KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

FACULTY OF AGRICULTURE

DEPARTMENT OF HORTICULTURE

FRUITS AND VEGETABLES CONSUMPTION IN TERTIARY INSTITUTIONS IN GHANA: A CASE STUDY OF UNIVERSITY OF EDUCATION, WINNEBA.

BY

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MAY, 2014

FRUITS AND VEGETABLES CONSUMPTION IN TERTIARY INSTITUTIONS IN GHANA: A CASE STUDY OF UNIVERSITY OF EDUCATION, WINNEBA.

A THESIS SUBMITTED TO THE SCHOOL OF RESEARCH AND GRADUATE STUDIES, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY (M.PHIL. POSTHARVEST TECHNOLOGY) DEGREE

BY

GIDEON OFORI ADINKU

MAY, 2014

DECLARATION

I hereby declare that, except for references which have been duly acknowledged, this project is the result of my own research and it has not been submitted either in part or whole for any other degree elsewhere.

…… ……

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(Head of Department)

DEDICATION

This work is dedicated to:

Mr. Ebenezer Kofi. Narh Adinku (my Dad), Ms. Ruth Doyoe Ocansey (my Mum) and my siblings:

Mrs. Dorcas Ohui Owusu, Charlotte Ogboo Adinku and Manasseh Tetteh Adinku.

ACKNOWLEDGEMENTS

Although words cannot fully express my gratitude to my Supervisor, Mr. Patrick Kumah, I would first like to thank him for offering his precious time and allowing me to dive into this research project and continuously guided this work through all its steps, constant enthusiasm, encouragements at each step in this long and arduous process, flexibility and most importantly his in-depth knowledge into the research area. I wish to acknowledge Dr. Francis Appiah and Dr. L. Atuah all of the Department of Horticulture for giving me the opportunity to buy into their knowledge and other necessary resources in the course of pursuing this study. My gratitude also goes to Mr. Prince Asiedu of the Planning Unit of the University of education, Winneba for his meticulous guidance in the analysis of the data that has made this work a success. A special thanks to my friends and course mates especially Mr. John Yankey for his assistance and motivation in the course of the study. My profound appreciation also goes to Rev. Jonathan Kuwornu Adjaottor and his family. I wish to say that you were more than an inspiration to me during my course of study.

Last, but not least, my appreciation and many thanks go to University of Education, Winneba and all the other three campuses for permitting me to conduct the research and rendering unconditional support during the data collection on the various campuses; and to students for their co-operation and interest to participate in the study. I am deeply grateful to the staff of the University who helped me directly and indirectly in different ways to bring this work into fruition.

Finally, to the Almighty God for seeing me through this study and for His abundant grace upon us I say I am grateful.

LIST OF ABBREVIATIONS

MoFA Ministry of Food and Agriculture

WHO World Health Organisation

UEW University of Education, Winneba`

IARC International Agency for Research on Cancer

ABSTRACT

There has been an upsurge in the effort to promote vegetables and fruits consumption multisectorially in Ghana. This study, therefore, sought to find out the levels and factors that influenced fruits and vegetables consumption among students in tertiary institutions in Ghana, with the University of Education (four campuses) as the study area. Purposive and quota sampling techniques were used in selecting students (262), retailers (42) and producers (38) as respondents for the survey and simple random sampling for selecting respondents (43 students) for determining the most important sensory attribute that influenced choice and consumption of vegetables and fruits. Data gathered was analysed using SPSS (version 16). A chi-test and a Post-hoc test were also applied. Cross tabulations were done to ascertain the relationship between related factors such as: location of campus, programme of study and the gender of respondents. The study showed that majority of the students had knowledge (89% for fruits, and

86% for vegetables) of the nutritional benefits from consuming fruits and vegetables. Others (5%vegetables and 2% for fruits) also patronised these just for satisfaction purposes or expressed no apparent knowledge of fruits and vegetables. The location of campus and programme of study significantly ($p \leq 0.05$) influenced the knowledge on fruits and vegetable consumption. A significant majority of the sciences students consumed fruits and vegetables just for satisfaction.

Although the level of knowledge was not influenced by gender, it was significantly influenced by campus location. The basic knowledge of consumption for nutritional purposes was high on the Ashanti Mampong campus. The most predominant storage method employed by students was the refrigerator (fruits, 45% and vegetables 28%) with majority (Std. Res. 2.2>1.96 for fruits and 2.1>1.96 for vegetables) of the respondents on the Kumasi campus storing fruits in the refrigerators and vegetables on the floor. The programme of study had no significant effect on the storage method for both fruits and vegetables. In a descending order, fruits and vegetables were commonly packed and conveyed in polythene bags, baskets, jute sacks, and carrying them by hand, unpackaged. Majority of fruit consumers (44%) consumed fruits once daily whilst majority (24%) of consumers of vegetables consumed vegetables twice daily. Consumption of vegetables four times daily was highest (p=0.00, Std. Res., 2.3) among students of the Kumasi and Ashanti-Mampong campuses. Surprisingly, Arts students consumed significantly more fruits (four times daily) than science students. Gender had a significant effect on the consumption of fruits and vegetables (p= 0.06; Std. Res.; males,-2.0<1.96; females, 2.2>1.96). Majority of the students (20%) , averagely, reported losses in fruits and vegetables of 35% and 36%, respectively. Significant losses of 10% and 20% in fruits and vegetables, respectively, were recorded on the Kumasi campus among producers and retailers. Gender had no effect on the losses recorded. Results from the second part of the study indicated that sensory attributes of texture, colour and taste influenced consumption of most common fruits and vegetables on the campuses: banana – colour; watermelon – taste and colour; citrus – taste; pineapple – taste; grape – colour; onion – taste; tomato – colour; carrot – taste; potato – taste; and cabbage - colour and taste. It is evident from the study that students need to be educated on the best handling methods for, and encouraged to consume more vegetables and fruits for their obvious benefits.

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1.0 INTRODUCTION

It is widely accepted that fruits and vegetables are components of a healthy diet and the World Health Organization (WHO) aims at promoting an increase in their consumption. Experts have recommended that fruits be made an essential component of every meal (Agudo, 2005). The term fruits and vegetables have different meanings depending on the context in which they are used. Vegetables could be defined as the plant part used as food typically as accompaniment to meat or fish, such as cabbage, potatoe, carrot or bean (O"Hare *et al.,* 2001). Fruits are however, known to be the sweet and fleshy product of a tree or plant that contains a seed and can be eaten as food. For the purpose of this study, vegetables shall be defined as the edible part of a plant, commonly cultivated or collected for their nutritional values for humans (Agudo, 2005). By the foregoing definition of vegetables, a fruit is then a subset of the vegetable. In the same way, processed fruits and vegetables such as jams and jellies that may not retain the nutritive value of the original food, are usually classified under „sweets" or „sugars" (Agudo, 2005).

Fruits are important sources of potassium, magnesium and fibre "all of which are necessary nutrients for a healthy individual (Dinkgrave, 2005). For nearly a century , fruits and vegetables have been recognised as a good source of vitamins and minerals. Their consumption has been valuable for their ability to prevent vitamins C and A deficiencies (Pomerleu *et al.,* 2003). It is widely known that eating plenty of fruits and vegetables can help consumers to ward-off heart diseases and stroke, control blood pressure and cholesterol levels (Mintah, 2012). Fruits and vegetables consumption is also known to be a guard against eye related problems such as cataract and macular degeneration which are

the two common causes of vision impairments (Dinkgrave, 2005). Diets that are high in fibre from fruits and vegetables help in the management of diabetes. They also serve as a risk factor to coronary diseases. Diets containing substantial and varied amounts of vegetables and fruits may prevent certain types of cancers and are also associated with healthy weight and decreased risk of obesity (Kratt, Shewchuk and Reynolds, 2009). Poor diets (diets without fruits and vegetables) in combination with lack of exercises had been ranked as second only to tobacco as cause of morbidity and mortality (McGinnis and Foege, 1993). In spite of the ever-growing evidence highlighting the protective effects of fruits and vegetables, their intake are still grossly inadequate, both in developing and developed countries. At present, only a small negligible minority of the world‟s population consume the recommended five servings of fruits and vegetables daily (consisting of 80g per meal) (WHO, 2003) of which students in tertiary institutions are no exception.

Notwithstanding the enormous benefits derived from the consumption of fruits and vegetables, little work has been done to study the consumption of fruits and vegetables and its associated challenges among tertiary education students in Ghana. Challenges to the consumption of fruits and vegetables among students may be influenced by the level of knowledge of the consumer on fruits and vegetables which may influence their preferences and how vegetables and fruits are be handled, stored and used. These challenges may also affect the level of losses thereby reducing the benefits obtained from their consumption. Evidence suggests that, postharvest losses tend to be highest in countries where the need for food is greatest (FAO, 1989: Babalola *et al.*, 2008). Lack of of fruits or vegetables has also been identified as a possible factor affecting outcomes in interventions to improve

fruits and vegetables intake (Kratt *et al.*, 2009). This study was therefore aimed at unearthing the level of use and the postharvest management of fruits and vegetables among University students.

The specific objectives sought to:

- assess the influence of knowledge of fruits and vegetables consumption on the consumption;
- evaluate the postharvest handling methods used by students in the postharvest management of fruits and vegetables; and their challenges;
- assess the losses that occur in students‟ postharvest management of fruits and vegetables; and
- identify the sensory attributes that influenced students preference for some selected fruits and vegetables.

2.0 LITERATURE REVIEW

2.1 NUTRITION IN FRUITS AND VEGETABLES.

The fruits and vegetables per capita consumption in sub-Saharan Africa revealed that Ghana in totality is ranked second to Kenya in fruits and vegetables consumption. However, globally fruits and vegetables consumption is considered minimal among countries such as Ethiopia, Burundi, Malawi, Mozambique, Tanzania, Rwanda, Kenya, Uganda, Ghana and many more. These countries record a fruit and vegetable consumption level below the recommended consumption level of (400g) per day (Reul, Minot and Smith, 2000). In other countries, per capita income is considered to be a determinant factor in fruit and vegetables consumption. This is evident in the consumption levels of some countries since some do not reach even half of the expected level of consumption set by the Food and Agriculture Organization (FAO) inspite of the ever-growing evidence highlighting the protective effects of fruits and vegetables consumption.

2.1.1 Fruits and Vegetables Defined

Vegetables in general have certain characteristics. The edible portion of vegetables has high water content. Vegetables are mostly consumed in their fresh state (Norman, 1992). Due to their perishable nature, they are stored for a short period of time. Vegetables, unlike fruits are mostly cooked before they can be eaten. However, some can be eaten in their fresh states, just like fruits. Fruit can be defined as the womb that holds, protects feeds, matures and eventually delivers the seed responsible for the survival of a species and its propagation (McKee, 1995). The fruit is a distinct organ that develops from the flower‟s female tissue, the ovary and encloses the female tissue. The word vegetable comes from the Latin verb “vegere” meaning to enjoy, delight in (McKee, 1995). By definition, vegetables then are inscribed in English as a useful fuel for humans while fruits are

perceived to be in a closer dimension to luxury and sensual pleasure (Mckee, 1995). In order to quantify fruits and vegetables consumption, it is important that both uses in the culinary state and fresh state are considered in defining fruits and vegetables. Certain groups of plants based foods are not usually regarded as vegetables during classification. Examples are (a) herbs (b) spices and plant products used to make coffee and tea.

2.2. IMPORTANCE OF FRUITS AND VEGETABLES.

The importance of fruits and vegetables is related to their nutritional value. Fruits and vegetables serve as a major source of vitamins and minerals which are necessary in ensuring balanced diet. They may also serve as supplementary foods. Some vegetables are used as richer sources of cheap proteins. They are also sources of roughages which by providing an indigestible matrix stimulates intestinal muscles and apart from keeping them in working order, prevents constipation due to their laxative effects (Norman, 1992). Fruits and vegetables are also important components of healthy diets and have been associated with the reduction of some cancers and cardiovascular diseases (Bazzano *et al.*, 2002; WHO, 1990).

Fruits have been identified to have a protective effect against the risk of cancers of the lungs, the bladder, mouth, pharynx and larynx. They are relatively cheap sources of essential micronutrients. They are also cost-effective means of preventing micronutrient deficiencies and also serve as protectant against chronic diseases which are the main killers in the world today (Ruel and Minot, 2005). Research has shown that, fruits and vegetables

are major sources of Vitamins A. and C. An inadequate or lack of the supply of Vitamin A causes infantile mortality with early symptoms such as night blindness (Monterell, 1989); whilst inadequate supply of Vitamin C causes curved bones and many more. Disasters are also significant determinants of fruits and vegetables that contain Vitamin A. and C. Women who consume more fruits and vegetables tend to live longer when they exercise more since they usually have a lower body mass index than those with lower fruits and vegetables intake rate (Lui *et al.*, 2004).

2.2.1 Fruits and Vegetables Consumption

Low fruits and vegetables intake is a main contributor to micronutrient deficiency in the developing world, especially in populations with low intake of nutrient dense animal source of food. The World Health Organisation (WHO) estimates that, low fruits and vegetables intake contributes to about 2.7 million deaths a year from chronic diseases and causes about 31% of ischaemic diseases and 11% of strokes worldwide (WHO, 2005). Fruits and vegetables consumption can be influenced by variable factors such as: household income, prices and availability of fruits and vegetables, consumer food preferences, home feasibility and home production of fruits and vegetables, household decision-making process, gender, age, proximity (closeness of production site to consumers), and the income levels of consumers. Research has shown that there is a relationship between the consumption of fruits and vegetables and disease prevention.

Women who consume five or more servings of fruits and vegetables a day stand a lower risk of attracting diabetes. It is recommended that on the average, each individual must consume 100g of fruits and vegetables per day (Grubben, 1975).

The portion size is an important issue in the loathing of reliable estimates about the actual quantity of fruits and vegetables that are consumed. It is known that the largest segment in processed fruit products is ready to serve beverages, followed by fruit pulp, pickles , preserves, chutneys, frozen fruits and vegetables, Tans and squashes and syrups (Grubben, 1975). Major exporters of fruits and vegetables include USA, Spain, Italy, Chile, France, Turkey, Netherlands, Ecuador and India. Major importers of fruits and vegetables also include the following countries: Germany, France, USA, France, UK, Japan, Italy, Netherlands and Canada.

2.2.2 Benefits of Fruits and Vegetables Consumption

Regular consumption of fruits is associated with reduced risks of cancer, cardiovascular diseases, stroke, alzheimer disease, cataracts and some functional diseases associated with stroke and ageing (Liu, 2003). It is more important to include a wide variety of fibre rich foods in daily diet(s) than it is to use the highest total fibre amount since different fruits and vegetables have different mixtures of the types of fibres. Eating 3-5 servings of colourful fruits and vegetables a day is important because deeply hued fruits and vegetables provide a wide range of vitamins, minerals, fibre and photochemicals which the body needs to maintain good health (Rasmussen *et al.*, 2006). Reduction in the consumption of refined foods and the promotion of fruits and vegetables can reduce the risk of obesity which includes the deviation or reduction in cholesterol levels, reduction in the accumulation of adipose tissues amidst the drying of one‟s life style (Tasheu, 1986).

2.2.2.1 Sources of vitamins C and E

The water soluble anti-oxidant (Vitamin C) is present in many fruits and vegetables, especially citrus and peppers. It is noted for the prevention of carcinogenic nitrosamines formation and also secondary amines in the stomach (Beaumont-Smith *et al.,* 1999).

2.2.3 Roles of Guardians in Fruits and Vegetables Consumption

Parents are arguably the most influential environmental factors in children‟s development of food preferences (Kratt *et al.,* 2000). Availability has also proven to be a determinant factor for fruits and vegetables consumption (Kratt *et al.,* 2000).

2.2.3.1 Proteins minerals and vitamins

Various species of leafy vegetables have markedly varying water contents. These differences are highly evident during both the dry and the wet seasons. The water content varies with the species and the variety, but it is also influenced by the ecological and cultivation factors such as climatic conditions, soil, fertilization, irrigation, storage and methods of harvesting, transportation and handling (Grubben, 1975).

Some fruits and vegetables are rich in indigestible cellulose and fibres which have a mild laxative effect when consumed. This is very useful in the tropical countries where constipation is the rule rather than an exception (Heil, 1984). Proteins present in the leafy vegetables are rarely mentioned because the quantities eaten are considered too small for a significant supply of proteins (Pasomore, 1974). However, regular supply of some

grammes of leafy proteins per day to children suffering from protein deficiency may lead to substantial improvement in their health. Many leafy vegetables contain more proteins in un-boiled than boiled dishes (Grubben, 1975). This reasoning is understandable because once the cooking water is thrown away, most of the nutrients are lost since the vegetables do not only absorb water but also lose some cellulose water during boiling. Green leaves are often consumed in quantities which are too small to contribute significantly to caloric requirements (Grubben, 1975).

Mineral salts which are important nutritional components in foods are also found in fruits and vegetables. They are present in dark green leaves. Calcium and iron are seen to be the most important in the diet(s) of communities in tropical countries. Calcium and zinc are also pre-eminent materials in *Amaranthus*. Iron from *Amaranthus* is easily absorbed through the intestines. However, patients suffering from anemia are capable of absorbing more iron from this.

Tropical leafy vegetables are very rich in B-carotene, ascorbic acid and in some vitamins of B- complex like riboflavin and folic acid. Thiamine also is available in sufficient quantities. Eating green leaves also helps to control xeropthalmia which is frequently found in tropical countries. The seeds of some leafy vegetables such as *Amaranthus* are high in nutritive values. Leafy vegetables also contain some oxalic acid content and other noxious substances (Grubben, 1975).

2.3 STORAGE OF FRUITS AND VEGETABLES

One of the most important functions of refrigeration is to control the rate of respiration in a produce. Respiration generates heat as sugars, fats and proteins are oxidized. The loss of these stored food reserves through respiration means decreased food value, loss of flavour, loss of salable weight and more rapid deterioration. The respiration rate of a produce strongly determines its postharvest life.

The rate of respiration of a stored produce increases with an increase in the rate of respiration For refrigeration to be effective in extending the shelf life of a commodity, it is important that the temperature in the storage room is kept as constant as possible. Exposure to alternating cold and warm temperatures may result in moisture accumulation on the surface of the produce which may hasten decay (Bachman and Earles, 2000). To reduce this effect, storage rooms should be well insulated and air circulated.

Acid degradation and ethanol production may be influenced by temperature during storage . Cold or warm storage were revealed in his research on the postharvest quality of orange as affected by pre-storage treatments with acetaldehyde vapour or anaerobic conditions.
The mode of storage employed by students during their use of fruits and vegetables immensely affects the quality of the vegetables and fruits they consume. It also affects greatly the quality of stored vegetables. Under different storage conditions, different fruits and vegetables may behave differently (Kim *et al.*, 2010). In a modified atmosphere, different fruits and vegetables experience different levels of weight loss.

Alteration in carotenoid content varies also from one produce to the other (Kim *et al.*, 2010). Humidity is the greatest variable affecting matter loss, hence affecting the shelf life of fruits and vegetables (Kim *et al.*, 2010).

2.3.1 Storage of Citrus

Citrus been have low respiration rates and thus are amenable to long term storage. Nevertheless, storage conditions are also cultivar dependent and fruit quality changes occur during prolong storage (Davies and Albrigo, 2006). For instance, in some areas of the world, citrus fruits are held in common storage where the temperature remains constant all year round. Fruits such as sweet oranges and mandarins could be stored for two months or more at zero to four(0 - 4) degrees celsius with very little loss of fruit quality (Davies and Albrigo, 2006)

Others also risk falling prey to chilling injury when kept under temperatures below 10 degrees celcius. A typical example of these are lemons and grape fruits (Davies and Albrigo, 2006). Consequently, lemons are best stored at (10-12) degrees celsius and grape fruits at (10-15) degrees celsius. Abscisic acid levels tend to decrease in the peels of citrus when harvested after January and the reducing sugar level tend to increase (Davies and Albrigo, 2006).

It must be well noted that, the required atmosphere for the storage of lemon is at a relative humidity of (95%). During the storage of citrus, the relative humidity should be kept

between (85-95%) in order to retard water loss due to vapour pressure. In as much as humidity is required to be high, high humidity also promotes wound healing, the growth of mould and the sustenance of the lives of other decay organisms (Davies and Albrigo, 2006).

