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Consumers' Knowledge and Handling Practices of the Watermelon

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Abstract:
The cross-sectional survey design was used to investigate the knowledge and handling practices of 200 watermelon consumers who were purposively selected for the study. Data were collected using structured interview guide, consisting of both closed and open-ended items, while SPSS version 17 was used for the analysis. The respondents' knowledge on vitamin C content of watermelons was collected through a five-point Likert scale and presented using frequency and percentage tables. A One-way ANOVA was used to test if the differences between the means obtained from respondents of different educational levels and occupations were significant at 95% confidence level.
Among the findings was that out of the 11 statements on respondents' knowledge on factors affecting vitamin C content of watermelons, respondents agreed with only four of them. The manner watermelons were handled by respondents revealed that despite respondents' high educational levels, their knowledge vitamin C conservation in watermelons was not encouraging. The recommendations were that sliced watermelons should be consumed immediately and they must be kept in cool temperatures to conserve the vitamin C. Consumers should be educated to avoid purchasing watermelons that have been kept under the sun, whether sliced or whole.

Keywords: *Watermelons, Vitamin C, Sliced watermelons, Sunlight, vitamin conservation*

1. Introduction

1.1. Background to the Study

Within the last few years, the relationship between food and health has become a major concern of many people. People are becoming increasingly aware of what and how much to eat in relation to their health. As far back as 1984, Cullings posited that balanced foods are eaten for health, thus making people very conscious of the kind of food selected and eaten. The foods eaten are chosen from different groups of food items, including fruits, and they are often eaten raw or mildly cooked. Some of these vital substances are also essential for the effective metabolism of some other food nutrients. For instance, vitamin C helps the body to absorb proteins; hence, there is the need for food items containing vitamins to be handled with care (Roth, 2011). Care must also be taken in handling fruits because the unstable vitamins are easily destroyed by oxygen, light, heat and water. Some vitamins such as vitamin C and some B groups are very sensitive to certain temperature conditions and so are unstable but other vitamins such as vitamins A, D, E and K can resist these conditions (Roth, 2011).

1.1.1. Health Benefits of Fruits

According to Khader (2004), fresh fruits contain (70- 96%) water, (3- 27%) carbohydrate and (0 - 3.1%) fibre, and a low amount of protein, fat and minerals. Also, fruits are important sources of pro-vitamin A and vitamin C. Fruits contain pigments which are responsible for their colour. The orange-yellow fruits contain beta-carotene which is converted to vitamin A when absorbed from the digestive tract. Most fruits contain an edible parts combined with an inedible parts. Fruits such as banana, sweet lime, oranges and pineapple contain a third or more inedible roughage. The carbohydrate content of fruits varies from 3% in watermelon to 27% in banana. Most of the energy from fruits (80-96%) is provided by the sugar present. Therefore fruits or fruit juices are given when a quick source of energy is needed. Examples are appetizers and as refreshing drinks for athletes. Some dry fruits are rich in minerals, calcium and iron. The cellulose and the laxative property of fruit acids also safeguards against constipation, especially in a meat diet (Kinne, 2009).

Fruits are usually sweet and acidic in nature, and have a protective tissue which takes the form of rind, skin and peel (Decuyprere, 2000). A research conducted and reported by *nutrition-and-you.com* (2011) concluded that many fruits have very high anti-oxidant values which is something measured by their "Oxygen Radical Absorbent Capacity" or ORAC. Anthocyanin, a flavonoid, are found in some blue fruits like blue-black grapes, mulberries, acai berry, chokeberries, blueberries, blackberries, and in many vegetables featuring blue or deep purple colour. These compounds have potent anti-oxidant properties.

Taking fruits as part of diet is one sure way to a healthier body. A daily intake of fruits can be of great benefit to your body in various ways. For instance, eating a healthier diet to help you lose weight, or just a way to become more energetic, a diet high in fruits, vegetables and whole grains is a great way to start. Again by eating more fruit makes the body feel better.

It is advisable to drink lots of water. However, some people do not get the recommended six to eight daily glasses of water. Fruits luckily contain approximately 80% water so adding fruit to diets increases the overall water intake. No other food on this planet exists that has that much amount of water. Digestive problems such as constipation, diarrhoea or abdominal cramping, can be alleviated by eating fruit. Fruits that contain natural fiber can also help regulate bowel movements. Fruits have also been proven effective when it comes to lowering cholesterol levels. This can help prevent strokes and heart diseases.

1.1.2. Watermelon and its Nutritional Value

Watermelon also scientifically known as *Citrulluslanatus* belongs to the family Cucurbitaceae. It is a vine-like (scrambler and trailer) flowering plant originally from southern Africa. Botanist refers watermelon as a pepo, a berry which has a thick rind (exocarp) and fleshy center (mesocarp and endocarp). Watermelon is derived from an inferior ovary, and is characteristic of the Cucurbitaceae. The watermelon fruit, loosely considered as a type of melon– although not in the genus Cucumis– has a smooth exterior rind (green, yellow and sometimes white) and a juicy, sweet interior flesh (usually pink, but sometimes orange, yellow, red and sometimes green if not ripe)(Mateljan, 2011)..

Watermelon is also related to the cantaloupe, squash and pumpkin and other plants that also grow on vines on the ground. Watermelons can be round, oblong or spherical in shape and feature thick green rinds that are often spotted or striped. They range in size from a few pounds to upward of ninety pounds. Watermelons are mostly in season or available during summer or sunny seasons.

Watermelon is an excellent source of vitamin C and a very good source of vitamin A, notably through its concentration of beta-carotene. As a matter of fact, high intakes of vitamin C and beta-carotene have been shown in a number of scientific studies to reduce the risk of heart disease, reduce the airway spasm that occurs in asthma, reduce the risk of colon cancer, and alleviate some of the symptoms of osteoarthritis and rheumatoid arthritis. A cup of watermelon juice provides 24.3% of the daily value for vitamin C, and, through its beta-carotene, 11.1% of the DV for vitamin A (Mateljan, 2011). It also contains other nutrients in different proportions. Figure 1 is the nutritive value of a diced watermelon;

