors

Cowpea contains some anti-nutritional components like phytic acid, tannins, and trypsin inhibitors which may interfere with nutrient absorption. However, proper processing methods can significantly reduce their levels.

2.6 Agronomy of Neem Plant

Neem (Azadirachta indica), a native of the Indian subcontinent, is now widely cultivated in tropical and semi-tropical regions including Nigeria. It is a fast-growing tree that belongs to the Meliaceae family.

2.6.1 Climatic Requirements

Neem grows well in semi-arid conditions with annual rainfall between 400 mm and 1200 mm. It is highly drought-tolerant and prefers well-drained sandy or loamy soils.

2.6.2 Propagation and Growth

Neem can be propagated through seeds or stem cuttings. It reaches up to 15–20 meters in height and begins to bear fruit after 3–5 years. Neem trees produce small white flowers and olive-like drupes containing the seed kernel.

2.6.3 Pest Resistance

One of the remarkable features of neem is its natural resistance to pests and diseases. This trait is due to the presence of biologically active compounds in its leaves, bark, and seeds.

2.7 Benefits of Neem

Neem has been extensively studied for its medicinal, agricultural, and environmental benefits. Its application as a biopesticide is well-documented and forms the basis of its proposed use in cowpea preservation.

2.7.1 Bioactive Compounds

Neem leaves contain azadirachtin, nimbin, salannin, and other limonoids which exhibit insecticidal, antifungal, antibacterial, and antiviral properties (Isman, 2006). These compounds affect insect feeding, reproduction, and development.

2.7.2 Agricultural Use

Neem extracts have been employed as bio-pesticides, soil enhancers, and seed protectants. The powdered leaves or seed kernel extracts deter pests like aphids, weevils, beetles, and caterpillars. Neem cake is also used as organic manure and nematicide.

2.7.3 Environmental and Human Safety

Unlike synthetic pesticides, neem products are biodegradable and pose minimal risks to humans, animals, and non-target organisms. They do not contaminate groundwater or leave harmful residues in food products.

2.7.4 Economic Viability

Neem is abundant and inexpensive in many rural areas. Its use as a preservation agent offers a cost-effective alternative for smallholder farmers who may not afford commercial pesticides.

2.8 Neem as a Natural Preservative for Cowpea

Several studies have explored neem's efficacy in protecting stored grains, especially cowpea, from insect pests. Neem leaves powder has been tested and shown to significantly reduce weevil infestation and damage when mixed with stored grains (Adedire & Ajayi, 2003).

2.8.1 Mode of Action

Neem compounds act as insect growth regulators, antifeedants, oviposition deterrents, and repellents. When neem powder is mixed with cowpea, it forms a physical and chemical barrier that disrupts the life cycle of storage pests.

2.8.2 Comparative Efficacy

Neem has been found to be as effective as some synthetic insecticides in preserving cowpea without the attendant risks. Its long-term use, however, depends on proper application techniques and dosage.

2.8.3 Limitations and Considerations

The major challenge with neem is its relatively short residual activity compared to synthetic chemicals. Regular reapplication may be necessary. Moreover, some pests may develop tolerance over time if not used as part of an integrated pest management system.

2.9 Summary of Literature and Research Gap

The literature reviewed establishes cowpea as a nutritionally rich and economically vital crop prone to post-harvest losses. Neem, on the other hand, presents a sustainable, affordable, and safe means of preservation due to its insecticidal properties. However, there remains a need for localized, empirical studies that assess the effectiveness of neem leaves powder under specific environmental and storage conditions in regions like Kwara State. This study seeks to fill that gap by evaluating the efficacy of neem leaves powder as a preservation method for cowpea.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials Used in the Study

The following material, apparatus and equipment are used during the research work:

i. Neem leaves

ii. Plastic container with lid

iii. Electronic weighing scale

iv. 10mm Sieve

v. Thermometer

vi. Digital spoon scale

vii. Electric blender

viii. Neem powder

3.1.1 Neem Leaves and Neem Powder

The neem leaves also known as wonder leaves or holy leave was use to preserve the grain. It was pounded. Plate 3.1 shows the pictorial view of Neem Leave and neem powder.

Plate 3.1 Neem leaves

3.1.2 Electronic weighing Scale

This is used to measure the neem powder extracted from the neem leaves. Plate 3.2 shows the pictorial view of the electronic weighing scale.

Plate 3.2 Electronic weighing Scale

3.1.3 Plastic container with lid

This was used for storing the grains (treated and un-treated) during the experiment. Plate 3.3 shows the pictorial view of the plastic container with lid.