Controlled atmosphere storage has the modest benefits of storage for citrus. It is however not recommended since it appears not to be cost effective. The use of refrigerators is the most economical and widely used. Citrus fruits undergo internal quality changes during storage (Davies and Albrigo, 2006). These changes are a function of cultivar and the storage conditions. Components such as fresh water, total soluble solids (TSS) received some internal and external alterations in response to temperature changes. Even though waxing may reduce the rate of desiccation, waxed fruits also develop off flavours when stored at high temperatures for longer period (Hagenmaeir and Shaw, 1992).

2.4 DETERIORATION OF FRUITS AND VEGETABLES

The quality of horticultural produce has been based on external characteristics in terms of size, colour, flavour and the absence of defects such as bruises.

An increase in the rate of loss because of normal physiological changes is caused by conditions that increase the rate of natural deterioration such as high temperature, low atmospheric humidity and physical injury, abnormal physiological deterioration such as high temperature and low atmospheric humidity. This deterioration occurs when the fresh produce is subjected to extremes of temperature, atmospheric modification or

contamination. Losses can also be caused by mechanical damage or diseases and pests (Beautmont-Smith *et al*.,1999).

2.4.1 Losses Due to Preparation

Losses occur during the preparation of fruits and vegetables. These losses can be distinguished in the following ways:

a. Losses through inactivation caused by the application of leaf, especially of Vitamin C.

b. Dissolution of a part of mineral salts.

c. Losses through the diffusion of part of the nutritive substances which are soluble in cooking water. Examples are sugars, organic acids, pectin, mineral matter, vitamins, pigments and aromatic substances.

With this nutritionist‟s advice, the processing or preparation of vegetables in very little water is recommended in order to avoid throwing away the cooking water. Research has also revealed that in instances where people are forbidden by taboos to consume fruits and vegetables, other meals are also used to replace them in terms of their nutritional values.

2.4.2 Decay in Fruits and Vegetables

Delay in cooling tends to increase decay losses. Damage to certain fruits and vegetables could be minimized by applying decay control treatments such as fumigation to reduce fungal infection. Plastic containers could be lined with plastic liners and sulphur dioxide

generation pad. Free water with high humidity speeds up decay development in tree fruits and berries.

For example, in a room temperature, only four hours of contact with free water allows brown rot to penetrate fruit tissues. Decay prone fruits and vegetables should be protected from prolonged water contact and very high humidity during cooling delays. Low humidity could also be detrimental to produce, such as carrots which could be later on corrected by the fruit re-absorbing water during storage.

2.4.3 Water Loss in Fruits and Vegetables

Shriveling and loss of fresh glossy appearance are the two most noticeable effects of cooling especially with regards to products that lose water easily and quickly and those that show visible symptoms of water loss like most leafy vegetables: For instance, *kontomire*, *amaranthus* , spinach and lettuce. However, moisture loss could be prevented by keeping produce in sealed containers. It must be noted that the liner must be vented to prevent temperature rise caused by damaging levels of respiration. Some produce such as tomatoes can tolerate water contact and spraying with water to slow down product moisture loss and can rehydrate slightly wilted produce notwithstanding the fact that surface water tend to increase decay and mould development. Water loss though detrimental on some occasions, is also beneficial since produce such as carrots need some turgidity loss to reduce mechanical damage during handling and transportation (Thompson *et al.*, 2001).

2.4.4 Taste components

Fructose, sucrose and glucose are sugars that affect the perception of sweetness in fruits and vegetables. Fructose is the sweetest and glucose is less sweet than sucrose.

A single sucrose equivalent value is the weighted average of these simple sugars (Koehler and Kays, 1991). Quantification of sugars requires complicated laboratory analysis. Organic acids such as citrate in citrus and tomatoes, tartaric acid in grapes and malic acid in apples, give fruits and vegetables their sour flavour.

Some fruits like watermelon or banana are low in acid (Wyllie *et al.*, 1995). Different acids can affect sources and perception depending on their chemical structure. It has been realised that an increase in carboxyl groups decreased acidity, while an increase in molecular weight or hydrophobicity increased sourness (Hartwig and McDaniel, 1995)

2.5 SENSORY ATTRIBUTES OF FRUITS AND VEGETABLES

Unless a product has an eye appeal, it is very difficult to market it even though the flavour and nutritional value may be very good. Attractive fruits and vegetables appeals to the ordinary consumer and is apt to be enjoyed more by the ordinary consumer than unattractive fruits and vegetables. Consequently, there is the need to take into consideration the characteristics that give eye appeal to the fruits. Generally, small fruits will sell at a discount (Molnar, 2006). Under glutted market conditions, small fruits and vegetables may

not even be considered as saleable. Larger fruits will command a great demand. The size therefore is another factor that affects the market acceptance of a commodity. Another important factor in eye appeal is good colour (Molnar, 2006).

Current market trends have favoured red fruits over yellow fruits. This has been true in apples, sand peaches and many other fruits where both red and yellow fruits are produced. Usually, red fruits will have much more eye appeal and consumer acceptance than will one with some amount of dull or dark colour . Ground colour refers to the green or yellow colour of fruits or vegetables. A fruit may have a yellow ground colour or a greenish ground colour (Molnar, 2006). One important characteristic, especially from the marketing point of view, is the colour of the produce. External amount and intensity of surface colour on a fruit of any type or cultivar is of prime importance to its appeal. Colour is such an important attribute of fruits and vegetables that it is used to grade the standards of fruits and vegetables such as pineapples, tomatoes, apples and mangoes.

2.5.1 Texture of Fruits

Texture is an important component of fruit quality. Flavour may be affected by texture because the release of the taste components in fruits and vegetables is related to tissue structure (Molnar, 2006).

Texture is related to attributes of quality associated with the sense of feel as experienced by the fingers, the hand or in the mouth. Included in the texture are sensations such as loudness, softness, crispness, meatiness, juiciness and toughness.

2.5.2 Flavour in Fruits and Vegetables

Often the same compounds are rested in genetically unrelated fruits with their presence or absence, resulting in vastly different flavours. The combinations of flavours also result in the production of certain unique flavours of certain cultivars.

Flavour and aroma are perhaps the most elusive and subjective quality of fruits (Baldwin *et al.,* 1999) The flavour of a produce usually is composed of sweetness, sourness and aroma which corresponds to sugars, acids and volatiles((Baldwin *et al.,* 1999). Other components of flavour includes bitterness (Derovira, 1997). The flavour quality of nonclimacteric fruits and vegetables usually decline after harvest while climacterics can reach their best after harvest. In the order of importance, the following are the determinants of flavour in fruits and vegetables:

- genetics
- pre-harvest environment,
- cultural practices; and
- and harvest maturity,

(Romani *et al.,* 1983).

For instance, heavy rains prior to harvest dilute flavour components in tomato. In the same vein, produce harvested at an immature green stage results in ripened produce with lower volatile levels than mature green harvested ones.

Heat treatment of fruits like apples reduces physiological and pathological disorders of apples. It also inhibits the emission of volatile esters (Falik *et al.*, 1997). The vitamin; folic acid is obtained from green leafy vegetables, oranges and orange juice. These and other outer layers play important metabolic roles in the synthesis of DNA (Baldwin *et al.*, 1999).

2.5.3 Aroma Components

Aroma is said to be the sensation perceived when volatile compounds are sniffed through the nose. It must be noted that most fruits synthesize volatile chemicals as they ripen. Such chemicals give fruits and vegetables their characteristic odour and can be used to determine whether they are ripe or not (FAO, 2003). Examples include a.banana, tomatoes, pawpaw.

2.5.4 Cooling of Produce

Quality of produce begins to deteriorate right after harvest. It is recommended that the cooling should begin as soon as possible after harvest. Delay in the cooling of produce is known to be the main causes of the following in a harvested produce:

- allowing respiration and its associated normal metabolism to continue at very high rates, consuming sugars, acids, vitamins and other constituents;
- fostering water loss; and
- increasing decay development

(Thompson, 2001)

Freshly harvested produce consume photosynthates that are stored in the product before harvest. The rate of metabolism is therefore dependent on the respiratory activity of a commodity and its temperature. Commodities such as apples, cabbage, citrus, potatoes and grapes have low respiration rates compared to avocados, mushrooms and asparagus.

The climacteric or non-climacteric nature of a fruit or vegetable also affects its rate of respiration. This may be due to the exponential increase respiration rate. Different exposure of fruits and vegetables to high temperatures also causes sunburn and scald injury.

2.6 DETERMINANTS OF FRUITS AND VEGETABLES CONSUMPTION

Cultural habits and traditions are important determinants of food consumption with different countries and regions having different cuisines. Individual preferences also play a significant role.

2.6.1 Conceptual Framework of Determinants of Fruits and Vegetables Consumption

The determinants of fruits and vegetables usage consist of the following:

- household income;
- prices and availability;
- consumer food preferences;
- cost and feasibility of products of fruits and vegetables; and
- intra household decision-making process.

However, these factors do not affect all people with the same economic levels. The demand for fruits and vegetables increases with higher income although the share of total expenditure allocated to fruits and vegetables tend to decline (IARC, 2003). This implies that at low income levels, the demand for fruits and vegetables is small. This is largely due to the fact that low income households must prioritize the fulfillment of their basic energy requirements to aid hunger. Thus, fruits and vegetables tend to be an expensive source of energy compared to other staples such as cassava, cocoyam, plantain and rice. A study in Cambodia found out that vegetables cost between (10- 40) times more expensive than rice per kilocalorie, thus the rice and certain fruits were up to 100 times more expensive than rice per unit energy (Prescott and Pradham, 1997). Higher incomes is therefore associated with an increase in volume and diversity of fruits and vegetables consumed (Minot, 2002).

2.6.2 Relationship Between Income Levels and Consumption of Fruits and Vegetables

Fruits and vegetables consumption increases with household income (Aimee, 2002). Although individuals with the lowest income levels are unable to meet the minimum requirements for consumption; at five servings daily, they are also unable to meet a minimum consumption of three servings daily (Aimee, 2002). Many factors influence food consumption. These include taste, nutrients, cost, convenience and weight control concerns. Researchers in a survey of 2,910 Americans found out that, in general, factors that influence consumption include the following in this descending order; (i) taste, (ii) cost (iii) nutrition, (iv) convenience and (v) weight control (Marie *et al.,* 2004).

Even though a multivariate analysis proved that the importance of the foregoing listed factors was not significantly related to income; income level did influence the purchasing power and convenience which were important factors considered by people with lower incomes as compared to those with higher income levels.

2.6.3 Prices and Availability of Fruits and Vegetables

There is a conventional wisdom that lower income households are more sensitive to prices than higher income earners (Marie *et al.,* 2004)

It is imperative that policies to reduce the market price of fruits and vegetables can have a significant impact on the amount of fruits and vegetables consumed. Considering the perishability of the fruits and vegetables and the infrastructure in many developing countries, another constraint to fruits and vegetables consumption is availability (Marie *et al.,* 2004). Their availability could also be increased throughout the year by the adoption

of storage methods such as solar drying of pepper or adoption of technologies to extend either their storage or shelf life (Ali and Tsou, 1997).

2.6.4 Consumer Preferences

Other non-economic factors also affect fruits and vegetables consumption. These include sensory appeal, desirability, personal and food ideology, convenience and media advertising (Pollard *et al.,* 2002). Taboos, cultural beliefs and dietary restrictions during lactation are also likely to play a significant role in this affair. Another period of high vulnerability to micronutrients deficiencies are also widespread in developing countries. It often includes several fruits and vegetables because of their perceived harm to either the mother or the young infant (Pollack, 2001). It is imperative that mothers who have greater knowledge on nutrition devote a share of their budgets to foods that are rich in micronutrients which include fruits and vegetables (Block, 2002).

2.6.5 Cost and Feasibility of Fruits and Vegetables Production

Cultural habits and traditions are important determinants of food consumption, with different countries and regions having different cuisines. In some occasions, fruits and vegetables consumption is higher for urban places than rural communities and towns.

Even though there is little research on the degree to which conception pattern is affected by home production. A research to promote fruits and vegetables by home production increased consumption in Bangladesh (Ali and Tsou, 1997). It therefore seems plausible that in areas where markets work imperfectly, fruits and vegetables consumption could be promoted with the promotion of home production.

2.6.6 Intra-household Decision-Making

Research on intra-household allocation of resources indicates that households in which women have more control over resources, (due to legal rights, greater inheritance, high share of assets or simply the absence of the husband or higher social status) one tends to place a higher priority on child health and nutrition in allocating household resources. A study of household budget data from Rwanda found female headed households allocated a larger share of their budgets to fruits and vegetables (Ministere du plan, 1998).

2.7 SENSORY AND PHYSICAL ATTRIBUTES OF FRUITS AND VEGETABLES

Several studies from a range of countries highlighted sensory and physical attributes of fruits and vegetables as both promoters and barriers for fruits and vegetable consumption among children. Taste and flavour has been identified to be the main positive indicators. This is because generally, children appear to prefer the taste of fruits to vegetables because of their sweet flavour (Walker and Millman, 1973) .

Predictors of low fruits and vegetables intake include low income, poor knowledge on nutrition, low level of education, living in an under privileged neighbourhood and low socio-economic status.

2.8 PRODUCTION AND RETAILING OF FRUITS AND VEGETABLES

The most important influences on food consumption in Ghana are of course the major retailers because they are extremely influential in determining what, where and at what price we can buy food (Raven *et al.*, 1995). Major supermarkets in this country have considerably increased their share of fruits and vegetables market in recent times. Retailers would also prefer to trade in fruits and vegetables with a very high demand and are easily

obtainable or in season. These factors would enhance the retail of fruits and vegetables. Losses of fruits and vegetables among retailers often occur in the course of transit by the crushing of some of the commodities and during storage through physiological deterioration and diseases and pests infestation. Fruits and vegetables which over ripe or have less firmer skins are also often easily loss in the hands of retailers.

2.9 TERMINOLOGIES

Composite foods: This refers to manufactured foods which include fruits and vegetables as their components. The inclusion of composite foods is as a result of the busy schedules of students and how feasible it is for them to consume whole fresh fruits and vegetables;

Frequency of consumption: It refers to the number of times a fruit or vegetable is eaten. In order to determine the frequency of consumption, it is imperative that consumption is combined with a quantitative estimate of the intake.

A serving of fruits or vegetables: This refers to 80g in quantity of fruits or vegetables. Five servings of this are needed to ensure that an individual consumes the expected quantity of fruits and vegetables in a day.

Climateric fruits: These are fruits that enter „climacteric phase" after harvest *that is,* they continue to ripen. During the ripening process the fruits emit ethylene along with increased rate of respiration. Ripe fruits are soft and delicate and generally cannot withstand rigours of transport and repeated handling.

3.0 MATERIALS AND METHODS

3.1 EXPERIMENTAL SITE

The research was conducted on all the four (4) campuses of University of Education Winneba namely; (a) Winneba Campus (b) Ajumako Campus (c) Kumasi Campus and (d) Mampong Campus. These campuses served as representations of the situation among University students in the country since these four campuses were spread across the country with two campuses chosen from each zone. That is,Winneba and Ajumako Campuses from the Southern Zone and Kumasi and Ashanti-Mampong Campuses representing the Northern Zones. The University has ten (10) teaching faculties which are spread across the four campuses (UEW Basic Statistics, 2012).

3.2 FIELD SURVEY

3.2.1 Experimental Design

The experiment was conducted in two parts. It was through a survey of consumers who were students of the University, retailers and producers of fruits and vegetables on the various campuses and a test with some selected sensory attributes to fruits and vegetables consumption.

3.2.2 Questionnaire Design

A pre-tested questionnaire, consisting of five main sections was used in collecting data from students. The first part of the questionnaire covered the socio and demographic data

of the students. The second part was used to assess students‟ knowledge on fruits and vegetables consumption. The third part assessed the consumption by students and the methods of storage used for fruits and vegetables. Students were made to indicate the kinds of storage methods they used and how often they used fruits and vegetables. Furthermore, they were requested to indicate how fruits and vegetables were handled and how often losses did occur and the amount of losses involved (Parts iv and v of the questionnaire in appendix A1).

3.2.3 Interview Schedule

An interview schedule which consisted of two main sections was developed for retailers and producers of fruits and vegetables. The first section consisted of the bio-data of retailers of fruits and vegetables on the various campuses. The second section sought to find out the sources of fruits and vegetables for the retailers. It also captured the types of fruits and vegetables that received high patronage among consumers and where the retailers acquired them for sale. This was used as a means to validate information received from students. The interview schedule for producers on the other hand covered the following areas: bio-data, production sites, the produce, people who patronised the produce and the major production challenges (Appendix A2).

3.2.4 Scope and the Sampling Method

A total number of 262 students, 42 retailers and 38 producers of fruits and vegetables were randomly selected from the four campuses of the University of Education, Winneba as the respondents for the study. The population was made up of all regular or fulltime students,

all fruits and vegetable retailers and producers on the four campuses of the University namely; Winneba Campus, Ajumako Campus, Kumasi Campus and AshantiMampong campus. The selection of the sample was done by quota, random and purposive sampling techniques where the sample size was the percentage representation from the entire population as cited in Sarantakos (2005). A baseline data of 10 students was set for all four campuses. This was to ensure that each campus was well represented in the study.

Table 3.1: Campus by campus sample selection of students

Target area	Number of students	Percentage (%)
Winneba Campus	136	51.91
Ajumako Campus	14	5.34
Kumasi Campus	79	30.15
Ashanti- Mampong Campus	33	12.6
Total.	262	100.00

Table 3.2 Campus by campus retailers selection.

	Campus Location	Items retailed	Number of retailers	Percentage
1	Winneba Campus	Banana	2	21.43%
		Pineapple and Watermelon	1	
		Orange and Watermelon	1	
		Grapes, Watermelon and Pineapples	2	
		Tomatoes	1	
		Pepper, Onions , Cabbage , Lettuce, Tomatoes	1	
		Potatoes	1	
2	Ajumako Campus	Banana	1	11.9%
		Onion	1	
		Pineapple	1	
		Orange	1	
		Tomatoes, Onions, Lettuce and Cabbage	1	
3	Kumasi Campus	Watermelon	2	35.71%
		Banana and Pineapple	3	
		Pineapple and Watermelon	1	
		Oranges	3	
		Grapes	2	
		Tomatoes	1	
		Lettuce and Cabbage	1	
		Onion and Potatoes	2	
		Banana,	2	
		Tomatoes and Onions	1	

4	Ashanti-Mampong Campus	Oranges	2	30.96%
		Pineapples	4	
		Watermelon	1	
		Potatoes	2	
		Lettuce and Cabbage	1	
5	**Total**		42	100%

Table 3.3: Fruits and vegetables producers from the four campuses

S/N	**Location**	**Fruits and Vegetables produced**	**Number of Producers**	**Percentage producers**
1	Winneba	Banana and Citrus	1	15.79%
		Pineapple	4	
		Watermelon,Citrus and Cabbages, Cucumber	1	
2	Ajumako	Lettuce	2	18.42%
		Pineapple and Cucumber and Lettuce	1	
		Watermelon and Lettuce	2	
		Watermelon and Pineapple	2	
3	Kumasi	Banana	3	21.05%
		Tomatoes,Cucumber, Lettuce and Pepper	1	
		Orange and pineapple	1	
		Watermelon	3	
		Lettuce and Tomatoes and cabbages	1	

4.	Ashanti Mampong	Watermelon	2	44.74%
		Citrus and Pineapple	2	
		Banana	10	
		Tomatoes and Onion and Cucumber	1	
		Citrus	1	
Total			**38**	**100%**

3.3 SENSORY ATTRIBUTES TEST

In order to determine the effect of sensory attributes on the patronage of fruits and vegetables forty three (43) students were randomly selected. The fruits (Fruits: pineapple (*Ananas commosus),* banana (*Musa paradisiaca(Cavendish),* watermelon*(Citrullus lanatus),* citrus(*Citrus sinensis*) and grape*(Vitis vinifera*). Vegetables: (onion(*Allium cepa*), tomatoes(*Solanum lycopersicon*), carrots(*Daudus carota*), cabbage(*Brassica oleracea var capitata*) which were common to all four campuses were selected and subjected to the various levels of the physical attributes. They were then set up for students"selection and consumption based on their most influential sensory attribute such as taste, colour, texture and others (nutritional benefits, beliefs, satisfaction). Students were made to complete assessment forms based on the ability of the attribute which influenced their patronage (Appendix B 1).