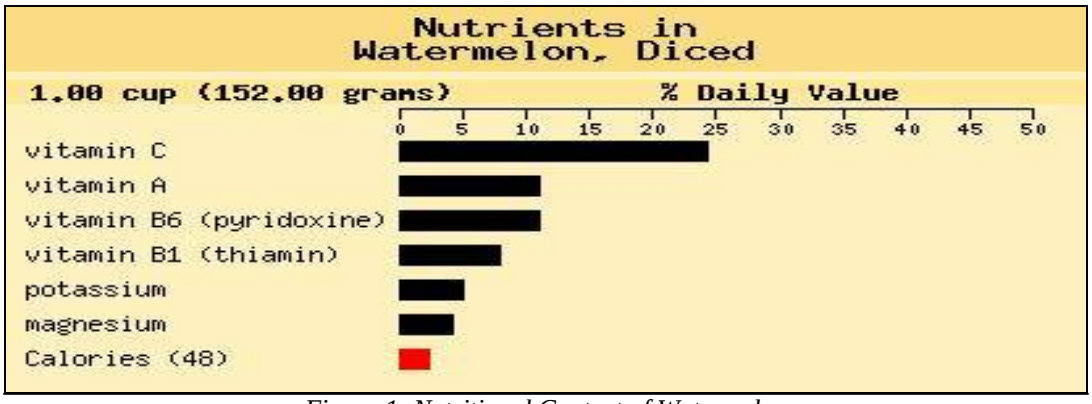

Figure 1: Nutritional Content of Watermelon
Source: Mateljan, (2011)

1.1.3. Vitamin C (Ascorbic Acid)

Generally, vitamins are defined as essential organic substances that are used in trace amounts. Examples of vitamins include vitamins A, D, E and K – fat soluble vitamins and vitamins C and the B group-water soluble vitamins (Johnson, 2003).

In 1753, it was discovered that citrus fruits which contain large amounts of ascorbic acid can cure scurvy. Vitamin C is a water-soluble vitamin which has the chemical formula $C_6H_8O_6$, that is, it is an organic compound of carbon, hydrogen and oxygen. It can be made by mammals but humans and other primates as well as bat obtain vitamin C from food. Fresh fruits and vegetables provide abundance of vitamin C if only there is absence of these conditions: heat, water, light and oxygen (Chang &Fernandes, 2000).

There are fruits such as guava, cashew fruit, alma which are extremely good source of vitamin C, providing 135 to 600mg of vitamin C per 100g of the edible part of the fruit (Khader, 2004). Some excellent sources of vitamin C are oranges, green peppers, watermelon, papaya, grapefruit, cantaloupe, strawberries, kiwi, mango, broccoli, tomatoes, Brussels sprouts, cauliflower, cabbage, and citrus juices or juices fortified with vitamin C. Raw and cooked leafy greens (turnip greens, spinach), red and green peppers, canned and fresh tomatoes, potatoes, winter squash, raspberries, blueberries, cranberries, and pineapple are also rich sources of vitamin C. Vitamin C is sensitive to light, air, and heat, so the most vitamin C is obtained if fruits and vegetables are eaten raw or slightly cooked.

Vitamin C is important for the growth and repair of tissues in all parts of the body. It helps the body to make collagen, an important protein used to develop the skin, cartilage, tendons, ligaments, and blood vessels. Vitamin C is essential for healing wounds, and for repairing and maintaining bones and teeth (Ehrlich, 2009; Medlineplus, 2010). From further studies made by Ehrlich (2009), vitamin C is an antioxidant. This antioxidant blocks damages made by free radicals which occur naturally when our bodies transform food into energy. It is known to provide the body with some health benefits.Ehrlich (2009) added that Vitamin C is known to lower cholesterol levels or reduce the overall risk of heart attack. Other evidence suggests that it may help protect arteries against damage. According to Ehrlich, the popular belief of most people is that vitamin C helps in curing cold but scientific evidence does not support this notion. But rather regular intake of vitamin C produces only a small reduction in the duration of a cold. Other health benefits of vitamin C provided by Ehrlich include the following:

i. Boosting immune system function;
ii. Maintaining healthy gums;
iii. Improving vision for those with uveitis (an inflammation of the middle part of the eye);
iv. Treating allergy-related conditions, such as asthma, eczema, and hay fever (called allergic rhinitis);
v. Reducing effects of sun exposure, such as sunburn or redness (called erythema);
vi. Alleviating dry mouth, particularly from antidepressant medications (a common side effect from these drugs);
vii. Healing burns and wounds; and
viii. Decreasing blood sugar in people with diabetes (Ehrlich, 2009).

The loss of vitamins in foods, especially vitamin C is as a result of the handling practices of people; from the farms to the seller, at the market place and even the consumers. Other factors that can also lead to the loss of vitamin C may include the method of preparation of a particular fruit, production factors; climate, temperature, oxygen and even sunlight can considerable cause the loss of some nutrients in fruits (Barasi&Mottram, 1993).

In Ghana watermelons are one of the types of fruits which are cultivated on commercial scale in several parts of Ghana but mostly along the coast, in the BrongAhafo and some parts of the Northern regions. They are transported from the places where they are produced to sites and towns where they cannot be produced. From observation, one can conclude that the rate of production as well as the consumption of watermelon has risen very high in Ghana, especially in the warm sunny seasons. They are available throughout the year but the production is very high between April and September and watermelons can be seen in heaps everywhere in the cities, along the streets and in the market. According to Barasi andMottram, (1993), is an excellent source of vitamin C and a very good source of vitamin A, notably through its concentration of beta-carotene. As a matter of fact, high intakes of vitamin C and beta-carotene have been shown in a number of scientific studies to reduce the risk of heart disease, reduce the airway spasm that occurs in asthma, reduce the risk of colon cancer, and alleviate some of the symptoms of osteoarthritis and rheumatoid arthritis (Barasi&Mottram, 1993, Fox & Cameron, 1993).

The handling of food especially by food sellers and retailers as well as the producers (farmers) has become an issue that should be considered. According to Vaclavik and Christian (2008), food quality is an important concept since the choice of food for consumption is dependent on the quality of the food, hence it is very important to consider the handling practices of the food consumers select. One can see producers of watermelons pile them along the roadsides waiting for transport to carry them to the sales points. The traders also stack the watermelons in big, often unclean trucks, boxes and basins, thus rendering them bruised, cut and often packed together with spoiled ones. These handling practices do not augur well for the vitamins in the fruits as sunlight, bruises, cuts, wilting are known to destroy vitamin C (Barasi&Mottram, 1993, Fox &Cameron, 1993).

