

**AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT**

**ASSESSMENT OF BACTERIOLOGICAL CONTAMINATION AND
PESTICIDE RESIDUES ON SELECTED VEGETABLES PRODUCED AT
THE ANLOGA DISTRICT IN THE VOLTA REGION OF GHANA**

ALBERT WISE KADEY

DECEMBER, 2023

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BY

**ALBERT WISE KADEY
(7181930004)**

**A thesis submitted to the school of graduate studies of the Akenten Appiah-
Menka University of Skills Training and Entrepreneurial
Development (AAMUSTED) in partial fulfilment of the requirements
for the award of a degree of Master of Philosophy degree in
Environmental and Occupational Health Education**

DECEMBER, 2023

DECLARATION

Candidate's Declaration

I hereby declare that except for references to other people's works which have been duly acknowledged, this thesis is my original work towards an award of a Master of Philosophy in Environmental and Occupational Health Education and that this thesis or part of it has not been accepted for the award of a degree in this university, or elsewhere.

Albert Wise Kadey

Signature: **Date:**

Supervisors' Declaration

We declare that the preparation and presentation of this thesis were supervised under the guidelines of the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development on thesis work for the award of Master of Philosophy in Environmental and Occupational Health Education.

Professor Emmanuel Dartey (Principal Supervisor)

Signature **Date**

Dr. Daniel Hayford (Co-supervisor)

Signature **Date**

ABSTRACT

Globally, countries are promoting food security, improved nutrition and food safety to meet the Sustainable Development Goal II (SDG 2). The current research sought to assess the bacteriological contamination and pesticide residues on selected vegetables produced in the Anloga District in the Volta Region of Ghana. Seventy-five vegetable samples (cabbage, lettuce and spring onion) were collected from five farm lands in five communities. These samples were examined for the occurrence and loads of *Salmonella* species, *Vibrio* species and total coliform, as well as the occurrence and levels of pesticide residues. The bacteriological analyses were based on ISO 6579-1:2017, ISO 21872-1:2017 and ISO 4832:2006. Furthermore, a gas chromatography instrument was used to analyse pesticide residue. The results of the current study showed the presence of only total coliform. Both *Salmonella* species and *Vibrio* species were not detected. The load of total coliform bacteria recorded for cabbage, lettuce and spring onion ranged from 2.0×10^3 to TNTC, 2.0×10^5 to 2.0×10^6 and 4.0×10^5 to TNTC, respectively. In addition, the results of the current study showed that none of the three vegetables had detectable amounts of any of the thirty-six active ingredients of chemical pesticides explored in the current study. These results suggest that the vegetables produced from the Anloga District of the Volta Region of Ghana may be unfit for human consumption due to contamination by coliform. The results of this study will be a useful tool for future researchers who may undertake studies of a similar nature. This calls for quick action to guarantee that vegetables grown in the Anloga District area are bacteriologically safe for human consumption.

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DEDICATION

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LIST OF ABBREVIATIONS AND ACRONYMS

ACC	Aerobic Colony Count
ADI	Acceptable Daily Intake
AEOs	Agriculture Extension Officers
AMC	Aerobic Mesophilic Count
AMD	Age-related Macular Degeneration
BSA	Bismuth Sulphite Agar
CDC	Centres for Disease Control and Prevention
CFU	Colony Forming Unit
DALY	Disability-Adjusted Life Years
ddPCR	digital droplet PCR
<i>E. Coli</i>	<i>Escherichia coli</i>
EU	European Union
EU MRLs	European Union Maximum Residue Levels
FAO	Food and Agricultural Organisation
FDA	Food and Drugs Authority
GC-ECD	Gas Chromatograph Electron Capture Detector
GC-MS	Gas Chromatography Mass Spectrometry
GC-PFPD	Chromatograph-Pulsed Flame Photometric Detector
GSA	Ghana Standards Authority
GSS	Ghana Statistical Service
ICMSF	International Commission on Micro Biological Specification for Food
IMS	Magnetic Immunity Isolation
ISO	International Standard Organisation
LC-MS	Liquid Chromatography Mass Spectrometry

MoFA	Ministry of Food and Agriculture
MRD	Maximum Recovery Diluent
MKTTn	Muller-Kauffman Tetrathionate Novobiocin
MPN	Most Probable Number
ND	Not Detected
NGS	Next Generation Sequencing
NPAS	Northern Presbyterian Agricultural Services
OCPs	Organochlorine and Pyrethroids
OPPs	Organophosphorous
PCR	Polymerase Chain Reaction
PSA	Primary Secondary Amine
RTE	ready-to-eat
RVSP	Rappaport-Vassiliadis Soya Peptone
SDG	Sustainable Development Goal
SP	Synthetic Pyrethroids
SPE	Dispersive Solid Phase Extraction
TC	Total Coliform
TCBS	Thiosulfate Citrate Bile Salts
TNTC	Too Numerous To Count
TS	Technical Specification
USA	United States of America
VRBL	Voilet Red Bile Lactose Agar
WGS	Whole-Genome Sequencing
XLD	Xylose Lysine Deoxycholate
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Study Background

Globally, countries are promoting food security and improve nutrition to meet Sustainable Development Goal II (SDG 2) [UN, 2017; UN, 2015, UN, n.d.]. Food security has always been connected with an abundance of grains, roots, and tubers—the staple crops that provide low-cost, nutrient-dense energy sources. However, this picture is shifting as dietary diversity becomes more important for optimal health and nutrition security becomes entwined with food security. Consuming the right amounts of various food groups is essential for a healthy, high-quality diet the consumption of a wide range of food categories in the right quantities (WHO, 2020; Hooper et al., 2015). The global efforts to eradicate hunger and malnutrition are backfiring, according to a 2022 assessment on food security and nutrition released by the World Health Organization. There was reportedly 828 million hungry people in the world in 2021. Given that there are 46 million people increase over 2020, the global goal of eradicating hunger, food insecurity and malnutrition in all its forms by 2030 seems to be sliding away from grasp (WHO, 2022). Vegetables are important for human health and well-being and are an important part of a healthy diet. They are extremely beneficial to overall health and have an important role in illness prevention (WHO, 2020; Kiwango et al., 2017). Kiwango et al. (2017) opined that vegetables have important micronutrients especially calcium, iron, iodine, vitamin A and zinc are required to build up and mend the body. They protect the body against non-communicable diseases such as cancers, heart diseases and diabetes), WHO has recommended a minimum daily

intake of 400 g of fruits and vegetables (WHO, 2020; McCarthy et al., 2020; WHO, 2015). Furthermore, according to reports (Coe & Spiro, 2022; WHO, 2020), eating raw vegetables and salads is expected because they retain their natural flavour and heat-labile nutrients.

Despite the benefits of vegetables, it is considered that today's consumers, including those with greater incomes, are falling short of this goal. The nutritional focus for low-income individuals is typically on consuming enough energy-rich items to meet calorie requirements; however, greater emphasis must be made on bridging this dietary gap and enabling people to benefit from the nutritive value of vegetables. Vegetables are relatively expensive in terms of calories per kilocalorie. That makes the decision to prioritise other expenses over buying vegetables seem reasonable. In that case, obtaining the 400 g of recommended daily consumption of vegetables requires but does not suffice from increasing the availability of vegetables.

Furthermore, greater affluence may not always result in adequate consumption of fruits and vegetables. Despite rising average wages, vegetable consumption has dropped in several nations (Global Panel, 2016). However, one of the most obvious and important initial duties is to increase the production of fruits and vegetables. Consumers' desire to vary their diets is already driving up market demand, as indicated by increased populations and incomes, particularly in major urban regions. In response to this need, increasing vegetable output gives excellent economic prospects, particularly for smallholder farmers (Schreinemachers, 2018).

Although not indigenous to Ghana, the following urban vegetables are frequently produced there: bell pepper (*Capsicum annuum* L.), cucumber (*Cucumis sativus* L.), spring onion (*Allium fistulosum* L.), cabbage (*Brassica oleracea* var. *capitata* L.) and lettuce (*Lactuca sativa* L.) (Wongnaa et al., 2019). Urban diets in Ghana are more nutritionally balanced when there is a greater supply of vegetables due to the cultivation of vegetables in and around the country's cities (Amoateng et al., 2017; Amo-Adjei & Kumi-Kyereme 2015; Drechsel & Keraita, 2014). Similar to Lomé, Accra too has over 90% of its lettuce coming from urban vegetable producers (Antwi-Agyei et al., 2016). Furthermore, due to insufficient cold transportation and storage, most perishable vegetables are grown in open fields on the outskirts of cities (Osei et al., 2022). Wongnaa et al. (2019) and Drechsel and Keraita (2014), on the other hand, suggest that this is a very profitable industry with the potential to raise vulnerable populations out of poverty. Growing vegetables in cities is a lucrative business. It is the primary source of income for many city dwellers, and it is generally double what they would have earned in a rural area (Abu et al., 2020; Wongnaa et al., 2019; Van Asselt et al., 2018). In many circumstances, it is equal to or greater than the salary of a senior government servant (Chan, 2017).

During the production period, most vegetables are extremely vulnerable to insect pests and plant diseases. Lower yields can result from certain pests and diseases producing blemishes or uneven forms. Because fresh fruit look is so important to buyers in marketplaces, farm managers often overuse pesticides in an attempt to reduce financial loss. Farmers typically spray preventively to protect their investments, and high-value crops use considerably more pesticides than low-value crops (Riwthong et al., 2015).

Although pesticide use has greatly aided to guaranteeing a consistent supply of fresh vegetables to Ghana's urban markets, it has come at a cost. The health consequences of pesticide overuse and, in most cases, indiscriminate use have been enormous. In addition to exposing agricultural workers and their families to residues that may be harmful to their health, the practice raises issues about consumer health and food safety (Praneetvatakul et al., 2013).

Moreover, there are several ways in which foodborne pathogens can contaminate vegetable supplies: using contaminated water for irrigation or washing produce; using organic waste as manure; and direct contamination by livestock, wild animals, or birds (Balali et al., 2020; Alemu et al., 2018; García & Heredia, 2017; Park et al., 2012). Customers are consequently growing more worried about the safety of vegetables. Consumers would link fresh vegetables with hazards rather than benefits if they are frequently contaminated or have more pesticide residue than is acceptable. Attempts have been made to handle such challenges. One example of such an approach is the modernization of supply chains, which includes things like supermarket-provided quality control systems and refrigeration. However, such a measure only offers a partial solution. Although retail veggies have lower levels of microbiological contamination than wet market vegetables (Duedu et al., 2014), both may have equal levels of pesticide contamination (Wanwimolruk et al., 2016). Innovative market channels have emerged in certain middle-income nations to offer a more consistent supply of fresh veggies. For instance, in Thailand, the Royal Project Foundation links poor highland vegetable producers with cold chain distribution networks and packaging facilities throughout the nation. Customers willing to shell out a substantial amount of money for this network

have a high degree of trust. In other areas, similar-or less expensive-enterprises are emerging, like organic farms that supply weekly baskets filled with a variety of vegetables to customers. Regular phone-based or internet applications are beginning to appear as additional lines of communication for vegetable growers and producer associations to ensure that buyers receive safe, high-quality vegetables. In order to achieve food safety objectives, legislators must establish appropriate guidelines for the cultivation and handling of vegetables as well as mechanisms for ensuring adherence, such as routine testing for pathogens and pesticide residues at important markets and making test results available to the public (Schreinemachers, 2018).

Traditional practices in cultivating, manuring and harvesting vegetables in many parts of Sub-Sahara Africa remain an area of concern. The use of sewage and other liquid wastes during cultivation are potential sources of contamination with the eggs and larvae of parasitic infections. Human infection occurs via the consumption of raw vegetables (Bekele et al., 2017; Duedu et al., 2014). Additionally, handling vegetables during their growth, harvest, transportation, and additional processing may expose them to disease causing organisms originating from either human or animal sources. Additionally, farmers and markets wash vegetables after they are harvested, and contaminated water might cause contamination. Transportation, warehousing, and market vendor contamination are further potential sources of secondary contamination. In locations where vegetables are washed with wastewater and irrigation water is tainted with human and animal waste, the circumstance may also result in secondary pollution. Those who come into contact with or consume these goods have a greater risk of contracting parasite infections (Khawaja et al., 2018).

In reality, the frequency of foodborne illness cases associated with fresh vegetables has increased (Santarelli et al., 2018; Nazemi et al., 2012; Pires et al., 2012; Said, 2012), and eating raw, unclean, and improperly prepared veggies has been related to an increased risk of infection. Eating contaminated vegetables grown in or handled with contaminated soil or sewage has been connected to multiple epidemics of typhoid fever (Balali et al., 2020). A study conducted by Kudah et al. (2018) also showed that improper handling, processing, and preparation procedures by handlers—including customers—may also be a factor in vegetable infection.

1.2 Problem Statement

Due to the rising scientific knowledge that the consistent consumption of vegetables is critical to guarding and boosting the immunity of infants and adult consumers, many farmers are resorting to all-year-round cultivation of vegetables such as cucumber, cabbage, lettuce, onions and green pepper. This is a good move, but the challenge is the safety of the environment in which vegetables are grown and consumed. According to Amuah et al. (2022), for example, rising urbanization in many areas of Ghana has led to increased urban agriculture that involves not only the use of storm but also water from open drain sources for irrigating cultivated areas in and around open-spaced areas in the urban settings. It has also been reported that the complex physical, chemical and microbial characteristics of irrigation water in the country present significant health risks to consumers (Quarcoo et al., 2022). This situation has made vegetable foods vehicles for the transmission of infectious diseases, for example, lowering efforts to achieve Sustainable Development Goal III of good health and well-being. Accordingly,

there was a need for a study to investigate the microbial and chemical safety of vegetables from farms where vegetables are grown, including the Anloga area of the Volta region of Ghana, West Africa.

Globally, numerous studies have shown the contamination of vegetables with pathogenic microbial agents (bacteria) and pesticide residues. Hence, people are doubting the safety of some vegetables for human use (Degaga et al., 2022; García-Sánchez et al., 2019; Elgueta et al., 2017). Some notable safety issues relate to public health risks associated with vegetable consumption. These risks include cancer and diarrhoea from exposure to pesticide residue and bacteria, respectively. Furthermore, recently published food safety-related studies in Ghana were conducted in the Veve area of the Upper East Region, Kumasi of Ashanti Region, Cape Coast of Central Region, Tamale of the Northern Region and Accra of Greater Accra (Quarcoo et al., 2022; Douti et al., 2021; Akabanda et al., 2019). This partially affirms that no recently published scientific study on vegetables from Anloga in the Volta region exists. There was, therefore, a need for a study which sought to help generate adequate scientific data and credible literature to add to existing literature to augment likely future policy revisions or formulation.

1.3 Research Questions

The following questions guided the study:

1. Are vegetables from Anloga contaminated with *Salmonella*, *Vibrio* and Total coliforms?
2. Are there detectable levels of pesticide residues on vegetables from the district?

1.4 Research Objectives

The study aimed to assess the bacteriological contamination and pesticide residues on selected vegetables produced in the Anloga District in the Volta Region of Ghana.

1.4.1 Specific Objectives

The study sought to:

- i. Detect, isolate and measure loads of bacterial (*Salmonella spp*, *Vibrio spp* and coliform) contamination of vegetables: cabbage, lettuce and spring onion.
- ii. Detect and measure pesticide residues.

1.5 Research Hypothesis

H₀: There is no significant level of bacteria species (*Salmonella spp*, *Vibrio spp* and Total coliform) on vegetables produced at the Anloga area.

H₁: There is a significant level of bacteria species (*coliform*, *Salmonella spp*, *Vibrio spp*) on vegetables produced at Anloga.

H₀: There is no significant level of pesticide residues on vegetables from Anloga.

H₁: There is a significant level of pesticide residues on vegetables from Anloga.

1.6 Justification

One of the major infectious diseases, diarrhoea, is the sixth cause of diseases in the Anloga District of the Volta Region of Ghana (Anloga District Assembly, 2021), and it is known to be caused mainly by bacteria and viruses (CDC, NCEZID and DFWED, 2020; Satitsri et al., 2016, Larcombe et al., 2016; Patzi-Vargas et al., 2015).

Accordingly, the current study which sought to determine bacterial contamination of vegetables produced from Anloga is deemed relevant. Information on bacteriological contamination of vegetables is essential since some of such pathogenic microbes and the diseases they cause could lead to stunting growth and affect children's cognitive development (Wierzba & Muhib, 2018). This increases the risk of death from other infections like measles, pneumonia and malaria due to reduced immunity (Pinkerton et al., 2016; Guerrant et al., 2013). Additionally, bacteria contamination of vegetables has also been linked with typhoid fever (Łepecka et al., 2022; Abakari et al., 2018).