3.3.1. Research Ethics

The consent of University authorities was sought before the study was conducted on the various campuses. Participants who took part in the study participated voluntarily. Data

was collected with the assistance of two trained students and some few lecturers from the University.

3.3.2 Pre-testing of Questionnaire

Twenty (20) students from the Kumasi campus of the University were used in the pre-test which was conducted for consumers of fruits and vegetables. This was to ensure that the items on the questionnaires had been well understood. It was also to ensure that the necessary modifications were made in order to achieve the research objectives.

3.4 SOURCE OF SECONDARY DATA

3.4.1 Respondents

Out of the entire regular student population of 14788 students in the University, more than fifty percent (50%) were accommodated in self-catering traditional halls of residence and hostels on and around the University campuses. Others also lived in self-acquired apartments and hostels. In this study, however, in self-acquired apartments, students were responsible for providing and cooking their own foods.

3.4.2 Winneba Campus (Winneba)

The overall student population on this campus is 9315(UEW Basic statistics, 2012). The male-female population ratio on this campus is about 1.5:1. The disciplines read on this campus include programmes such as human rights, Graphic design, B.Ed Home economics, B.Ed. Business Administration, Music and Theatre arts, BSc. Science education, BSc.

Mathematics Education, social studies and many other undergraduate and prograduate programmes.

The diversity of programmes on this campus might have accounted for the population ratio on this campus. The Winneba campus is divided into three(3). North campus, Central campus and South campus. The campuses are positioned at about 500m apart from each other. The North campus has canteen which also serves as a market where domestic foods cooked and uncooked are sold to students. This campus has a fruits and vegetables shed where fruits salad is sold. Among the varieties of fruits available to students on this campus are pawpaw, citrus, watermelon, grapes and so many other vegetables.

The Central campus is also located close to the main market of the Winneba Municipality. In-addition to the patronage of foods from the main market in Winneba, students on this campus who reside outside the premises of the University obtained most of their fruits and vegetables from hawkers around the main market. It is obvious that the cost of foods at the main market would differ slightly (cheaper) from those sold on the campus since the hawkers and other retailers are also into business for profit and most of their retailed produce are obtained from the market. The South campus which is of no exception from the other campuses also has a canteen and a micro-market on the campus where fruits and vegetables are sold. Students also patronized foods from vendors of fruits and vegetables and hawkers on weekends. The South campus is the largest of all the campuses with the student population spread across the length and breadth of the Winneba Municipality.

Sources of supply of fruits and vegetables for the market in Winneba include AgonaSwedru, Pomadze, Apam, Kasoa and other nearby towns and farming communities.

The most common economic activities in Winneba include fishing and trading. Traders sold items such as foodstuffs, fruits, vegetables, fish and other fishing related products basically because Winneba is a coastal town.

3.4.3 Ajumako Campus (Ajumako)

The overall student‟s population on this campus was 231. Out of this population, 14 people were randomly sampled for the study. The campus is female dominated with a female-male population ratio was about 2:1 on this campus. Programmes read on this campus include Ewe Education, Akan-Nzema Education and many other language related programmes (UEW, Basic Statistics‟, 2012). Ajumako township is a farming community. Indigenous people in this town are mostly engaged in the cultivation of foods such as maize, cassava, and pineapple and watermelon. The campus has a canteen where fruits and vegetables are sold to students. In addition to the fruits and vegetables sold on the campus. Students patronized fruits and vegetables sold by vendors in and around the University campus. Sited in this town is a community market from which students purchased fruits, vegetables and other items for the preparation of their meals .

3.4.4. Kumasi Campus (Kumasi)

Agriculture production in the Ashanti region has been centered on cocoa as majority of

Ghana‟s cocoa is grown in the region. This is because cocoa production is partly supported by the government through Ghana Cocoa Board. However, an increasing number of farms have diversified their crops by growing maize, palms, pineapples and citrus fruit (KPMG, 2008). The city of Kumasi is renowned for its local enterprise and artisan skills, particularly in the areas of furniture making, wood and leather works and textile production. The entire region has a very significant breadth in its agricultural production which includes cocoa, palm oil and citrus. The Kumasi metropolis is said to be a cosmopolitan in nature due to the combination of its industrial nature with culture and the abundance of natural resources, agricultural products and many more.

The entire population on this campus is about 3440. This is made up of a partially even number of males and females. Out of this population, about 70% are resident in the traditional halls of residence while the rest are non residents but live in self acquired apartments, hostels or rooms which were located at places not far from the campus Closeness of their places of residence gave them the opportunity to make use of all available facilities of the University such as the University library and other privileges like the internet wireless facilities. The population consisted of students reading the following programmes: B.Sc. Technology Education, B.Sc. Management in Education, B.Ed.

Management Studies, BBA. Secretarial Education and other Business related programmes. Technical and vocational education programmes are ran on this campus. (UEW Basic Statistics, 2012)

The data for this location was collected between January 19-29 ,2013. This campus has three (3) major halls traditional of residence. The most populated among these halls is located at about 50 metres from the main entrance of the University. The second most populated hall of residence is located at about 350 metres from the entrance of the University and the third hall which is the least populated is located at about 200 metres from the entrance. The first hall has with a domestic market where foods in the form of cooked dishes, fresh fruits and vegetables and processed fruits such as canned or packaged fruits and vegetables are sold. These products are made accessible to students all day long. The market also receives patronage from students from all other halls of residence apart from where it is sited. It was also observed that students patronized largely fruits and vegetables sold by hawkers during the day. Produce sold included fresh cabbages, lettuce , *kontomire*, carrots, sweet and green peppers and other fruits such as banana, citrus, sliced watermelons, pineapples and apples. Students also patronized foodstuffs from the Tanoso market on weekends since that was the closest big market where they could buy foodstuffs. This is also because produce purchased directly from the market seem to be relatively cheaper compared to produce acquired from other vendors who may be termed as

secondary retailers of the fruits and vegetables as the case was on flea markets as opined by Haynes-Maslow *et al.,* (2011)

3.4.5. Ashanti - Mampong Campus (Ashanti-Mampong)

The campus is located at the outskirts of Ashanti-Mampong Township. It is about seven (7km) from the town. The entire regular students‟ population on this campus was 1802. One third of these students were resident students in the only hall of this campus while the rest

reside in nearby rented apartments and hostels which were about 100-200 metres away from the campus. The disciplines read on this campus included: B.Sc. Agriculture Education; B.Sc. Environmental Science and Sanitation Education; B.Sc. Integrated Science Education and many other science related programmes. The campus is male dominated with a male-female ratio of 4:1(UEW Basic Statistics, 2012). The campus is endowed with a multi-purpose canteen where various processed foods, fresh fruits and vegetables are sold to students. Products and produce within the canteen received patronage from both resident and non-resident students. Students on this campus patronised also goods from the main market in town where the prices of all produce, including fruits and vegetables were relatively cheaper than from hawkers on and around the University campus. A total of three (3) days was used in administering questionnaires and gathering information from this campus during the study. Foods which were regularly sold on this campus included banana, citrus, sliced watermelons, coconuts and pawpaw.

3.5 STATISTICAL ANALYSIS

The Statistical Package for Social Sciences (SPSS) version 16 was used to analyse data collected, compiled and collated from the study. A cross tabulation was done to ascertain the effect of location, gender and programme of study on the selected factors that were considered. A Chi- square test was used to test for the degree of significance. A further test (Post-hoc-test) was conducted to determine the details of the effect. This was done at a 5% level of significance.

4.0 RESULTS

This chapter presents the results obtained from the respondents which comprised of student consumers of fruits and vegetables, producers and retailers. It contains also, results from test of sensory attributes on the selected fruits and vegetables.

4.1 FIELD SURVEY

A total of 400 structured questionnaires were given out to students to complete. Out of this number, the return rate of the completed questionnaire was 65.5%. Two hundred and sixty two (262) student respondents completed the questionnaires. The return rate of the survey of producers and retailers was high since respondents were subjected to an interview with a semi-structured questionnaire (Appendix A 2 and A 3). A baseline data of 10 respondents was set for all four campuses.

4.1.1 Consumers of Fruits and Vegetables

The Winneba campus of the University contributed the largest (51.8%) share of the population. The second largest contributors to the population were students from the Kumasi campus (30.31%). Ashanti- Mampong campus contributed 12.59% of the population and the least of 5.30% were from the Ajumako Campus (Figure 4.1).The percentage gender distribution among respondents indicated that 23.56% females and 28.24% males were chosen from the Winneba campus. The second most populated campus, which was Kumasi campus contributed 12.66% males and 17.65% females of the sample size that was used for the study. Mampong Campus also had a total of 0.76% female and 11.83% males of its population being used for the study. The least population was from the

Ajumako Campus which contributed a total of 5.3% of the sample (3.46 % females and 1.90% Females).

Table. 4.1: Sample distribution on the four campuses by gender

Gender	Winneba	Ajumako	Kumasi	Mampong	Total
Male	74(28.24%)	5(1.90%)	33(12.66%)	31(11.83%)	54.63%
Female	62(23.56%)	9(3.46%)	46(17.65%)	2(0.76%)	45.40%
Total	**51.80%**	**5.30%**	**30.31%**	**12.59%**	**100%**

Programmes in the University were put into three major groups into which all students were categorized; Science, Arts and Humanities. Majority (53%) of the students belonged to the humanities category; which included programmes such as the Business Administration, Social Studies, Languages, Geography and other social related programmes. The second majority (42%) also read sciences which included all pure science courses such as Physics, Chemistry, Biology, Integrated science. The least in number (5%) were students who read the arts related courses such as Sculpture, Painting, Graphic design, Wood art, Music, Performing arts, English, French and the general education programmes (Figure 4.1).

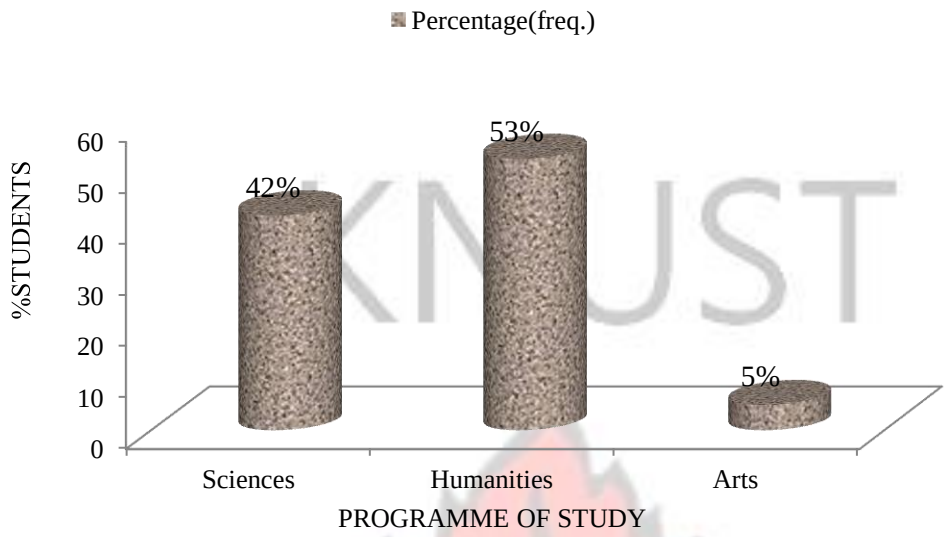
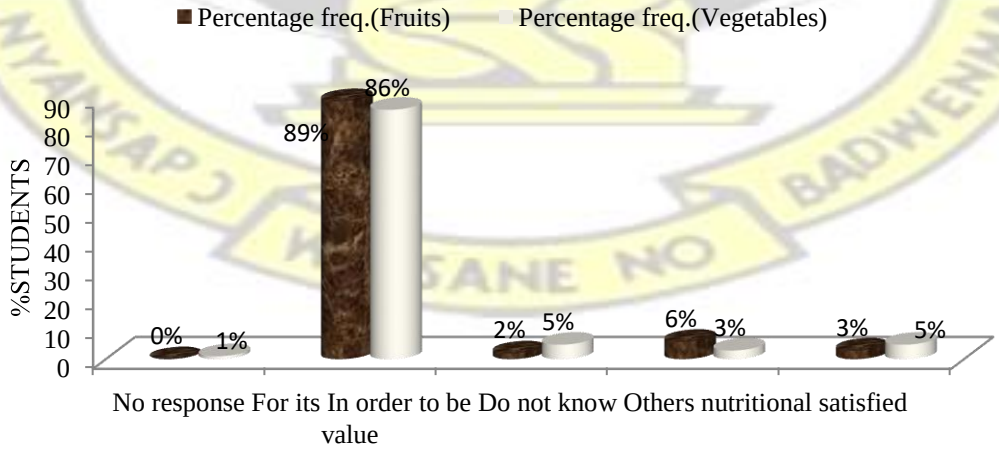


Figure. 4.1: Distribution of the sampled students by their programmes of study.

4.1.2 Knowledge on Consumption of Fruits and Vegetables

Figure 4.4 presents students reasons for the consumption of fruits and vegetables. From the study, majority of the students indicated that fruits and vegetables were consumed for their nutritional purposes (vegetable: 86% and fruits: 89%). Also, fruits (6%) and vegetables (3%) were consumed for no apparent reason and the least did so for satisfaction.



REASONS FOR CONSUMPTION

Figure 4.2: Assessment of knowledge on fruits and vegetables

As indicated in Table 4.3 below, campus location had a significant effect on knowledge about the benefits derived from the consumption of fruits (Std.Res.;3.3.>1.96).

Knowledge of consumption for other benefits was also higher among students on the Ashanti-Mampong campus than all the other campuses. The programme of study, the gender of respondents and the location of campus however had no significant effect on the students knowledge about the benefits of vegetables consumption.

A significant number of students on the Ashanti-Mampong campus had knowledge on the benefits of fruits but was not significant for vegetables [Vegetables (Location) P=0.57>0.05; and; Vegetables (gender), P=0.71>0.05; Fruits (gender), P=1.37>0.05]

Table 4.2: Effect of the location of campus on the knowledge possessed by students on the benefits of fruits (Chi-square test) .

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	23.041(a)	12	**.027**
Likelihood Ratio	25.037	12	.015
Linear-by-Linear Association	.224	1	.636
N of Valid Cases	262		

P=0.027<0.05 (significant effect)

Table 4.3: Effect of the location of campus on the knowledge possessed by respondents on the benefits of fruits (Post-hoc test)

Location	No response	For its nutritional value	In order to be satisfied	Do not Know	Others
Winneba	. 7	-.2	. 5	.6	-.3
Ajumako	-.2	.5	-.6	-.9	-.6
Kumasi	-.5	.4	-13	.5	-1.5
Mampong	-.4	-.4	1.4	-1.4	**3.3**

Std. Res. =3.3>1.96 (Significant effect)

The study showed that gender and programme of study had no significant effect on students‟ knowledge on vegetables consumption p=0.058>0.05; p=0.137 (Appendix C1 and, C2). The programme of study however had a significant effect on the knowledge about fruits consumption (Table 4.4)

Table 4.4: Programme of study on knowledge of fruits consumption (Chi-Square Test) p<0.05 and p=0.047<0.05 (significant effect).

	Value	Df	Asymp. Sig. (2 sided)
Pearson Chi-Square 15.677(a)	**.047** Likelihood Ratio	18.103 8	.020
Linear-by-Linear Association	2.245	1	.134
N of Valid Cases	262		

P=0.047<0.05 (Significant effect)

Consumption of fruits for its nutritional purposes were significantly high among students studying the sciences than those of humanities and arts programmes. A study of the arts and humanities on the contrary had no significant impact on their knowledge.

4.5: Effect of programme of study on the knowledge on fruits consumption (Post-hoc test).

Programme	No response	For its nutritional value	In order to be satisfied	Do not know	Others
Sciences	.9	**2.2**	-.8	.9	.6
Humanities	-.7	.7	-1.8	-1.2	-.4
Arts	-.2	-.2	-.5	1.4	-.6

Std. Res. = 2.2 and 2.2>1.96 (significant effect)

4.1.3 Consumption of Fruits and Vegetable

Figure 4.3 revealed that consumption of fruits and vegetables once and twice daily was common among respondents. The percentage of students that consumed fruits and vegetables decreased with increased frequency by day. Others also indicated their irregular rates of consumption during the study. The highest percentage patronage of fruits and vegetables were 44% and 23% respectively. There was an inverse relationship between consumption and the percentage of students consuming the fruits and vegetables (Figure, 4.3).

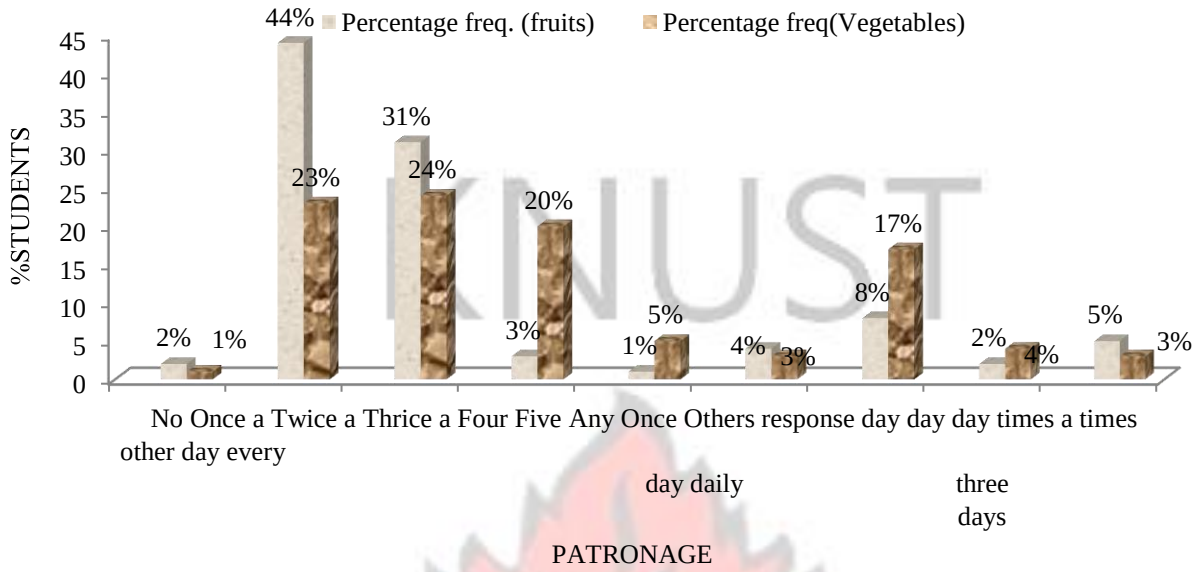


Figure. 4.3: Consumption of fruits and vegetables

Consumption of vegetables was significantly high among respondents on the Kumasi campus. A high number of respondents consumed vegetables four times daily. Consumption of fruits and vegetables twice a day was also high among students on the Ajumako campus (Std. Res. 2.0>1.96). Irregular pattern of consuming fruits and vegetables was also realized among students at the Ajumako. [.P=0.00<0.05; Kumasi, Std. Res.; 2.3>1.96, Mampong 2.4>1.96]. [Tables 4.6 and 4.7] .

Table 4.6: Location of campus and rate of vegetable consumption (Chi-square test) .

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	91.001(a)	24	**.000**
Likelihood Ratio	90.321	24	.000
Linear-by-Linear Association	.124	1	.724
N of Valid Cases	261		

P=.000<0.05 (significant effect)

Table 4.7: Location of campus and rate of vegetables consumption (Post-hoc test).

Location of campus	No response	Once a day	Twice a day	Thrice a day	Four times a day	Five times a day	Any other day	Once every three days	Others
Winneba	.9	.9	-.3	-.5	**-2.5**	1.9	.2	1.4	-1.9
Ajumako	-.3	-1.8	**2.0**	.1	-.8	-.7	-1.5	-.8	**5.9**
Kumasi	-.8	-1.2	1.0	.3	**2.3**	-1.5	.2	-1.8	.6
Mampong	-.5	1.2	-2.1	.5	2.0	-1.0	.2	.5	-.9

Std. Res.=5.9, 2.0,2.3>1.96

Table 4.8 shows that location of campus had a significant effect on how often fruits are consumed by students. A significant number of students on the Kumasi campus indicated that they do not eat fruits regularly (Table 4.9).

Table 4.8: Location of campus on how often fruits are consumed (Chi-square test)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.919(a)	21	**.001**
Likelihood Ratio	61.968	21	.000
Linear-by-Linear Association	.925	1	.336
N of Valid Cases	261		

P=0.001<0.05 (Significant effect)

Table 4.9: Campus location and the rate of fruits and consumption (Post-hoc test).