From informal conversations with colleagues and friends as well as relatives, it can be deduced that some people eat watermelons due to the colourful nature and the water content which is refreshing and believed to quench peoples' thirst, especially on hot afternoons. For most Ghanaians who eat watermelons, the considerations in selecting watermelons are based on the physical appearance, that is, whether it is bruised or not; the outer colour, which ranges from light green to deep green, and the inner colour which also ranges from rose pink to deep red. Aside these, some consumers consider the inconveniences of carrying whole watermelons which are quite heavy to from the market place to their homes or work places. In most cases, particularly during the lean seasons, coupled with high transportation costs, watermelons can be very expensive and as a result most consumers find it difficult to purchase the whole fruits and so they select the sliced watermelons.

The university community is made up of a mixed group of people; academicians with very high levels of education and income, workers with middle level of education and income, those with low educational levels and income, all with their dependents and students of the university. There are also those from the several villages surrounding the university with very low or no formal education and low incomes. Generally, it can be observed that watermelon consumers in Cape Coast and the university community in particular, the same conditions and the handling of watermelons are not different from other parts of the country. The assumption is that with the high educational levels, awareness of the handling and sunlight effects might be high.

Watermelons are usually seen heaped along the roads side and in our markets in the sun and a lot of watermelon traders hawk sliced watermelons covered with polythene bags in the hot sun everywhere in our cities and towns, while some of them place these watermelons in glass containers under some umbrella or shade, thinking that there is nothing wrong with that practice. Consumers buy these sliced watermelons for various reasons, without considering the loss of nutrient, particularly vitamin C which is very unstable to heat. This study was carried out to investigate knowledge watermelon consumers have on environmental factors that affect the vitamin C content in watermelons so as to suggest the best ways watermelons should be handled to prevent loss of vitamin C.

1.1.4. Factors that Cause Depletion of Vitamin C in Fruits

In a research by Stevens (1980), oxygen was found to be the most destructive element in causing degradation of vitamin C. In the same study, he also found that, a major sugar (fructose) which was found in fruits also causes the depletion of vitamin C and therefore concluded that the higher the fructose content the greater the loss of vitamin C. Higher levels of citric acid and malic acid could stabilize vitamin C hence depletion of vitamin C. Further studies by Stevens showed that the production practices, such as the use of fertilizers and other agricultural chemicals, could affect the vitamin C levels of fruits.

In a similar research by Bryan (2000), heat was revealed as a factor that depletes the levels of vitamin C. The total available heat in climate also affects vitamin C levels of fruit. Areas with cool temperatures produce fruits such as watermelons and oranges which have high vitamin C content.

Ripening was another factor that causes vitamin C depletion in fruits and should be avoided. Addition of sodium bicarbonate greatly increases the destruction of vitamin C and should be avoided (Mullick, 2007). In another related study by Fernandes (2000), vitamin C is denatured in the skin by exposure to blue light and also to ultra violet light. The evidence helps to conclude that exposure to factors such heat, water, light and oxygen depletes the amount of vitamins of fruits.

1.1.5. The effect of Sunlight on Vitamin c of Watermelon

According to Barasi and Mottram (1993), sunlight destroys vitamin C and also wilting, bruising and exposure of cut surfaces do decrease vitamin C levels in watermelon. Temperature above 85^{o}C and inactivating the oxidizing enzymes can also destroy the vitamin C in watermelon. Further studies, by Barasi and Mottram (1993), shows that, fruits kept under the sun for some time is very destructive to vitamin C. When kept under the sun for 15 minutes, a quarter of the original amount is lost and after 90 minutes three quarters is lost. The problem is greater when fruits are transported from farm gates under the sun to distance market. In this case the loss is inevitable. In a related study, sunlight was found to decrease the jelly power of pectin; that is, degradation of pectin found in the walls of fruits may occur if the fruits are kept under the sun above 80^{o}C. This makes jelly tough due to over concentration.Mateljan (2011) stated that sun drying of fruits result in loss of vitamins. For example, when mangoes are sun dried, it results in the loss of 94% 0f beta- carotene and 84% of vitamin C. Therefore, recommendation made was to choose fresh fruits over dried fruit.

1.2. Statement of Problem

Vitamin C is known to be very important in the diet of humans. The vitamin is known to be very important as it functions in boosting immune system; maintaining healthy gums; improving vision for those with uveitis (an inflammation of the middle part of the eye). It also helps in treating allergy-related conditions, such as asthma, eczema, and hay fever (called allergic rhinitis); reducing effects of sun exposure, such as sunburn or redness (called erythema); alleviating dry mouth, particularly from antidepressant medications (a common side effect from these drugs); healing burns and wounds and in decreasing blood sugar in people with diabetes (Ehrlich, 2009).

Watermelons are consumed by a number of people for various reasons. The fact is that a lot of consumers cannot buy whole watermelons as result of constantly rising prices. Often some people are seen buying sliced watermelons from hawkers and consuming them immediately. It is now common to observe the watermelon hawkers cut whole watermelons, ice them, cover them with transparent polythene bags and hawk them around in the sun, the obvious reason being that the traders cannot carry big and heavy watermelons around. They are seen at along the roads, in residential areas, schools, work places and every nook and corners of towns hawking sliced watermelons.

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The problem is that in the study area, watermelons are transported from very far distances in truck, deposited along the roadsides and market place under the very bright sunlight. The hawkers also sell sliced watermelons in the flat trays everywhere. Thus, based on the findings by Barasi and Mottram (1993), Fox and Cameron (1993) and Mateljan (2011) that losses of vitamin C from fruits are greater when fruits are transported from farm gates under the sun to distant markets become inevitable, it is possible that consumers might be consuming watermelons that have lost considerable amounts of vitamin C, and will therefore be missing the numerous benefits of the vitamin.

Consumers usually buy those heaped whole or sliced watermelons in the sun along the roadside and in the market as well as the sliced ones being hawked under the high scorching tropical sunlight they seem to be unaware of the effects of sunlight on the nutrients in the watermelon, especially the vitamin C content. Again, when consumers do their selection mostly based on colour, appearance, cost implications and carrying convenience, do they also consider the nutrient-loss due to bad handling practices? Are they aware that there are differences between the vitamin C content of the whole harvested watermelons and those heaped under the sun in the market or the sliced ones being sold by hawkers? There was therefore the need to carry out this study to find answers to these questions.

1.3. Purpose of the Study

The main purpose of this study is to investigate the knowledge and handling practices of watermelons by consumers in the University of Cape Coast community that are likely to affect the vitamin C content in watermelons that they purchase and eat.

1.3.1. Objectives of the Study

The specific objectives set out to achieve the purpose of the study were to:

1. find out the background characteristics of the selected sample of watermelon consumers at the old-site of University of Cape Coast campus;

2. examine the knowledge the selected sample of watermelon consumers at the old-site of University of Cape Coast campus have on some factors that affect vitamin C content in watermelons;
3. investigate how the selected sample of watermelon consumers at the old-site of University of Cape Coast campus handle watermelons after they purchase them;
4. suggest acceptable ways of handling watermelons to avoid or lessen the amount vitamin C loss in watermelons.

