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EVALUATING CONSUMER ACCEPTABILITY OF WATERMELON BRITTLE

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ABSTRACT
The aim of the study was to produce and evaluate the acceptability of watermelon brittle. Three different samples of watermelon seed brittle were produced and coded as A, B and C in a ratio 100:0, 50:50 and 70:30. Product A contained 100% crushed water melon seed, B 50% crushed watermelon seed and 50% groundnut, C 70% crushed watermelon seed and 30% groundnut. The study population was drawn from households in Kwadaso Sub-metropolitan area of Kumasi Metropolis in the Ashanti Region of Ghana. The coded products were sent to the field for sensory analysis using a 9 point hedonic rating Scale where 9 represents 'Liked very much' and 1 'Disliked extremely'. The study noted that, greater numbers of people are aware of the use of watermelon seeds. However, only few people had actually used water melon seeds to prepare a product before. Product C containing 70% crushed watermelon seed and 30% groundnut was accepted as very good in terms of taste, flavour, appearance, texture and colour.
KEY WORDS: ***Watermelon brittle, groundnuts, snacks, consumer acceptability, Kumasi Metropolis***

INTRODUCTION

The achievement of good health status has become a major concern of policy-makers in recent times. This can be deduced from the sustainable development goals targeting the achievement of some goals and targets by 2030. Among such goals are the measures to end hunger (Goal 2), to ensure good health and well-being (Goal 3). As at 2015, more than 800 million people around the globe still live under $1.25 a day and that has serious repercussion on their dietary intake and health status (UNDP, 2015). Poor health has therefore remained a challenge, especially in developing countries. For instance, whilst some parts of the world have recorded over-nutrition, others have track records of under-nutrition [1, 2, 3].

In the developed countries, daily intake of fruits is routine unlike the case of developing countries. Fruits form part of daily diet of the rich and hardly the poor. In Ghana, the entire country consumes about 4,729 tonnes of fruits. The principal fruits consumed are pineapple, citrus, banana, cashew, pawpaw, mangoes, tomatoes, watermelon, pepper, okro, eggplant and onion. Among these fruits, water melon is gaining prominence globally.

Watermelon otherwise (*Citrullus lanatus*) is one fruit that can be developed into many products. Watermelon which is from the cucumber group is an oval or round in shape with very smooth skin, dark pre-pale green in colour. It becomes yellowish green when matured. The watermelon fruit is a good source of vitamins and it is usually used for breakfast, snacks and served as appetizer in most homes and events. The watermelon fruit provides phytochemical and lycopene which serves as antioxidant during normal metabolism

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and guards against cancer and other non-communicable diseases [4].

The Juice or flesh of watermelon is consumed whilst the rind and seeds are normally treated as solid wastes [5]. However, kernel from watermelon seeds can be used for bread, cake, confectionery and snack [6]. Apart from these, the seed of the watermelon fruit can be used in other areas such as food application. The seeds can also be cooked, grounded and fermented to be used as species in gravies and local soups [7, 8, 9].

Watermelon seeds have their own nutritional constituents; proteins, fats, iron and other nutrients. Watermelon seeds are also a source of calories. Its seed are rich in nutrients and minerals. It contains crude protein and oil in appreciable quantities. The seed oil contains 80 % unsaturated fatty acids with linoleic acid being the dominant fatty acid [10]. The study was undertaken to ascertain consumer acceptability of watermelon seed brittle.

MATERIALS AND METHODS

2.1 Study design

This is an experimental study. The study was in two parts. Initially, consumer awareness and utilization of watermelon seeds were evaluated using questionnaires. Subsequently, consumer acceptability of watermelon seeds based brittle was also evaluated using point hedonic rating scales.

2.2 Population of Study

The study population was drawn from households in Kwadaso Sub-metropolitan area of Kumasi Metropolis in the Ashanti Region of Ghana. The Kwadaso sub-metropolis has a population of 210,000 [11]. Ashanti Region was chosen based on its urbanized nature, multi-ethnicity, busy administrative works, business orientation and the easy access to fruits and high level of fruit usage based on the population volume of the region.