Campus Location	No response	Once a day	Twice a day	Thrice a day	Four times a day	Any other day	Once every three days	others
Winneba	1.3	.5	**-2.1**	-.3	1.1	1.5	1.9	-.8
Ajumako	-.5	-.5	1.7	-.7	-.4	-.3	-.7	-.9
Kumasi	-1.1	-.4	1.9	.2	-.9	**-2.8**	-1.5	**2.4**
Mampong	-.7	-.1	.2	.8	-.6	1.5	-1.0	-1.3

Std. Res=2.4>1.96

Gender had a significant effect on the consumption patterns of fruits (Table 4.10). A further test revealed that both female and male students did not eat fruits regularly. [Female (fruits), P=0.006<0.05; Std. Res., 2.2>1.96; Vegetables P=0.008; Std. Res., 2.2>1.96].

Table 4.10: Gender and the rate of fruits consumption (Chi-square test)

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	19.983(a)	7	**.006**
Likelihood Ratio	24.517	7	.001
Linear-by-Linear Association	.010	1	.920
N of Valid Cases	261		

P=0.006<0.005 (Significant effect)

Table 4.11: Gender and the rate of fruits consumption (Post-hoc test) .

Gender	**No response**	**Once a day**	**Twice a day**	**Thrice a day**	**Four times a day**	**Five times a day**	**Any other day**	**Once every three days**	Others
Male	.9	-.4	-1.3	1.3	.2	-.2	.8	.8	-2.0
Female	-1.0	.5	1.4	-1.4	-.2	.2	-.9	-.9	**2.2**

Std. Res., 2.2>1.96

Gender had a significant effect on the consumption patterns of vegetables.

Table 4.12: Effect of gender on how often vegetables are consumed (Chi-square test)

	Value	**df**	**Asymp. Sig. (2-sided**
Pearson Chi-Square	20.788(a)	8	**.008**
Likelihood Ratio	24.358	8	.002
Linear-by-Linear Association	.342	1	.559
N of Valid Cases	261		

P=0.08<0.05 (Significant effect)

Consumption of vegetables among females was higher than the males. A significant number of female students consumed vegetables three times daily (Table 4.13).

Table 4.13: Effect of gender on how often vegetables are consumed (Post-hoc test)

Gender	No response	Once a day	Twice a day	Thrice a day	Four times a day	Five times a day	Any other day	Once every three days	Others
Male	.9	-.4	-1.3	1.3	.2	-.2	.8	.8	0
Female	-1.0	.5	1.4	**2.2**	-.2	.2	-.9	-.9	-1.4

Std. Res.=2.2>1.96(Significant effect)

The programme of study also influenced consumption significantly (Table 4.14). It was observed that a significant number of arts students consumed vegetables thrice daily. A significant number of Science students also consumed vegetables once every day. A high number of Arts students surprisingly consumed vegetables thrice daily (Table 4.15).

Table 4.14: Programme of study and rate of vegetables consumption (Chi-square test)

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.146(a)	16	**.005**
Likelihood Ratio	39.464	16	.001
Linear-by-Linear Association	.859	1	.354
N of Valid Cases	261		

p=0.005<0.05 (Significant effect)

Table 4.15: Programme of study and rate of vegetables consumption among students (Post-hoc test)

Programmes	**No response**	**Once a day**	**Twice a day**	**Thrice a day**	**Four times a day**	**Five times a day**	**Any other day**	**Once every three days**	**Others**
Sciences	-.9	**2.0**	-.5	-1.1	-.5	1.4	-.4	.6	-1.7
Humanities	.9	**-2.2**	.5	.9	.7	-1.1	.8	-1.2	1.7
Arts	-.3	1.1	-.1	**2.0**	.2	-.6	-1.5	-.8	-.6

Std. Res. =2.0>1.96

The programme of study had a significant effect on the rate of fruit consumption among students (Table 4.16).

Table 4.16: Programme of study and rate of fruits consumption among students (Chisquare test)

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	92.571(a)	14	**.000**
Likelihood Ratio	51.203	14	.000
Linear-by-Linear Association	.378	1	.539
N of Valid Cases	261		

P=0.00<0.005 (significant effect)

Consumption of fruits was high among students offering arts related programmes. Majority of them consumed fruits four times daily (Table 4.17).

Table 4.17: Programme of study and rate of fruits consumption among students (Post-hoc test).

Programme	No response	Once a day	Twice a day	Thrice a day	Four times a day	Any other day	Once every three days	Others
Sciences	-1.3	.4	.1	-.9	-1.1	.6	1.4	-1.2
Humanities	-.1	-.6	.6	1.0	-1.3	-.2	-1.1	1.3
Arts	4.0	.9	-2.0	-.7	**7.4**	-1.1	-.6	-.8

Std. Res.=7.4>1.96

4.1.3.1 Consumption of indigenous fruits and exotic on the various campuses

Consumption of indigenous fruits on the campuses was in the following decreasing order: (a) Kumasi campus, (b) Mampong campus, (c) Ajumako campus and (d) Winneba campus. The location of campus had no significant effect on consumption. Location had significant effects on the patronage of fruity vegetables, tuber vegetables, and bulb vegetables (Indigenous fruits (p=0.00<0.05; Std. Res.; Ajumako campus, 5.6>1.96;

Kumasi Campus, 3.2>1.96; and Mampong campus, 2.0>1.96; Exotic fruits=0.229 P>0.05).

Table 4.18: Location of campus and consumption of indigenous fruits (Chi-square test)

	Value	Df	Asymp. Sig. (2 sided)
Pearson Chi-Square	74.154(a)	15	**.000**
Likelihood Ratio	70.005	15	.000
Linear-by-Linear Association	3.935	1	.047
N of Valid Cases	262		

P=0.00<0.05 (Significant effect)

Table 4.19: Location of campus and the consumption of indigenous fruits (Post-hoc test)

Location	Non	1	2	3	4	5
Winneba	.7	.6	.0	.8	.6	-1.7
Ajumako	-.2	**5.6**	-1.4	-.1	**-2.1**	.7
Kumasi	-.5	-2.2	.3	-2.3	-.2	**3.2**
Mampong	-.4	-1.4	.6	**2.0**	.3	**-2.0**

Std. Res.= 5.6, 3.2>1.96

4.1.3.2 Consumption of different types of vegetables

Consumption of leafy vegetables was predominant among students on the Kumasi campus. They were observed to consume high quantities of leafy vegetables than all the other campuses (p=0.00 <0.05, Std. Res.; 4.2>1.96).

The location of campuses had a significant effect on the consumption of root vegetables Students on the Winneba and Ajumako campuses consumed a significantly high quantity of these vegetables than the others (P=0.004<0.05 Std. Res; (Winneba, 2.2>1.96; Ajumako Campus 2.2>1.96).The location of campus had a significant effect on the patronage of fruity vegetable in Ajumako, Kumasi and Mampong campuses where their patronage were significant (p=0.00, 0.05 and Std. Res., 2.4, 2.1, 2.4>1.96 (Appendix C5). Consumption of bulb vegetables were also significantly high on the Mampong campus but insignificant on the other campuses (p=0.00<0.05 and Std. Res.; 3.3>1.96). Patronage of tuber vegetables was also significantly high among students on the Winneba campus than all the other campuses (Appendix C8 and C9, P=0.01<0.05 Std. 2.1>1.96

(Appendices C4, C5, C6, C7, C8).

4.1.3.3 Influence of the physical attributes on consumption of fruits

The most influencing factor among respondents from all the satellite campuses on the patronage of fruits and vegetables was the taste of the produce. In a decreasing order of taste on preference was 56% for fruits and 41% for vegetables. The texture of fruits and vegetables also was also influential to the consumption (30% for fruits, 16% for vegetables). The last and the least

influential factors to patronise fruits and vegetables included aroma and storage period (Figure 4.4).

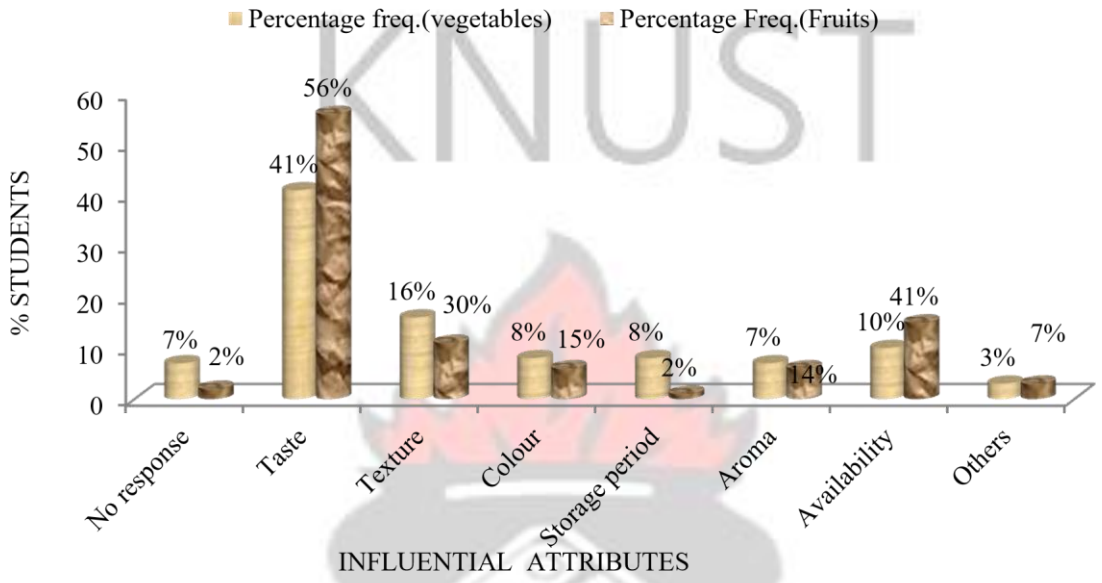


Figure 4.4: Extent to which selected attributes influenced patronage of fruits and vegetables.

4.1.4 Handling of Fruits and Vegetables

4.1.4.1 Storage of fruits and vegetables

From Figure 4.5, the most predominant method of storage employed by students was the use of refrigerators (fruits (28%) and vegetables (45%). Majority (a total of 49%) did not either store or use other unnamed means of extending the shelf life of produce. Some respondents also employed other means such as storage in baskets, on shelves and on the floor (Figure 4.9).

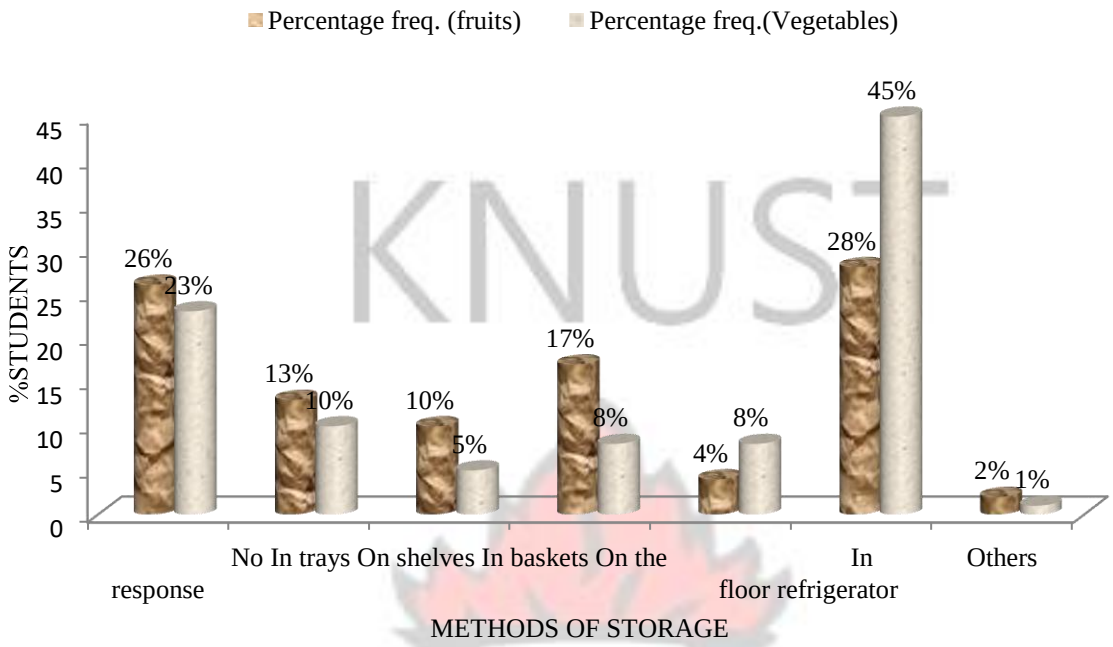


Figure 4.5: Storage methods employed by students in their storage of fruits and vegetables.

The location of campus had a significant effect on the storage method used by students (Table 4.20). A significant number of students on the Winneba Campus gave no response to this. A high number of students on the Ajumako campus stored their fruits by keeping them on the floor. Storage in the refrigerator was also predominant among students on the Kumasi and Ajumako campuses (Table 4.21) (p=0.00>0.005, Std. Res.; Winneba, 2.4>1.96, Ajumako, 3.1>1.96, Mampong, 2.5>1.96).

Table 4.20: Campus location and how fruits are stored (Chi-square test)

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	75.316(a)	18	**.000**
Likelihood Ratio	88.274	18	.000
Linear-by-Linear Association	6.149	1	.013
N of Valid Cases	261		

P=0.00<0.05(Significant effect)

Table 4.21: Campus location and how fruits are stored (Post-hoc test)

Campus Location	No response	In trays	On shelves	In baskets	On the floor	In refrigerator	Others
Winneba	**2.4**	-.8	-.7	-1.7	**-2.0**	.2	1.6
Ajumako	-1.9	.9	**3.1**	-1.5	-.8	1.0	-.6
Kumasi	-.5	1.6	-.3	-2.4	1.5	**2.2**	-1.3
Mampong	**-2.9**	-1.6	-.2	1.0	2.2	**2.5**	-.9

Std. Res.= 2.4,3.1,2.2,2.5>1.96

The location of campus also had effect on the storage method used by students for vegetables. A significant number of students stored their vegetables by resorting to other means not named on the Ajumako campus; and students stored vegetables on the floor on the Kumasi campus as indicated in (Tables 4.22 and 4.23)

Table 4.22: Effect of location on how vegetables are stored (Chi-Square Tests)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.272(a)	18	**.035**
Likelihood Ratio	32.573	18	.019
Linear-by-Linear Association	.886	1	.347
N of Valid Cases	261		

P=0.035<0.05 (Significant effect)

Table 4.23: Campus location and how vegetables are stored (Post-hoc test)

Campus location	No response	In trays	On shelves	In basket	On the floor	In refrigerator	Others
Winneba	1.3	-.1	-.1	.5	**-2.0**	-.3	.3
Ajumako	-.2	-1.2	-.8	-1.0	-.1	1.0	**2.1**
Kumasi	-1.7	.4	.7	-1.2	**2.1**	.6	-.9
Mampong	.1	.4	-.4	1.6	.9	-1.0	-.6

Std. Res.=2.1>1.96

As shown in Tables 4.24 and 4.25, gender of respondents had a significant effect on how students stored fruits. It was revealed from the study, that male students usually did not adopt one particular method of storage. Their storage methods were dependent on the type of fruits under consideration. Gender, however, had no effect on the storage of vegetables.

The gender of respondents had a significant effect on the storage method employed by Students (Table 4.26) .

Table 4.24: Gender of students and how fruits are stored (Chi-square test) .

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	13.220(a)	6	**.040**
Likelihood Ratio	15.531	6	.017
Linear-by-Linear Association	6.179	1	.013
N of Valid Cases	261		

P=0.040<0.05 (Significant effect)

A significant number of the male students used other means of storage rather than the listed storage methods (Table 4.26).

Table 4.25: Effect of the gender of respondents on how fruits are stored (Post-hoc test)

Gender	No response	In trays	On shelves	In baskets	On the floor -.8	In refrigerator	Others
Male	-1.1	-.5	-.3	1.0		.7	**2.5**
Female	1.2	.5	.4	**-2.1**	.9	-.8	-1.6

Std. Res.2.5>1.96

The programme of study of students had a significant effect on the method of storage used by students (Table 4.26).

Table 4.26: Effect of the programme of study on the storage method employed for fruits (Chi-square test)

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	26.045(a)	12	**.011**
Likelihood Ratio	32.136	12	.001
Linear-by-Linear Association	12.209	1	.000
N of Valid Cases	261		

P=0.011>0.05 (Significant effect)

As indicated in Table 4.27, a significant number of science students used other methods not named in the study for storing fruits on some occasions. On other occasions, these methods were not used at all. The programme of study however, had no effect in the storage of vegetables.

Table 4.27: programme of study and storage method employed for fruits (Post-hoc test)

Programme	**No response**	**In trays**	**On shelves**	**In baskets**	**On the floor**	**In refrigerator**	**Others**
Sciences	-1.7	-.8	.3	-.1	-.3	1.6	**2.2**
Humanities	1.1	.6	.1	.6	.5	-1.6	-1.8
Arts	1.5	.3	-1.1	-1.5	-.7	.7	-.5

Std. Res.= 2.2>1.96

4.1.4.2 Conveying of fruits and vegetables

The study showed that, the predominant means of conveying fruits and vegetables among respondents from all four campuses was by the use of polythene bags (53%). Others also used baskets (19%), jute sacs (18%) while the least number of students (2%) conveyed fruits and vegetables in hand.

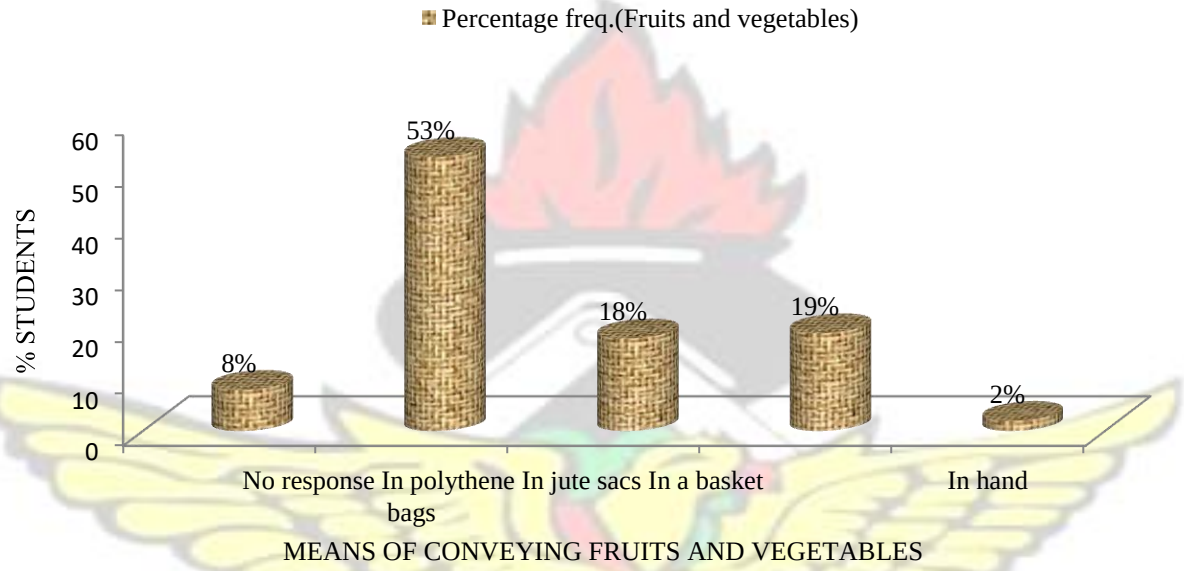


Figure. 4.6: Fruits and vegetables conveyance among students.

As in indicated in Table 4.29, the use of baskets and jute sacs in conveying produce was significantly low among students on the Winneba campus and the Kumasi campus respectively. Conveying fruits and vegetables in baskets was high on Kumasi and Mampong campuses (P=.00<0.05; Std. Res.; 3.8>1.96).

Table 4.28: Effect of location of campus on how fruits and vegetables are conveyed (Chisquare test).

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	48.851(a)	12	**.000**
Likelihood Ratio	51.602	12	.000
Linear-by-Linear Association	5.914	1	.015
N of Valid Cases	261		

P=0.00<0.05 (Significant effect)

Table 4.29: Location of campus and how fruits and vegetables are conveyed (Post- hoc test).