- Hypothesis

The hypothesis formulated for the study is:

→ $H_{0:}$ There will be no significant difference between consumers of different educational levelsand occupation with regard to their knowledge on vitamin C conservation in watermelons.

1.4. Significance of the Study

The research sought to find out the effect of sunlight on vitamin C content of watermelons. The main significance of the study is to create awareness of watermelon consumers generally on the benefits of vitamin C in the diets of humans throughout the life-cycle. They will also be made aware of on the fact that vitamin C is one of the very unstable vitamins and that watermelons need to be handled with care so as to conserve the vitamin C content.

The findings of the study would help different categories of people irrespective of their background, whether literate, illiterate, adolescents or adults to know the best places to purchase their watermelons from, and also, it would help watermelon sellers to handle watermelons in a more appropriate way.

The results of the research would be used to suggest effective ways of handling watermelons on the markets to prevent direct sunlight exposure leading to loss of vitamin C.

Finally, the results, if adopted, will be of help to Health personnel in their health education programmes in addressing the problem of lack of vitamins C in communities.

1.5. Delimitations and Limitations

The study has some limitations in that vitamin C is one of the most unstable vitamins and is affected by several environmental factors. The consumers did not buy or eat watermelons cultivated on the same type of soil and the crops were not handled in the same manner. The time, place of harvest and the plant from which the consumers obtain watermelons and also levels of maturity could definitely not be the same for every consumer. The data for the research was collected from consumers in and around the University of Cape Coast community using structured-interview guide. Responses to the interview might likely contain some biases which might influence the results of the study. Generalization of the study findings therefore, is applicable to only the respondents in the sample from the study area and all other areas with similar characteristics.

The study covered the University of Cape Coast and its environs and was also restricted to consumers of watermelons. The study in no way attempted to determine the level of different handling practices of watermelon sellers and retailers. The views sought from consumers were also based on vitamin C in watermelons, both whole and sliced.

2. Methodology

2.1. Research Design

The cross-sectional survey design was used in this study. A cross-sectional survey research design is a descriptive survey design in which data are collected at one point in time for a sample selected to represent a larger population. Cross-sectional surveys make it possible for a group of respondents to be asked a set of questions at one point in time. According to Owens (2002), a cross-sectional survey attempts to capture the attitudes of a different groups in a sample at specific time frames and this timeline is vital in collecting bit by bit relevant results for the study.

2.2. Population, Sample and Sampling Techniques

The target population consisted of consumers of watermelons in and around the University of Cape Coast campus. It was therefore difficult to get the total population since there had not been any census carried out to find out the number of people who eat watermelons in Cape Coast or the study area. This made it difficult to obtain a sample frame.

It was difficult to define the sample frame since the target population was based on consumers of watermelons at least once a day. In view of this, the targeted people were first asked to indicate whether they ate watermelons. Purposive sampling technique was used to sample 200 respondents based on availability and willingness to participate. The purposive sampling technique was done in such a way that groupings such as traders, students, Junior and Senior Staff and Senior members were considered because these groups formed the population of respondents at the study area (Amedahe, 2005). This type of sampling was employed because it sought to address respondents whose opinions were thought to be relevant to the study and respondents were watermelon consumers.

2.3. Instruments

Structured-interview guide was used in the survey for the data collection of views from respondents. This structured interview was selected since it was appropriate for collecting views of respondents, some of whom were illiterates and could not answer questionnaires. It was also appropriate since it helped attend to all the respondents selected for the sample; hence aided in achieving a valid and reliable result for generalization. The items on the interview guide were also related to the objectives of the study (Amedahe, 2005).

The items for the data collection were in sections. Section A focused on biographic characteristics of the respondents and it had four items, two of which were open-ended questions. Section B dwelt on consumption and source from which the watermelons were obtained while section C had items on the storage of watermelons. Items in section D was based on the views of respondents on the factors that affect the level of vitamin C of watermelons. Respondents were provided with a five-point Likert (Strongly Agree = 5. Agree = 4; Somehow Agree = 3; Disagree = 2 and Strongly Disagree = 1), consisting of statements on vitamin C content in watermelons and some environmental conditions that affect the vitamin. The respondents were made to select from each of the statements which represented their knowledge. Means were computed for the Likert scale and compared with the mean for the statement which was 3.00 (15/5 = 3.00). One-way ANOVA was used to compare the means to indicate if the differences were statistically significant.

The structured-interview guide items were first pre-tested by interviewing 30 respondents who ate watermelons at least once a week just as the study sample to check for clarity. None of the questions were changed after the pre-test.

2.4. Data Collection Techniques

Structured interview guide was used for the interviews that took place at work places, homes or hostels, and lecture halls during break. As stated earlier, the structured interview guide was because some of the respondents were watermelon sellers who could neither read nor write. It took 15 minutes to interview each respondent. The interview was conducted within a period of 21 days.

2.5. Data Analysis

The data collected were edited and coded. The Statistical Package for Social Sciences (SPSS) version 17. The results from the analysis were presented using frequency and percentage tables and pie charts. The use of the tables gave a good overview of the results at a glance. A One-way ANOVA was used to test if the differences between the means obtained from respondents of different educational levels and occupations were statistically significant at 95% confidence level.

3. Results and Discussion

3.1. Demographic Information on the Respondents

Structured-interview guide were administered to 200 hundred consumers of watermelons in and around the University of Cape Coast campus. The demographic information on respondents consisted of gender, age, and highest level of education. The summary of responses on the demographic information on the respondents is presented in Table 1.

Background characteristics	Frequency	Percentage (%)
Sex		
Female	101	50.5
Male	99	49.5
Total	200	100
Age in years		
Less than 20	23	11.5
21 – 30	94	47.0
31 - 40	71	35.5
More than 40	12	6.0
Total	**200**	**100**
Highest Educational Level		
Basic/education/Middle school	25	12.5
Senior High/Vocational/ Technical	31	16.0
Diploma	25	12.5
Undergraduate	94	47.0
Postgraduate	25	12.5
Total	**200**	**100**
Occupation		
Traders	37	18.5
Students	94	47.0
Junior members	39	19.5
Senior members	30	15.0
Total	**200**	**100**

Table 1: Demographic Characteristics of Respondents

A critical examination of Table 1 indicates that out of the 200 respondents, 101 were females and 99 were males representing 55.5% and 49.5% respectively. On the age range of the respondents, it can be noticed from the data in the table that most of respondents (82.5%) were between the ages of 21 and 40 years. Those aged 20 years and below were 11.5% and those aged above 40 years and more were only 6.0%.