Pesticide abuse, particularly overuse and microbiological contamination of green crops, have also become a concern in Ghana and throughout Africa. However, the use of pesticides and organic manure in Africa generally only represents a considerably small portion of the global total (Demi & Sicchia, 2021; European Parliament, 2021; Srivastava et al., 2014). According to Demi and Sicchia (2021), government policy, activities of non-governmental organizations, environmental challenges, lack of or high cost of labour, and competition among farmers influence farmers' decisions to employ agrochemicals in Ghana. Consequently, it is not unexpected that the use of agrochemicals in the nation presents a significant risk to public health and the environment, with chemical poisoning and poor self-reported health quality ranking among the most serious health effects. The current study, which aimed at exploring the prevalence and concentrations of pesticide residues on vegetables sourced from Ghana's Volta Region's Anloga District, is therefore relevant. It is anticipated that the information gathered from the current research project on bacteriological and pesticide residues would educate interested parties about the current state of pesticide residues

on the vegetables under investigation as well as the microbiological dangers connected to vegetable intake. The information generated through the current study is also expected to add to the existing literature on pesticide residues and bacterial contamination of vegetables in the country. To the best of the knowledge of the researcher, the current study was the first to be conducted on the subject matter in question in the Anloga District of the Volta Region of Ghana.

1.7 Significance of the Study

The purpose of this study was to evaluate bacterial contamination and pesticide residues on selected vegetables grown in the Anloga district of Ghana's Volta Region. Though some studies on the topic have been undertaken in other locations, there is little or no known published research on the topic in Volta Region in numerous other settings in the country. The study's outcome is expected to give some insight into the safety of the agronomical practices of vegetable farmers. The results from this study may also be expected to demonstrate whether farmers produce safe vegetables to meet both local and international standards. The findings of this study will serve as a basis to make purposeful suggestions to stakeholders at local, district, regional and national levels to tighten their monitoring operations or activities. Another significance of the study is that it could be a basis for the Ministry of Food and Agriculture and other policy makers to provide technical assistance on water, fertilizer and pesticide application on vegetables in the country and the world at large to protect consumers' health. Furthermore, the research will function as a source of information for scholars and students who might carry out a comparable investigation in the future.

1.8 Limitations and Delimitations of the Study

The study focused on assessing bacterial contamination and pesticide residues on selected vegetables produced in the Anloga district in the Volta Region. The relevant literature reviewed consisted of those appertaining to pesticides used in agriculture, reports on pesticide residues on food items, microbial contamination of food, especially fruits and vegetables, health risks due to microbial contamination, techniques used in determining microbial contaminants and health risks associated with microbial contaminants. The main problem encountered in the research was the unavailability of staff at certain offices to take the researcher around. There was also no valid data on pesticide residues and bacteria contamination from the district and regional levels. The study explored three bacterial species implicated in foodborne diseases associated with consuming raw and cooked vegetables. Other known microbial contaminants of vegetables were not explored in the current study. The current study covered thirty-six active ingredients of chemical insecticides from the four classes of insecticides approved for pest control, namely, pyrethroids, carbamates, organochlorines and organophosphates. Despite these limitations, data analyses are meaningful and sufficient to answer the research questions.

1.9 Organization of the Study

The goal of the study, which was to evaluate the bacteriological contamination and pesticide residues on particular vegetables grown in the Anloga District, is introduced and summarized in Chapter 1. It also documented the problem statement, background data, research objectives, research questions, significance, and scope of the study, in addition to its limitations and delimitations. The review of the relevant literature is

covered in Chapter 2 of the work. Comprehensive papers pertaining to the subject being studied are included in the review. The study's methodology was covered in the third chapter. It accurately captured the methods for gathering and analyzing data as well as the research design, instrument, sample, and sampling technique. The fourth chapter summarized the findings and discussions. Finally, chapter five summarized the findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Vegetables, their Usefulness and Contamination

Given their high nutritional content and numerous health advantages, fresh food items like vegetables have a significant impact on human diets (Atuna et al., 2022; FAO, 2019; Towns & Shackleton, 2018; Pem & Jeewon, 2015; Slavin & Lloyd, 2012; Dias, 2012). Any edible portion of an herbaceous plant that is consumed by humans, including leaves, stems, flowers, seeds, bulbs, and fruit, is generally referred to as a vegetable. It also includes the plant itself when it is grown for its edible parts. However, the term "vegetable" is occasionally used arbitrarily and subjectively, and it has more of a culinary meaning than a scientific one. There are many of exceptions, but generally speaking, people think of veggies as savoury rather than sweet. Despite being a member of the fungal kingdom, mushrooms are often thought of as vegetables. Generally speaking, nuts, herbs, and spices are not regarded as vegetables (New World Encyclopaedia, 2016). It is acceptable to refer to a plant part as both a fruit and a vegetable as the word "vegetable" is not used in botany. According to this broad classification, vegetables can be everything from lettuce leaves to asparagus stems, carrot roots, broccoli blooms, garlic bulbs, peas, beans, and, of course, botanical fruits like cucumbers, squash, pumpkins, and capsicums (Welbaum, 2015).

Fresh foods which are viewed to be vegetables are vital parts of good nutrition. They are rich sources of essential nutrients, mainly vitamins and minerals, in addition to other non-nutritive phytochemicals. Vegetables play key role in the food culture of the people

of Ghana and elsewhere (Atuna et al., 2022; Towns & Shackleton, 2018; Pem & Jeewon, 2015; Slavin & Lloyd, 2012; Dias, 2012). Studies on longevity have demonstrated that eating more veggies in addition to fruits and full grains is correlated with living a long life. Consequently, it is advised to consume more fruits and vegetables (Van Boxtael et al., 2013). The World Health Organization (2020) states that eating 400g of fruits and vegetables a day can help prevent the development of some chronic illnesses, including diabetes, cancer, heart disease, high blood pressure, and obesity. There are many different ways to eat vegetables, both as snacks and as part of larger meals. Varieties differ significantly in terms of their nutritious content. Except for pulses (annual leguminous crops with one to twelve grains or seeds in a pod, like garden peas, lima beans, protein beans, and chickpeas), vegetables are low in fat and protein (Willett et al., 2017). Along with carbohydrates and minerals, vegetables also include fat-soluble vitamins like vitamin A and vitamin D and water-soluble vitamins like vitamin B and vitamin C. Colourful veggies and fruits are excellent sources of phytochemicals, which are trace minerals. Polyphenol antioxidants represent one of the most significant families of phytochemicals, with several health benefits for the immune and cardiovascular systems. One well researched phytochemical is zeaxanthin, a yellow-pigmented carotenoid presents in a variety of yellow and orange fruits and vegetables. Age-related macular degeneration (AMD) prevention and therapy have been demonstrated to be strongly correlated with zeaxanthin consumption in several studies (Mrowicka et al., 2022). Demand for these foods may rise year after year as consumers become more aware of their health benefits (Naanwaab & Yeboah, 2012). Vegetables are regarded a significant component of human meals in this scenario, and are employed in the manufacture of ready-to-eat salads and other items (Lepecka et al.,

2022; Abakari et al., 2018; Hassan & Purwani, 2016; Pem & Jeewon, 2015). As a result, fresh fruit and vegetable consumption are anticipated to climb by 24-27% and 19-24%, respectively, by 2020 (Hassan & Purwani, 2016). Pesticides residues have been found in food materials from both developed and developing countries however, a higher prevalence of residues exceeding the MRLs are observed in food products from developing countries. These foods exceeding the tolerance of pesticide residues in foods are consumed by the general public, pausing public health concern due to increased risk of detrimental effects of pesticide exposure (EFSA, 2016 and Neff et al., 2012). As a result of such dynamics, competition among vegetable producers is likely, which could lead to abuse of synthetic chemical pesticides and inappropriate management of their produce, resulting in microbial contamination. According to Demi and Sicchia (2021), for example, competition amongst farmers is one of the main variables influencing farmers' decisions to use agrochemicals in Ghana.

2.2 Pesticides Used in Agriculture

In spite of their prohibition in Ghana, Donkoh, et al. (2016) found that there was an increase in the use of Confidor 2500SL [Imidacloprid (2500g soluble liquid)], Karate 2.5 [Lambda-cyhalothrin (25g emulsifiable concentrate)], Karate 5.0 [Lambda-cyhalothrin (50g emulsifiable concentrate)], Rambo 2.5EC [Deltamethrin (25g emulsifiable concentrate)] and Pawa [Lambda-cyhalothrin] tomatoes, okro, sweet pepper and garden eggs, respectively. Similar to this, Akoto et al. (2015) investigated the types of pesticides used in the cultivation of tomatoes, eggplants, and okra from Kumasi. These pesticides included 12 organophosphates (OPs), 10 organochlorines (OCs), and 6 pyrethroids. Together, the studies by Donkoh, et al. (2016) and Akoto et al. (2015)

demonstrated that while many of the pesticides that have been outlawed are no longer used in developed nations, such as Ghana, many developing nations continue to use them. There are other safe pesticides that are employed in a range of settings. Furthermore, there are signs that dichlorodiphenyltrichloroethane and its hexachlorocyclohexane (BHC) residues are widely contaminating different parts of the environment in a number of Third World countries (Fusheini et al., 2021; Taiwo, 2019). The use of pesticides has skyrocketed globally since the 1960s. It has played a significant role in the "green revolution," or the enormous rise in food production that is achieved from the same area of land with the use of intense irrigation, more efficient machinery, and mineral fertilizers (nitrogen, phosphorus, and potassium). The output of crops like maize, vegetables, potatoes, and cotton was increased, while crop losses were greatly decreased with the application of pesticides. Pesticides certainly have certain benefits, but their detrimental impacts on the environment and human health are well-established. This is a significant issue that raises concerns on a local, regional, national, and international level (Mishra et al., 2021; Dhananjayan et al., 2019; Kumar & Kumar, 2019; Begum et al., 2017). Pesticide residues damage soils and water, linger in crops, make their way up the food chain, and ultimately end up in people's diets and water sources. Furthermore, the use of pesticides has been linked to the decline of natural habitats and biodiversity (Hossain et al., 2022).

Instances of pest rebound, pesticide resistance development, secondary pest outbreaks, and extinction of non-target species have all been documented. Agriculture is clearly the main industry where pesticides are used adversely though they are also used in other settings (Tanda, 2024; Khan et al., 2023; Sánchez-Bayo, 2012). Different pesticides are

applied differently depending on the area. Herbicides are used to chemically manage weeds more frequently in North America and Western Europe than in East Asia and Latin America, for example, because of the high expense of labour in these regions. Insecticides are also used extensively in many tropical climates, both on small farms and on large industrial plantations, due to insect pests and plant diseases. Regarding the current use of pesticides, developing countries frequently take a different approach in these areas while developed countries like the United States of America (USA), Canada, and European nations move toward using fewer chemicals and more "green products" (Manida, 2021).

Vegetable cultivation has a significant and varied nutritional and socioeconomic impact within the agriculture sector. In Ghana, the production of vegetables has evolved from being mostly a female-led subsistence endeavour to a predominantly male-driven commercial enterprise. It is in rural, peri-urban, and urban locations that vegetables are produced. In all sixteen (16) regions of Ghana, people grow tomatoes, eggplants, peppers and onions. But some areas are more productive and focused on producing just one or two of the four crops mentioned above. Pests and disease that decimate harvests are among the main issues facing Ghanaian vegetable farmers. Vegetables often draw a diverse array of pests and illnesses, necessitating rigorous pest control (Gupta & Thind, 2018). In Ghana, the production of vegetables uses very hazardous pesticides for pest management, which are mostly administered incorrectly and contaminate both the environment and the food. Not much scientific research has been done to address the long-term adverse impacts of pesticides on the environment and the health of Ghana's resources, despite the growing concern of the nation's elite.

2.3 Reports on Pesticide Residues on Food Items, Especially Fruits and Vegetables

To address the high demand for high-quality, disease-free agricultural products, complex chemicals have been developed. Kumah et al. (2023) who took a look at concentrations of organochlorine pesticides, including residues of γ -HCH, δ -HCH, heptachlor, aldrin, p, p'-DDT, o, p'-DDT and p, p'-DDE detected in vegetables the Ho Municipality.

Bolor et al. (2018) who took a look at concentrations of organochlorine pesticides in lettuce, cabbage and onion tested from Kumasi. These were β -HCH, γ -HCH, δ -HCH, aldrin, endosulfan sulphate, p,p'-DDT and methoxychlor European Union Maximum Residue Limits (EU MRLs) These are the active compounds found in insecticides for vegetables sold under various brand names. Akomea-Frempong et al. (2017) discovered six synthetic pyrethroid residues in ready-to-eat vegetable samples (salads) at varying quantities in a comparable investigation conducted in Kumasi. "Bifenthrin, permethrin, cypermethrin, deltamethrin, lambda-cyhalothrin, and fenvalerate" were among them. Once more, two organophosphates; chlorpyrifos and diazinon were found in the samples yet, all of the samples tested included lambda-cyhalothrin residues. All the samples had diazinon concentration. Likewise, in one sample from each of the cafeteria and street food vendor location, chlorpyrifos outperformed the MRLs. Samples from Adum (cafeteria), KNUST (farm) and Asafo (street food vending sites) included deltamethrin, fenvalerate, and permethrin. Moreover, Blankson et al. (2016) found pesticide residues in every vegetable sample they examined from the chosen

marketplaces in the Accra city. Approximately, 21 pesticides were analysed in the samples out of which 17 of the pesticide concentrations were more than 1% at varying frequencies. Of the analyzed samples, 52% had pesticide residues. Monitoring showed that 32% of samples had readings below the MRL and 20.0% of samples violated MRLs. Akoto et al. (2015) conducted a study in Kumasi on three vegetables: tomatoes, okra, and eggplants. It was discovered that all vegetable commodities contained more pesticides above the MRLs, including methamidophos. In the eggplant and tomato samples, malathion and dimethoate levels were likewise greater than the maximum residual levels MRLs. Conversely, the okra samples had greater MRLs for endrin, α -endosulfan, γ -hexachlorocyclohexane (HCH), γ -chlordane, and heptachlor than the eggplant samples did. For tomatoes and eggplant, organophosphates (OPs) constituted the largest risk factor, accounting for 95.78% and 95.64%, respectively, of the total pesticide-related risk in the veggies.

Ghanaians grow a lot of vegetables, and they make up a big part of their diet on average. They enhance the menu's flavour, intrigue, and variety and are necessary for a balanced, healthful diet. But veggies can also draw a variety of pests and illnesses, necessitating rigorous pest control. Pesticides are used by most Ghanaian vegetable farmers. Diseases and pests are major issues in the production of vegetables. Farmers are utilizing pesticides as a result of the harm they have created (Afari-Sefa et al., 2015). Ghanaian farmers employ chemical pesticides to manage diseases and pests on their vegetables. To keep pests and diseases at bay, farmers applied insecticides on their crops. Farms that grow vegetables, no matter how big or little, use a variety of chemicals like insecticides, fungicides, and/or herbicides (Bandanaa et al., 2024; Onwona-Kwakye et

al., 2020). Many farmers ignore the pre-harvest phase and apply the same insecticides to all vegetables (Odhiambo et al., 2014). Bempah et al. (2012) discovered that in most of the samples they looked at, organochlorine pesticides were more common than organophosphorus and synthetic pyrethroid pesticides. Notably, samples of vegetables contained the highest amounts. The results indicated that there were no detectable pesticide residues in 39.2% of the fruit and vegetable samples that were evaluated, minimal quantities of pesticide residues below the maximum residue limit (MRL) in 51.0% of the samples and extra pesticide residues in 9.8% of the samples. Kolani et al. (2016) detected concentration of OCPs such as dieldrin, chlordane, DDT, lindane, heptachlors and HCH in tomato, cabbage and lettuce.

Accordingly, Kapeleka et al. (2020) reported on different types of pesticide residues (oxyfluorfen, lambda cyhalothrine, profenofos, triadimenol, chlorpyrifos, cyhalothrin (Gamma), Pirimiphos–methyl, Endosulfan (Beta), carbofuran and dieldrin) were detected from tomatoes, onions, sweet paper and Chinese cabbage. Food that has been cooked has residues that are higher than acceptable. Consuming tainted food can pose a risk to the public's health and is a key way that people are exposed to pesticide residues (Khan & Rhaman, 2017).