Location	**No response**	**In polythene bags**	**In jute sacs**	**In a basket**	**In hand**
Winneba	.2	.5	1.8	**-2.7**	-.1
Ajumako	-.1	1.0	-.4	-1.6	1.2
Kumasi	-1.6	.0	**-2.2**	**3.8**	-1.3
Mampong	7	-1.5	.0	**2.2**.	1.4

Std. Res. = 3.8 >1.97

Gender had an effect on the method of conveying produce after buying. Male students mostly conveyed fruits and vegetables by the use of polythene bags (Table 4.31). The programme of study of students had no effect on the method used by students to convey fruits and vegetables to their respective places of residence. (P>0.05, Not significant).

Table 4.30. Gender of students on how produce are conveyed (Chi-Square Tests)

		Df	Asymp. Sig. (2-sided)	Value
		4		
Pearson Chi-Square	23.765(a)		**.000**	
Likelihood Ratio	26.011	4	.000	
Linear-by-Linear Association	1.718	1	.190	
N of Valid Cases	261			

P=0.00<0.00 (significant effect)

Table 4.31 Gender of students and how fruits and vegetables are conveyed

Gender	**No response**	**In polythene bags**	**In jute sacs**	**In a basket**	**In hand**
Male	1.3	**2.1**	-1.0	1.6	.9
Female	**-2.3**	1.5	1.1	-1.7	-1.0

Std. Res. = 2.1>1.96

4.1.5 Losses in Fruits and Vegetables

As indicated in Figure 4.7, the study showed that 10% of the fruits and vegetables were rendered unuseable (loss) among a total of 45% of respondents (Fruits consumers ,25%;Vegtables consumers, 20%). Twenty percent (20%) losses was also recorded among thirty five percent (Fruits:35%) and thirty six percent (Vegetable: 36%) of the students in their daily use of vegetables and fruits.

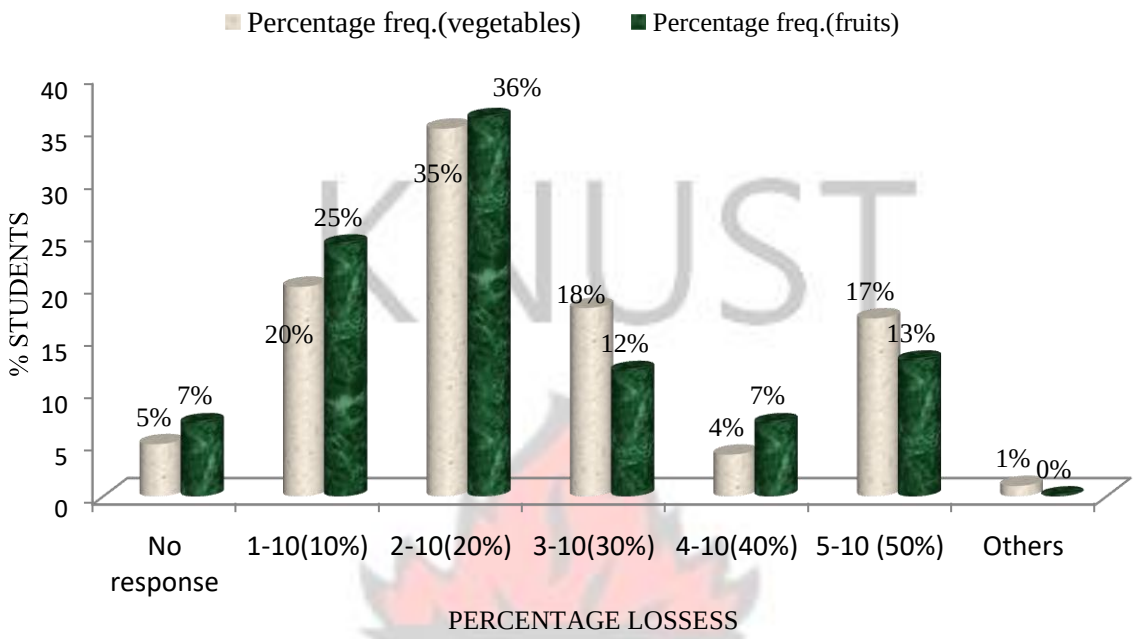


Figure 4.7:Lossess of fruits and vegetables

The study revealed that campus location influenced the quantity of losses in vegetables but did not affect the losses that occurred in fruits. A significant number of students on the Kumasi and Ajumako campuses indicated losses of 20% and 10% respectively. The location of campus had no effect on the losses recorded in fruits.

Table 4.32: Location of campus on the percentage losses in vegetables (Chi-square test) .

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	39.202(a)	18	**.003**
Linear-by-Linear Association	.195	1	.659
N of Valid Cases	261		

P=0.003<0.05 (significant effect)

Table 4.33: Location of campus and the percentage losses in vegetables (Post-hoc test) Vegetables

Location	No response	1-10(10%)	2-10(20%)	3-10(40%)	4-10(40%)	5-10 (50%)	Others
Winneba	.9	-1.8	.2	.3	.6	.7	.9
Ajumako	.4	-1.1	1.9	-1.6	.6	-.2	-.3
Kumasi	-.3	-2.0	**2.5**	.7	-1.7	-.9	-.8
Mampong	-1.2	**2.0**	-1.3	-.4	1.5	.2	-.5

Std. Res. = 2.5, 2.0>1.96

The programme of study of students had a significant effect on the losses in vegetables (Table 4.34). It was recorded that, 10% of the losses for arts students arose from student"s postharvest management of fruits and vegetables. It however had no effect on the losses of fruits recorded (Table 4.35). The gender of students had no effect on the losses in fruits and vegetables that were recorded.

Table 4.34: Programme of study on the percentage of vegetables that are loss (Chi-square test)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.396(a	12	**.045**
Likelihood Ratio	24.230	12	.019
Linear-by-Linear Association	.469	1	.493
N of Valid Cases	261		

P=0.045<0.05 (significant effect)

Table 4.35: Programme of study and the percentage of vegetables that are loss (Post-hoc test)

	No response	1-10(10%)	2-10(20%)	3-10(30%)	4-10(40%)	5-10 (50%)	Others
Sciences	-1.4	.1	1.1	-.1	.4	-.8	-.9
Humanities	1.5	-.7	-.6	.5	-.1	.2	.9
Arts	-.8	**2.0**	-1.2	-1.5	-.7	1.9	-.3

Std. Res. =2.0>1.96

4.1.5.1 Stages at which losses of fruits and vegetables occur

Losses of fruits and vegetables in transit and storage were observed to be the stage at which the highest losses in fruits and vegetables occurred among students. These were followed with losses during the stages of processing, packaging and packing in a descending order (Figure 4.11).

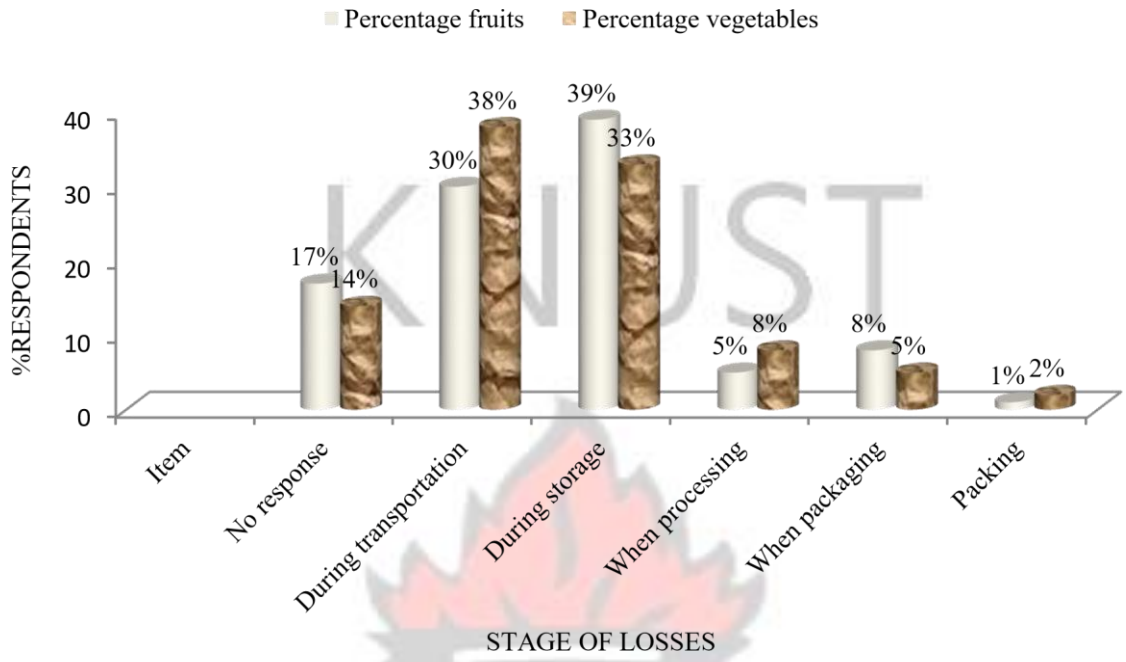


Figure: 4.8 Stages at which losses occurred in postharvest handling of fruits and vegetables.

4.1.6 Producers and Retailers of Fruits and Vegetables

4.1.6.1 Producers of fruits and vegetables

A total of 38 respondents were chosen from the four study areas. The main occupation of these producers was farming. 87% of the producers being solely farmers while the others traded in addition to farming. A survey of producers during the study revealed that majority of the producers of fruits and vegetables were males (Table 4.35).

Table 4.36: Gender and main occupation of producers

Occupation	Males	Females
Farmers	86.20% (25)	88.80% (8)

Traders	13.8% (4)	11.20% (1)
Total	**100**	**100**

The distribution of ages of the producers were as follows: 35% were above age 51, 29% were between the ages of 46-50years, 18% were aged between 41-45 years, while the remaining producers were distributed across the following range of years: 26-30,3135,36-40 at a percentage of six (6%) each (Table 4.36).

Table 4.37: Age of producers.

Ages of producers	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	**51 yrs and above**
Percentage of Producers	6%	6%	6%	18%	29%	35%

A high percentage of people who patronized produce from the producers were consumers (59%). The second highest group of people who patronised the produce were retailers of fruits and vegetables (35%). The least (6%) were producers who could not tell whether they were retailers or consumers and others who patronised fruits and vegetables for sale in the immediate future (Figure 4.9).

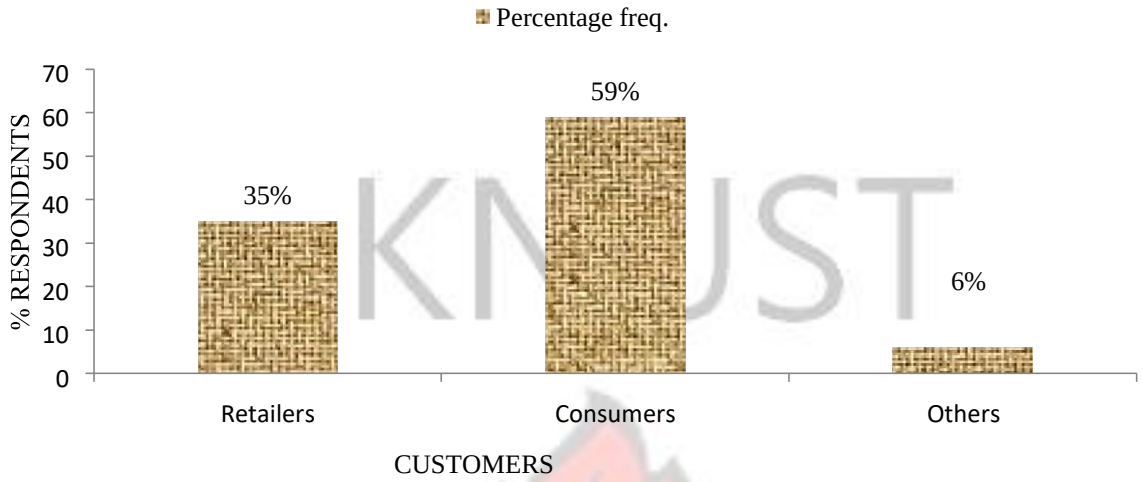


Figure 4.9: People who patronised fruits and vegetables from producers

Challenges to the production of fruits and vegetables among producers included unavailable market for produce (12%) and inadequate land and labour for the production of fruits and vegetables(35%). Other factors (41%) also affected the production of these commodities (Figure 4.10).

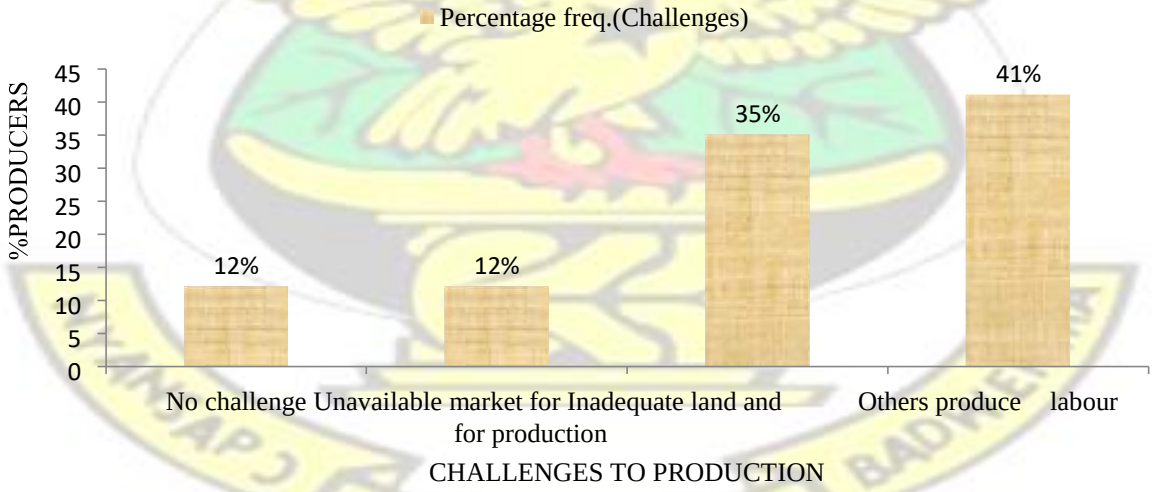


Figure 4.10: Challenges in the production of vegetables and fruits

4.1.6.2 Retailers of fruits and vegetables

As indicated in Table 4.38, majority (87.9%) of retailers of fruits and vegetables were females and males accounted for 12.1%. Majority (76%) of the respondents sold only fruits and vegetables. Some (9.0%) of the respondents combined fishing and trading. Others (8.7%) of the retailers were also made up of people who were neither traders nor farmers but traded in fruits and vegetables occasionally. Other respondents (6.3%) also produced and traded in fruits and vegetables (Table 4.38).

Table 4.38: Gender and main occupation of retailers

Occupation	**Trading Only**	**Trading and farming**	**Trading and fishing**	**Others**	**Total**
Males	2.0%	4.0%	2.0%	4.1%	**12.1%**
Females	74.0%	2.3%	7.0%	4.6%	**87.9%**
Total	**76.0 %**	**6.3%**	**9.0%**	**8.7%**	**100%**

Table 4.39: Ages of respondent retailers

Ages	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**46-50**	**51 years and above**
Percentage Retailers	6%	13%	16%	23%	23%	6%	13%

Prior to selling, the study revealed that majority(29%) of retailers stored their produce by keeping them on the floor. Twenty six percent(26%) of them did not store at all, while 22%

of the retailers stored their produce in baskets. Thirteen percent (13%) of the retailers did not have any definite means of storage but varied their methods of storage depending on the produce they purchased.

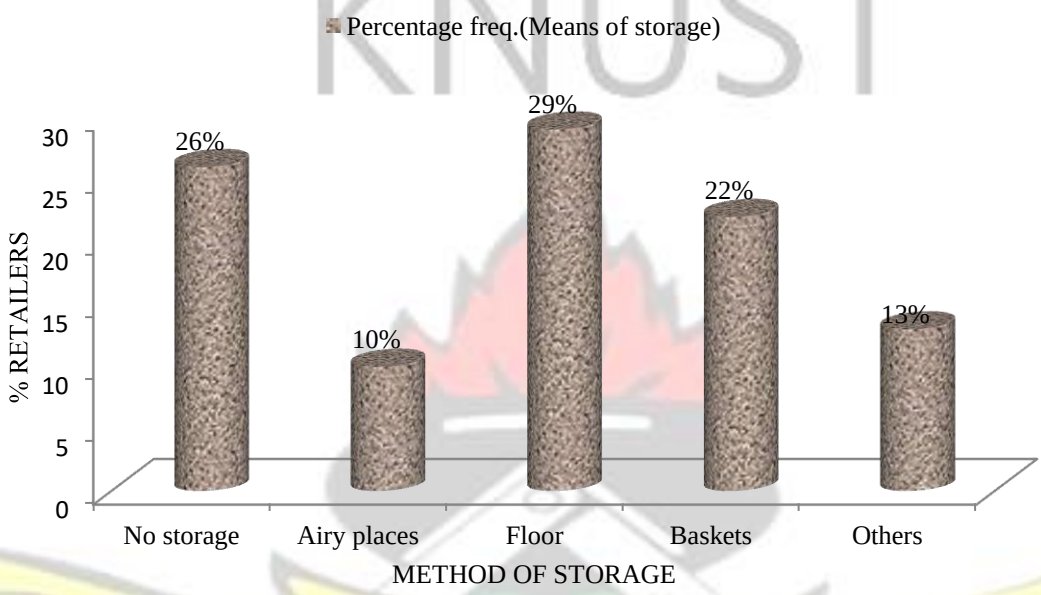


Figure 4.11: Means of storage of fruits and vegetables by retailers

The major challenge to retailers of fruits and vegetables was the crushing of fruits in transit(48%). The next was rotting of produce during transit(23%). Though a third category(17%) of traders had no challenge, a few of them indicated other reasons such as inadequate storage space, disease and pest infestation, high cost of transportation among other reasons(Figure 4.12).