The data presented in Table 1 again indicate that out of the 200 respondents, 25 (12.5%) had basic/middle school education. Those with second cycle (senior high, vocational and technical) school certificates, formed 16.0%; 12.5% had diploma, and 12.5% also had postgraduate levels of education respectively. Most of the respondents, being 94 (47.0%), were undergraduates.
The final aspect of Table 1 covered the occupational status of the respondents. Ninety-four(47.0%)of the respondents were students who had no occupation; 39 (19.5%) were Junior and Senior Staff, composed of cleaners, drivers, research assistants, assistant registrars and teachers and nurses employed by the university. The remaining 30 (15.0%) respondents were senior members composed of Lecturers, Senior Registrars, and Medical Officers. The rest, 37(18.5%) were traders who are found selling on the university compound.

3.2. Frequency of Watermelon Consumption by Respondents in a Week
The respondents were asked to indicate number of times watermelons were consumed in a week andFigure 2presents the results.

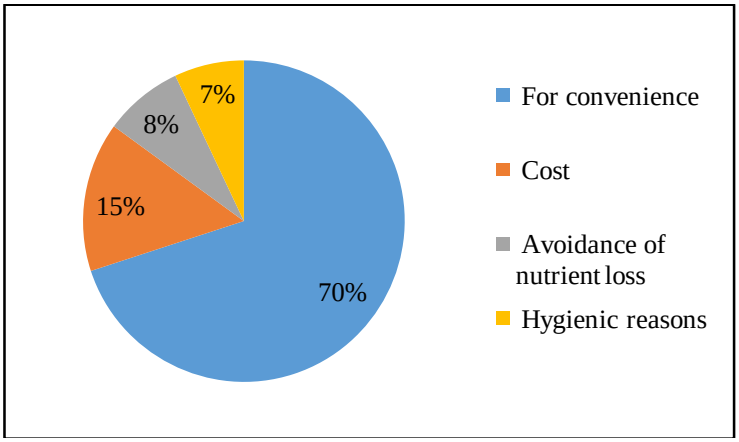

Figure 1: Frequency of Watermelon Consumption by Consumers

An examination of the data as presented in Figure 1 reveals that as high as 65.0% of respondents ate watermelons less than twice a week but 21.0% ate watermelons six or seven times daily, meaning everyday of a week.

3.3. Sources from which Consumers Obtained Watermelons in the Study Area
Where consumers obtained the watermelons they consumed and the form the watermelons were obtained were thought to be significant issues very relevant to the study and so questions were asked on these. The inquiry was prompted by the assumption that that most of the watermelons eaten by consumers in Cape Coast were not fresh and might have lost more vitamin C because of the long hours or days that usually elapse before watermelons got to the market or the campus. Figure 3 presents the sources from which watermelons were obtained by consumers.

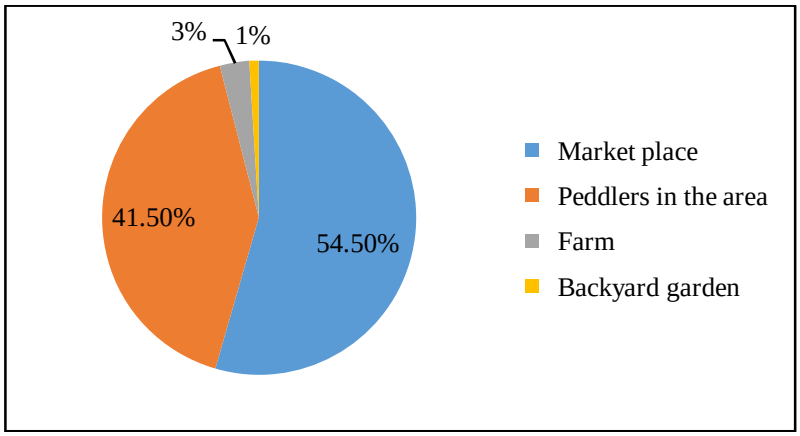

Figure 2: Sources from which Respondents Obtained Watermelons

It can be noticed from Figure 3 that most of the respondents, representing 109(54.5%), obtained watermelons from the traders stationed at the market places in town, along the roads or on campus and 83(41.5%) bought the melons from the peddlers who hawk them. Very few of the respondents, being eight (4.0%) in number, either obtained watermelons from their farms or their backyard gardens. This goes to show that the respondents mainly purchased their watermelons although there is evidence that watermelons can be cultivated in the area. It would have been very good to have backyard garden since the watermelons are likely to have a lesser risk of losing the vitamin C content as compared to the ones obtained from the markets and peddlers for the simple reason that they are

likely to be picked fresh and at the time when they are needed. Barasi and Mottram (1993), Fernandes (2000) and Mullick (2007) stated that long exposures to sunlight deplete vitamin C content of fruits.
The respondents were again asked to give reasons for their choice of the various watermelon sources and their responses are tabulated in Table 2.

Reasons	Frequency	Percentage (%)
For convenience	140	70.0
Cost	30	15.0
Avoidance of nutrient loss	16	8.0
Hygienic reasons	14	7.0
Total	200	100

Table 2: Reasons for Choice of Source

Table 4 reveals that the majority (70.0%) of the respondents chose those specific sources of watermelon for the sake of convenience and 30 (15.0%) chose their sources because of the cost of the watermelons. They claimed that the melons were cheaper at the markets or where there were large heaps, since they had been piled there by the traders who brought them from the producing sites. Sixteen (8.0%) considered the hygienic reasons, while the remaining 14 (7.0%) knew about nutrient loss and so it formed their basis for their decisions.
Further probes were based of the forms in which the watermelons were purchased. This question was of prime importance to the study because it formed the main subject for the study on vitamin C content of the fruit. Table 3 focuses on the forms in which consumers bought watermelons.