For all of their crops, vegetable producers applied the same insecticides. In Abagale et al.'s (2020) report, pesticides such lindane, aldrin, dieldrin, p, p'-DDE, p, p'- DDT, α -HCH, β -HCH and δ -HCH in tomatoes, okro, pepper and garden eggs samples from Veve, Tono, Pungu and Wuru irrigation sites in the Upper East Region. These pesticides have implications for public health. Vegetables are not part of the restricted application

of endosulfan in Ghana, however there have been reports of its use in certain regions. Moreover, they asserted that endosulfan misuse poses a risk to public health even though there aren't any overt symptoms of it. The use of endosulfan on vegetables in Ghana is alarming because of its toxicity and extended environmental half-life (endosulfan is not overly persistent, although being more persistent than organophosphates and pyrethroids). Koomson (2018)'s findings supported those of Okoffo et al. (2016), who detected active metabolites from organochlorine pesticides in Ghanaian milk and food crops. Because of their resistance to environmental degradation, organochlorines can accumulate in plant and animal tissue and become concentrated in the higher part of the food pyramid (Akor et al., 2021). Moreover, Onwona-Kwakye et al. (2019) noted that there were significant variations in the quantity of pesticides sprayed throughout each agricultural cultivation season depending on the crops, localities, and farmers surveyed. For instance, from May 2013 to January 2014 at five vegetable irrigation sites: Okyereko in the Central region, Weija and Ashaiman in the Greater Accra Region, Akumadan in the Ashanti region and Tono in the Upper East region, farmers sprayed on frequent basis. They observed that pesticide usage among farmers varied greatly between climatic seasons as well. For instance, farmers applied extra insecticides during the rainy seasons due to the prevalence of diseases and pests and rising rainy wash-off. Ghana is not the only country where vegetable fields employ pesticides. According to Tukahirwa (2019), Mubuka farmers in Uganda sprinkled phosphamidon on tomato plants up to once a week until they reached maturity. Growers of vegetables surely need good advice to help them with their pest and disease control programmes.

2.4 Health Risks Due to Bacteriological Contamination

Unfortunately, microbes such as bacteria, fungus, and viruses are so common that they can be detected on fresh vegetables, especially ready-to-eat veggies (Yousuf et al., 2022; Abakari et al., 2018; Orji et al., 2016; Bonah, 2014). This has been linked to the sanitary and hygienic quality of post-harvest practices, as well as water, transportation, storage, and production processes. Thus, the observation of microorganisms on vegetables serves as a standard indication of the sanitary and hygienic conditions (Tong Thi et al., 2021; Becker et al., 2019; Pesewu et al., 2014).

In Ghana's Accra Metropolis, Quansah et al. (2018) examined the microbiological quality of African spinach, lettuce, cabbage, jute, roselle and eggplant leaves. They discovered faecal coliforms, enterococci, yeasts, moulds and aerobic bacteria in addition to *Salmonella*. On the vegetables tested, the mean counts of aerobic bacteria, yeast and mould, enterococcus and faecal coliform were 8.80, 4.95, 4.90, and 3.67 log CFU/g, respectively. In 96.0% of the vegetable farms and 94.6% of the vegetable sellers, enterococci were detected in 75.4% of the vegetables and 84.3% of the vegetables from 97.3% of the vendors; faecal coliforms were detected in 81.1% of the farms and 83.7% of the sellers' veggies. *Salmonella* strains were isolated in 5.1% of vegetables from 16.0% of vegetable farms and 15.7% of vegetables from 24.3% of vegetable sellers. In a separate study, Abakari et al. (2018) investigated the microbiological quality of ready-to-eat vegetable salads marketed in Tamale, Ghana's key business centre. *Escherichia coli* was found in 96.7% of the salad samples, ranging from 0 to 7.56 log₁₀ cfu/g. *Bacillus cereus* was discovered in 93.3% of prepared vegetable salads, with concentrations ranging from 0 to 7.44 log₁₀ cfu/g. *Shigella* and

Salmonella spp. were also detected in 76.7% and 73.3% of the salads, respectively. The range for *Shigella* species was 0 to 4.54 log₁₀ cfu/g, while the range for *Salmonella* species was 0 to 5.54 log₁₀ cfu/g. According to statistics, the four delimited zones had significantly different levels of contamination from *Shigella* spp., *Bacillus cereus*, and *Escherichia coli* ($p < 0.05$). Nonetheless, there was no discernible variation in *Salmonella* spp. contamination levels ($p > 0.05$) among the zones. The increased quantities and presence of microorganisms could be related to contamination from the raw vegetable production source. For instance, Benami et al. (2016) found that the use of grey water—a waste product from kitchens, bathrooms, and laundry rooms—in the production of most vegetables is typically the cause of bacterial contamination of the plants. Food vendors' poor hygiene procedures and faecal contamination were indicated by the presence of *E. coli* in food samples (Bakobie et al., 2017). Human gastroenteritis and diarrhoea can be brought on by some *E. coli* strains that are present in food (Akter, 2016). *E. coli* does not normally cause foodborne illness in adults, according to Luna-Guevara et al. (2019), but it can cause diarrhoea in children in less developed nations. In a separate study, Boateng (2014) found that 64% of vegetable-derived products (pepper/tomato sauce) in Kumasi were contaminated with *E. coli*. In a similar vein, Bonah (2014) found that *E. coli* was present in 66.6% of the ready-to-eat tomato sauce samples from Tamale Metropolis. One of Abakari et al.'s (2018) weaknesses was that they did not evaluate the various preparation stages carried out by vendors before to serving. Such analysis could have provided better view of microbial content found in the salad. Also, different hygiene practices were not linked to the detection of the microbes in the salad and comparison of the different components of salad was not included.

Kapeleka et al. (2020) reported on some pathogenic bacteria which were isolated on fresh fruits and vegetables produced from Morogoro, Iringa, Arusha, Kilimanjaro, Manyara and Dar es Salaam in Tanzania where kale, watermelons, African eggplant, spinach, onion, amaranths, cucumbers, night-shade, onion, sweet pepper, Ethiopian mustard, cabbages and tomatoes were highly contaminated with enterobacter, *pseudomonas aeruginosa*, *E. coli*, *Salmonella* strains, *Citrobacter* and *klebsiella oxytoca*. Owing to increased daily consumption of these fresh vegetables among lower and middle income urban and peri-urban dwellers, the fresh vegetable chain prompts high public health concern. Other pathogens discovered in salads included *Salmonella* and *Staphylococcus aureus* (Olaimat et al., 2021). Salads comprising turnip, onion, cucumber, beetroot, carrot, radish, tomato, coriander leaves, and *S. aureus* (50.57%) and *P. aeruginosa* (60.85%) were infected with *Salmonella* (32.28%), *E. coli* (33.14%), and *S. aureus* (50.57%), according to a study conducted in Dehradun, India. Furthermore, Sabbithi et al. (2014) evaluated the microbiological quality of salads provided with popular street foods in Hyderabad, India, and discovered that the salads were contaminated with one or more diseases. Carrot and onion salads are the most commonly served salads in Hyderabad Street foods, according to Sabbithi et al.'s (2014) research. Carrots and onions both contained 74% and 56% of *Staphylococcus*, respectively. While *Yersinia* was detected in 24% of onions and 68% of carrots, *Salmonella* was found in 58% of carrots and 45% of onions. Microbes can be found in salads due to a variety of factors, including inappropriate handling and processing, the use of contaminated water for washing and diluting, cross-contamination from rotting vegetables, and the use of unclean utensils and trays. Because carrots were not peeled,

their study found that their bacterial load was higher than onions (Sabbithi et al., 2014). Peeling, as expected, reduces bacterial burden; Behraves et al. (2012) found that peeled carrot reduced bacterial load by roughly 40%. Food handlers and other infected personnel may carry *Staphylococcus aureus* in their nasal passages, which can lead to contamination. Behraves et al. (2012) discovered that touching vegetables in the market area by sick employees, sellers and customers was the primary source of *Salmonella* spp. contamination in vegetables. Sabbithi et al., (2014) did not take into consideration the different preparation processes carried out by vendors before serving. Also, different hygiene practices were not linked to the detection of the microbes in the salad.

Abaza (2017) undertook a bacteriological examination of certain vegetables and ready-to-eat (RTE) salads in Alexandria, Egypt. The results showed that the aerobic colony count (ACC) of the 71 fresh vegetable samples tested ranged from 2.0 to 10.4 log CFU/g. green pepper (8.4 log CFU/g) and lettuce (5.1 log CFU/g) had the highest mean ACC values. Sixty-six percent of RTE samples and ninety-one percent of vegetable samples tested positive for fecal coliforms. 18.2% of the 22 RTE samples from street vendors exhibited significantly low *E. coli* levels. *Salmonella* spp were not found in any of the tested samples. According to Gómez-Aldapa et al. (2013), certain countries' allowable ACC limit for fresh vegetables intended for export shouldn't go beyond 6.69 log CFU/g. In the Abaza (2017) study, 71 fresh vegetable samples were evaluated. These samples' ACC varied from 2.0 to 10.4 log CFU/g, with a mean of 6.761.94 and a median of 7.08. This was consistent with the findings of Faour-Klingbeil et al., (2016) in Lebanon, who discovered that mean ACC levels ranged from 2.90 to 7.38 log CFU/g,

with 17% of their samples having counts greater than 107 CFU/g. Furthermore, for traditional vegetable samples in Egypt, Khalil & Gomaa (2014) discovered a broad range of aerobic mesophilic counts (AMC) (3.63-7.17 log CFU/g). On the other hand, lower ranges of high AMC were reported by Nyenje et al., (2012) in South Africa and Weldezigina & Muleto (2016) in Ethiopia, respectively, from 6.94 to 8.06 and from 6.3 to 6.8 log CFU/g. Buyukunal et al., (2015) reported an AMC range of 2.95–3.75 log CFU/g in Turkey, which is much lower than the average. The range in the ACC mean values could be attributed to the numerous locations where vegetables are cultivated as well as the different types of irrigation. One indicator of food quality has been found to be the plate count of aerobic mesophilic bacteria found in food; most foods are considered dangerous when they contain significant populations of these microbes, even if the organisms are not known to be pathogens (Bintsis, 2017).

Green pepper had the highest ACC mean value “ 8.4 ± 2.0 log CFU/g” in the study by Abaza (2017), followed by coriander “ 6.5 ± 2.0 log CFU/g”, mint “ 7.7 ± 1.0 log CFU/g”, arugula “ 7.9 ± 1.0 log CFU/g”, and parsley “ 7.9 ± 1.0 log CFU/g”. According to Kidar & Yamani et al. (2024), parsley samples obtained from Amman in Jordan had a total aerobic plate count ranging from 8.3 to 9.85 log₁₀ CFU/g, which is a higher count of parsley. Nevertheless, among the 118 fresh-cut vegetable samples that were analyzed, coriander had the highest mean count (7.38 ± 0.00 log CFU/g) followed by cucumber (4.60 ± 2.01 log CFU/g), radish (5.09 ± 2.2 log CFU/g), lettuce (5.50 ± 1.55), parsley (5.42 ± 1.32 log CFU/g), and arugula (3.99 ± 2.44 log CFU/g) according to (Faour-Klingbeil et al., 2016). Khalil & Gomaa (2014) discovered that lettuce had the lowest mean AMC (3.15 ± 0.46 log CFU/g), which is consistent with this finding. Conversely,

Buyukunal et al. (2015) in Turkey found that compared to other commodities examined, the microbial loads of spinach, iceberg lettuce, cos lettuce, and green leaf lettuce were much greater. Furthermore, Mcheik et al. (2018) conducted research in Lebanon and discovered that all lettuce, cabbage and onions samples from various Bekaa Valley parts had a greater incidence of total aerobic bacteria count ranged between 7.84-8.75 log CFU/g, total coliforms 6.25-6.80 log CFU/g and faecal coliforms 5.51-6.50 log CFU/g whereas onions recorded total aerobic bacteria, total coliforms and faecal coliforms count of 1.72-2.25 log CFU/g, 1.24-1.65 log CFU/g and 0.89-1.28 log CFU/g respectively. Cabbage on the other hand had 3.25-4.73 log CFU/g 2.54-3.25 log CFU/g, 2.10-2.25 log CFU/g for total aerobic bacteria, total coliforms and faecal coliforms count. Pathogen presence may be more likely when indicator bacteria are present. Due to their tendency to be more prevalent than most diseases and their ease of identification, they are helpful in evaluating the safety of food products. Mixed vegetables were still shown to have considerable amounts bacteria pathogen. Between May 2018 and February 2019, for example, Srisamran et al. (2022)'s study on sweet basil, spring onion, coriander, cabbage, lettuce, cucumber and tomato from fresh open-air markets, supermarkets and organic items supermarkets in Bangkok, Thailand observed the prevalence of faecal coliforms, *Salmonella*, *Shigella* and *E. coli* in various loads. Large amounts of untreated manure used in preharvest and extensive handling during postharvest can directly affect high coliform burdens in RTE vegetables at retail levels. All things considered, the writers neglected to account for the many ways of preparation and storage that vendors employ before to serving. A clearer picture of the microbial content of the ready-to-eat salad may have been obtained via such an examination.

2.4.1 *Salmonella* Species

Salmonella is a gram-negative rod genus in the Enterobacteriaceae family. Common pathogens like salmonella can survive for weeks in a dry environment and months in water. It belongs to the Enterobacteriaceae family, and its ecological niche includes the human and animal intestinal tracts (Carroll et al., 2019). They primarily disseminate in the environment via excreta (Delahoy et al., 2018). According to WHO (2018), *Salmonella* species are the most common and significant cause of infectious illnesses in humans worldwide. Food poisoning causes gastrointestinal illnesses, fever, abdominal cramps, vomiting, and diarrhoea (Erhirhie et al., 2020). Vegetables can become contaminated as a result of inappropriate handling and other environmental conditions (Wills & Golding, 2016). As a result, it has been suggested that cleaning with disinfectants be used to make the vegetables fit for raw consumption (Degaga et al., 2022). Niyomdecha et al. (2016) and Wills & Golding (2016) published research on *Salmonella* species isolated from vegetables, namely lettuce samples. Folded foliar surfaces of lettuce leaves may have aided bacterial development by providing a conducive surface (Doan et al., 2020; Jacob & Melotto, 2020; Zwe & Yuk, 2017). In addition, (Dyda et al., 2020; Silva et al., 2017; Isoken, et al., 2015; Kumar, 2012) discovered that vegetables commonly harbour *Salmonella* species. Accordingly, (Liu et al., 2018; Li et al., 2015; Li et al., 2014; Huang et al., 2014), were of the view that stagnant water used for sprinkling and cleaning vegetables may be the most common source of *Salmonella* spp contamination. Furthermore, the presence of *Salmonella* species beyond the limit may constitute a major harm to consumer health and is considered inappropriate for consumption (Mkangara, 2023).

2.4.2 Total Coliforms

Mazzariol et al. (2017) state that coliforms are rod-shaped, gram-negative, non-spore-forming aerobes that are facultative anaerobes that break down lactose into gas and acid in 48 hours at 35 degrees Celsius. Coliform bacteria are considered indicator microorganisms because their presence in food indicates that conditions are conducive for the emergence of enteric pathogens and may signal incorrect or inadequate sanitary conditions (Halkman & Halkman, 2014). The limits for fresh faecal coliform presence in food that have been proposed by the International Commission on Microbiological Specification (ICMSF) and WHO for Food (ICMSF) [1974] are 1×10^3 per 100 ml and 1×10^3 100 g⁻¹, respectively.

2.4.3 Vibrio Species

Bacteria classified as *Vibrio* species are members of the Vibrionaceae family. These facultative anaerobic bacilli are gram-negative and have a single polar flagellum. They are also fermentative. Except for *Vibrio cholerae* and *V. mimicus*, every known species of *Vibrio* is halophilic or salt-requiring. For nontoxigenic *Vibrio* species, putative virulence factors have been described. These variables include cell-associated adhesins, extracellular toxins, and proteases; however, it is still unclear how these factors actually contribute to disease. Cholera toxin is produced by specific strains of *V. cholerae*, including non-O1, non-O139, and *V. mimicus*. Regrettably, there is no information available regarding the extent of immunity within the scientific community worldwide to nontoxigenic *Vibrio* species or strains (Wong et al., 2018).

It is known that certain *Vibrio* species can exist freely in brackish inland lakes and streams as well as marine coastal waters. In no way does their existence imply faecal contamination. The majority of *Vibrio* species have different concentrations depending on salinity and water surface temperature. Since surface waters are warmer in the summer and fall, these seasons see the highest number of *Vibrio* infections. Patients with high iron levels are more susceptible to infection because *V. vulnificus* develops on iron (Wong et al., 2018). On the other hand, contamination of vegetables by bacteria of the genus *Vibrio* have been reported by several researchers across the globe (Andrea et al., 2022; Turki et al., 2020; Dun-Dery & Addo, 2016). For instance, Ferdous et al. (2024) found contamination of coriander leaves with vibrio in some market places in Dhaka city of Bangladesh. *Vibrio* species have also been isolated from vegetables obtained from both open markets and supermarkets (Pule et al., 2020). Also, studies conducted by Mufida et al., (2022) on five vegetables which are usually eaten raw, namely, lettuce, tomato, cabbage, basil, long bean and cucumber which were sampled from traditional markets, reported *V. cholerae* on all of them.