Plate 3.3: plastic container

3.1.4 Thermometer:

This is used to measure the amount of temperature in the room where the neem leaves were kept. Plate 3.5 shows the pictorial view of Thermometer

Plate 3.1.4: Thermometer

3.1.5 Digital spoon Scale

This was use to give us the correct amount of neem powder need in the jar as preservative

Plate 3.6 shows the pictorial view of Digital spoon scale

3.1.6 Electric Blender

This was use to blend the dry neem leaves into powder form. Plate 3.7 shows the pictorial view of the electric blender

3.2 METHODOLOGY

3.2.1 Sourcing of Experiment Materials

The cowpea was purchased from Mandate market in Ilorin West Local Government area of Kwara State. The neem leave was gotten from the back of Kwar State Polytechnic mini campus. The fresh neem leaves were dried under room temperature for nine days and the dried neem leaves were blended to neem powder.

3.2.2 Sample Preparation

The cowpeas were sorted to remove damage grains and unwanted particles. The wholesome grains were cleaned by manual winnowing. The grains were divided into potion by weighing them with electronic weighing scale into plastic containers. The neem was prepared in a room temperature (28°C) and the dried neem leaves were blended into neem powder.

3.2.3 Experimental Procedure

The clean cowpea was divided into ten (10) portions of 100g for four samples each, 50g for four samples and two samples were used as control with the following descriptions into the plastic container.

i. Two (2) containers of 50g each contains infected and non-infected cowpea with 5g neem powder

ii. Two (2) containers of 50g each contains infected and non-infected cowpea with 10g neem powder

iii. Two (2) containers of 100g each contains infected and non-infected cowpea with 5g neem powder

iv. Two (2) containers of 100g each contains infected and non-infected cowpea with 10g neem powder

v. Two (2) jars of 100g each contain infected and non-infected cowpea with no preservation (no neem powder) which was used as control

3.2.4 Experimental Design

Proximate composition was done on the fresh cowpea before the addition of preservative and storage. The cowpea was preserved and stored for a period of twelve weeks. The proximate composition was conducted on the 4th and 6th, 8th, 10th and 12th weeks of storage in order to determine the effect of the preservatives on the stored cowpea

3.3 Proximate composition of Cowpea

This study aimed at determining the proximate composition, mineral constituents and tyrosine inhibitory activity of the cultivar. Cowpea presents (100g): 24.5 protein, 51.4 carbohydrates, 16.6 insoluble fibers and 2.7 soluble fibers, 2.6 ash; major mineral constituents.

3.3.1 Initial and Final Moisture Content Determination on Dry Basis (db)

Fresh beans sample of 100g were placed in pre-weighed electro weighing balances and mixed with neem powder, temperature of 70c for 6h at 26.1HG vacuum in a thelco 29 vacuum oven (precisions scientific, Chicago, IL) dishes were removed and placed immediately in desiccators to allow temperature to equilibrate before weighing.

The weighing used for the scale had an accuracy of 0.01g. All moisture measurement for each trial were replicated twice and moisture contents were calculated on dry basis using the following formula to obtain the initial moisture content of the samples.

$$MC (\% db) = \frac{(W_I - W_F)}{W_F} \times 100 \qquad 3.1$$

W_I =initial weight of the sample

W_F =final weight of the sample

The final moisture of the dried samples was the determined using infrared moisture determination balance AD/4714A,(centurion scientist limited). Following manual recommendation, 5g of each sample was weighed into a cleaned dried dish. The sample was then placed in the infrared mixture determination balance. The temperature regulated to 105Oc. The mixture content was indicated automatically by the reading on the machine.

3.3.2 Determination of Fat Contents

About 5g of each of the sample weighted and wrapped in a filter paper and placed in an extraction thimble. The thimble weighed before the additional of the sample, (W_1), the thimble with sample (W_2) was then inserted in soxhlet apparatus. Extraction under reflux was carried out with petroleum ether (30- 60^{0}C boiling range) for 5hrs. At the end of the extraction thimble was dried in an oven for about 180s at 100^{0}c for the evaporation of the solvent and the thimble was allowed to cool in a desiccators and later weighed (W_3) (AOAC,2005)

% Fat = (weight loss of a sample {extracted fat})−(original weight of sample) x 100 ($W_2 - W_3$) −(W_2 −W_1) x 100

3.3.3 Determination of Carbohydrate Contents

The carbohydrate contents were determined by the subtraction of the summation of crude protein, crude fiber, and ash, fat contents in percentage from 100 percent.