Forms	Frequency	Percentage (%)
Sliced	92	46.0
Whole	62	31.0
Both	46	23.0
Total	200	100

Table 3: Forms in Which Watermelon was Purchased by the Respondents

Table 3 shows that 92 (46.0%) of the consumers purchased watermelons in the sliced form, 62 (31.0%) purchased watermelons whole and 46 (23.0%) bought either the sliced or whole watermelons.
In the literature, Barasi and Mottram (1993) and Mullkick (2007) revealed that sliced fruits lose some amount of vitamin C, especially when exposed to sunlight. There is therefore the possibility that those consumers who purchased watermelons in the sliced form were likely to have some amount of vitamin C reduced, particularly, those being peddled by hawkers in the hot sun. However, this does not mean that those who bought the whole fruits could not have some of the vitamin C lost. In a previous experiment conducted on the effect of sunlight on vitamin C in watermelons, it was found out that even whole (unsliced) watermelons still lost some vitamin C although the losses were not as high as the sliced ones. The rooms are usually warm so some amount of vitamin C was likely to be lost. Table 4 shows some reasons why consumers chose sliced or whole watermelons.

Statement	Frequency	Percentage (%)
Convenience	116	58.0
Preference	74	37.0
Nutrient loss	10	5.0
Total	200	100

Table 4: Reasons for Choice of Form

From the results presented in Table 4, it can be deduced that a little more than half of the consumers in the sample, representing 58.0%, chose sliced watermelons due to convenience. They claimed that most often they bought the melons when they were thirsty or hungry and since they could not carry knives on them for cutting, the simplest way was to buy the sliced ones. The sellers even cut them into smaller sizes for them. Some claimed that it was easy to detect the mature melons when they are sliced. They often got disappointed when they took whole watermelons home to discover that they were immature.
Again in Table 4, 37.0% of consumers indicated they bought watermelons based on preferences that included the size of the family and hygiene. Some consumers even added that since watermelons could easily be contaminated and the fact that they could not predict how neat the knives used to slice were, it was safer to buy the whole watermelons. Interestingly, a few, representing 5.0% of the consumers indicated they were considerate of the loss of nutrients at the point of sales due to poor handling practices by sellers.
The respondents were again asked to indicate the time between the purchase of the watermelons and the consumption time and the responses are tabulated in Table 5.

Time	Frequency	Percentage (%)
Immediately after purchase	110	55.0
Between 30 minutes to 24 hours	38	19.0
Between 30 minutes to 5 hours	20	10.0
After lunch or supper	16	8.0
Ate part and stored part from 6 hours to 3 days	16	8.0
Total	200	100

Table 5: Time between Purchase and Consumption of Watermelons

When consumers were asked how long it took them to eat the watermelons bought, 110 of them, representing 55.0%, claimed they ate the watermelons immediately after purchase, 38 (19.0%) said they normally ate the watermelons between 30 minutes to 24 hours after purchasing the fruit and 20 (10.0%) ate them later, usually between 30 minutes and 3 days. From Table 5, sixteen consumers preferred eating the watermelons after meals lunch and or supper and the remaining 16(8.0%) of the respondents indicated they ate part of the watermelons and then kept the remaining part for periods from six hours after the day of purchase to even three days, so long as it remained edible.

The fact that some of the respondents stored the watermelons for periods as long as three days was an issue of concern since a substantial quantity of vitamins was likely to be lost. It should be noted that even if a single day lapses before the fruit is eaten, the vitamin C content is lowered, according to Barasi and Mattram (1993). There was therefore the need for further probing and so the next session focuses on the storage of purchased and leftover watermelons.

3.4. Storage of Watermelons by Consumers

This section focuses on the way the watermelons are stored by consumers after they are purchased, particularly the leftover watermelons. The analysis therefore centred on how consumers kept the whole and sliced watermelons after purchase andare presented in Table 6.

Place of Storage	Frequency	Percentage (%)
Whole watermelons		
In the refrigerator	64	32.0
In a polythene and placed in the refrigerator	63	31.5
On the top of surfaces	52	26.0
In the cupboard	21	10.5
Total	200	100
Sliced Watermelons		
Placed in a refrigerator, without wrapping	110	55.0
Wrapped in a polythene and stored in a refrigerator	37	18.5
Wrapped in a polythene bag and placed in the kitchen	32	16.0
Placed in a plastic bowl and stored in a cupboard	21	10.5
Total	200	100

Table 6: Storage of Purchased Watermelons

The responses presented in Table 6 indicate that 64(32.0%) just left the watermelons in the refrigerator, and 63(31.5%) stored the melons in the fridge after wrapping them in polythene bags. The remaining 73(36.5%) respondents answered that they left the melons either in the cupboard or on any surface in the kitchen.

Concerning sliced leftover watermelons, 110(55.0%) the respondents said they stored them in the refrigerator without wrapping them but 37 of them representing 18.5%, stored their leftover sliced watermelons wrapped in polythene in the refrigerator. Thirty-two (16.0%) of the respondents stored theirs in the kitchen after wrapping them in polythene bags but the remaining 21(10.5%) placed the sliced watermelons in bowls and stored them in their cupboards.

The way sliced watermelons were stored did not seem to be in line with the proper method of storing watermelons in order to retain the vitamin C. The reasons include the fact that oxidation will go on since the kitchen is warm. A research conducted by Stevens way back in 1980, found out that oxygen was the most destructive element in causing the degradation of vitamin C in fruits.In a similar research by Bryan (2000), heat was revealed to be a factor that depletes the levels of vitamin C. Bryan further found out that the total available heat in climate also affects vitamin C levels of fruit. According to Chang and Fernandes (2000), fresh fruits and vegetables provide abundance of vitamin C if only there is absence of these conditions: heat, water, light and oxygen. These practices again indicate that sliced watermelons were not treated in ways that would retain the vitamin C, because the warm environment will certainly aid the loss of vitamin C through oxidation.

3.5. Knowledge of Watermelon Consumers on Factors the Vitamin C Content in Watermelons

The need for this study was largely based on the observations of the manner in which watermelon consumers and sellers handled the fruit. Respondents were asked to express their views on certain statements in order to ascertain the knowledge they had on the effects

of different conditions on vitamin C content of watermelons. The means of the statements were analyzed and compared with the general mean of each statement which is 3.00. Table 7 presents the results in a descending order.