2.5 Techniques in Determining Bacteriological Contaminants

There are several techniques which are employed in exploring bacterial contaminants of food and other relevant products. The most frequently used bacteriological techniques depend on macroscopic and/or microscopic features. Macroscopic properties include a microorganism's size, shape, colour, and smell in addition to its overall appearance. Agar cultures can be used to detect and classify different types of microorganisms based on their macroscopic or gross morphological characteristics. On the other hand, the microscopic features include those traits which cannot be seen with

unaided eye. That is, it is possible to identify microbes using the microscope to determine rods, cocci, spiral-shaped bacteria, as well as bacterial cells with flagella budding yeast and filamentous fungus with branching hyphae. Staining with appropriate dyes and microscopy make it easier to see and identify bacteria species under a microscope. Gram staining, Endospore staining and Ziehl-Neelsen staining are some of the staining techniques. Catalase, oxidase, and substrate consumption tests are simple biochemical assays used to isolate and identify bacterial and fungal species (ASM, 2020; Franco-Duarte et al., 2019; Pitt & Barer, 2012). Obeng et al. (2018) found tomato pollutants using sterile swabs and cultured them on Blood, Nutrient and MacConkey agar. A sterile swab stick was used to swab the cut interior of the tomatoes where swabs were then streaked onto Blood agar (Oxoid, UK), Nutrient agar (Oxoid, UK), and MacConkey agar (Oxoid, UK) and incubated at 37°C for 18-24 hours. Unlike damaged tomatoes, samples were obtained with a sterile swab and streaked onto Blood agar, Nutrient agar, and MacConkey agar before being incubated at 37°C for 18-24 hours. The antibiogram of bacterial isolates was determined by Kirby-Bauer disc-diffusion.

There are two main problems with traditional microbial identification techniques. First of all, they only apply to organisms that are in vitro culturable. Finally, several strains display distinct biochemical characteristics that defy classification into any known genus or species. As a result, a lot of contemporary techniques for detecting microorganisms do not require live cultures and can show subtle variations in bacteria that are missed by traditional methods. Such methods include polymerase chain reaction, microarray-based identification, immunological identification, enzyme-linked

immunosorbent assay-based methods and chemical or analytical tactic involving fatty acid profiling (for gas chromatography and mass spectrometry) and metabolic profiles or chemo-profiling (for high-performance liquid chromatography and mass spectrometry) (Manthou et al., 2022; Karki, 2020; Law et al., 2015; Holmes et al., 2012). These approaches detect infections in vegetables at a lower rate and with greater precision. Healthy vegetable intake is essential, and it can only be achieved when these technologies are integrated into the various manufacturing and inspection chains of the vegetable production chain.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The Anloga District is situated between latitudes 5.47⁰N and 5.79⁰S and longitudes 0.53⁰E and 0.89⁰W. It is roughly 160 kilometres east of Accra, east of the Volta Estuary. Its borders are shared by the Gulf of Guinea to the south, Akatsi South District to the north, South Tongu District to the west, and Keta Municipality to the east. The total land area for the district is 90,624.9 acres, comprising 36,855.4 acres of Lagoon and Volta River, 18,986.4 acres of wetlands, and 34,801.1 acres of arable land. The 2021 Population and Housing Census put the total population of the district at 94,895. The population comprises 52.9% females and 47.1% males. It has been projected that the human population of the district could reach about 100,000 by 2025. The presence of sandy soils, which are often without any top layer of humus along the coastal strip, implies that the place mostly supports coconut cultivation. Of course, when the soil is manured, shallot, okro, pepper, and other vegetables are cultivated, and the yield is considerably good. There is evidence that the strip is the main shallot-producing area in Ghana, although covering only about 11% of the district's landmass (excluding lagoons) (Anloga District Assembly, 2021).

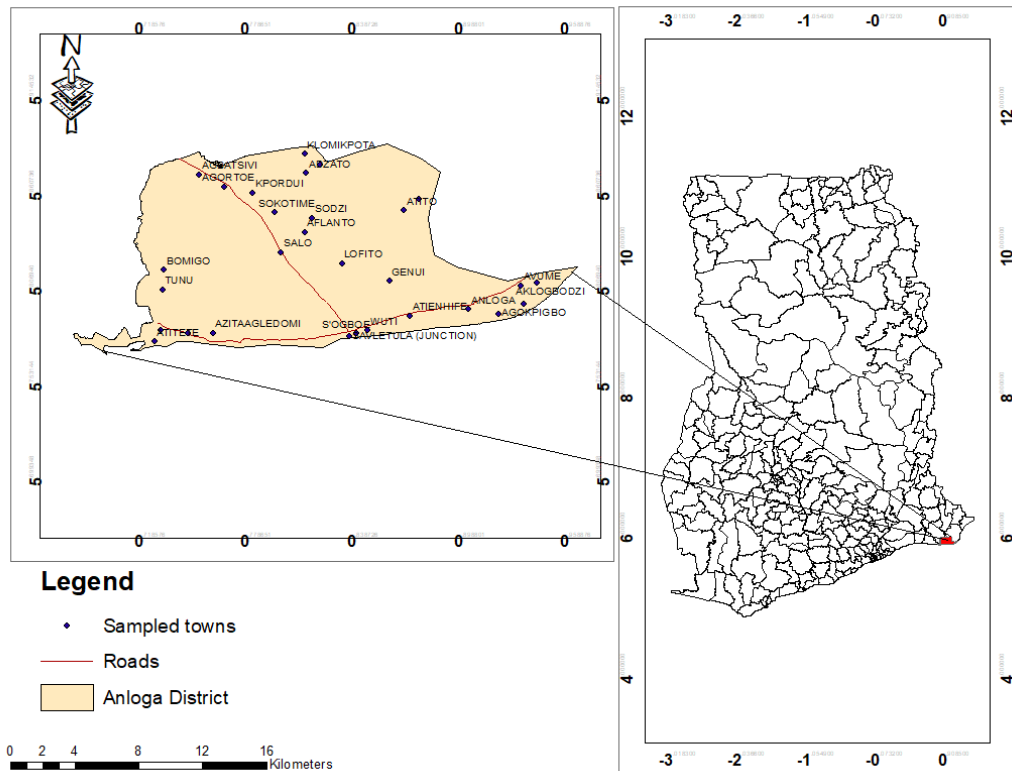


Figure 3.1: Map showing District Boundary and Communities

3.2 Research Design

This is a cross-sectional study to examine bacteria contamination and pesticide residues in vegetables grown in Ghana's Anloga District, Volta Region. The study involved sample collection, processing, and laboratory analysis during the harvest period. Thus, the study involved the use of primary data.

3.3 Sampling Technique

A total of five samples each of vegetables (cabbage, lettuce, and spring onion) were collected from each of the five selected vegetable farm sites (Woe Dekumornu, Woe

Aklorbordzi, Woe, Woe Morkporkpor, and Tegbi Ashiata), resulting in a total of 75 vegetable samples (5 samples x 3 vegetables x 5 farm sites).

The choice of vegetable farm sites was based on purposive sampling, where sites were selected deliberately due to specific criteria that defined them as hot zones (Lavrakas, 2008). These criteria encompassed factors such as temperature, humidity, and proximity to potential sources of contamination. Besides, produce from this area feeds both local and foreign market demand. Subsequently, within each selected farm site, systematic random sampling was employed to collect vegetable samples in an unbiased and representative manner (see Daniel, 2011). Specific sampling locations were chosen based on a systematic procedure that involved selecting every n^{th} vegetable row or plant. This technique ensured that each potential sample had an equal chance of being selected.

3.4 Sample Collection, Transportation, Processing and Laboratory Analysis

From each of the five farms, five samples each of vegetable: cabbage, lettuce, and spring onions—were collected diagonally for testing. The samples were labelled, put in sterile polythene bags and stored in a fitting container in an ice cooler box with ice packs. They were then transported to the Ghana Standards Authority Microbiology and Pesticides laboratories for analysis.



Plate 1: Sampling cabbage on farm



Plate 2: Sampling lettuce on farm



Plate 3: Sampling of spring onion on site



Plate 4: weighing samples on a balance

In the laboratory, the samples were tested for the following pathogenic bacteria: *Salmonella* species, *Vibrio* spp., and total coliform and pesticide concentrations of **organochlorine**: “aldrin, dieldrin, endrin, heptachlor, lindane, beta-HCH, delta-HCH, gamma chlordane, p,p'-DDE, alpha-endosulfan, beta-endosulfan, endosulfan sulphate, p,p'-DDD, p,p'-DDT, and ethoxychlor”. **Organophosphate**: Diazinon, Chlorpyrifos, Parathion, Malathion, Fenitrothion, Pirimiphos-methyl, Methamidophos, Fonofos, Dimethoate, Ethopropos, Profenofos, and Chlorfenvinphos. **Pyrethroid**: Allethrin, Permethrin, Cyfluthrin, Cypermethrin, Fenvalerate, Bifenthrin, Lambda-cyhalothrin, Deltamethrin and Fentropathrin.

Samples processing and extraction involved standard procedures for examining food samples for bacterial. A few millilitres of peptone water (diluent) were added, and vegetable samples were macerated for the enumeration of the pathogenic bacteria on TCBS and MEndo microbial agar under a temperature of 37 °C.



Plate 5: Taking pesticide concentration reading from the Gas chromatography

3.5 Analytical Procedures for Microbiological Analysis

3.5.1 Sample Preparation

Thirty millilitres (30 ml) of each of the samples were weighed into a sterile stomacher bag. About 270 ml of a diluent (Maximum Recovery Diluent) was added to the aliquot under aseptic conditions. This was the first dilution. The dilution was homogenized at 8000 rpm for two minutes (2 mins). Serial dilutions of the sample were prepared by taking one millilitre (1 ml) of the first dilution into nine millilitres (9 ml) of MRD. This became the second dilution. The same was repeated for the next dilutions via the previous dilution.

3.5.1.1 Total Coliform

International Standards Organization (ISO) 4832:2006 protocol (a colony-count technique) was used to obtain the total coliform count. In duplicate sterile Petri dishes, approximately one millilitre (1ml) of the initial dilution of the material was infected. This was done for all subsequent dilutions, which were prepared with a sterile pipette for each dilution. On each inoculated plate, about 20–25 ml of freshly prepared Violet Red Bile Lactose Agar (VRBL) medium, cooled to a temperature of 44 °C, was poured. The inoculum and the medium were carefully mixed to allow solidification of the mixture. The inoculated plates were inverted and incubated at 37 °C for 18 to 24 hours.

3.5.1.2 Salmonella Species

This analysis was conducted in accordance with (the ISO 6579-1:2017 protocol). To homogenize a sample of 25 g of Salmonella, 225 ml of buffered peptone water was added. This was incubated at 37 °C for a whole day. After incubation, 10 ml of

Rappaport-Vassiliadis Soya (RVS) peptone broth was readied, and 0.1 ml of the incubated sample was put into it using a sterile pipette. After that, this was incubated at 41.5 °C for 24 hours. Ten millilitres (10 ml) of freshly prepared Muller-Kauffman Tetrathionate-Novobiocin (MKTTN) broth was added to another one millilitre (1 ml) of the previously incubated sample, and the mixture was then incubated for a full day at 37 °C. After that, Xylose Lysine Deoxycholate (XLD) and Bismuth Sulphite Agar (BSA) were streaked with the infected RVS and MKTTN, and the mixture was incubated for 24 hours at 37 °C. After that, growth on the medium was used to detect the presence or absence of *Salmonella* species.

3.5.1.3 Vibrio Species

The method used for this analysis was based on the ISO 21872-1:2017 protocol. About 225 millilitres of alkaline peptone were used to homogenize a sample weighing around 25 grams for a full day and was incubated at 37°C. Following incubation, the sample was streaked over Thiosulfate-Citrate-Bile Salts-Sucrose Agar (TCBS) and incubated for a full day at 37° C. The existence of *Vibrio* species was then investigated in the colonies.

3.6 Analytical Procedures for Pesticide Residue Analysis

3.6.1 Extraction

“First, a 50 mL centrifuge tube was filled with a sample of the homogenous comminuted sample, weighing 10 g ± 0.1 g. After adding 10 mL of acetonitrile, the mixture was vortexed for a duration of one minute. The product also included the following mixtures: 0.5 g ± 0.03 g disodium hydrogen citrate sesquihydrate, 1 g ± 0.05

g sodium chloride, 4 g \pm 0.2 g magnesium sulphate anhydrous, and 1 g \pm 0.05 g trisodium citrate dihydrate. The mixture was centrifuged at 3000 rpm for five minutes at 3000 rpm after being vortexed for one minute”.

3.6.2 Extract Purification

3.6.2.1 Dispersive Solid-phase Extraction (SPE)

Six (6) mL aliquots of the extract were mixed with 150 mg of primary secondary amine (PSA) and 900 mg of magnesium sulphate in a 15-mL centrifuge tube. The mixture was aggressively mixed for thirty seconds before being centrifuged at 3000 rpm for five minutes. A volume of roughly 4 millilitres of the extracted clean was put into a flask with a circular bottom. Its pH was rapidly brought down to about 5 by adding 40 microliters of a 5% formic acid solution in acetonitrile (v/v) and cooling the filtrate on a rotary evaporator below 40°C until it was almost dry. A millilitre (1 ml) of ethyl acetate was pipetted into the concentration to dissolve it again. Moreover, 20 μ L of 1% polyethylene glycol in v/v ethyl acetate was administered. A two-millilitre (2-ml) standard opening vial was filled with the extract in order to be quantified using either gas chromatography mass spectrometry (GC/MS), gas chromatograph-pulsed flame photometric detector (GC-PFPD), or gas chromatograph electron capture detector (GC-ECD). Until they could be quantified, the extracts were frozen.

3.6.3 Chromatographic Conditions for the Determination of Organochlorine and Synthetic Pyrethroid Pesticide Standards and Retention Times

The following is an overview of the typical chromatographic settings used for quantification of organochlorine and synthetic pyrethroid pesticide standards:

Summary of chromatographic conditions for organochlorine and synthetic pyrethroids pesticides

Apparatus:

Instrument	Description
Gas Chromatograph	Varian CP-3800 GC-ECD with a CombiPAL Autosampler
Analytical column	30m +10m EZ Guard x 0.25mm internal diameter fused silica capillary coated with VF-5ms (0.25µm film) from Varian Inc or equivalent.

Temperatures:

Item	Conditions
Injector	Splitless mode, temperature 270°C
Oven	70°C / 2 min $\frac{25^{\circ}\text{C}/\text{min}}$ 180°C/1min $\frac{5^{\circ}\text{C}/\text{min}}$ 300°C
Detector-ECD	300°C

Gases:

Gas	Flow rate
Nitrogen (carrier)	1 ml/min constant flow
Make-up	29 ml/min

Summary of Chromatographic Conditions for Organophosphorus Pesticides

Apparatus:

Instrument	Description
Gas Chromatograph	Varian CP-3800 GC-PFPD with a CombiPAL Autosampler
Analytical column	30m x 0.25mm internal diameter fused silica capillary coated with VF-1701ms (0.25µm film) from Varian Inc or equivalent.

Temperatures:

Item	Conditions
Injector	Splitless mode, temperature 270°C
Oven	70°C / 2min $\frac{25^{\circ}\text{C}/\text{min}}$ 200°C/1min $\frac{20^{\circ}\text{C}/\text{min}}$ 250°C
Detector-PFPD	280°C

Gases:

Gas	Flow rate
Nitrogen (carrier)	2 ml/min constant flow
Air 1	17
H ₂	14
Air 2	10

3.7 Quality Control Measures/Procedures for the Pesticide Analysis

Solvent blanks and matrix blanks were analysed alongside samples. Spiked or fortified samples were also analyzed alongside the samples. Results from these solvent blanks, as well as the method and matrix blanks were then subtracted from the calculated results

of each sample. These were used as a quality control check. Certified reference materials (cabbage, lettuce and spring onion) from Food Analysis Performance Assessment Scheme, (FAPAS) were also analysed as a quality assurance parameter.

3.8 Data Processing, Analysis and Expression

Data (bacteria loads and pesticide concentrations) were entered and presented in tables and graph. The pesticide data was expressed using standard units and compared with published international standards. Bacterial loads observed for the total coliforms were expressed using standard units and compared with published international standards. Data for the study was process and partly analysed in Microsoft Excel and using the Interactive Chi-square calculator which was designed by Preacher (2001). The Microsoft Excel was used to generate the tables and the graphs. On the other hand, the Interactive Chi-square test calculator was used to explore the goodness of fit of the total coliform loads recorded on vegetables in the current study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings on bacterial load enumerated, including *Salmonella*, *Vibrio* and total coliform. It also covers residues of active ingredients of pesticides.