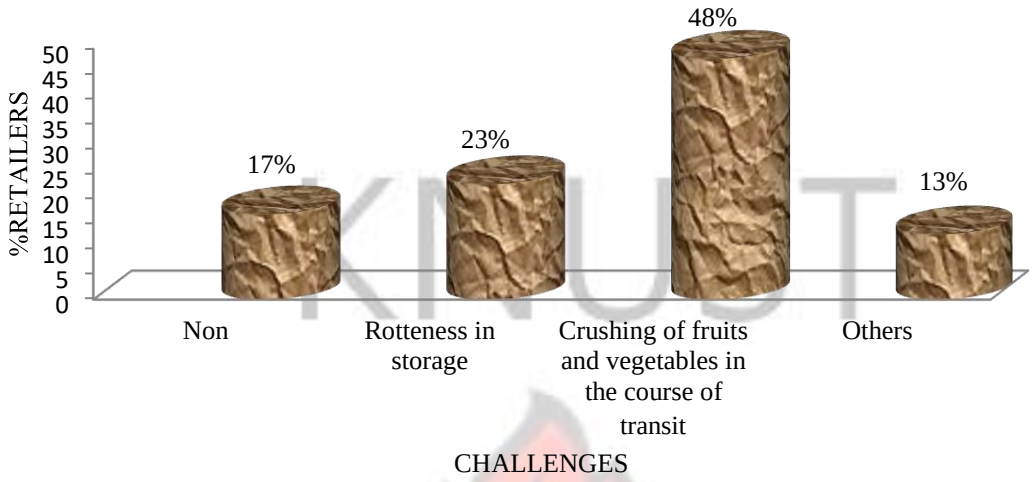


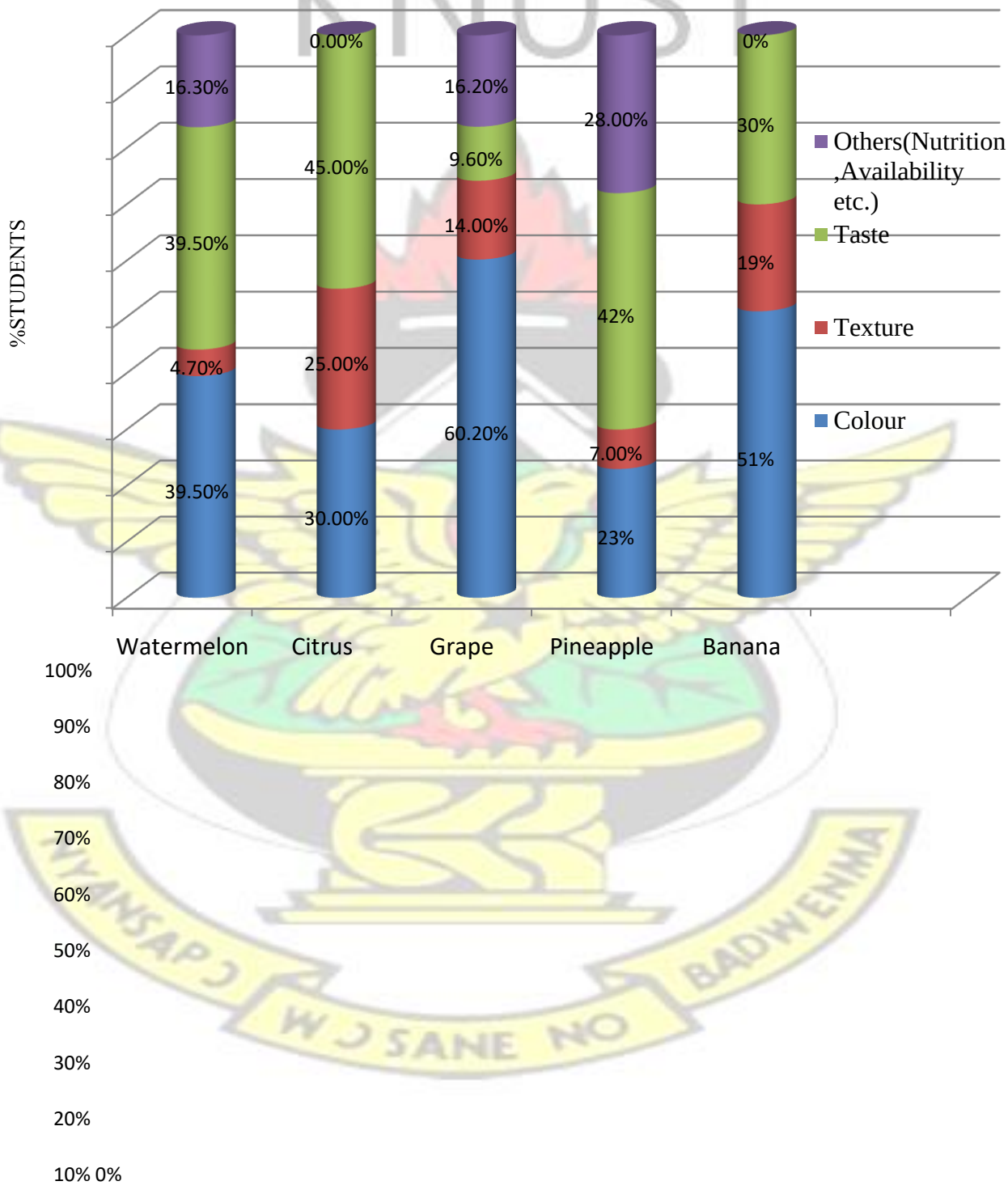
Figure 4.12: Challenges of retailers of fruits and vegetables.

4.2 SENSORY ATTRIBUTE TEST

4.2.1 Sensory Attributes Test on Fruits

A test of sensory attributes was conducted to determine the most influential physical attributes on the patronage of some selected fruits and vegetables. A total of 43 students were selected from the four campuses for this phase of the study. Selected fruits and vegetables subjected to varying levels of ripeness and maturity were set up for students to willingly choose from. An assessment sheet on this exercise was given out to students to complete after their choices had been made from the available fruits and vegetables (Appendix B1 and B2).The attributes considered were as follows: (a).Colour, (b)Texture and (c) Taste; Watermelon: colour (39.5%), taste (39.5%), Texture (4.7%). Citrus; colour (30%), taste (45%), texture (25%) ; Grape: Colour (60.40%), taste (9.6%), texture (14.00%);other factors (nutritional values and beliefs) 16.20%; Pineapple: colour

(23%),Taste (42%), texture (7%). other factors(Norms, nutrition, beliefs) (28%) and Banana: colour (51%), taste (30%) and texture (19%) (Figure 4.13). From the study, the most influencing factor in the patronage of the selected fruits was as follows:



SELECTED FRUITS

Figure 4.13: Effect of physical attributes on the patronage of selected fruits

4.2.2 Sensory Attributes Test on Vegetables

Colour influenced 9.3% of the respondents to patronise vegetables. Another percentage (48.9%) was also influenced by the taste of onion. Texture also influenced 9.3% of the students. Other factors such as availability, nutritional values and other non sensory attributes influenced 37.20% of the students onto its consumption (Figure 4.14).Influential attributes for tomatoes were also as follows: colour (74.41%), taste (6.99%). Texture (9.3%) and other non sensory attributes which include availability, nutrition, satisfaction and societal beliefs (9.3%) . The influential attributes to the consumption of carrots among students were as follows: Colour, (25.4%), 27.9% of the students were also influenced by the taste of carrots. The texture of carrots influenced 18.8% of the students and 27.9% were also influenced by other non sensory factors such as nutrition, societal norms, cost and availability. From the test of sensory attributes, 9.3% of the students were influenced by the colour of potatoes. Taste influenced the highest percentage of students (62.8%) for the consumption of potatoes. Another percentage thus, 9.3% was influenced by the texture of potatoes. Factors such as the nutritional benefits, availability and other non-sensory attribute also influenced 18.60% of the students. The taste of cabbage was the most influential attribute to students‟ patronage of cabbage. Attributes that influenced patronage were as follows: colour, 39.52%, Taste-39.53%, Texture-7.00% and other non sensory attributes such as

nutritional benefits obtained, availability influenced 13.95% of the students (Figure 4.14).

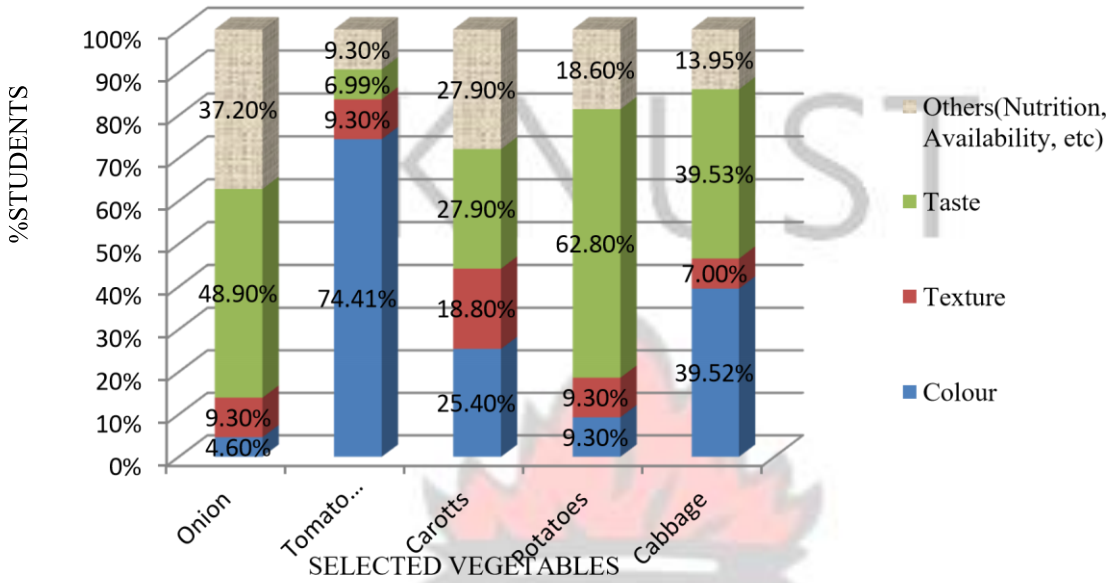


Figure. 4.14: Effect of physical attributes on the patronage of selected vegetables.

5.0 DISCUSSION OF RESULTS

5.1 SURVEY

5.1.1 Background Information on Students, Producers, Consumers and Retailers of Fruits and Vegetables

From results obtained, it can be deduced that consumption of fruits and vegetables is not peculiar to people of a particular gender. This was because the gender distribution among respondents did not conform to any specific pattern or a specific gender. However, in terms of production and retailing of produce, the population was male dominated for production and female dominated for retailing of fruits and vegetables. This is to the advantage of the female gender considering the assertion by Codjoe (2009) that women are more likely to face production related challenges such as labour, farm equipments, technical assistant and information. Few women going into agriculture may also be due to their responsibilities in a typical rural setting. They would prefer to produce on subsistence scale for household

consumption, since they usually assume the responsibility of taking care of their household without any support from the men (vanVuuren, 2000)

5.1.2: Knowledge of Students on Fruits and Vegetables

Students expressed knowledge of the health benefits derived from fruits and vegetables. Some stated that they consumed fruits and vegetables for other reasons such as health and curative purposes which confirmed the report by Ruel *et al*., (2004). The opinion of students about this is in line with the assertion of Norman (1992) that fruits and vegetables are consumed for nutritional purposes.

In a general sense, the programme of study could influence the knowledge possessed by respondents on fruits and vegetables consumption. The study however revealed that it had no significant effect on their knowledge about fruits and vegetables consumption. Location had no significant effect on the knowledge about the consumption of vegetables. This could be because notwithstanding the geographical location, vegetables were usually consumed as part of prepared dishes and could not be avoided under any circumstance in meal preparation. The knowledge of the use of fruits was however different since students are expected to make conscious effort to obtain not withstanding their geographical location. Consumption of vegetables as complete dishes was rare, except under exceptional circumstances where consumers resorted to patronising fruits and vegetables salad as recorded among students on the Winneba campus.

Respondents also showed preference for fruits in the form of juices and drinks or snacks which were made readily available to consumers no matter their geographical location and the time of the day. It could be inferred that knowledge on consumption might also have been obtained from other sources rather than their programmes of study at the tertiary level, since their programmes of study at the tertiary level showed no effect on their consumption. Knowledge of students might have been obtained from other sources and levels of their education especially at the basic or second cycle schools they attended, the media or through non-formal education hence the ability of their tertiary education programme to influence their consumption.

5.1.3 Consumption of Fruits and Vegetables

As the income of the respondents increased, their demand for fruits and vegetables also increased. Consumption patterns may depend partly on the the socio-economic status of the consumer and his ability to monitor his behaviour (Quisumbing, 1995). It was however observed to be significantly low among students on the Winneba campus. This could be associated with the cost involved in the acquisition of vegetables, usually for food preparation on the Winneba campus.

Comparing the most predominant economic activities in Winneba (a coastal town) in the Central region which is known to be the fifth poorest region in Ghana as opined by Kuwornu *et al.*(2011), to Kumasi and Ashanti-Mampong which are both forest areas and farming communities with Kumasi serving as a market centre and a regional capital(KPMG,2008), the cost and availability of fruits and vegetables are better and quite affordable to students than in Winneba. This might have led to the relatively high rate of

consumption on the Kumasi and Mampong campuses for fruits. These findings are similar to the findings of Liu (2003) who asserted that location plays a significant role in the patronage of fruits and vegetables.

Students adopted irregular consumption patterns for fruits instead of conforming to the normal dietary recommendation of 80g of five servings of fruits and vegetables as opined by Anderson *et al*. (2005). This could be as a result of low educational knowledge on the required quantity that ought to be consumed. From the results, majority of the students consumed vegetables three times daily (Table 4.15). This consumption rate could be motivated by the state and the mode of consumption of vegetables in Ghana. Vegetables are usually served with dishes as stew; hence a high rate of consumption since every meal was consumed with a vegetable stew or soup.

Patronage of vegetables among male students was insignificant compared to the female students. Consumption of fruits did not follow regular patterns among female students. Most female students consumed vegetables three times daily (Std. Res. 2.2>1.96) (Table 4.13). This could also be attributed to the average number of meals consumed by the average Ghanaian and what goes into the preparation of the dishes. Consumption in general among female students was higher than in males. This pattern can be likened to the assertion by Lock *et al.* (2005); that the average fruits and vegetables intake among men is 349g/day for male and 358g/day for females.

It is presumed that since most vegetables are used during the preparation of dishes, lack of adequate cooking skills among students could increase their preference for convenience

foods or food away from home (European Food Information Council, 2005), that is, canned and or processed foods instead of fresh fruits and vegetables. Even though consumption at four times daily is presumed to be close to the expected five servings daily, it was uncertain whether they were consumed in their right quantities; that is 80g per-serving or not.

One would presume that, the knowledge of students in the use and benefits derived from fruits and vegetables consumption could affect their daily consumption but the study proved otherwise with convenience being an important factor considered in making purchasing decisions (Chou *et al.,* 2002). Students offering arts programmes recorded a significantly high rate of consumption compared to the sciences. This could be attributed to the busy schedule of science students in the tertiary institutions (Hyanes- Maslow *et al.,* 2012). This finding is similar to that of Rubina *et al*. (2009) in his study of fruits and vegetables consumption among medical students. He found out that, although students had sufficient knowledge on fruits and vegetables consumption, they failed to put the knowledge into practice by consuming more of it. The low consumption rate could also be attributed to the stressful nature of University life and the load in the study of medical sciences (Mikolajczyk and Ansari, 2009) for which other science related programmes are no exceptions. Their consumption pattern may also be a behavioural consequences of stress from their schedule as opined by Adam and Epel (2007). It could also be that, science students unlike students studying the arts and humanities did not consume enough quantities due to the fear of contamination from pesticides and inorganic chemicals used in the control of diseases and pests for which they are presumed to be more knowledgeable about.

Students could also be influenced by culture since food consumption is cultural (Barthes, 1997). The patronage patterns of students could also be navigated towards the fruits and vegetables consumption behaviours of their parents or guardians (Schroeter, House and Lorence, 2007). Another possibly influential factor is that, respondents who were raised in urban environments may also have an increased ability to consume certain fruits and vegetables more than those raised up in rural environments. Food purchases are mainly influenced by taste, cost, and convenience, with health assuming a subsidiary role (Drenowski and Levine, 2003). Proximity and visibility or availability may also serve as influential factors (Gregory and Heather, 2012). It is therefore necessary that adequate measures are put in place to ensure that students consume the expected quantity irrespective of their programmes of study.

5.1.3.1 Consumption of indigenous and exotic fruits

There were however, no significant differences among students on the various campuses in the patronage of exotic fruits. It could be inferred from the study that location of campuses had no effect on the consumption of exotic fruits since place of production does not play any significant role in consumption at the various geographical locations in the country. A typical example is apples (*Malus domestica*) which could be due to fact that, they are imported and made available or unavailable no matter the geographical location of the consumer. Locke *et al*. (2005) reported that the average fruits and vegetables consumption among females is higher than that of males and exotic fruits are also part of the fruits under consideration. Consumption of indigenous fruits and vegetables was exceptionally high on the Ajumako, Mampong and Winneba campuses. It could also be

inferred that consumption is largely based on the availability of the produce. It is deemed imperative that students would consume what is readily available and accessible to them since locations such as Ajumako, Mampong and Kumasi are farming communities. This findings mirrors the findings of Haynes-Maslow *et al*. (2011) and Leone *et al*.(2012) that consumers usually prefer fruits and vegetables that are locally produced and easy to access. Indigenous fruits included fruits such avocado pear , mango (*Mangnifera indica*) and sour sap (*Annona muricata*).

5.1.3.2 Consumption of vegetables

Consumption of leafy vegetables was high on the Ashanti-Mampong campus. It may be construed that, student‟s patronage of leafy vegetables could be as a result of its availability and manageable cost to students on this campus (Jamy *et al*., 2006). It could also be inferred from the study that students had easy access to produce such as *Kontomire,* lettuce, cabbage and many others (from retailers of the produce) on the University campus (Table 3.2). Patronage of tuber vegetables such as sweet potatoes was high on the Winneba and Kumasi campuses. This could be as a result of the availability of the root vegetables retailers on these campuses.

Student consumers on Mampong, Kumasi and Ajumako campuses had special preference for fruity vegetables than Winneba. This could be attributed to the community type and the predominant economic activity in these localities. KPMG (2008) asserts that, the Ashanti Region, with Kumasi as the capital, is a metropolitan assembly and the entire region has a

significant breadth in Agricultural production. More so, availability and affordability play a much influential role in the selection of vegetables among students as opined by Aimee (2002). Patronage of bulb vegetables among students on the AshantiMampong campus was significantly high compared to the other campuses. This could be attributed to the source of production and its availability in the said area since it is a farming community. They are mostly used to spice cooked foods and they include vegetables such onions and garlic. Patronage of these was also significantly high among students on the Winneba campus. It could be inferred that, the location of campus was a determinant factor to the type of vegetable available for student consumers. Students on the Ashanti-Mampong campus seem to have more types of fruits and vegetables available to them thereby increasing their chances of patronage than those from the other campuses. Cultural habits and traditions also serve as challenges to the consumption of fruits and vegetables (Leather, 1995). Seasonal availability of certain fruits and vegetables may serve as a major set-back to adequate consumption of certain types of fruits and vegetables as opined by Ali and Tsou (1997).

5.1.4 Handling of Fruits and Vegetables

5.1.4.1 Storage of fruits and vegetables

From the results (figure 4.5 and table 4.21), students showed preference for storage in refrigerators. This method of storage may be attributed to its desirability and convenience as asserted by Kemper (2007). Even though this method does not improve quality, it is deemed convenient and easy to use. Like other preservation methods, refrigeration prevents

micro-organisms from growing and thereby causing spoilage. One unique advantage of cooling is that, the nutritional quality of the produce remains good and the produce can be kept for many months with a little or no change in colour, texture or taste (Kemper, 2007).

Storage in baskets, on shelves, on the floor and in trays as practiced by some students also enhances free ventilation and serves as a cost-free method of reducing temperature and the build-up of pests and diseases. Produce such as potatoes (*Ipomea batatas*) when stored under such conditions promotes curing of bruised produce. It is however detrimental to other produce such as tomatoes, garden eggs, mangoes and other leafy fruits and vegetables. Kemper (2007) further explained that, the inability to control the temperature, ventilation and humidity demands of certain fruits and vegetables is a possible cause of decay in storage. Storage of produce in refrigerators was high among students on the Kumasi campus. This could be due to the industrialized and metropolitan nature of the location of campus compared to other locations and the convenience of storing fruits and vegetables in refrigerators.

Transporting refrigerators to industrialized towns or acquiring one in a metropolitan or regional capital would be considered easier than in less developed places like Ajumako, (a farming community), Ashanti-Mampong (a farming community) and Winneba (a coastal fishing municipality). Storage of fruits and vegetables by keeping them on the floor was also a common scenario on the Kumasi campus. This could also be as a result of the types of vegetables that are usually sold since vegetables such as the tuber and most bulb vegetables store better outside cold environments like the refrigerators.

Storage by keeping fruits in refrigerators was also predominant among students on the Ashanti-Mampong campus which could also be attributed to the closeness of the Ashanti-Mampong Township to Kumasi, a regional capital where access and means of transporting refrigerators was quite easier and convenient. Both locations have similarities also in terms of the fruits and vegetables usually used by students residing in such area, hence making students adopt similar means of storing fruits and vegetables.

Majority of students on the Winneba campus however, did not respond to this item and could be inferred that due to the closeness or proximity of their halls of residence to where these fruits and vegetables were sold and the regular availability of vendors to supply these produce to consumers. Adoption of storage technologies was however minimal. While majority of students stored vegetables on the floor in Kumasi, a significantly few number of students used this method in Winneba.

It was revealed from the study that, a significant minority of the female students stored their fruits in baskets. This could be attributed to their ability to assess fruits and determine appropriate means of storing them. Most of the male students also preferred other means of storage different from the listed methods. This could imply that they only bought the quantity needed and so they did not employ any means of storage. It could also be possible that, the means of storage differed from one produce to the other, hence their non-response. Their no response to this could also be associated with availability of the required fruits. It

could be inferred that, the habit of not storing fruits and vegetables among students on the Winneba campus was as a result of readily availability of the needed fruits while vegetables were not significantly affected. It is possible that, knowledge on the most convenient storage method among this group of respondents might have been acquired from other backgrounds rather than their academic disciplines of study at the tertiary levels in education. Environmental factors such as temperature, relative humidity and oxygen balance, especially in storage are also greatly responsible in enhancing the shelf life of fruits and vegetables in storage.