3.3.4 Determination of Ash Contents

The ash content was determined as described in association of official analytical chemists (AOAC) official standard and methods (2005). A know weigh of the beans was charred in a low flame. Thereafter, the sample was transferred to the furnace regulated at 600$_o$c for about 30min. the sample was then cooled and reweighed the procedure was respected until gray ash was resulted. The ash content was calculated as shown in equation developed by

AOAC (2005).

$$C_{ASH} = \frac{W_{ASH}}{W_{AS}} \times 100$$

Where,

C_{ash} = the ash content in %

$_{ASH}$ = ash weigh, kg

W_{as} = sample weigh, kg

3.3.5 Determination of Crude Fibre Contents

The fibre content was determined by the method described in AOAC, (2005). Two grams of the samples were accurately weighed into fibre flask and 100 ml of 0.255 N H_2SO_4 was added. The mixture was then heated under reflux for one hour with the heating mantle and the hot mixture was filtered through fibre sleeve cloth. The filtrate was thrown of while the residue was returned to the fibre flask to which 100ml of 0.313 NNAOH was added and heated under reflux for another 1hr. The mixture was filtered through a fibre sleeve cloth and 100ml of acetone was added to dissolve ant organic constituent. The residue was washed with some hot water twice on the sleeve cloth before it was finally transferred into a crucible. The crucible containing the residue was cooled in the desiccators and later weighed to obtain weight W_2

The different W_1- W_2 gives the weight of fibre and the percentage fibre was obtained as

$$\% \text{ Fibre} = \frac{W_1 - W_2 \times 100}{\text{Weight of sample}}$$

3.3.6 Determination of Crude Protein Content

Protein content of the test sample was determined using micro kjedhel method as described by AOAC (2005). One gram of test sample was weighed into digestion tube, 15ml of concentrated H_2SO_4 and one tablet of selenium catalyst was added. The mixture was digested on an electro-thermal heater until clear solution is obtained. The flask was allowed to cool after which the solution was diluted with distilled water to 50ml, 5ml of this was transferred into the distillation apparatus, 5ml of 2% boric acid was pipette into a 100ml conical flask (the receiving flask) and 4 drop of screened methyl red indicator was added 50% N_aOH was continually added to the digested sample until the solution turned cloudy and this indicates the alkalinity of the solution. The distillation was carried out the acid solution in the receiving flask with the delivery tube below the acid level. As the distillation is going on, the pink color solution of the receiving flask turned blue. Distillation was continued was continued until the content of the round bottom flask is about 50ml. The resulting solution in the conical flask was titrated with 0.1 M HCI.

$$\% \text{ Nitrogen} = \frac{\text{Titre value} \times 0.1\ \text{HCI} \times 0.014 \times 100 \times {}^{50}/_{5}}{\text{Original weight of sample}}$$

% Protein = % Nitrogen x protein conversion factor.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

The average results of a proximate composition of the cowpea before storage and preservation is presented in table 4.1 while that of freshly prepared neem powder is presented in table 4.2.

Table 4.3- 4.6 shows the average results of the proximate composition of the treatment applied to the cowpea after eight (6) weeks of the experiment for the different quantities of neem powder applied.

Table 4.7 shows the average result of the proximate composition of cowpea before storage and preservation, the freshly prepared neem powder and when different treatment were applied to the cowpea are present in the appendix A-L

Table 4.1 Average Proximate Composition of Cowpea before Storage

Proximate Composition (%)						
SAMPLE	MC	ASH	FAT	FIBRE	PROTEIN	CHO
COWPEA	14.02	3.3	3.2	3.1	5.1	71.3

Table 4.2 Average Proximate Composition of Neem Powder

Proximate Composition (%)						
NEEM POWDER	MC	ASH	FAT	FIBRE	PROTEIN	CHO
	14.12	1.06	3.8	3.07	1.02	76.95

Table 4.3 Average Proximate Composition of Cowpea with Neem Treatment under Ambient Storage

Proximate Composition (%)	Treatment Applied	Preserved Infested with Insect
MC	14.32	15.16
PROTEIN	5.71	5.10
CARBONHYDRATE	76.14	71.48

Table 4.4 Average Proximate Composition of Cowpea (50g) with Neem Powder (5g) under Ambient Storage

Proximate Composition (%)			
SAMPLE	MC	PROTEIN	CHO
COWPEA	14.21	5.90	76.23

Table 4.5 Average Proximate Composition of Cowpea (50g) with Neem Powder (10g) under Ambient Storage