4.2 Analysis of Vegetables for Bacterial Contamination

4.2.1 Analysis of Vegetables for *Salmonella* and *Vibrio*

Table 4.1 shows the bacterial load present in the vegetables sampled from various sites. *Salmonella* and *Vibrio* counts were undetected in all of the tested samples.

Table 4.1: Bacterial load enumerated from vegetables

Site	Sample	<i>Salmonella spp</i>	<i>Vibrio spp</i>
Woe Dekumornu	Cabbage	Nd	Nd
Woe Aklorbordzi	Cabbage	Nd	Nd
Woe	Cabbage	Nd	Nd
Woe Morkporkpor	Cabbage	Nd	Nd
Tegbi Ashiata	Cabbage	Nd	Nd
Woe Dekumornu	Lettuce	Nd	Nd
Woe Aklorbordzi	Lettuce	Nd	Nd
Woe	Lettuce	Nd	Nd
Woe Morkporkpor	Lettuce	Nd	Nd
Tegbi Ashiata	Lettuce	Nd	Nd
Woe Dekumornu	Spring Onion	Nd	Nd
Woe Aklorbordzi	Spring Onion	Nd	Nd
Tegbi Ashiata	Spring Onion	Nd	Nd
Woe Morkporkpor	Spring Onion	Nd	Nd
Woe	Spring Onion	Nd	Nd

Source: Field data, 2022

Nd denotes not detected.

The results of the current research work, as presented in Table 4.1, showed that, there were no *Salmonella* species detected from any of the vegetables from five communities located in the Anloga District of the Volta Region of Ghana. This suggests that

vegetables from the study area are relatively free from faecal matter and other contaminants, which can lead to food poisoning or make the vegetables unpleasant for human consumption.

The observation of heavy loads of total coliforms on the vegetable samples from the five major vegetable hubs in the Anloga District of the Volta of Ghana is of interest. Another interesting result of the current study is that there were significant differences in the loads of total coliforms which were recorded on the vegetables sampled from the various sites. The detection of high loads of total coliforms of the fresh vegetables can be attributed to the application of animal-based manure, such as those formulated from cow dung and poultry droppings, as observed and was confirmed by the farmers during the sampling activities. A number of previous studies have also made similar observation. The study by Atidéglá et al. (2016), for example, showed that application of contaminated poultry manure to crops could lead to contamination of vegetables by faecal coliforms, *E. coli*, and faecal streptococci. The application of animal-based manure under consideration may be a long traditional use in the setting which might have left faecal bacteria in the soil or it could be due to recent applications which the current researcher observed on the farms during the current study. Contamination of farmlands by faecal bacteria is a significant risk or danger in terms of the health of the farmers, local populaces, and all other consumers of those vegetables (Atidéglá et al. 2016; Błażejewska et al., 2022).

The fact that the observation of contamination of vegetables in the current study and others may be attributable to application of animal-based manure (Błażejewska et al., 2022; Atidéglá et al. 2016) is of interest due to the fact that combination of gardening

and livestock raising, for example, is generally adjudged a great way to raise plant yields. Nevertheless, the faecal coliform contamination of vegetables as seen in the current study and the previous ones suggests that such a combination can result in negative impacts on the health of consumers. This necessitates immediate advocacy for the application of possible properly composted animal-based manure in particular to help reduce the risks of contamination of fresh vegetables with pathogenic agents. In the long run, it is also necessary that developers of revolutionary cropping systems should factor environment and of public health concerns into their activity. Besides, those systems should be designed via multidisciplinary research works which covers social, economic, biomedical and environmental aspects (Atidéglá et al. 2016).

Furthermore, it is likely that the detection of high total coliforms on cabbage from Woe Morkporkpor than the other settings may be due to significant variations in the bacteriological quality of irrigation water, as well as both the quality and intensity of application of animal-based manure by the farmers involved. In addition, it has been indicated that coliforms could easily get attached to the relatively large leaves and some of the inner tissues of cabbage, and thereby escaping any likely treatment on such vegetable as compared to lettuce and spring onions whose leaves grow above the soil surface, and are exposed to the effect of sun that alters bacteria growth on their leaf surfaces (Viviers et al., 2024). In other words, cabbage has tightly packed, and layered leaves, which can create microenvironments which could retain moisture and organic debris. Such dense structure can trap bacteria, making it easier for them to proliferate within the folds of the leaves. This is coupled with the fact that the inner layers are less

exposed to various environmental cleaning methods, allowing coliforms to thrive (Lu et al. 2024).

On the other hand, the observation of higher total coliforms on spring onion at the Woe site than most of the other studied communities need not necessarily be a puzzle as such. Like the cabbage, this observation could be due to variations in the quantity and quality of animal-based manure which are applied by the farmer of the spring onions and those who farm the other vegetables. It is also possible for variations in bacterial loads in contaminated irrigation water to significantly affect bacterial load on vegetables on various farms. Since the farmers use different water sources for their irrigation activities, the difference in bacterial loads may also be due to variation in the intensity of contamination of the water sources used to irrigate the onions. Again, it is likely that a higher total coliform load on spring onions than other vegetables may be due to the fact that the onion grows partly underground, and that the part of it which is underground has direct contact with soil, which is an essential repository of total and faecal coliforms. Another important fact is that onions have tightly packed outer layer which can trap moisture, soil particles and also allow coliform bacteria to adhere, and thereby making it difficult for such bacterial cells to be washed away. In other words, like the cabbage, spring onions have a bulbous base and layered leaves which can harbor moisture and organic matter. Like the cabbage, the structure of spring onions allows for the retention of soil and contaminants, which can contribute to higher microbial loads, depending on the availability of sources of contamination such as availability of contaminants in the soil and also animal-based manure or water for irrigation activities (Alegbeleye et al., 2018).

It is also interesting to note that the results of the current study showed that the loads of total coliforms on lettuce samples were comparatively lower than those found on the other vegetables. This situation could be expected due to the fact that although lettuce possesses a more open leaf structure with a larger surface area, such design may facilitate washing and cleaning, and thereby potentially reducing microbial loads. Furthermore, the leaves of lettuce are less likely to trap moisture and debris compared to cabbage and spring onion, and such a situation might have contributed in some way to the lower total coliform counts observed (Querido et al., 2019).

To conclude, the comparatively higher total coliform loads on cabbage and spring onions than the lettuce samples may be explained by the fact that the dense layered structures of cabbage and spring onion create environments which are conducive to microbial growth, particularly the growth of total coliforms. Furthermore, their ability to retain moisture and organic matter, coupled with agricultural practices, which may introduce pathogens, contributes to higher contamination levels compared to the more open and wash-friendly structure of lettuce (Viviers et al., 2024; Querido et al., 2019; Alegbeleye et al., 2018; Lu et al. 2024).

This result is similar to the studies by Abass et al. (2017) and Amoah (2014), which did not detect *Salmonella* species in all cabbage. Together, the results of the current study, and that of Abass et al., (2017) are odds with those of a prior investigation carried out in Cape Coast by Yafetto et al. (2019), which identified *Salmonella* spp. from vegetables. *Salmonella* was also found to be common in farm-collected lettuce and

cabbage in the Accra Metropolis, with 7.6 log CFU/g and 5.9 log CFU/g, respectively, among spinach, eggplant leaves, roselle leaves, and jute leaves, according to Quansah et al. (2018). Additionally, the results of the current study did not agree with those of a study conducted in the Nigerian Plateau and Kano states by Abakpa et al. (2015), which found that spinach, cucumber, tomatoes, green pepper, and cabbage were among the vegetables that contained *Salmonella*. *Salmonella* was also found in 42.7% of the cabbage and lettuce samples purchased from Nigerian markets, according to Nma et al. (2013). Furthermore, Manjunath et al. (2017) observed an aerobic bacterium count of about 8.36 log CFU/g of Nigerian cabbage and 7.83 log CFU/g of *Amaranthus* on cabbage, respectively.

Bacterial detection on vegetable samples is not uncommon in Ghana and other West African countries alone. According to Moneim et al. (2014), between 38.9% and 43.3% of the lettuce gathered from farms or retail outlets in Egypt had *Salmonella* species. Degaga et al. (2022) published research on raw vegetable contamination in Fiche Town, Ethiopia, where 25% of lettuce samples were found to be contaminated with *Salmonella* species. De Silva et al. (2013) found *Salmonella* in 20.7% of the samples collected in Jimma City. A comparable study conducted in the same city of Jimma in southwestern Ethiopia by Dugassa et al. (2014) found that 23 (12.8%) of the 180 vegetable samples tested positive for *Salmonella*. This was most prevalent in lettuce, which accounted for 16.7%, with tomato and cabbage accounting for roughly 13.9% each, and carrot and green pepper accounting for 11.1% and 8.3%, respectively. A study conducted in Arba Minch Town, southern Ethiopia, found that less hygienically treated vegetables, which are typically consumed raw, help to transmit a variety of infectious diseases (Tong Thi

et al., 2021; Erhirhie et al., 2020). *Salmonella* prevalence was found to be 17.6% on fresh leafy greens offered in Vietnam by Chau et al. (2014) and Desiree et al. (2021) observed 5.4 log CFU/g and 4.0 log CFU/g of *Salmonella* in lettuce.

According to the Centres for Disease Control and Prevention (2014), there are a million cases of foodborne *Salmonella* species-related infections in the United States each year, with roughly 19,000 hospitalizations and 380 deaths. While the absence of *Salmonella* species in the current study and those by Abass et al. (2017) and Amoah et al. (2014) may suggest that the vegetable handling practices of the farmers were probably of good quality to a considerable extent, Yafetto et al. (2019) indicated that the presence of this bacteria on the vegetables they studied in Cape Coast could be attributable to the handling of vegetable production processes, including the kind of water used in cultivating the vegetables.

The results of the current study, as indicated in Table 4.1, also showed that there were no *Vibrio* species associated with the vegetable samples explored. In other words, there was zero prevalence of *Vibrio* species on vegetables in the Anloga area of the Volta Region. In contrast, Osei-Tutu & Anto (2016) noted four foodborne diseases that were reported during the period 2009–2013 in the Greater Accra Region. These were: cholera (59.8%), typhoid fever (16.5%), dysentery (shigellosis) (2.6%), and viral hepatitis (1.6%) at the Greater Accra Regional Hospital. Likewise, Almagro-Moreno et al. (2015) examined vegetables, rice, sea food, potatoes, and cucumbers and found them to harbour diarrheal disease-causing pathogens. In southern Nigeria, Igbiosa et al. (2021) reported a high *Vibrio parahaemolyticus* microbial density of 3–10 MPN/g

(13/33; 39.39%) on salads. Furthermore, Jamila & Shamsuddeen (2021) reported the presence of *V. cholerae* (31 strains) representing 24.4% of the raw vegetable samples, of which onion formed about 38.4%. Yang et al. (2017) observed a 19.44% prevalence of *V. parahaemolyticus*.

According to Igbinosa et al. (2021), the presence of *V. parahaemolyticus* in African salad could be due to the ingredients used in the preparation process, specifically the vegetable, water, and seafood. Gómez-Govea et al. (2012) also established those pathogenic bacteria such as *Vibrio cholerae*, *Salmonella*, *E. coli* O157:H7, and *Campylobacter jejuni* can pollute fresh products from a variety of sources, including raw fertilizer, improper fertilizer, animal wastes, faeces, or polluted water. Because salad is a ready-to-eat product, the presence of pathogenic *V. parahaemolyticus* (>100-1,000 MPN/g) is cause for concern. Instead, the absence of *Vibrio* species on vegetables in Anloga, where diarrhoea is the sixth of the top ten diseases (Anloga District Assembly, 2021), seeks to suggest this species may not necessarily be the cause of diarrhoea there. Further studies may be necessary to establish the pathogenic organism that is behind the diarrhoea episodes reported in the Anloga District.

4.2.2 Analysis of Vegetables for Total Coliform Count

As illustrated in Figure 4.1, total coliform counts for the vegetables tested, namely, cabbage, lettuce and spring onions, ranged from approximately 2.0×10^3 colony-forming units (CFU) as recorded for the cabbage samples from the Woe farm to a bacterial load which was found to be too numerous to be counted (TNTC) as recorded for cabbage from both the Woe farm and the Woe Morkporkpor farm. To begin with, bacterial load

of the cabbage samples ranged from approximately 2.0×10^3 CFU as recorded for the Woe farm site to a load which was adjudged too numerous to count as recorded for Woe Morkporkpor. In other words, there significant variations in total coliform loads on cabbage samples from the various farm sites within the Anloga District ($p < 0.001$). In addition, there were significant variation in total coliform loads which was observed and counted on the lettuce samples from the farming sites in Woe, Tegbi Ashiata, Woe Dekumornu, Woe Aklorbordzi and Woe Morkporkpor ($p < 0.001$), with the total loads ranging from 2.0×10^5 CFU found on samples from Tegbi Ashiata to 2.0×10^6 CFU as recorded for each one of the other farm sites: Woe Dekumornu, Woe Aklorbordzi, Woe, and Woe Morkporkpor. Furthermore, the total coliform loads of approximately 4.0×10^5 CFU recorded for each of the four study sites, namely, Woe Aklorbordzi, Tegbi Ashata and Woe Morkporkpor was found to be significantly lower than the load for the spring onion from the Woe community since the latter was found to be too numerous to be counted ($p < 0.001$).

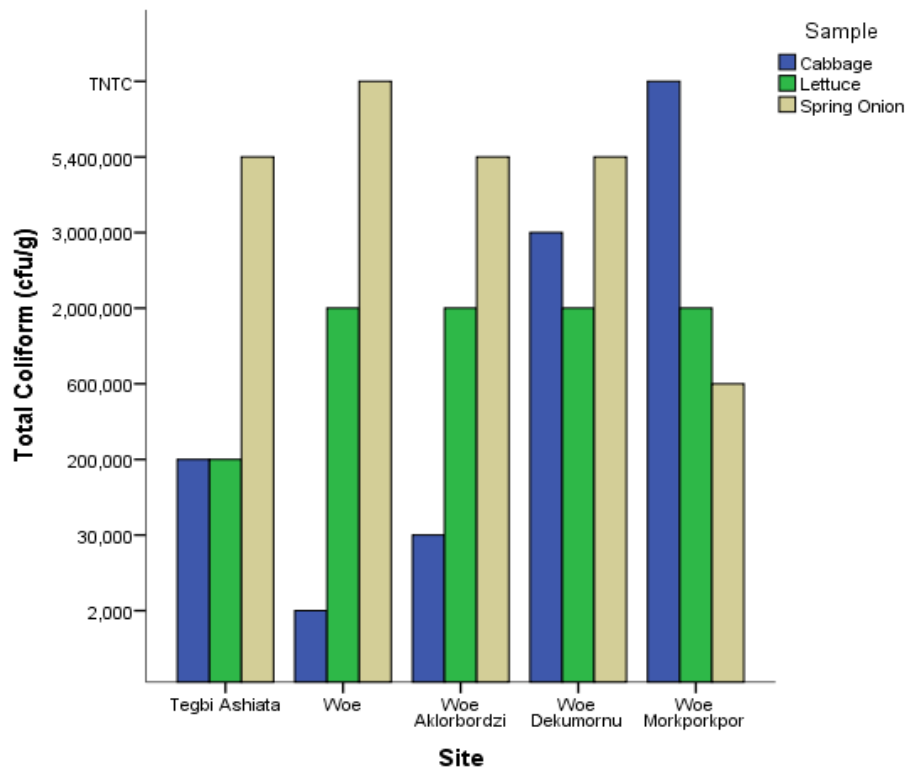


Figure 4.1: Total coliform load of sampled vegetables

The current study's findings, which are shown in Figure 4.1, showed that total coliforms were present on the vegetable samples (cabbage, lettuce and spring onion) that were examined. For the three vegetable samples, the range of total coliform/100 ml was approximately 2.0×10^3 CFU to TNTC, 2.0×10^5 CFU to 2.0×10^6 CFU, and 4.0×10^5 CFU to TNTC, respectively. This observation is comparable to the outcome of the study conducted in Kumasi by Abass et al. (2017), which showed a relatively higher TC range of 4.0×10^7 CFU to 9.3×10^9 CFU, 2.3×10^7 CFU to 2.4×10^7 CFU, and 9.0×10^9 CFU to 9.3×10^9 CFU for cabbage, lettuce and spring onion, respectively. The findings in the Anloga area are also consistent with a study conducted on vegetables such as tomatoes, carrots, spring onions, and cabbage in the Veia area in the Upper East Region, which also recorded faecal and total coliforms that were above threshold and ranged between