The study also revealed that students reading science related programmes had special preference for storage methods different from those in the given range of options in the study. These included storage methods which are fruit or vegetable specific. It is presumed that, because of their advanced knowledge about storage methods that could be employed most of them had preference for different methods of storage.

5.1.4.2 Conveying of fruits and vegetables

It could be inferred from the sources of fruits and vegetables that, students patronised mostly, vegetables from hawkers who delivered fruits and vegetables at their doorstep. This makes it unnecessary for purchased produce to be packaged in any form before consumption. A significant majority of the respondents on the Kumasi campus conveyed their produce in baskets. This was a special case among students. Due to the closeness of the Ashanti-Mampong township to the villages where fruits and vegetables were produced,

students on some occasions may buy produce directly from the villages, hence, the use of baskets to transport of bulky produce. This could be associated with the fact that the hostels and means of accommodation for students outside the halls of residence were mostly sandwiched among the indigenous residents on the Ashanti-Mampong campus, thereby making students adopt practices peculiar to indigenous town people. The results showed that, male students did not employ any regular means of conveying fruits and vegetables to their residence. This could be attributed to the activities of hawkers and vendors who deliver of fruits and vegetables to the door steps of students on the various campuses. The programme of study of students however showed no significant effect on these challenges.

5.1.5 Assessment of the Losses that Occur in Students' use of Fruits and Vegetables

Losses that rendered the vegetables unusable were significantly high on the Ashanti-Mampong and Kumasi campuses.

The study showed that, the highest percentage of fruits and vegetables that were rendered unusable was twenty percent (20%) of the fruits and thirty six percent (36%) of the vegetables. One would speculate losses of fruits and vegetables to differ if there were any among students of different gender. The study revealed that, there were no significant differences (fruits, $P= 0.28$ & $0.054>0.05$) in the losses that were recorded in both fruits and vegetables for both sexes. The location of campus had no effect on the losses that occurred in fruits, but proved otherwise in vegetables. It can be inferred from the method of storage and transport in these areas that high levels of vegetable losses arose from the way and manner vegetables are transported after purchasing. Gender, however, had no

significant effect on the losses that were recorded in vegetables and fruits. Inadequate management skills for fruits and vegetables may also account for the high losses recorded among the students since most of them on these campuses subscribed to storage in the refrigerators and on the floor and the conveyance of the produce in baskets.

Most of the losses identified occurred in the course of transit and during the storage stages of fruits and vegetables. Other losses which were on smaller scales were reported to occurred in the course of processing, packing and packaging stages. It is presumed that, factors that contributed to these losses were prevalent on the Kumasi and AshantiMampong campuses. It is presumed that losses on these campus locations might have occurred due to inappropriate means of storage. Most of the losses recorded occurred at the storage stage. Since the commonest means of storage was in the refrigerator, it is imperative that these losses occurred in the refrigerators for fruits and on the floor for vegetables. It could be implied that, students opted for inappropriate storage methods for fruits and vegetables types since they used the refrigerators for storage which under normal circumstances should help in extending the shelf life of the produce. This finding is similar to the findings of Sablani *et al*. (2006) in his study of handling and storage conditions in produce. He concluded that, storage conditions could also go a long way to affect the quality and nutritional quality of harvested produce. Losses might have also occurred due to physical and mechanical injury and uncontrolled conditions, mainly temperature and humidity as opined by Chandy (2004).

It could also be implied that regular power outages on campuses could have accounted for losses during the storage phase of fruits and vegetables since environmental conditions which could serve as contributing factors were not significantly different on these campuses. Losses in the course of transportation was recorded to be high. This might also have resulted from the use of unsuitable packaging containers as opined by

Idah *et al.* (2007).

5.1.6 Producers and Retailers of Fruits and Vegetables

The ages of the work force for the production of fruits and vegetables increased with an increasing number of producers.This makes majority of the workforce aged people which is detrimental to food production. This phenomeneon could be as a result of young men migrating to urban places to seek greener pastures as opined by Codjoe,(2009). Not withstanding this challenge, there was a clear indication that males engaged in the production of fruits and vegetables more than their female counterparts. The increase in the number of producers of fruits and vegetables was directly proportional to the increase in the age distribution during the study(Figure 4.18). It was imperative that, people only engaged in fruits and vegetable production when they were far advanced in age and could not take part in very active or lucrative excercise anymore. Babalola *et al*. (2010) asserts that, ages of producers are significant factors to be considered because it also determines the type and the quality of the labour force available for fruits and vegetables production. The study showed that most of the farmers were into fruits production. The second majority were into the production of both fruits and vegetables whilst the least number produced solely vegetables.

Production was dominated by males whilst the females dominated the trading of the produce. Majority (44.74%) of the producers were also located in Ashanti Mampong (Table 3.3). Some of the producers also compounded as retailers of fruits and vegetables as indicated in Table 4.38. By gender, the percentage female retailers outnumbered the males. This implied that, a vast majority of retailers on these campuses were females. The major occupation among the retailers was trading. The findings also revealed that retailers engaged in other ventures which included the trading in farm products such as fruits and vegetables and other fish products especially in Winneba (Table 4.38). Respondents reported of postharvest losses in the course of transportation as a major challenge to their retail business on the various campuses. These, they reported occurred through crushing of fruits and vegetables. The crushing of fruits such as banana, tomatoes and watermelon, were normal examples of this incidentals in the transportation of fruits and vegetables. Thus increasing the losses that occur and hastening the deteriorating rate of the produce. This is inline with the assertion by Ayandiji and Omodoji (2011) that inappropriate packing, packaging and storage of produce also promote post harvest losses of fruits and vegetables. This was because; farmers on some occasions had to transport their produce through long distances to the market centres in order to obtain market for their produce. It could be inferred that, this also affected patronage by students since most student consumers had preference for fresh fruits and vegetables void of notches, insect piercing and infestation or bites and fruits which look very appetizing and are much endowed in the necessary influential attributes for its consumption.

Retailers who happened to be hawkers and not stationed also faced the difficulty of carrying very bulky fruits like water melons round the campuses. This also may influence the type of fruits and vegetables that are hawked by retailers, thereby restricting students who patronised foods from consuming certain types of fruits and vegetables. Predominant among the storage methods for retailers were the keeping of the produce on the floor.

Even though this enhances adequate ventilation, it may also trigger ripening of climacterics and induce rottenness among non climacterics if they are both stored under the same condition in the same environment.

5.2 SENSORY ATTRIBUTES TEST

The most influential physical attribute for consumption of fruits varies from one fruit to the other. This exercise tested the influence of some selected attributes (colour, texture, taste) on the patronage of fruits and vegetables such as watermelon, citrus, grapes, banana and some selected vegetables such as onion, tomatoes, carrots and cabbage.

5.2.1: Sensory Attributes

The most influential physical attribute for consumption of fruits varies from one fruit to the other. This exercise tested the influence of some selected attributes (colour, texture, taste) on the patronage of fruits and vegetables such as watermelon, citrus, grapes, banana and some selected vegetables such as onion, tomatoes, carrots and cabbage.

5.2.1.1 Watermelon

The consumption of watermelon was highly influenced by the taste of the fruit more than any other attribute. Students (39.50%) had preference for very ripe watermelons with very pleasant tastes. Students showed preference for very ripe watermelons which connoted it deliciousness. A second majority (39.50%) were also influenced by the colour of the fruit. From the findings, it was imperative that, respondents based their choices on the assumption that the taste of fruits was dependent on the colour. This is similar to the finding of (Haynes-Maslow *et al.*, 2011) in his qualitative study of the perceived barriers to fruits and vegetable consumption among low-income populations in North Carolina. He found out that, consumers would patronise fruits and vegetables that are presented in appealing manner.

5.2.1.2 Citrus

The consumption of citrus was also highly influenced by the taste of the fruits more than all other attributes. Students (45%) had preference for citrus with very pleasant tastes compared to bitter or sour tasting ones. The second majority (30%), were also influenced by colour of the citrus and the rest were were influenced by texture (25%) and other factors such as for satisfaction, cost, available variety, nutritional purposes and many more. The influence of other non sensory attributes is similar to the findings of HaynesMaslow *et al*. (2011) in his qualitative study of perceived barriers to fruits and vegetables consumption.

He opined from his study that, the consumption of fruits and vegetables could be influenced by factors such as the quality, variety and societal norms.

5.2.1.3: Grapes

As an exotic fruit, grapes were not common on the four campuses of the University of Education. They were completely unavailable on the Ajumako and the Ashanti-Mampong campuses, hence respondents‟ not familiar with this type of fruit (Table 3.2). Nonetheless when introduced, their choice of it was influenced by the colour (60.40%) and its attractive nature. Others also had preference for it due to the nutritional benefits and beliefs (16.27%) (Figure 4.13). The major challenge to the consumption was availability.

5.2.1.4 Pineapples

The results from the sensory attributes test revealed that, taste was the most influential attribute in to the consumption of pineapples (Figure 4.13). This finding is similar to the findings of Aimee (2002) who in her study on fruits and vegetables consumption by low income Americans, found out that, factors such as taste, nutrition, convenience and weight control concerns influenced consumption of fruits. Students showed preference for pineapples with very desiring tastes and flavour which are influenced by growing practices, weather conditions and the degree of ripeness before it was harvested (Anon, 2013).

5.2.1.5 Banana

The most influential physical attribute to the patronage of banana among students was the colour which is mostly an indication of its ripeness (Figure 4.13). Majority of the respondents preferred ripened fruits which were void of notches to either partially ripened bunches or over ripened banana. This might have also connoted certain tastes hence students‟ preference for taste as an influential factor in the exercise. This implies that to be able to induce consumption among students, banana must be served in the fully ripened yellow, fresh and appetising states.

5.2.2 Vegetables

Students indicated also that colour served as the most influential factor to their consumption of vegetables especially tomatoes. This was followed by cabbage which when fresh and matured are light green coloured in nature. Carrots, potatoes and onions in the descending order were also no exceptions in this case. Preference for potatoes, onion, cabbage, carrots were also high due to their taste, nutritional and medicinal values. Other students also had no apparent reasons for their choice or preference of certain vegetables. Taste as the most influential factor to the consumption of potatoes is in line with the assertion by Engel *et al.* (2002) that taste is the primary sensory factor to the consumption of vegetables. Dinehart *et al.* (2006) expressed also that, sweetness of vegetables also served as potential predictors to the preference of variability of intake of vegetables confirming the case of potatoes in the exercise.

6.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY

A survey was undertaken to assess the postharvest challenges from the consumption of fruits and vegetables among students. The survey sought to assess the influence of their knowledge on consumption, evaluate the handling methods and also to assess the losses that are recorded. This was done on the four campuses of the University of Education namely; Winneba Campus, Ajumako campus, Kumasi campus and Ashanti-Mampong campus. A sensory attribute test was also conducted to ascertain the influential ability of the attributes (colour, taste, texture) on the consumption of some selected fruits and vegetables from the various fruits and vegetables food groups which were peculiar to the four campuses.

The survey revealed that majority of the students had profound knowledge about the nutritional benefits derived from fruits and vegetables consumption. It was also found that consumption of vegetables was in general higher than fruits. Students on campuses where the produce were available and affordable consumed more than other campuses where there was none or where fruits and vegetables were available in limited quantities, even though their consumption patterns were mostly on irregular patterns.

Processing ability also served as a hindrance to the consumption of fruits and vegetables Students studying arts related programmes consumed more fruits and vegetables than those studying the science and mathematics related programmes even though irregular consumption patterns were common among students. The geographical location which

affected the environment of campuses also influenced the types of vegetables that are usually patronised. Leafy vegetables were commonly consumed on the Kumasi and Ashanti Mampong campuses while consumption of rooty vegetables and fruity vegetables were common on the Winneba and Ajumako Campus.

The study also revealed that students conveyed their fruits and vegetables usually in polythene bags and jute sacs. It was also noticed that, the method of conveying was dependent on how longer or shorter the distances under consideration. It also depended on quantity of fruits and vegetables involved as well as the types and nature of the fruits and vegetables that were being dealt with.

The commonest storage method identified among students was by the use of refrigerators and keeping of mostly vegetables in airy places. It was observed that students on the Kumasi and Ajumako campuses showed preference for storing of fruits in refrigerators and vegetables on the floor. This situation was not different on the Ashanti-Mampong campus but it was different on the Ajumako Campus since the preferred form of storage was keeping the produce in airy places, such as the floor and on shelves. The use of refrigerators could be attributed to the metropolitan nature of the location and its convenient nature. Storage of vegetables by keeping them on the floor could be attributed to the size and the types of vegetables under consideration in these locations. The survey also revealed that losses were significantly high among students on the Kumasi and Mampong campuses with about 10-20% of their fruits and vegetables being rendered unusable. The survey also

revealed that most of these losses occurred in storage and in the course of transporting the course of transporting the harvested fruits and vegetables to consumers.

A survey also of retailers and producers of fruits and vegetables also revealed that the retailers are dominated by females while the producers are mainly males. The peculiar fruits and vegetables or most commonly consumed fruits and vegetables were those produced within the geographical location of production except for exotic fruits and vegetables which were often imported.

The study revealed that the most influential sensory attribute for the consumption of watermelon is the taste and colour, orange – taste, grape - colour and the nutritional benefits derived from it, pineapple-taste, and banana- colour. The most influential attribute to the consumption of selected vegetables were also as follows: onion –taste, tomatoes-colour, carrots - taste, potatoes – taste, cabbage-taste.

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6. 2 CONCLUSIONS

Students, not withstanding their programmes of study, had adequate knowledge of the nutritional benefits derived from fruits and vegetables consumption. They were aware of

the nutritional and health benefits derived from the consumption of fruits and vegetables. Preference for the vegetable types available in their locality was high since students did not usually patronise fruits and vegetables that were far from their reach or accessibility. Students consumed more vegetables than fruits and the consumption rate of females was relatively higher than that of males. It was however deduced that they had little knowledge of the quantity of fruits and vegetables that needed to be consumed on daily basis. Students, for the sake of convenience, preferred to stored their produce in refrigerators and conveyed them in polythene bags. Exotic fruits were hardly patronised by students.

Most of the losses that were recorded in fruits and vegetables consumption were mainly during the storage stage and in the course of transit. Most of the labour or workforce for the production of fruits and vegetables were aged people.The most influential sensory attribute to the consumption of selected fruits and vegetbles was the taste of the produce.

6.3 RECOMMENDATIONS

The following recommendations are suggested:

1. The introduction of composite foods could be promoted in order to cater for students, e.g. science students, with too busy schedules to ensure that they also benefit from the consumption of fruits and vegetables.

2. Partly prepared fruits and vegetables could be prepared for students who are unable to consume due to their busy schedules so that they could carry them along in order to increase their consumption.

3. Research into the areas of quantifying fruits and vegetables consumed and the nutritional dynamics that take place in produce during storage.

4. The activities of hawkers and vendors could also be promoted to enhance students access to fruits and vegetables.

5. To ease the promotional efforts to fruits and vegetables consumption, it is also imperative that the sensory attributes of fruits and vegetables are heightened in the supply of fruits and vegetables to students.

6. It is also recommended that the scope of a future research should be broadened to include a larger representative sample size in order to enhance the generalisabilty of findings.

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APPENDIX A: QUESTIONNAIRE FOR STUDENTS CONSUMERS, RETAILERS AND PRODUCERS OF FRUITS AND VEGETABLES

Appendix A 1.Survey of Students

THIS QUESTIONNAIRE IS AIMED AT UNEARTHING POSTHARVEST CHALLENGES OF FRUITS AND VEGETABLES CONSUMERS IN TERTIARY INSTITUTIONS IN GHANA. RESPONDENTS TO THIS QUESTIONNAIRE ARE HEREBY ASSURED OF CONFIDENTIALITTY OF ANY INFORMATION GIVEN. INFORMATION SUPPLIED IS ONLY FOR RESEARCH AND ACADEMIC PURPOSES.

By this research, the operational definition of the **fruits** and **vegetables**, examples of the staples under consideration are as listed below:

Vegetables among others include; Tomatoes, Garden eggs, Ginger, Okra, Pepper, Onion, Garlic, etc.

Fruits among others include; Orange, Pawpaw, Pear, Lemon, Lime, Guava, Banana, Apple, Water melon, Mango, Sugar cane etc.

Section A: Biodata of respondents (Students)

1. Nationality. ……....
2. Region of origin. a. Eastern Region [ ] b. Ashanti Region [ ] c. Central Region [ ] d. Western Region [ ] e. Northern Region [ ] f. Upper East Region [ ] g. Upper West Region [ ] h. Brong – Ahafo Region [ ] i. Greater Accra Region [ ] j. Volta Region [ ]
3. District and town of origin. …….....
4. Sex of respondent. a. Male [ ] b. Female [ ]
5. Age of respondent, a.16-20 years [ ] b. 21-25 years [ ] c. 26-30 years [ ] d. 31-35 years [ ] e. 36-40 years [ ] f. 41-45 years [ ] g. 46-50 years [ ] h. above 50 years [ ]
6. Campus/Location. a. Winneba Campus [ ] b. Ajumako Campus [ ] c. Kumasi Campus [ ] d.

Ashanti Mampong Campus [ ]

7. Educational level Postgraduate /Undergraduate students a.1st year [ ] b. 2nd year [ ] c. 3rd year [ ] 4th year. [ ]

8. State title of programme. ……

Section B: Knowledge.

1. Is consumption of **fruits** necessary? a. Yes [ ] b. No [ ] c. Don"t know [ ]

1. Why do you consume fruits? a. For its nutritional value (source of vitamins) [ ] b. In order to become satisfied [ ] c. Do not know [ ] d. Others [ ] Please specify …….

2. Tick appropriately the fruits you usually purchase or use, rank your consumption on the scale of 15 in terms of how often you consume. *Scale (1) lowest and 5(highest).*

Criteria(classification)	**Scale**				
	1	**2**	**3**	**4**	**5**
Indigenous(Banana [ ] Citrus [ ] Mango[ ] Coconut[ ] Pineapple [ ] Sour sap [ ] Berries[ ] Cashew[ ] sugar Cane [ ] **Others [ ] pls. state…….**					
Exotic(AvocadoPear [ ]Sweet pepper[ ] Water melon [ ] Grapes [ ]Apple [ ] Papaya/Pear [ ] Guava [ ] Cherries[ ]) Others[ ] Please state……..					

3. When do you consume **fruits**? a. Before meals [ ] b. After meals [ ] c. With meals [ ] d. As a meal [ ] e. between meals [ ] f. Others [ ] Please, specify ……

4. When do you consume **vegetables**? a. Before meals [ ] b. After meals c. With meals [ ] d. As a meal [ ] e. between meals [ ] f. Others [ ] Please, specify .....

5. Is consumption of **vegetables** necessary? a. Yes [ ] b. No [ ] c. Don"t know [ ]

6. Why do you consume **vegetables**? a. For its nutritional value (source of vitamins) [ ] b. In order to become satisfied [ ] c. Do not know [ ] d. Others [ ] Please specify …….

7. Tick appropriately the **vegetables** you usually purchase or use and rank your consumption on the scale of 1-5 in terms of how often you consume. *Scale(1) lowest and 5(highest).*

Type of Vegetable	**1**	**2**	**3**	**4**	**5**
Leafy vegetables(spinach[ ], Amaranthus[ ],Bitter leaf, Lettuce,[ ],Cabbage[ ] Kontomire [ ] others……					
Root Vegetables(Carott[ ],Turnip[ ], Beetrot[ ],Ginger[ ] others……....					
Fruit Vegetable(Pepper[ ], Tomatoe[ ],Green pepper[ ], Okra[ ]Garden eggs [ ],Cucumber [ ] Dawadawa[ ]) others[ ] Please specify……..					
Bulb Vegetable(Onion [ ], Garlic[ ],Shallot[ ]) others[ ]Please state ……					
Tuber Vegetables(sweet potatoe[ ], potatoe[ ]) others[ ] Please specify ……					

8. Rank the importance of **fruits**. a. 1-20% [ ] b.21-40% [ ] c. 41- 60% [ ] d.61-80%[ ] e. 81-100% [ ]

9. Rank the importance of **vegetables**. a. 1-20% [ ] b.20-40% [ ] 40- 60% [ ] c.60-80%[ ] e.80100% [ ]

10.How did you acquire the current knowledge you have on **fruits** consumption? a. From school [ ] b. From parents/guardians [ ] c. From friends [ ] d. From the Media [ ] e. From health professionals / experts [ ]. f. Others [ ] (specify) **……..……..**

11. How did you acquire the current knowledge you have on **vegetables** consumption. a. From school [ ] b. From parents/guardians [ ] c. From friends [ ] d. From the Media [ ] e. From health professionals or experts [ ]. f. Others [ ] Please (specify)...