Proximate Composition (%)			
SAMPLE	MC	PROTEIN	CHO
COWPEA	15.10	5.40	74.28

Table 4.6 Average Proximate Composition of Cowpea (100g) with Neem Powder (5g) under Ambient Storage

	Proximate Composition (%)		
SAMPLE	MC	PROTEIN	CHO
COWPEA	15.03	5.62	75.06

Table 4.7 Average Proximate Composition of Cowpea with no Neem Powder

Proximate Composition (%)	Cleaned Cowpea	Cowpea with Insect
MC	14.52	15.32
PROTEIN	5.94	5.42
CARBOHYDRATE	76.11	70.03

4.2 Discussions

4.2.1 Effect of Neem powder on cowpea

Tables 4.3- 4.6 revealed the effect of different quantities of neem powder added to preserve the cowpea. In all the results presented the moisture content increases as well as the protein. It was also observed that there was no emergence of insects which are responsible for feeding on the carbohydrate. Therefore, the decrease on the carbohydrate was negligible when compared with the fresh cowpea before storage and preservation.

4.2.2 Effect of Carbohydrate on Cowpea

Table 4.3- 4.6 show the result of the carbohydrate of the cowpea when neem powder was applied and when insect was introduced.

The carbohydrate ranged between 70.03 to 76.28% when neem powder was applied. The highest value recorded was when 10g neem powder was applied to the cowpea while the lowest carbohydrate was recorded when no treatment was applied to the cowpea with infested insects.

The value recorded for the cowpea which treated with 5g of neem powder is still higher with the value recommended for carbohydrate in cowpea by (Mainaet al., 2000) which ranged between 68-73%.

4.2.3 Effect of Moisture Content on Cowpea

The moisture content recorded in this study ranged between 14.08 to 15.32%. The highest recorded was when no treatment was applied to the cowpea (control). The lowest moisture content was when 5g of neem powder was added to the cowpea. This implies that increase in moisture content will reduce the storage life of cowpea. This will cause insect multiplication in the cowpea under study. The reverse is the case when there is decrease in the moisture content,

4.2.4 Effect of protein on Cowpea

The protein content on the non-infested cowpea ranged between 5.71 to 6.10% and the protein content in the infested cowpea ranged between 5.10 to 5.62%. The protein content with 5g of neem powder was the highest recorded and the least was when 2g of neem powder was applied. The infested cowpea when 2g of neem powder was the lowest and 5g of neem powder was the highest. The protein content when 5g of neem powder favors the infested and non-infested cowpea.

4.2.5. Effect of neem powder on Cowpea

It was also observed that the cowpea infested with insect and preserved with various quantity of neem powder were found dead and there were no multiplication of insect. Also the cleaned and healthy cowpea preserved with various quantity of neem powder remains clean and fresh without any emergency of insect. Thus, the neem powder had persevered the shelf life of the cowpea throughout the experiment thereby prohibiting insect multiplication and no detection of life insect during the period of study.

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Table 4.3- 4.6 show the result of the carbohydrate of the cowpea when neem powder was applied and when insect was introduced.

The carbohydrate ranged between 70.03 to 76.28% when neem powder was applied. The highest value recorded was when 3g neem powder was applied to the cowpea while the lowest carbohydrate was recorded when no treatment was applied to the cowpea with infested insects.

The value recorded for the cowpea which treated with 5g of neem powder is still higher with the value recommended for carbohydrate in cowpea by (Maina et al.,

2000) which ranged between 68-73%.

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CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The effect of organic preservatives for the treatment of insects and pest in agricultural crops was investigated, based on the experiment conducted, the following conclusion was drawn:

i. Neem powder in different quantity of 2g, 3g, 4g, and 5g were applied to cowpea under ambient storage of 28°c using infested and non-infested cowpea.

ii. Neem powder favors the non-infested cowpea when 5g of neem powder is applied and also showed no emergence of life insect throughout the experiment.

iii. The infested cowpea showed no further emergence of insect and confirmed death of the entire insect introduced when 5g of neem powder was used.

iv. Neem powder can be used as an alternative preservative for cowpea.

5.2 RECOMMENDATIONS

The following recommendation were made at the end of the study for further work

i. Famers should be encourage and educated on the effectiveness of use of neem powder.

ii. The awareness of the use of neem powder as an alternative to chemical should be advocated.

iii. Other agricultural crop can be tested and treated with the neem powder.

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