	Statements	Strongly Agree No. (%)	Agree No. (%)	Somehow Disagree No. (%)	Disagree No. (%)	Strongly Disagree No. (%)	Mean	Standard Deviation
1	Watermelons contain Vitamin C	55(27.5)	56(28.0)	16(8.0)	51(25.5)	22(11.0)	3.35	1.39
2	Watermelons exposed to sunlight for a long time can loose the Vitamin C content	64(32.0)	26(13.0)	14(7.0)	64(32.0)	32(16.0)	3.25	1.99
3	Watermelons can lose an appreciable amount of Vitamin C in a warm room	55(27.5)	27(13.5)	46(23.0)	43(21.5)	29(14.5)	3.18	1.42
4	Whole watermelons can lose Vitamin C	38(19.0)	40(20.0)	31(15.5)	59(29.5)	31(15.5)	3.08	1.63
5	Vitamin C in watermelons is easily destroyed by Oxygen	58(29.0)	22 (11.0)	23(11.5)	47(23.5)	50(23.0)	2.97	1.60
6	Vitamin C in watermelons can be lost at room temperature	46(26.0)	27(13.5)	32(16.0)	61(30.5)	34(17.0)	2.95	1.43
7	Vitamin C is easily oxidized on exposure to light	56(28.0)	24(12.0)	26(13.0)	27(13.5)	67(33.5)	2.87	1.65
8	Sliced watermelons should be consumed immediately	56(28.0)	24(12.0)	26(13.5)	27(13.5)	67(33.5)	2.87	1.65
9	Sliced watermelons lose most of their Vitamin C, even inside the room	28(14.0)	40(20.0)	45(22.5)	47(23.5)	40(20.0)	2.84	1.33
10	Vitamin C is unstable to heat	38(19.0)	41(20.5)	19(14.5)	51(25.5)	51(25.5)	2.82	1.49
11	Leftover watermelons must be wrapped and stored in cool temperature	48(24.0)	27(13.5)	24(12.0)	34(17.0)	66(33.0)	2.80	1.61

Table 7: Respondents' Views on the Factors Affecting the Level of Vitamin C of Watermelons

On the whole, it can be concluded that the respondents' knowledge on the effects of different conditions on the vitamin C content in watermelons is just fair. This conclusion is based on the examination of the results presented in Table 7, which indicate that the consumers in the study agreed with four of the statements on the factors affecting vitamin C in watermelons.

i) Watermelons contain vitamin C;
ii) Watermelons exposed to sunlight for a long time can lose the Vitamin C content;
iii). Watermelons can lose an appreciable amount of Vitamin C in a warm room; and
iv. Whole watermelons can lose Vitamin C.

These statements had means of 3.35 and Standard deviation of 1.39), 3.25 and Standard deviation of 1.39, 3.18 and Standard deviation of 1.39 and 3.08 and Standard Deviation of 1.39), which are all above but close the general mean of 3.0.

A comparison of the results with the responses on the forms in which they purchased watermelons and how they handled and stored the fruits are in line with their knowledge on the environmental factors that influence vitamin C content of watermelons. In other words, their knowledge on the statements was reflected in the responses to the way they handled watermelons. Their responses clearly revealed that they did not have much knowledge on the environmental influences on the vitamin content of watermelons. They disagreed with the following seven statements:

i) Vitamin C in watermelons is easily destroyed by Oxygen (Mean = 2.97, SD 1.60);
ii). Vitamin C in watermelons can be lost at room temperature (Mean = 2.95, SD 1.43);
iii). Vitamin C is easily oxidized on exposure to light (Mean = 2.87, SD 1.65);
iv). Sliced watermelons should be consumed immediately (Mean = 2.87, SD 1.65);
v). Sliced watermelons lose most of their Vitamin C, even inside the room;
vi). (Mean = 2.82, SD 1.33; Vitamin C is unstable to heat (Mean = 2.82, SD 1.49) and
vii). Leftover watermelons must be wrapped and stored in a cool temperature (Mean = 2.80, SD 1.61).

These statements had means below 3.00 (means between 2.80 and 2. 97). Surprisingly, the consumers in the sample generally had high levels of education and so it was assumed that they would practice what they knew.

In the literature, Barasi and Mottram (1993) listed the conditions decreasing vitamin C in fruits and they include: sunlight, wilting, bruising and exposure of cut surfaces, temperatures above 85ºC, inactivating the oxidizing enzymes, and keeping fruits kept under the sun for some time was very destructive to vitamin C. they added that when fruits are kept under the sun for 15 minutes, a quarter of the original amount is lost and after 90 minutes three quarters is lost. The problem is greater when fruits are transported from farm gates under the sun to distance markets. Other researchers support the findings. For example, in a research by Stevens (1980), oxygen was found to be the most destructive element in causing degradation of vitamin C.

In a similar research by Bryan (2000), heat was revealed as a factor that depletes the levels of vitamin C. Bryan further found out that the total available heat in climate also affects vitamin C levels of fruits. Areas with cool temperatures produce fruits such as watermelons and oranges which have high vitamin C content. According to Chang and Fernandes (2000), fresh fruits and vegetables provide abundance of vitamin C if only there is absence of these conditions: heat, water, light and oxygen. This shows that quite a

number of the respondents did not appear to have a good knowledge on the issues raised on the factors that affect vitamin C content of watermelons.

3.5.1. Hypotheses

One-Way ANOVA was used to compare the means obtained for the responses on the knowledge of respondents of different educational levels to test whether the differences were statistically different. The test was again conducted by comparing the means of the knowledge of respondents from different occupations on factors that affect vitamin content of watermelons were statistically different. The results are presented in Table 8.

S/N	Statements	Educational	Level	Occupation	
		F- value	Significance Level	F- value	Significance Level
1	Watermelons contain Vitamin C	78.135	.000	32.348	.000
2	Watermelons exposed to sunlight for a long time can lose the Vitamin C content	15.634	.000	4.539	.004
3	Watermelons can lose an appreciable amount of Vitamin C in A warm room	26.046	.000	14.574	.000
4	Whole watermelons can lose Vitamin C	5.582	.000	9.388	.000
5	Vitamin C in watermelons is easily destroyed by Oxygen	25.552	.000	13.042	.000
6	Vitamin C in watermelons can be lost at room temperature	28.178	.000	14.207	.000
7	Vitamin C is easily oxidized on exposure to light	11.949	.000	6.534	.000
8	Sliced watermelons should be consumed immediately	29.569	.000	16.841	.000
9	Sliced watermelons lose most of their Vitamin C, even inside the room	24.719	.000	12.722	.000
10	Vitamin C is unstable to heat	15.634	.000	4.539	.004
11	Leftover watermelons must be wrapped and stored in a cool temp	21.591	.000	10.119	.000

Table 8:One-Way ANOVA on Educational Level and Occupation and Respondents' Knowledge on Factors that Affect Vitamin Content of Watermelons

The results of the One-Way ANOVA presented in Table 8 indicate that the differences between i) educational level of the respondents and their knowledge on factors that affect vitamin content of watermelons, and ii) differences between respondents from various occupations and their knowledge on factors that affect vitamin content of watermelons were all statistically significant with values of .000 and .004 at 0.05 significance level.