……..……..

6. Are you satisfied with the depth of knowledge you have on **fruits**? a. Yes [ ] b. No [ ]Please,

explain **……**

7. Are you satisfied with the depth of knowledge you have on **vegetables**? a. Yes [ ] b. No [ ]

Please, explain

……..

8. How different is the use of **fruits** from the use of other staples/foods/foodstuffs? a. They are easier to use compared to other staples [ ]. b. They are difficult to use compared to other staples [ ]. c. They are not easy to obtain(come by) [ ] d. They are easy to obtain (come by) [ ]. e. They are affordable and easy to handle [ ].f. They are not easily perishable [ ] g. They are easy to store [ ] h.

Others [ ] Please, specify. **……..……**

9. How different is the use of **vegetables** from the use of other staples/foods/food stuffs?

a. They are easier to use compared to other staples [ ]. b. They are difficult to use compared to other staples [ ]. c. They are not easy to obtain (come by) [ ] d. They are easy to obtain (come) by [ ]. e. They are affordable and easy to handle [ ] f. They are not easily perishable [ ] g. They are easy to store [ ] h. Others [ ] Please specify……..

10. How does your knowledge on **fruits** consumption affect your daily intake? a. I‟m able to determine the most nutritious fruits and consume [ ] b. I‟m able to store fruits well before consumption [ ] c. I‟m able to process fruits well before consumption [ ] d. I‟m able process and store fruits well before consumption [ ] e. It does not affect my consumption [ ] f. Others [ ]Please specify ……

11. How does your knowledge on **vegetables** consumption affect your daily intake? a. I‟m able to determine the most nutritious vegetables and consume [ ] b. I‟m able to store vegetables well before consumption [ ] c. I‟m able to process vegetables well before consumption [ ] d. I‟m able process and store vegetables well before consumption [ ] e. It does not affect my consumption [ ] f. Others [ ] Please specify …….

12. What other challenges does your knowledge on **fruits** and **vegetables** consumption pose to your

daily consumption? …… **Section C: Consumption/Usage/Storage. All questions bearing the asterix sign (*) in this section may require multiple answers.**

1. How often do you consume **fruits**? a. Once a day [ ] b. Twice a day [ ] c. Thrice a day [ ] d. Four times a day [ ] e. Five Times a day [ ] f. Any other day [ ] g. Once in 3 days [ ] h. Others [ ] Please, specify. …….....
2. What quantity of **fruits** do you consume daily ? a. One serving a day [ ] b. Two servings a day [ ] c.Three servings a day [ ] d. Four servings a day [ ]. e. Five servings a day [ ] f. Others [ ] Please specify. …….……..
3. *Why do you use that quantity? a. It‟s unavailable [ ] b. It‟s unaffordable [ ]. C. That is what is available [ ]. d . It is affordable [ ]. e. It is affordable and available [ ] f. It is not perishable [ ] g. It is nutritious [ ] h. Fear of fruits contamination [**]** i. Others [ ] Please, specify……
4. Which of the following does your acquired **fruit**s usually suffer from? a. Microbial contamination [ ] b. Pesticides or in-organic residual deposits [ ] c. Diseases and pest attack [ ] d. Others [ ] Please,specify ……..
5. What is your major challenge with respect to your daily use of **fruits?** a. Seasonal availability of fruits [ ] b. They are costly [ ] c. They are difficult to store [ ] d. They are difficult to process[ ] e. They are not available [ ] f. Fear of contamination [ ] g. Fear of chemical residues [ ] h. Others [ ] Please specify ……...……..
6. What is your major challenge with respect to your daily use of **vegetables**? a. Seasonal availability of vegetables [ ] b. They are costly [ ] c. They are difficult to store [ ] d. They are difficult to process [ ] e. They are not available [ ] f. Fear of contamination [ ] g. Fear of chemical residues [ ] h. Others [ ] Please specify …….
7. How often do you consume **vegetables**? a. Once a day [ ] b. Twice a day [ ] c. Thrice a day [ ] d. Four times a day [ ] e. Five Times a day [ ] f. Any other day [ ] g. Once in 3 days [ ] h. Others [ ] Please, specify. …….....

8. Why do you consume that quantity? a. It‟s unavailable [ ] b. It‟s unaffordable [ ]. C. That is what is available [ ]. d . It is affordable [ ]. e. It is affordable and available [ ] f. It is not perishable [**]** g. It is nutritious [ ] h. Fear of fruits contamination **[ ]** i. Others [ ] Please, specify ……

9. Which of the following does your acquired **vegetable** usually suffer from? a. Microbial contamination [ ] b. Pesticides or in-organic residual deposits [ ] c. Diseases and pest attack [ ] d. Others [ ] Please, specify **……**

10. Do you process/cook **fruits** before usage? a. Yes [ ] b. No. [ ]

    If your response is yes to the above question, how do you process/cook **fruits**? a. By boiling [ ] b. By frying [ ] c. steaming [ ] d. others [ ] Please, specify **……..……..**

11. Why do you process/cook **fruits**? a. To make it taste better [ ] b. To reduce contamination [ ] c. To increase its shelf life [ ] . d. Others [ ] Please specify **……..……..**

12. If your response is no, why? a. To avoid denaturing the nutrient (vitamins in it) [ ] b. They taste better when consumed in the fresh state [ ] c. Others [ ] Please, specify **……**

13. Do you process/cook **vegetables** before usage? a. Yes [ ] b. No. [ ]

14. If yes to the above question, how do you process **vegetables**? a. By boiling [ ] b. By frying [ ] c. By steaming [ ] d. Others [ ] Please, specify……

15. Why do you process **vegetables**? a. To make it taste better [ ] b. To reduce contamination [ ] c. To increase the shelf life [ ]. d. Others [ ] Please, specify……

16. If your response was no, why? a. To avoid denaturing the nutrient/ vitamins in it [ ] b. They taste better when consumed in the fresh state [ ] c. Others [ ] Please,specify …….

17. *Which of these influences your appetite for **fruits** consumption? a. Taste [ ] b. Texture[ ]c.Colour [ ] d. Storage period [ ] e. Aroma [ ] f. Availability [ ] g. Others [ ] Please, specify **……**How?.....

18. Does the processing/cooking method has any effect your appetite for **fruit** consumption? a. Yes [ ] b.No [ ] How? and why? **……**

19. Does the processing/cooking method has any effect on your appetite for **vegetable** consumption?

a. Yes [ ] b. No [ ] How? **……**

20. Do you have any other alternative for **fruits**?

a. Yes [ ] b. No [ ]. If yes, what are they. If no, why ?.....

21. In what form do you usually consume **fruits**? a. Fresh state[ ] b. Fruit juices/drinks[ ] b. Jams and jellies [ ] c. Food supplements/drugs in the form of tablets, capsules or syrups [ ] d. Others[ ] Please,

specify……

22. Are you able to acquire and consume enough **vegetables** to your satisfaction? a. Yes [ ] b. No [ ].

Why ? a. Because they are unavailable [ ] b. They are unaffordable [ ]c. They are affordable and available[ ] c. They are affordable [ ] d. They are available [ ] e. Others [ ] Please,

specify**……..……..**

23. Which of these affect your appetite for **vegetables** consumption? a. Taste[ ] b. Texture[ ] c. Colour [ ] d. Storage period [ ] e. Aroma [ ] f. Availability [ ] g. Others [ ] Please,

specify……How?.....

24. Are you able to acquire and consume enough **fruits** and to your satisfaction? a. Yes [ ] b. No [ ]

Why ? a. They are unavailable [ ] b. They are un affordable [ ] c. They are affordable and available [ ] c. They are affordable [ ] d. They are available [ ] e. Others [ ] Please

specify**……..……**

25. Do you store **fruits**? a. Yes [ ] b. No [ ].

*Why ? a. They are cheap when in abundance [ ] b. They are readily available [ ] c. They are seasonal [ ] d. They taste better after storage[ ]. e. The texture and taste of fruits changes after storage [ ]. d. Others[ ] Please, specify……

26. How do you store **fruits** if you do? a. In trays b. On shelves [ ] c. In baskets [ ] d. On the floor [ ] e. In refrigerator [ ] f. Others [ ] Please, specify……..

27. How long do you store **fruits** before commencement of usage? a. 1-5 days [ ] b. 6-11 days [ ]

c. 12-16 days .[ ] d. 17-21 days [ ] e. 22- 27 days. f Above 27 days [ ]

28. Are you able to store **fruits** up to the number of days you intend storing them to your satisfaction? a. Yes [ ] b. No [ ].

29. Does the storage method pose any challenge to your daily use of **fruits**? a. Yes [ ] b. No [ ]

Please, explain your choice of answer ……**……**

30. Do you store **vegetables**? a. Yes [ ] b. No [ ].

*Why ? a. They are cheap when in abundance [ ] b. They are readily available [ ] c. They are seasonal [ ] d. They taste better after storage [ ]. e. The texture and taste of fruits changes after storage [ ] f. Others [ ] Please, specify**……..**

31. How do you store **vegetables** if you do? a. In trays [ ] b. On shelves [ ] c. In baskets [ ] d. On the floor [ ] e. In refrigerator [ ] f. Others [ ] Please, specify

…….

32. How long do you store **vegetables** before commencement of usage a. 1-5 days [ ] b. 6-11 days [ ]

c. 12-16 days .[ ] d. 17-21 days [ ] e. 22- 27 days. f. Above 27 days [ ]

33. Are you able to store **vegetables** up to the number of days you intend storing them to your satisfaction? a. Yes [ ] b. No [ ]

34. Do you have any alternative for **vegetables** a. Yes [ ] b. No [ ]. If yes, what are they. If no, why**.....**

35. Does the storage method pose any challenge to your daily use of **vegetables**? a. Yes [ ] b. No [ ]

Please, explain your choice of answer

……

……

Section D: Handling NB: All questions bearing the asterix (*) in this section may require multiple answers.

1. Do you reduce the temperature of **fruits** after acquiring them? a. Yes [ ] b. No [ ]. Give reasons for your choice of answer **……...**

2. If yes to question 1, how do you reduce the temperature of the **fruits**? a. By dipping(washing)them in cold water [ ] b. By refrigerating [ ] c. By putting them on the floor [ ] d. By putting them in a well ventilated place [ ] e. Others [ ] Please, specify **…….....**

3 Do you reduce the temperature of **vegetables** after acquiring it? a. Yes [ ] No. [ ]. Give reasons for your choice of answer **…….**

4. *If yes to question 3, how do you reduce the temperature of the **vegetables**? a. By dipping(washing)them in cold water b. By refrigerating [ ] c. By putting them on the floor [ ] d. By putting them in a well ventilated place [ ] e. Others [ ] Please, specify **……...**

5. *How do you carry the produce home for consumption after buying? a. In polythene bags [ ] , b. In a jute sac [ ], c. In a basket [ ] d. In a tray [ ] e. In hand [ ] f. Others [ ] Please, specify **…… ……**

6. Does the handling method pose any challenge to your consumption of **fruits**? a. Yes [ ] b. No [ ] What challenge does it pose? **……**

7. Does the handling method pose any challenge to your consumption of **vegetables**? a. Yes [ ] b. No []

8. What challenge does it pose? **……**

Section E: Losses NB: All questions bearing the asterix (*) in this section may require multiple answers.

1. Do you experience losses of **fruits** as a result of the way you handle them? a. Yes [ ]b. No [ ]. Please explain **……..……**

2. Do you experience any losses of **vegetables** as a result of the way you handle them? a. Yes [ ] b. No [ ]. Please ,explain **……..**

3. Do you experience any losses of **vegetables** as a result of the way you manage them after buying? a. Yes [ ] b. No [ ]. Please ,explain

……

4. Why? a. They get crushed in the course of transport [ ] b. They become contaminated because of how they are handled [ ]. c. they get rotten in the course of transport [ ] d. They are handled cautiously after buying to prevent losses [ ] e. They get rotten in storage [ ] f. Others [ ] Please, specify……

5. At what stage do you record the highest losses in the postharvest management of **fruits**? a. During transportation [ ] b. during storage [ ] c. When processing [ ] d. When packaging [ ]e. When precooling [ ]. f. Others [ ] Please, specify

……

6. Do you experience any losses of **fruits** as a result of the way you manage them after buying? a. Yes [ ] b. No [ ].

7. Why? a. They get crushed in the course of transport [ ] b. They become contaminated because of how they are handled [ ] c. They get rotten in the course of transport [ ] d. They are handled cautiously after buying to prevent losses [ ] e. They get rotten in storage [ ] f. Others [ ] Please, specify

…….

8. At what stage do you record the highest losses in the postharvest management of **fruits**? a. During transportation[ ] b. During storage [ ] c. When processing [ ] d. When packaging[ ] e. When precooling [ ]. f. Others [ ] Please, specify

……

9. Does any of your **fruits** get rotten? a. Yes [ ] b. No [ ]. Why? a.Physiological deterioration [ ] b. Pest and diseases infection [ ] c. Mechanical damage(Poor handling) [ ] d. Others [ ]

……

10. How often? a. Within 2-3 days [ ], b. Within 4-5 days [ ]. c. Within 6-7 days [ ]. d. One week [ ]. e. Others [ ] Please,

specify…….....

11. Does any of your **vegetables** get rotten? a. Yes [ ] b. No [ ] Why ? a. Physiological deterioration [ ]

b. Pest and diseases infection [ ] c. Mechanical damage(Poor handling) [ ] d. Others [] Please, specify

…….....

12. How often? a. Within 2-3 days [ ], b. Within 4-5 days [ ]. c. Within 6-7 days [ ]. d. One week and above [ ]. e. Others [ ] Please, specify ……....

13. What proportion of your **fruits** get rotten? a. 1 out of 10 (10 %) [ ] b. 2 out of 10 (20%) [ ] c. 3 out of 10 (30%) [ ] d. 4 out of 10 (40%) [ ] e. 5 out of 10% (50%) [ ]. f. Others [ ],

Please specify [ ] **……...**

14. What proportion of your **vegetables** gets rotten? a. 1 out of 10 (10 %) [ ] b. 2 out 10 (20%) [ ] c. 3 out of 10(30%) [ ] d. 4 out of 10 (40%)[ ] e. 5 out of 10 (50%) [ ]. f. Others Please specify [ ]

…..……

15. Are you able to control these losses? a. Yes [ ] b. No [ ]. Please, explain**.…….....**

.

16. Do you have the desire to consume more **fruits** and **vegetables** than what you are consuming now? a. Yes [ ] b. No [ ]

17. Do you have the desire to consume more **vegetables** than what you are consuming now? a. Yes [b. No [ ]

18. Any additional comments on **fruits** and **vegetables** consumption

Appendix A2

Interview schedule for retailers of fruits/ vegetables

1. Gender: a. Male ( ) b. Female ( )

2. Age in years : a. 16-20 ( ) b.21- 25 ( ) c. 26-30 ( ) d.31- 35 e.36- 40 ( ) f.41- 45 ( ) g.46-50 ( ) h.51 and above ( )

3. Occupation …….

4. Which fruits/vegetables do you sell?

5. Source of your produce:……...……

6. Do you get a readily available market for your fruits/ vegetables? Yes/ No

7. Explain ……..……..

8. Do you store fruits? a. Yes ( ) b No ( )

9. How do you store them if you do?

10. Do you subject your fruits/ vegetables to any pre-sale treatment before selling them? a. Yes ( ) b. No ( )

11.What treatment do you subject it to if your answer is yes?

12. What is your biggest challenge with regards to your daily supply of fruits/vegetables from the producers? ……

Appendix A3:Interview schedule for producers of fruits/vegetables

1. Gender: Male ( ) Female ( )
2. Age in years : a. 16-20 ( ) b.21- 25 ( ) c. 26-30 ( ) d.31- 35 e.36- 40 ( ) f.41- 45 ( ) g.46-50 h.51 and above ( )
3. Occupation
   ……

4. Which fruits/vegetables do you cultivate? ……

5. Why do you cultivate them? …….

6. Do you get readily available market for your fruits/ vegetables after cultivating?

   Yes/ No

7. Explain ……

8. Which category of people patronise most of your produced fruits/ vegetables? a.

   Retailers ( ) b. Consumers ( ) .c. Others……

9.What is you major challenge with regards to your production of fruits/ vegetables?

……

APPENDIX B: SENSORY ATTRIBUTES TEST SHEET.

Appendix B1: Sensory attributes test on fruits

After observation and tasting where necessary, tick the most appropriate response applicable

Which of these attributes influences most, your appetite for the consumption of the underlisted fruits?

Banana 2. Citrus 3. Pineapple 4. Water Melon

	FRUITS				
ATTRIBUTES	Banana	Pineapple	Orange	Grape	Water melon
Colour					
Texture					
Flavour					
Taste					
None of the above					

Others(specify)					

Appendix B. 2: Sensory attribute test on vegetables

After observation of the list of displayed items, tick the most appropriate response applicable.

Which of these attributes influence most, your appetite for the consumption of the underlisted vegetables?

	VEGETABLES					
ATTRIBUTES	Tomatoes	Onion	Carrot	Sweet potatoes	Cabbage	Lettuce
Texture						
Flavour						
Taste						
Colour						
None of the above						
Others(specify)						

Appendix C 1:Chi-square test of programme with vegetable consumption.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.833(a)	10	.058
Likelihood Ratio	22.669	10	.012
Linear-by-Linear Association	1.154	1	.283
N of Valid Cases	261		

P=0.058>0.05 (Not significant)

Appendix C2: Chi-square test of gender with vegetable consumption.

	Value	df	Asymp. Sig. (2sided)
Pearson Chi-Square	6.977(a)	4	.137
Likelihood Ratio	9.623	4	.047
Linear-by-Linear Association	.443	1	.505
N of Valid Cases	262		

P=0.058>0.05 (Not significant)

Appendix c3**:**Location and exotic fruits consumption

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.662(a)	15	.229
Likelihood Ratio	19.740	15	.182
Linear-by-Linear Association	.653	1	.419
N of Valid Cases	262		

Appendix C4 : Patronage of fruity vegetables (chi test)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	41.066(a)	15	.000
Likelihood Ratio	45.149	15	.000
Linear-by-Linear Association	8.129	1	.004
N of Valid Cases	261		

.
P=0.00>0.05 (Significant effect)

Appendix C5 : Patronage of fruity vegetables (post hoc test)

Campus Location	Non response	1	2	3	4	5
Winneba	.2	-1.5	-1.7	.6	.5	.5
Ajumako	-.5	-.8	-1.1	**2.3**	-1.7	.5
Kumasi	-1.2	**2.1**	1.2	-1.7	-.5	.5
Mampong	1.7	.3	**2.4**	-.1	.9	-2.1

Std Res. 2.3, 2.1,2.4 :1.96 age of bulb

Appendix C 6: Patron /egetabl es among st dents (Chi-Squ ıre Tests)

	Value	df	Asymp. Sig. (2-sided)
Pearson ChiSquare	39.749(a)	15	.000
Likelihood Ratio	45.606	15	.000
Linear-by-Linear Association	3.219	1	.073
N of Valid Cases	261		

Appendix C7:
Patrona ge of bulb vegetables among students **(post hoc tests)**

Location	Non response	1	2	3	4	5

Winneba	-.1	.8	.2	-.6	-1.2	1.0
Ajumako	-.7	-.7	-.1	.8	.0	-.1
Kumasi	-1.7	-1.7	-1.1	.8	.9	.6
Mampong	-.5	1.5	1.4	3.3	1.2	-2.9

P=0.00 <0.05 and std.3.3>=-1.96

Appendix C 8:Patronage of tuber vegetable

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	37.079(a)	15	.001
Likelihood Ratio	39.556	15	.001
Linear-by-Linear Association	4.931	1	.026
N of Valid Cases	261		

P=0.01<0.05 (Signifcant)

Appendix C9: Consumption of tuber vegetables (post-hoc test)

Location	Non response	1	2	3	4	5
Winneba	.2	2.1	.5	-1.9	.1	-1.0
Ajumako	.9	.1	-.4	-1.7	.4	1.1
Kumasi	-1.2	-1.9	-.4	1.5	-.1	1.9
Mampong						