150 and 1,600 CFU/100 ml and 2.2–3.2 log CFU/100 ml (Douti et al., 2021). According to Ercumen et al. (2017), such an observation shows that vegetables are unsafe for human ingestion, posing a significant public health risk. This is because the presence of Total coliform bacteria can cause ailments such as stomach pains, diarrhoea, and skin rashes. Therefore, it should come as no surprise that rising fresh vegetable produce consumption has been associated with rising foodborne outbreak rates, even in developed nations like the US, Canada, and other European nations (Bennett et al., 2018; Callejon et al., 2015; Kozak et al., 2013). Cudjoe et al. (2022) investigated the consequences of such contaminated vegetables on people, particularly when the veggies are consumed raw, and documented many health concerns such as typhoid, dysentery, diarrhoea, vomiting, cholera, and ascariasis. Another microbial risk assessment discovered that eating salad contaminated with *E. coli* and other dangerous pathogens led in a loss of around 298 100 disability-adjusted life years (DALYs) in major cities per year (Ababio & Lovatt, 2015). In 2019, WHO reported 4,786 WASH-attributable deaths with a mortality rate of 18.8% in Ghana due to various types of water and sanitation-related diarrhoea (WHO, 2019). The current study's findings are also in line with those of Mngoli and Ngongola-Manani (2014), who reported 5.08–5.84 log CFU/g of faecal coliform on lettuce sampled in Malawi, and Cobbina et al. (2013), who reported 3.7, 3.5, and 3.1 log CFU/g on cabbage, amaranthus, and lettuce in Tamale Metropolis to be the respective counts. Dao et al. (2018) reported loads of total coliform on lettuce leaves which ranged from 2.9×10^3 CFU g⁻¹ to 1.3×10^6 CFU g⁻¹ in Ouagadougou is lower than that of the current study. These observations concord with a survey done by Akoachere et al. (2018) in the Fako Division of Cameroon, where coliforms were detected in salad vegetables. The study by Yafetto et al. (2019) also

reported the presence of coliforms such as *Enterobacter* spp., *Escherichia coli*, *Klebsiella* species, *Salmonella* species, *Serratia marcescens*, and *Staphylococcus*. Compared to other vegetables, lettuce leaves are more prone to contamination due to their vast surface area that can be contaminated by water, dirt, air and bird faeces. The high application of manure from cattle, poultry and other animal sources may be the cause of the prevalence of Total coliform. This increases the risk of pathogen infection in the soil, water, crops and humans (Amissah-Reynolds et al., 2020; Javanmard et al., 2018; Alegbeleye et al., 2018; Atidéglá et al., 2016; Jiang et al., 2015; Allende & Monaghan, 2015; Brooks et al., 2012).

4.3 Analysis of Vegetables for Pesticides Residues

The pesticides residues of the sampled vegetables are shown in Table 4.2. None of the three vegetables investigated, namely, cabbage, lettuce and spring onion, had a detectable amount of any of the thirty-six (36) active ingredients of pesticides in this current study.

Table 4.2: Pesticides Residues from studied vegetables

Pesticide	EU MRLs	Cabbage	Lettuce	Spring onion
Methamidophos	0.01	Nd	Nd	Nd
Ethoprophos	0.01	Nd	Nd	Nd
Dimethoate	0.01	Nd	Nd	Nd
Beta-HCH	0.01	Nd	Nd	Nd
Delta-HCH	0.01	Nd	Nd	Nd
Diazinon	0.01	Nd	Nd	Nd
Fonofos	0.01	Nd	Nd	Nd
Lindane	0.01	Nd	Nd	Nd
Hepthachlor	0.01	Nd	Nd	Nd
Pirimiphos-methyl	0.01	Nd	Nd	Nd
Fenitrothion	0.01	Nd	Nd	Nd
Malathion	0.50	Nd	Nd	Nd
Chlorpyrifos	0.01	Nd	Nd	Nd
Aldrin	0.01	Nd	Nd	Nd
Allethrin	0.01	Nd	Nd	Nd
Parathion	0.05	Nd	Nd	Nd
Chlorfenvinphos	0.01	Nd	Nd	Nd
Gamma Chlordane	0.01	Nd	Nd	Nd
Profenofos	0.01	Nd	Nd	Nd
p,p'-DDE	0.05	Nd	Nd	Nd
Dieldrin	0.01	Nd	Nd	Nd
Endrin	0.01	Nd	Nd	Nd
Alpha-Endosulfan	0.05	Nd	Nd	Nd
Beta-Endosulfan	0.05	Nd	Nd	Nd
Endosulfan Sulphate	0.05	Nd	Nd	Nd
p,p'-DDD	0.05	Nd	Nd	Nd
p,p'-DDT	0.05	Nd	Nd	Nd
Bifenthrin	0.01	Nd	Nd	Nd
Fenfropathrin	0.01	Nd	Nd	Nd
Methoxychlor	0.01	Nd	Nd	Nd
Lambda-cyhalothrin	0.15	Nd	Nd	Nd
Permethrin	0.05	Nd	Nd	Nd
Cyfluthrin	1.00	Nd	Nd	Nd
Cypermethrin	2.00	Nd	Nd	Nd
Fenvalerate	0.20	Nd	Nd	Nd
Deltamethrin	0.50	Nd	Nd	Nd

Nd denotes Not Detected, whereas EU MRLs denote European Union Maximum Residue Levels.

4.4 Analysis of Vegetables for Pesticide Residues

The outcome of the analysis of vegetables from the various communities studied in Anloga District is shown in Table 4.2. None of the three vegetables investigated, namely, cabbage, lettuce, and spring onion, had a detectable amount of any of the thirty-six (36) active ingredients of chemical pesticides explored in the current study.

The current study's findings demonstrate that none of the 36 pesticide active components surveyed could be found in the cabbage, lettuce, and spring onion vegetable samples that were examined. Methamidophos, Ethoprophos, Dimethoate, Beta-HCH, Delta-HCH, Diazinon, Fonofos, Heptachlor, Lindane, Pirimiphos-methyl, Fenitrothion, Malathion, Chlorpyrifos, Aldrin, Allethrin, Parathion, Chlorfenvinphos, Gamma chlordane, Profenofos, p,p'-DDE, Dieldrin, Endrin, Alpha-Endosulfan, Beta-Endosulfan, Endosulfan sulphate, p,p'-DDT, p,p'-DDD, Bifenthrin, Fentropathrin, Methoxychlor, Fenvalerate, Lambda-cyhalothrin, Permethrin, Cyfluthrin, Cypermethrin and Deltamethrin were among the active ingredients in the pesticides that were tested. The fact that none of the active ingredients of the pesticide surveyed were detected in the vegetables explored is of interest because such an observation seeks to suggest that the vegetables produced from Anloga may be safe for human consumption as far as pesticide contamination is concerned. The absence of pesticide residues on the vegetables in the district may be attributable to the good agricultural practices employed by the farmers studied. Of course, anecdotal evidence provided by some of the farmers also suggested that there was no use of pesticides in their farming operation. Furthermore, it was observed that some farmers reported that they use organic pesticides such as Bypel 1, OFA (Organic Farming Aid), Bio-SoilZ, Bio-PlantZ,

Esefort and Sulfa 80 WDG. They have withdrawal period of 24 hours except Sulfa 80 WDG whose withdrawal period is 72 hours.

The observation of undetectable concentrations of pesticides in vegetables in the current research work agrees to some extent with Bempah et al. (2016), who concluded that approximately 7% of 400 fruits and vegetables that they surveyed from open and closed markets in Accra contained no detectable level of the monitored pesticides. Unlike the current study's findings, Bempah et al. (2016) discovered that 20% of the samples they investigated had pesticide residue levels over the MRL, while 73% of the samples had detectable quantities of pesticides, while the levels were below the MRLs. Based on the latter, Bempah et al. (2012) concluded that Kumasi metropolitan city residents are exposed to pesticide concentrations that may induce chronic disorders.

Kumah et al. (2023) revealed organochlorine pesticides residues of γ -HCH, δ -HCH, heptachlor, aldrin, p, p'-DDT, o, p'-DDT and p, p'-DDE detected in vegetables sampled were above recommended EU MRL. Lettuce recorded the highest aldrin (1.23 mg/kg) as well as γ -HCH (0.013 mg/kg) residue levels, while heptachlor (1.05 mg/kg) and δ -HCH (0.23 mg/kg) were highest for cabbage. Maximal residues of p, p'-DDT (1.194 mg/kg) and p, p'-DDE (0.147 mg/kg) were found in tomatoes. Despite the fact that OCPs have been illegal and banned in Ghana for many years, researchers continue to find them in environmental matrices. This is due to their high environmental tolerance (Fosu et al., 2017). Findings from the current study in which no pesticide residues were detected aligns partly with Quansah et al. (2024) who did not also detect any organochlorine pesticide residues in their study however, chlorpyrifos, diazinon,

dimethoate, malathion, pirimiphos-methyl, bifenthrin, cypermethrin, deltamethrin, fenvalerate, lambda-cyhalothrin and permethrin were found in lettuce, cabbage, African spinach, African eggplant leaves, roselle leaves and jute leaves leafy vegetables respectively. Methoxychlor, aldrin and gamma-hexachlorocyclohexane (HCH) exceeded the maximum residue limits in watermelon whereas aldrin had the highest pesticide residue in Ghanaian fruits and vegetables, with a concentration of 0.1462 ng/g in watermelon fruits, according to Forkuoh et al. (2018). Fenvalerate has the highest concentration ever seen in eggplant, with a mean concentration of 25.6 mg/kg (Fosu et al., 2017). The majority of vegetables contained insecticide residues, while OCPs were identified in lower concentrations than OPPs and SPs. According to these data, vegetable growers are now employing approved OPPs and Synthetic Pyrethroids (SP) instead of OCPs.

Apart from the observation of some residues of chemical pesticides on vegetables from Ghana (Mohammed et al., 2019; Fosu et al., 2017), pesticide residues have also been reported in some other countries around the world. Chlorpyrifos, for example, was discovered in tomatoes at a rate of 667.45 mg/kg in Burkina Faso, much beyond the European maximum residue limit of 0.50 mg/kg (Lehmann et al., 2017). Similarly, chlorpyrifos was shown to be one of the most prevalent insecticides in Senegalese vegetables (Diop et al., 2015). Outside of Africa, some studies have discovered organochlorine pesticide residues in a variety of commodities, including those from Saudi Arabia and China (Ramadan et al., 2020; Qin et al., 2016;) and Chinese fruits (Liu et al., 2016). Of course, the residues discovered in some of these investigations were below the MRL. Yet, even moderate pesticide contamination in food products

may have long-term negative effects on human health (Kim et al., 2017), because pesticides can accumulate in organism tissues (Tomer et al., 2015).

Additionally, Elgueta et al. (2017) found that in most cases, substantial quantities of imidacloprid, γ -cyhalothrin, methamidophos, dithiocarbamates, chlorpyrifos, and propamocarb were found in lettuce during their study in Chile's North Central Agricultural Areas. For instance, lettuce had the highest detection rates of imidacloprid. In Spain, Lemos et al. (2016) detected pesticides in over 60% of tomatoes and lettuces, and 8.3% and 4.2% of the tomato and lettuce samples, respectively, had levels higher than the European MRLs. In addition, Li et al. (2018) also detected acetamiprid, chlorpyrifos, cyhalothrin, cypermethrin, imidacloprid in peaches from China. Once more, Wu et al. (2017) examined 19,786 vegetable samples and found 6325 samples (31.97%) contained pesticide residues whereas 768 samples (3.88%) exceeded the MRLs respectively. These concentrations occurred in leafy and leguminous vegetables where procymidone (6.43%) concentration was a frequently detected pesticide while cypermethrin (7.40 mg/kg) was the highest detected among others. This investigation was conducted in Xinjiang.

According to Demi and Sicchia (2021), competition among farmers constitutes one of the most significant factors that influence farmers' decisions to employ agrochemicals in Ghana. Such competition probably leads to the abuse of such chemicals. In fact, pesticide abuse, including overuse, has become pertinent in Ghana and in Africa in general, even though the use of pesticides in Africa only represents a relatively small portion of the global total (Demi & Sicchia, 2021; European Parliament, 2021; Aidoo

et al., 2019). Even though there are benefits that come with pesticide use, such as preventing, destroying, repelling, or lessening the damage caused by pests (Abubakar, 2020), pesticide residues left on fruits and veggies can be very harmful when consumed by humans. This may explain why there have been reports of the banning of pesticides around the globe. For example, most countries have prohibited or restricted the use of organochlorine pesticides (Shoiful et al., 2016; Kumah et al., 2014) because of the tremendous harm they cause to human health and the long-term persistence of these pesticides in the environment (Jayaraj et al., 2016; Weaver et al., 2012). Regretfully, several developing nations continue to use these pesticides covertly (Montory et al., 2017; Ali et al., 2014). Be that as it may, on the whole, the current study has shown that vegetables examined in the Anloga of the Volta Region area, as far as pesticide residues are concerned, can be said to be safe due to non-detectable traces of residues. Further studies may be necessary to help establish the reason behind the findings of the current study with certainty.

CHAPTER FIVE

RESULTS SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Results Summary and Conclusion

The results of the current study showed that there were no *Salmonella* species detected on or any of the vegetable samples subjected to bacteriological analyses. Furthermore, no *Vibrio* species were observed on the vegetables from the communities studied. On the other hand, the results of the current showed the presence of total coliforms of various loads, ranging from about 2.0×10^3 estimated for cabbage collected from Woe to huge numbers that were too numerous to be counted at Woe Morkporkpor. Lettuce ranged from 2.0×10^5 and it was recorded at Tegbi Ashiata to 2.0×10^6 for the other four communities. Once more, the findings demonstrated that there were too many coliforms on the spring onion samples from 4.0×10^5 at Woe Dekumornu to uncountable numbers at Woe. In addition, the findings of the current study revealed that none of the three vegetables had a detectable amount of any of the thirty-six (36) active ingredients of chemical pesticides explored in the current study. These results suggest that the vegetables produced in the Anloga District of the Volta Region of Ghana may be unfit for human consumption due to contamination by coliform. Urgent action is needed from the appropriate stakeholders, including Environmental Health and Public Health Officers, to help manage the situation, given that coliforms are a key cause of ill health. Such activity may help eliminate diarrhoea as one of the top ten diseases in the Anloga District of the Volta Region of Ghana.

5.2 Recommendations

The recommendations identify concerns that need to be addressed further to improve vegetable and food safety in Ghana's Anloga District of the Volta Region. There is a need for the leadership of the district to help in ensuring that vegetables sold in the area

and on the Ghanaian market in general conform to the various local and international standards.

1. **Laws/Legislation:** Although there were no detectable pesticide residues in any of the vegetables investigated, it will be expedient for the government to tighten the enforcement of its laws on pesticide handling in the country. By doing so, vegetables and any other food produced in the country will be wholesome for human consumption and lessen the burden of pesticide-related complications.
2. **Education and Training for farmers:** The results on the total coliforms suggest a need for intensive education in the farming communities of the Anloga District and its environs. Such training needs to be conducted by experts, especially Agriculture Extension Officers (AEOs) and other staff of MoFA, on irrigation, the application of both manure and other organic fertilizers and pesticide application on vegetables and other food crops. There is a need for farmers to be trained on a regular (quarterly) basis on any current trend or dynamics in agricultural development, especially with regards to the handling of manures before use. Furthermore, the farming communities of Anloga and the neighbourhood should be educated on the right siting of their sanitary facility or toilet, especially with regards to how distant such facilities should be from the wells or boreholes that they use for irrigation to avoid faecal contamination.
3. **Consumer Protection:** Some strong consumer associations and watchdog committees should be founded and legally empowered to verify, agitate, and protect consumers from pesticides and other potential pollutants.
4. **Standard Control:** The Ghana Standards Authority should be expanded with equipped laboratories to enable it to operate in the major vegetable-producing

sites so that it can afford to undertake routine bacteriological investigations and to do routine pesticide residue analyses on vegetables and other food crops to enable the products to meet international standards.

5. ***Establishment of Monitoring Task Force:*** A Monitoring Task Force should be established in order to conduct routine field monitoring and make sure that users follow the regulations pertaining to the application of chemical pesticides. The monitoring programme should be planned and implemented in such a way that it can gather sufficient data to guide policymaking on vegetables grown in the country.
6. ***Adopting Integrated Pest Management Approach:*** There is a need for the farmers to be trained to adopt the Integrated Pest Management Approach to help decrease the use of synthetic chemical pesticides to the barest minimum.
7. ***Policy:*** Policy should be formulated to make certain that vegetables that are produced from the farms conform not only to the national standards but also to the MRL values set by the European Commission.
8. ***Ensuring Data Management:*** There should be data on all vegetable farmers to guide future researchers because, during the time of the current study, no data was available both at district and regional levels regarding the study area. The data should include the number of farmers for the various crops produced in the area, production capacity, and ranking at both district and regional levels, among others. This will be useful in stakeholder engagements, decision-making, and policy formulation.
9. ***Filling Staffing gaps:*** The Anloga District Agriculture Office has inadequate Agriculture Extension Officers. The district has only four (4) AEOs, which

makes it difficult for them to frequently meet farmers in the various operational areas within the district. It is recommended that MoFA should recruit other technical staff, such as AEOs, and duly resource them to work effectively.