4. Summary, Conclusions and Recommendations

In this section the summary, conclusions and recommendations are presented

4.1. Summary of Key Findings

1. Out of the 200 respondents, 101(55.5%) were females and 99(49.5%) were males and most of them, 82.5% were between the ages of 21 and 40 years, with 82.5% aged from 21 to 40 years.
2. Of the 200 respondents, 25 (12.5%) basic/middle, 16.0% had second cycle (senior high, vocational and technical) school certificates, 12.5% had diploma, and postgraduate levels of education respectively. Ninety-four 94 (47.0%) were undergraduates.
3. Thirty-seven (18.5%) were traders, 94 (47.0%) were students, 39 (19.5%) were Junior and Senior Staff and 15.0% were Senior members composed of Lecturers, Senior Assistant Registrars, and Medical Officers.
4. As high as 65.0% of respondents consumed watermelons less than twice a week and but 21.0% consumed watermelons six or seven times daily.
5. Most of the respondents, 109(54.5%), obtained watermelons from the traders stationed at the market place either in town, along the road or on campus and 83(41.5%) bought the melons from the peddlers who hawked them.
6. The majority (70.0%) of the respondents chose specific sources of watermelon for the sake of convenience.
7. Ninety-two (46.0%) of the consumers purchased watermelons in the sliced form, 62 (31.0%) purchased watermelons whole and 46 (23.0%) bought either the sliced or whole watermelons.
8. Slightly more than half of the consumers, 110 (55.0%) claimed they ate the watermelons immediately after purchase, 38 (19.0%) normally ate the watermelons between 30 minutes to 24 hours after purchasing the fruit and 20 (10.0%) ate them usually between 30 minutes and 3 days
9. Sixty-four **(**32.0%) **c**onsumers stored watermelons in the refrigerator, 63(27.5%) stored the melons in the fridge after wrapping them in polythene bags. The remaining 73(41.9%) respondents left the melons either in the cupboard or on any surface in the kitchen.
10. Concerning sliced leftover watermelons, 110 (55.0%) the respondents said they stored them in the refrigerator without wrapping them but 37 (18.5%) wrapped them in polythene and stored in the refrigerator, 32(16.0%) stored theirs in the kitchen after wrapping them in polythene bags but the remaining 21(10.5%) placed them in bowls and stored them in their cupboards.

11. The consumers in the study agreed with four of the statements on the factors affecting vitamin C in watermelons which are: i) Watermelons contain vitamin C (mean, 3.35 and Standard deviation of 1.39); Watermelons exposed to sunlight for a long time can lose the Vitamin C content (Mean = 3.25 and Standard deviation of 1.39); Watermelons can lose an appreciable amount of Vitamin C in A warm room (3.18 and Standard deviation of 1.39) and Whole watermelons can lose Vitamin C. and 3.08 and Standard deviation of 1.39),
12. They disagreed with the following seven statements: i) Vitamin C in watermelons is easily destroyed by Oxygen (Mean = 2.97, SD 1.60); ii). Vitamin C in watermelons can be lost at room temperature (Mean = 2.95, SD 1.43); iii). Vitamin C is easily oxidized on exposure to light (Mean = 2.87, SD 1.65); iv). Sliced watermelons should be consumed immediately (Mean = 2.87, SD 1.65); v). Sliced watermelons lose most of their Vitamin C, even inside the room; vi). (Mean = 2.82, SD 1.33; Vitamin C is unstable to heat (Mean = 2.82, SD 1.49) and vii). Leftover watermelons must be wrapped and stored in a cool temperature (Mean = 2.80, SD 1.61).
13. The results of the One-Way ANOVA indicated that the differences between i) educational level of the respondents and their knowledge on factors that affect vitamin content of watermelons, and ii) differences between respondents from various occupations and their knowledge on factors that affect vitamin content of watermelons were all statistically significant with value of .000 and .004 at 0.05 significant level.

4.2. Conclusions

1. The watermelon consumers in this study had high levels of education and apart from a few (19.0%) who were traders, the rest were all university students and employees made up of junior, senior staff and senior members.
2. Very few of the respondents being eight (4.0%) in number either obtained watermelons from their farms or their backyard gardens. This goes to show that the respondents mainly purchased their watermelons. It would have been very good to have backyard garden since the watermelons are likely to be picked fresh and at the time when they are needed and are also likely to have a lesser risk of losing the vitamin C content as compared to the ones obtained from the markets and peddlers.
3. Very few of them, 14 (7.0%) based their decisions for selecting watermelons based on the possibility of nutrient-loss.
4. Most of the consumers stored leftover watermelons, whole or sliced in the warm kitchen or room, in some cases, without wrapping them in polythene bags, which will not help in conserving the vitamin C.
5. On the whole, it can be concluded that the respondents' knowledge on the on the effects of different conditions on the vitamin C content in watermelons was just fair, based on their views on the statements on factors affecting the Vitamin C content of watermelons.
6. Surprisingly, the consumers in the sample generally had high levels of education and so it was assumed that they would practice what they knew. Their responses however, clearly revealed that they did not have much knowledge on the how to handle watermelons in order to conserve vitamin C.
7. The results of the One-Way ANOVA indicated that the differences between i) educational level of the respondents and their knowledge on factors that affect vitamin C content of watermelons, and ii) differences between respondents from various occupations and their knowledge on factors that affect vitamin C content of watermelons were all statistically significant with values of 0.000 and 0.004 at 0.05 significance level.

4.3. Recommendations

Given the results of the present study, the general overview of the related literature and the fact that sunlight and bad handling practices influence the vitamin C content in watermelon, the recommendations are:

1. The Ministry of Health, particularly, the Public Health Division should educate consumers on the importance of vitamin to health.
2. The environmental and community health personnel should organize a lot of education on the mass media about the effects of selling fruits in the sun. Watermelon peddlers should be forced to sell the sliced watermelons under the shade.
3. As much as possible, all individuals and institutions that are involved in the production and marketing of watermelons should make it a point to prevent exposure of watermelons to sunlight and high temperatures. This can be ensured by keeping watermelons under sheds neatly arranged on a platform. Watermelon suppliers can keep watermelons in well-ventilated cargo vehicles or at the back of vehicles covered with thick fabric during the transportation and supply of watermelons to traders to prevent exposure to sun.

4.4. Areas for Further Studies

Further studies should be carried out on consumers' knowledge on the effects of environmental conditions vitamin B. This is because it one of the unstable vitamins.

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