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APPENDIX

PROF. ALEX DODOO

GSA/TES/FAD/724-738/PES2/22

2022-07-07



**GHANA
STANDARDS
AUTHORITY**

Member
International Organisation for Standardisation (ISO)
African Regional Organisation for Standardisation (ARSO)

MR. ALBERT WISE KADEY
STUDENT
DEPARTMENT OF PUBLIC HEALTH
EDUCATION
AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS
TRAINING AND ENTERPRENEURAL
EDUCATION
P. O. BOX 40
ASHANTI MAMPONG
GHANA.


Dear Sir/Madam,

TEST REPORT

We refer to your request for the analysis of sample(s) submitted to us on 2022-06-22. Please find attached analytical test report(s) on sample(s) collected for pesticide residues analysis:

Lab No. 724/PES2/22 -- Spring Onion -- Farm 1
Lab No. 725/PES2/22 -- Lettuce -- Farm 1
Lab No. 726/PES2/22 -- Cabbage -- Farm 1
Lab No. 727/PES2/22 -- Spring Onion -- Farm 2
Lab No. 728/PES2/22 -- Lettuce -- Farm 2
Lab No. 729/PES2/22 -- Cabbage -- Farm 2
Lab No. 730/PES2/22 -- Cabbage -- Farm 3
Lab No. 731/PES2/22 -- Lettuce -- Farm 3
Lab No. 732/PES2/22 -- Spring Onion -- Farm 3
Lab No. 733/PES2/22 -- Spring Onion -- Farm 4
Lab No. 734/PES2/22 -- Lettuce -- Farm 4
Lab No. 735/PES2/22 -- Cabbage -- Farm 4
Lab No. 736/PES2/22 -- Lettuce -- Farm 5
Lab No. 737/PES2/22 -- Spring Onion -- Farm 5
Lab No. 738/PES2/22 -- Cabbage -- Farm 5

Yours faithfully,


REGINA VOWOTOR (MRS)
Ag. DIRECTOR, TESTING (BIOCHEMICAL SCIENCES)
for: DIRECTOR GENERAL

GSA Head Office, Okponglo, Accra
T: (+233-302) 506 991-5 • 5000 65/6
Fax: (+233-302) 5000 92 • 500 231

P. O. Box MB 245, Accra, Ghana
E: gsanep@gsa.gov.gh; gsadir@gsa.gov.gh
www.gsa.gov.gh • Doc No.: GSA-FM-G08-A



GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:

Our Ref.: 724/PES2/22

TO: MR. ALBERT WISE KADEY
STUDENT
DEPARTMENT OF PUBLIC HEALTH
EDUCATION
AKENTEN APPIAH MENKA UNIVERSITY OF
SKILLS TRAINING AND ENTERPRENEURAL
EDUCATION
P. O. BOX 40
ASHANTI MAMPONG
GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BV.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 724 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

PESTICIDE RESIDUES LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P. O. BOX MB 245
ACCRA.

NAME OF SAMPLE: Spring Onion – Farm 1

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for spring onions
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.02(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.02(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 724/PES2/22

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.02(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
ALL	Allethrin	mg/kg	Not detected	0.01(Max) default
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.02(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.10(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.10(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.10(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.20(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.02(Max)
CYP	Cypermethrin	mg/kg	Not detected	0.50(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.02(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.30(Max)

Lab. No. 724/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Lambda-cyhalothrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Diazinon, Fenpropathrin, p,p'-DDT, Fonofos, Ethoprophos, Cyfluthrin, Pirimiphos-methyl, Malathion, Methoxychlor, Cypermethrin, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Methamidophos, Gamma Chlordane and Parathion were not detected in the Cabbage – Farm 1 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 2022-07-07

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:

Our Ref.: 726/PES2/22

TO: MR. ALBERT WISE KADEY
STUDENT
DEPARTMENT OF PUBLIC HEALTH
EDUCATION
AKENTEN APPIAH MENKA UNIVERSITY OF
SKILLS TRAINING AND ENTERPRENEURAL
EDUCATION
P. O. BOX 40
ASHANTI MAMPONG
GHANA.

<u>Codes</u>	
Generalised Product Codes	.....VF.....
Specific Product Code	.....BR.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 726 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

PESTICIDE RESIDUES LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P. O. BOX MB 245
ACCRA.

NAME OF SAMPLE: Cabbage – Farm 1

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for head cabbages
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 726/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.40(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.30(Max)
CYP	Cypermethrin	mg/kg	Not detected	1.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.08(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.10(Max)

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:
Our Ref.: 727/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BV.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 727 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Spring Onion – Farm 2

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for spring onions
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.02(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.02(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 727/PES2/22

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.02(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
ALL	Allethrin	mg/kg	Not detected	0.01(Max) default
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.02(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.10(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.10(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.10(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.20(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.02(Max)
CYP	Cypermethrin	mg/kg	Not detected	0.50(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.02(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.30(Max)

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Chlorpyrifos, Bifenthrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Cypermethrin, Delta-HCH, Lambda-cyhalothrin, Fenpropathrin, p,p'-DDT, Cyfluthrin, Fonofos, Ethoprophos, Pirimiphos-methyl, Malathion, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Allethrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Spring Onion – Farm 2 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by: Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines - 0.01 mg/kg
LOQ of Organophosphorous - 0.01 mg/kg
LOQ of Synthetic Pyrethroids - 0.01 mg/kg

SIGNATURE:.....

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE:.....

SIGNATURE:.....

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE:.....

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 4. This report shall not be reproduced in part or full without the written approval of the Director General of Ghana Standards Authority.

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:
Our Ref.: 728/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

 Generalised Product CodesVF.....
 Specific Product CodeLH.....
 Officer Responsible for ReportEA.....
 Code of Approving OfficerPO.....
 Period of Report07/2022.....
 Lab. No.: 728 Dept. PES Source Code 2 Yr 2022

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Lettuce – Farm 2

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for lettuce
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)	

Lab. No. 728/PES2/22

TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.50(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	1.00(Max)
CYP	Cypermethrin	mg/kg	Not detected	2.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.20(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.50(Max)

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenpropathrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 2 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

*QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix

NOTE: LOQ of Organochlorines - 0.005 mg/kg
LOQ of Organophosphorous - 0.010 mg/kg
LOQ of Synthetic Pyrethroids - 0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 

Note: The results relate only to the items tested

- Conditions:
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 4. This report shall not be reproduced in part or in full without the written approval of the Director General of Ghana Standards Authority.

Lab. No. 728/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:

Our Ref.: 729/PES2/22

TO: MR. ALBERT WISE KADEY
STUDENT
DEPARTMENT OF PUBLIC HEALTH
EDUCATION
AKENTEN APPIAH MENKA UNIVERSITY OF
SKILLS TRAINING AND ENTERPRENEURAL
EDUCATION
P. O. BOX 40
ASHANTI MAMPONG
GHANA.

Codes	
Generalised Product Codes	.....VF.....
Specific Product Code	.....BR.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 729 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

PESTICIDE RESIDUES LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P. O. BOX MB 245
ACCRA.

NAME OF SAMPLE: Cabbage – Farm 2

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for head cabbages
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 729/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**


TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.40(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.30(Max)
CYP	Cypermethrin	mg/kg	Not detected	1.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.08(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.10(Max)

Lab. No. 729/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Lambda-cyhalothrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Diazinon, Fenpropathrin, p,p'-DDT, Fonofos, Ethoprophos, Cyfluthrin, Pirimiphos-methyl, Malathion, Methoxychlor, Cypermethrin, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Methamidophos, Gamma Chlordane and Parathion were not detected in the Cabbage – Farm 2 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE: 

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

DATE: 2022-07-07

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.

Lab. No. 729/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:

Our Ref.: 730/PES2/22

TO: MR. ALBERT WISE KADEY
STUDENT
DEPARTMENT OF PUBLIC HEALTH
EDUCATION
AKENTEN APPIAH MENKA UNIVERSITY OF
SKILLS TRAINING AND ENTERPRENEURAL
EDUCATION
P. O. BOX 40
ASHANTI MAMPONG
GHANA.

<u>Codes</u>	
Generalised Product Codes	.....VF.....
Specific Product Code	.....BR.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 730 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

PESTICIDE RESIDUES LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P. O. BOX MB 245
ACCRA.

NAME OF SAMPLE: Cabbage – Farm 3

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for head cabbages
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 730/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.40(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.30(Max)
CYP	Cypermethrin	mg/kg	Not detected	1.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.08(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.10(Max)

Lab. No. 730/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Lambda-cyhalothrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Diazinon, Fenpropathrin, p,p'-DDT, Fonofos, Ethoprophos, Cyfluthrin, Pirimiphos-methyl, Malathion, Methoxychlor, Cypermethrin, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Methamidophos, Gamma Chlordane and Parathion were not detected in the Cabbage - Farm 3 sample received from MR. ALBERT WISE KADEY - STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 2022-07-07

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

Note: The results relate only to the items tested

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Lab. No. 730/PES2/22

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:
Our Ref.: 731/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

 Generalised Product CodesVF.....
 Specific Product CodeLH.....
 Officer Responsible for ReportEA.....
 Code of Approving OfficerPO.....
 Period of Report07/2022.....
 Lab. No.: 731 Dept. PES Source Code 2 Yr 2022

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Lettuce – Farm 3

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for lettuce
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)	

Lab. No. 731/PES2/22



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.50(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	1.00(Max)
CYP	Cypermethrin	mg/kg	Not detected	2.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.20(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.50(Max)

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenpropathrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 3 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

*QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix

NOTE: LOQ of Organochlorines - 0.005 mg/kg
LOQ of Organophosphorous - 0.010 mg/kg
LOQ of Synthetic Pyrethroids - 0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 

Note: The results relate only to the items tested

- Conditions:
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 4. This report shall not be reproduced in part or in full without the written approval of the Director General of Ghana Standards Authority.

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:
Our Ref.: 732/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

 Generalised Product CodesVF.....
 Specific Product CodeBV.....
 Officer Responsible for ReportEA.....
 Code of Approving OfficerPO.....
 Period of Report07/2022.....

Lab. No.: 732 Dept. PES Source Code 2 Yr 2022

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Spring Onion – Farm 3

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	EU MRLs for spring onions 0.02(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.02(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 732/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Chlorpyrifos, Bifenthrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Cypermethrin, Delta-HCH, Lambda-cyhalothrin, Fenpropathrin, p,p'-DDT, Cyfluthrin, Fonofos, Ethoprophos, Pirimiphos-methyl, Malathion, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Allethrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Spring Onion – Farm 3 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by: Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines – 0.01 mg/kg
LOQ of Organophosphorous – 0.01 mg/kg
LOQ of Synthetic Pyrethroids – 0.01 mg/kg

SIGNATURE:.....

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE:.....

SIGNATURE:.....

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE:.....

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 4. This report shall not be reproduced in part or full without the written approval of the Director General of Ghana Standards Authority.

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

Your Ref.:
Our Ref.: 733/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BV.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 733 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Spring Onion – Farm 4

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for spring onions
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.02(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.02(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 733/PES2/22

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.02(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
ALL	Allethrin	mg/kg	Not detected	0.01(Max) default
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.02(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.10(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.10(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.10(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.20(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.02(Max)
CYP	Cypermethrin	mg/kg	Not detected	0.50(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.02(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.30(Max)

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Chlorpyrifos, Bifenthrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Cypermethrin, Delta-HCH, Lambda-cyhalothrin, Fenprothrin, p,p'-DDT, Cyfluthrin, Fonofos, Ethoprophos, Pirimiphos-methyl, Malathion, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Allethrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Spring Onion - Farm 4 sample received from MR. ALBERT WISE KADEY - STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by: Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines - 0.01 mg/kg
LOQ of Organophosphorous - 0.01 mg/kg
LOQ of Synthetic Pyrethroids - 0.01 mg/kg

SIGNATURE: 

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

DATE: 2022-07-07

Note: The results relate only to the items tested

- Conditions:**
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TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E
Your Ref.:
Our Ref.: 734/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

<u>Codes</u>	
Generalised Product Codes	.....VF.....
Specific Product Code	.....LH.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 734 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Lettuce – Farm 4

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for lettuce
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected		0.01(Max)

Lab. No. 734/PES2/22



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.50(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	1.00(Max)
CYP	Cypermethrin	mg/kg	Not detected	2.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.20(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.50(Max)

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenpropathrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 4 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 2022-07-07

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

Note: The results relate only to the items tested

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Lab. No. 734/PES2/22

GHANA STANDARDS AUTHORITY FORM


TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E
Your Ref.:
Our Ref.: 735/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BR.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 735 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Cabbage – Farm 4

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for head cabbages
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 735/PES2/22

GHANA STANDARDS AUTHORITY
FORM



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.40(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.30(Max)
CYP	Cypermethrin	mg/kg	Not detected	1.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.08(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.10(Max)

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Lambda-cyhalothrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Diazinon, Fenpropathrin, p,p'-DDT, Fonofos, Ethoprophos, Cyfluthrin, Pirimiphos-methyl, Malathion, Methoxychlor, Cypermethrin, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Methamidophos, Gamma Chlordane and Parathion were not detected in the Cabbage – Farm 4 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines - 0.005 mg/kg
LOQ of Organophosphorous - 0.010 mg/kg
LOQ of Synthetic Pyrethroids - 0.010 mg/kg

SIGNATURE: 

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

DATE: 2022-07-07

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
 3. Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 4. This report shall not be reproduced in part or full without the written approval of the Director General of Ghana Standards Authority.

Lab. No. 735/PES2/22

TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E
Your Ref.:
Our Ref.: 736/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

 Generalised Product CodesVF.....
 Specific Product CodeLH.....
 Officer Responsible for ReportEA.....
 Code of Approving OfficerPO.....
 Period of Report07/2022.....
 Lab. No.: 736 Dept. PES Source Code 2 Yr 2022

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Lettuce – Farm 5

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for lettuce
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pyrimiphos-methyl	mg/kg	Not detected		0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected		0.01(Max)

Lab. No. 736/PES2/22

TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.50(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	1.00(Max)
CYP	Cypermethrin	mg/kg	Not detected	2.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.20(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.50(Max)

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenpropathrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 5 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines - 0.005 mg/kg
LOQ of Organophosphorous - 0.010 mg/kg
LOQ of Synthetic Pyrethroids - 0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 

Note: The results relate only to the items tested

- Conditions:
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
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 4. This report shall not be reproduced in part or in full without the written approval of the Director General of Ghana Standards Authority.

Lab. No. 736/PES2/22

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenprothrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 5 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE:.....

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE:.....

SIGNATURE:.....

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE:.....

Note: The results relate only to the items tested

- Conditions:**
1. Not valid without Ghana Standards Authority's Seal.
 2. This report does not signify that product tested has been certified.
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Lab. No. 736/PES2/22

GHANA STANDARDS AUTHORITY FORM

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.02(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
ALL	Allethrin	mg/kg	Not detected	0.01(Max) default
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.02(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.10(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.10(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.10(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.20(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.02(Max)
CYP	Cypermethrin	mg/kg	Not detected	0.50(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.02(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.30(Max)

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Chlorpyrifos, Bifenthrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Cypermethrin, Delta-HCH, Lambda-cyhalothrin, Fenprothrin, p,p'-DDT, Cyfluthrin, Fonofos, Ethoprophos, Pirimiphos-methyl, Malathion, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Allethrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Spring Onion – Farm 5 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by: Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.01 mg/kg
LOQ of Organophosphorous	-	0.01 mg/kg
LOQ of Synthetic Pyrethroids	-	0.01 mg/kg

SIGNATURE: REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 2022-07-07

SIGNATURE: APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

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GHANA STANDARDS AUTHORITY FORM


TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E
Your Ref.:
Our Ref.: 738/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BR.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....
Lab. No.: 738 Dept. PES Source Code 2 Yr 2022	

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Cabbage – Farm 5

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
					EU MRLs for head cabbages
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	0.01(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.01(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pirimiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 738/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.40(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.30(Max)
CYP	Cypermethrin	mg/kg	Not detected	1.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.08(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.10(Max)

**GHANA STANDARDS AUTHORITY
FORM**



TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Lambda-cyhalothrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Diazinon, Fenpropathrin, p,p'-DDT, Fonofos, Ethoprophos, Cyfluthrin, Pirimiphos-methyl, Malathion, Methoxychlor, Cypermethrin, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Methamidophos, Gamma Chlordane and Parathion were not detected in the Cabbage – Farm 5 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines	-	0.005 mg/kg
LOQ of Organophosphorous	-	0.010 mg/kg
LOQ of Synthetic Pyrethroids	-	0.010 mg/kg

SIGNATURE: 

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 2022-07-07

DATE: 2022-07-07

Note: The results relate only to the items tested

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TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E

FEN	Fenitrothion	mg/kg	Not detected	0.01(Max)
MAL	Malathion	mg/kg	Not detected	0.50(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.01(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.05(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.05(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.05(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.15(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	1.00(Max)
CYP	Cypermethrin	mg/kg	Not detected	2.00(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.20(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.50(Max)

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Bifenthrin, Chlorpyrifos, Cypermethrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Delta-HCH, Fenpropathrin, p,p'-DDT, Cyfluthrin, Lambda-cyhalothrin, Malathion Fonofos, Ethoprophos, Pirimiphos-methyl, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Lettuce – Farm 1 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by Customer

*QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix

NOTE: LOQ of Organochlorines - 0.005 mg/kg
LOQ of Organophosphorous - 0.010 mg/kg
LOQ of Synthetic Pyrethroids - 0.010 mg/kg

SIGNATURE: 

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE: 

SIGNATURE: 

APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE: 

Note: The results relate only to the items tested

- Conditions:
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Lab. No. 725/PES2/22

TITLE: Analytical Test Report
Doc. No. : GSA-FM-T09-E
Your Ref.:
Our Ref.: 724/PES2/22

TO: MR. ALBERT WISE KADEY
 STUDENT
 DEPARTMENT OF PUBLIC HEALTH
 EDUCATION
 AKENTEN APPIAH MENKA UNIVERSITY OF
 SKILLS TRAINING AND ENTERPRENEURAL
 EDUCATION
 P. O. BOX 40
 ASHANTI MAMPONG
 GHANA.

Codes

Generalised Product Codes	.....VF.....
Specific Product Code	.....BV.....
Officer Responsible for Report	.....EA.....
Code of Approving Officer	.....PO.....
Period of Report	.....07/2022.....

Lab. No.: 724 Dept. PES Source Code 2 Yr 2022

LABORATORY CONDUCTING TEST

 PESTICIDE RESIDUES LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P. O. BOX MB 245
 ACCRA.

NAME OF SAMPLE: Spring Onion – Farm 1

SAMPLE SIZE: 1 kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-23 to 2022-06-30

SOURCE / PURPOSE: MR. ALBERT WISE KADEY – STUDENT / PESTICIDE RESIDUES ANALYSIS

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATIONS
MEH	Methamidophos	mg/kg	Not detected	MRM by GC-PFPD and GC-ECD GSA-SM-T03* (2021-05)	EU MRLs for spring onions 0.02(Max)
ETH	Ethoprophos	mg/kg	Not detected		0.01(Max)
DIM	Dimethoate	mg/kg	Not detected		0.01(Max)
BHC	Beta-HCH	mg/kg	Not detected		0.01(Max)
DHC	Delta-HCH	mg/kg	Not detected		0.01(Max) default
DIA	Diazinon	mg/kg	Not detected		0.02(Max)
FON	Fonofos	mg/kg	Not detected		0.01(Max) default
GHC	Lindane	mg/kg	Not detected		0.01(Max)
HEP	Heptachlor	mg/kg	Not detected		0.01(Max)
PIM	Pririmiphos-methyl	mg/kg	Not detected		0.01(Max)

Lab. No. 724/PES2/22

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

PIM	Pirimiphos-methyl	mg/kg	Not detected	0.01(Max)
FEN	Fenitrothion	mg/kg	Not detected	0.02(Max)
MAL	Malathion	mg/kg	Not detected	0.02(Max)
CHL	Chlorpyrifos	mg/kg	Not detected	0.01(Max)
ALD	Aldrin	mg/kg	Not detected	0.01(Max)
ALL	Allethrin	mg/kg	Not detected	0.01(Max) default
PAE	Parathion	mg/kg	Not detected	0.05(Max)
CHF	Chlorfenvinphos	mg/kg	Not detected	0.01(Max)
GCH	Gamma Chlordane	mg/kg	Not detected	0.01(Max)
PRO	Profenofos	mg/kg	Not detected	0.02(Max)
PDE	p,p'-DDE	mg/kg	Not detected	0.05(Max)
DIE	Dieldrin	mg/kg	Not detected	0.01(Max)
END	Endrin	mg/kg	Not detected	0.01(Max)
AEN	Alpha-Endosulfan	mg/kg	Not detected	0.10(Max)
BEN	Beta-Endosulfan	mg/kg	Not detected	0.10(Max)
ENS	Endosulfan Sulfate	mg/kg	Not detected	0.10(Max)
PDD	p,p'-DDD	mg/kg	Not detected	0.05(Max)
PDT	p,p'-DDT	mg/kg	Not detected	0.05(Max)
BIF	Bifenthrin	mg/kg	Not detected	0.01(Max)
FEP	Fenpropathrin	mg/kg	Not detected	0.01(Max)
MET	Methoxychlor	mg/kg	Not detected	0.01(Max)
LCY	Lambda-cyhalothrin	mg/kg	Not detected	0.20(Max)
PER	Permethrin	mg/kg	Not detected	0.05(Max)
CYF	Cyfluthrin	mg/kg	Not detected	0.02(Max)
CYP	Cypermethrin	mg/kg	Not detected	0.50(Max)
FEV	Fenvalerate	mg/kg	Not detected	0.02(Max)
DEL	Deltamethrin	mg/kg	Not detected	0.30(Max)

**GHANA STANDARDS AUTHORITY
FORM**

TITLE: Analytical Test Report

Doc. No. : GSA-FM-T09-E

REMARKS:

Chlorpyrifos, Bifenthrin, Dimethoate, Permethrin, Fenvalerate, Profenofos, Deltamethrin, Cypermethrin, Delta-HCH, Lambda-cyhalothrin, Fenpropathrin, p,p'-DDT, Cyfluthrin, Fonofos, Ethoprophos, Pirimiphos-methyl, Malathion, Methoxychlor, Chlorfenvinphos, Heptachlor, Lindane, p,p'-DDD, Fenitrothion, Dieldrin, Endosulfan Sulfate, Alpha-Endosulfan, p,p'-DDE, Endrin, Aldrin, Allethrin, Beta-Endosulfan, Beta-HCH, Diazinon, Methamidophos, Gamma Chlordane and Parathion were not detected in the Spring Onion – Farm 1 sample received from MR. ALBERT WISE KADEY – STUDENT, AKENTEN APPIAH MENKA UNIVERSITY OF SKILLS TRAINING AND ENTERPRENEURAL EDUCATION and analysed.

Product sampled by: Customer.

**QuEChERS Method: A multiresidue method for the analysis of pesticide residues in low-fat matrix*

NOTE: LOQ of Organochlorines - 0.01 mg/kg
LOQ of Organophosphorous - 0.01 mg/kg
LOQ of Synthetic Pyrethroids - 0.01 mg/kg

SIGNATURE:.....

REPORTED BY: ERNESTINA A. ADEENZE
(CHIEF SCIENTIFIC OFFICER)

DATE:.....

SIGNATURE:.....

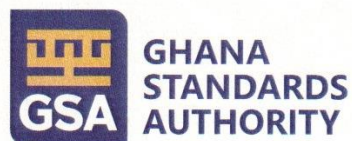
APPROVED BY: PAUL OSEI-FOSU (PhD)
(HEAD OF DEPARTMENT)

DATE:.....

Note: The results relate only to the items tested

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PROF. ALEX DODOO



Member
International Organisation for Standardisation (ISO)
African Regional Organisation for Standardisation (ARSO)

GSA/MIC/101.7/VOL. 34/1278-1292
2022-07-13

ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTERPRENEURIAL DEVELOPMENT
P. O. BOX 40 MAMPONG-ASHANTI

Dear Sir/Madam,


ANALYTICAL REPORT(S)

Please find attached test report of sample(s)

LETTUCE – FARM 1
LETTUCE – FARM 2
LETTUCE – FARM 3
LETTUCE – FARM 4
LETTUCE – FARM 5
SPRING ONIONS – FARM 1
SPRING ONIONS – FARM 2
SPRING ONIONS – FARM 3
SPRING ONIONS – FARM 4
SPRING ONIONS – FARM 5
CABBAGE - FARM 1
CABBAGE - FARM 2
CABBAGE - FARM 3
CABBAGE - FARM 4
CABBAGE - FARM 5

Lab# 1278-1292/MIC2/22, submitted for microbiological analysis.

Yours faithfully,


REGINA VOWOTOR (MRS.)
Ag. DIRECTOR, BIOCHEMICAL SCIENCE DIRECTORATE
For: DIRECTOR GENERAL

Encl.

GSA Head Office, Okponglo, Accra
T: (+233-302) 506 991-5 • 5000 65/6
Fax: (+233-302) 5000 92 • 500 231

P. O. Box MB 245, Accra, Ghana
E: gsanep@gsa.gov.gh; gsadir@gsa.gov.gh
www.gsa.gov.gh • Doc No.: GSA-FM-G08-A





GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes	
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1278 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: LETTUCE – FARM 1**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY / QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁶	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1278/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE:.....
[Handwritten Signature]

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE:.....
2022-07-06

SIGNATURE:.....
[Handwritten Signature]

APPROVED BY: CELESTINA ATAKPAH
(Ag. Head of Department)

DATE:.....
2022/07/06

Note: The results relate only to the items tested

- Conditions
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Lab. No. 1278/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes	
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1279 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: LETTUCE – FARM 2

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁶	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1279/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE:.....

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE:.....

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
- 1 Not valid without Ghana Standards Authority's seal.
 - 2 This report does not signify that product tested has been certified.
 - 3 Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 - 4 This report shall not be reproduced in part or full without the written approval of the Director General of Ghana Standards Authority.



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes

Generalised Product Codes:FV.....
Specific Product Code:LH.....
Officer Responsible for Report:BA.....
Code of Approving Officer:CA.....
Period of Report:07/2022.....
Lab. No. 1280 Dept MIC Source Code 2 Yr. 2022

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: LETTUCE – FARM 3

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁶	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1280/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

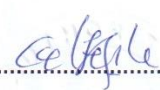
Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
- 1 Not valid without Ghana Standards Authority's seal.
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Lab. No. 1280/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

Codes

Generalised Product Codes:FV.....
 Specific Product Code:LH.....
 Officer Responsible for Report:BA.....
 Code of Approving Officer:CA.....
 Period of Report:07/2022.....
 Lab. No. 1281 Dept MIC Source Code 2 Yr. 2022

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: LETTUCE – FARM 4**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁶	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1281/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE:.....

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06.....

SIGNATURE:.....

APPROVED BY: CELESTINA ATAKPAH
(Ag. Head of Department)

DATE: 2022/07/06.....

Note: The results relate only to the items tested

- Conditions
- 1 Not valid without Ghana Standards Authority's seal.
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Lab. No. 1281/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

Codes	
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1282 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: LETTUCE – FARM 5

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1282/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAP
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions**
- 1 Not valid without Ghana Standards Authority's seal.
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Lab. No. 1282/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1283 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: SPRING ONIONS – FARM 1**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	4.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1283/MIC2/22



GHANA STANDARDS AUTHORITY FORM




TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions**
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Lab. No. 1283/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1284 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: SPRING ONIONS – FARM 2

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	4.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1284/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions**
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Lab. No. 1284/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes	
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1285 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: SPRING ONIONS – FARM 3

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	4.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1285/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
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Lab. No. 1285/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1286 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: SPRING ONIONS – FARM 4**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	6.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1286/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.


Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions**
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Lab. No. 1286/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1287 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: SPRING ONIONS – FARM 5

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	TNTC	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1287/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: The Coliform counts was too numerous to count.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
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Lab. No. 1287/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1288 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: CABBAGE – FARM 1**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	3.0 x 10 ⁶	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1288/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
- 1 Not valid without Ghana Standards Authority's seal.
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Lab. No. 1288/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

Codes

Generalised Product Codes:FV.....
 Specific Product Code:LH.....
 Officer Responsible for Report:BA.....
 Code of Approving Officer:CA.....
 Period of Report:07/2022.....
 Lab. No. 1289 Dept MIC Source Code 2 Yr. 2022

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: CABBAGE – FARM 2

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	3.0 x 10 ⁴	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1289/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022-07-06

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
- 1 Not valid without Ghana Standards Authority's seal.
 - 2 This report does not signify that product tested has been certified.
 - 3 Not to be used for litigation and advertisement without written consent of the Director General of Ghana Standards Authority.
 - 4 This report shall not be reproduced in part or full without the written approval of the Director General of Ghana Standards Authority.

Lab. No. 1289/MIC2/22



GHANA STANDARDS AUTHORITY

FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
 AKENTEN APPIAH MENKA
 UNIVERSITY OF SKILLS TRAINING AND
 ENTREPRENEURIAL DEVELOPMENT
 P.O.BOX 40 MAMPONG-ASHANTI

	Codes
Generalised Product Codes:	.....FV.....
Specific Product Code:	.....LH.....
Officer Responsible for Report:	.....BA.....
Code of Approving Officer:	.....CA.....
Period of Report:	.....07/2022.....
Lab. No. 1290 Dept MIC Source Code 2 Yr. 2022	

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
 SHIASHIE (LEGON – MADINA ROAD)
 GHANA STANDARDS AUTHORITY
 P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: CABBAGE – FARM 3

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ³	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1290/MIC2/22



GHANA STANDARDS AUTHORITY FORM




TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: NIL.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE: 

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE: 2022-07-06

SIGNATURE: 

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE: 2022/07/06

Note: The results relate only to the items tested

- Conditions
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Lab. No. 1290/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes

Generalised Product Codes:FV.....
Specific Product Code:LH.....
Officer Responsible for Report:BA.....
Code of Approving Officer:CA.....
Period of Report:07/2022.....
Lab. No. 1291 Dept MIC Source Code 2 Yr. 2022

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: CABBAGE – FARM 4

SAMPLE SIZE: 1 x 1 Kg

DATE RECEIVED: 2022-06-22

DATE(S) OF PERFORMANCE: 2022-06-24 to 2022-06-28

SOURCE/PURPOSE: ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	TNTC	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1291/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

REMARKS: The Coliform counts was too numerous to count.

Product sampled by: Customer.

*Method not accredited.

SIGNATURE:.....

REPORTED BY: BLESSING AZUBUIKE
(Scientific Officer)

DATE:.....*2022-07-06*.....

SIGNATURE:.....

APPROVED BY: CELESTINA ATTAKPAH
(Ag. Head of Department)

DATE:.....*2022/07/06*.....

Note: The results relate only to the items tested

- Conditions
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Lab. No. 1291/MIC2/22



GHANA STANDARDS AUTHORITY FORM



TITLE: Analytical Test Report

Doc. No.: GSA-FM-T09-E

Your Ref:

Our Ref:.....

To: ALBERT WISE KADEY
AKENTEN APPIAH MENKA
UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
P.O.BOX 40 MAMPONG-ASHANTI

Codes

Generalised Product Codes:FV.....
Specific Product Code:LH.....
Officer Responsible for Report:BA.....
Code of Approving Officer:CA.....
Period of Report:07/2022.....
Lab. No. 1292 Dept MIC Source Code 2 Yr. 2022

LABORATORY CONDUCTING TEST

MICROBIOLOGY LABORATORY
SHIASHIE (LEGON – MADINA ROAD)
GHANA STANDARDS AUTHORITY
P.O. BOX MB 245, ACCRA.

NAME OF SAMPLE: CABBAGE – FARM 5**SAMPLE SIZE:** 1 x 1 Kg**DATE RECEIVED:** 2022-06-22**DATE(S) OF PERFORMANCE:** 2022-06-24 to 2022-06-28**SOURCE/PURPOSE:** ALBERT WISE KADEY/ QUALITY EVALUATION

TEST CODE	TEST CONDUCTED	UNIT	RESULTS	TEST METHODS	SPECIFICATION
F-SS	<i>Salmonella</i> /37°C/24hr/ BSA/XLD	cfu/g	None Detected	ISO 6579-1 2017-02	
F-TC	Coliforms/37°C/24hr/ VRBL	cfu/g	2.0 x 10 ⁵	ISO 4832 2006-02	
F-VS	<i>Vibrio sp</i> /37°C/24hr /TCBS	cfu/g	None Detected	ISO 21872-1* 2007	

Lab. No. 1292/MIC2/22