2.3 Selection of Sample Size of the Study

The sample size was determined by adopting the following statistical formula for minimum sample size calculation (Yamane, 1967).

$$n = \frac{N}{1 + N(e)^2}$$

Where n=minimum sample size
N=210,000 (Population in the Kwadaso sub metro area)
e = 5% (the margin of error)

$$\frac{210{,}000}{1 + 210{,}000\ (0.05)^2}$$

n=210,000 /526

(1st Stage) 1st n=400 respondents

In the 2nd stage, the researchers were interested in selecting respondents from households. The total number of households in Kwadaso sub-metro =19,964. To get the number of households for the semi-structured interviews the 19,964 was divided by 400 respondents and the result was 50 households which were used for the study.

Therefore 2nd n=50 households

2.4 Households Members Selection for the Semi-Structured Interviews

The Kwadaso sub metropolitan area is divided into 8 enumeration areas. These are Kwadaso Nsuom, Apatrapa, Nyankyerenease, Kagyare, Edwenease, Ohwimasi, Tanoso and Kwadaso Estates. In 6 of enumeration areas, simple random selection was used to select 6 households for the interviews and 7 households each selected at Tanoso and Kwadaso estates which are the biggest enumeration areas to get a total of 50 households. Simple random sampling is used to the person to be interviewed. All the names of the persons above 15years are written on pieces of papers and people blinded to pick. The person who picks the folded paper with the word 'interview' is then interviewed. After the interview, the phone number of the interviewee was collected and was contacted for the second part of the interview pertaining to the consumer acceptability of watermelon seed brittle.

2.5 Pre-testing

The instruments were pretested at Suame in Kumasi Metropolitan Area. This area equally had the characteristics of the Kumasi Metropolitan Area in terms of cluster of schools, population characteristics, commercial activities, and among others. The outcome of the pretesting was assessed and questions that need amendments were amended accordingly.

2.6 Ethical Consideration

Ethical approval was sought from the Department of Catering and Hospitality, University of Education Kumasi.

2.7 Informed Consent and Confidentiality

The respondents chosen were briefed about the research and the various objectives it hoped to achieve. For those who may not understand English the researcher explained to them in the Twi language. The respondents were assured of strict confidentiality as especially in the management of data and report writing. No identity of respondents was revealed. Those who agreed to take part in the research were given a consent form to sign and date and the time for the interview was fixed. This arrangement was made for those respondents who could not have time instantly

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to fill the questionnaire. However, those respondents who had the time, questionnaires were given instantly.

2.8 Formulation of Watermelon Seed Products

2.8.1 Ingredients formulation

Three different samples of watermelon seed brittle were produced and coded as sample A, B and C in a ratio 100:0, 50:50 and 70:30.

Table 1 Watermelon Seed Brittle Preparation

INGREDIENTS	A	B	C
Crushed watermelon seed (g)	100	50	70
Groundnuts (g)	0	50	30
Sugar (g)	50	50	50

A (100% crushed water melon seed**), B (**50% crushed watermelon seed and 50% groundnut**),**
C (70% crushed watermelon seed and 30% groundnut**)**

Method of preparation

Watermelon seeds were procured. The seeds were put in a bowl of water for 1 hour. The seeds floated were not good and thus discarded. The seeds were washed with water and sundried for 48 hours and after which it was roasted for 15 minutes in the oven at 162°C to make them brown and crispy. The seeds were crushed to get a flaky texture. Subsequently, sugar was melted into a caramel at a temperature of between 160°C and 171°C for 10minutes. The crushed seed was added to the caramel and was stirred for 5minutes until thoroughly mixed. After which the mixture was poured on a smooth working board. Rolling pin was used to spread the mixture to a thickness of 1cm. It was then quickly cut into a desired size and shape. This is shown on flow chart 1

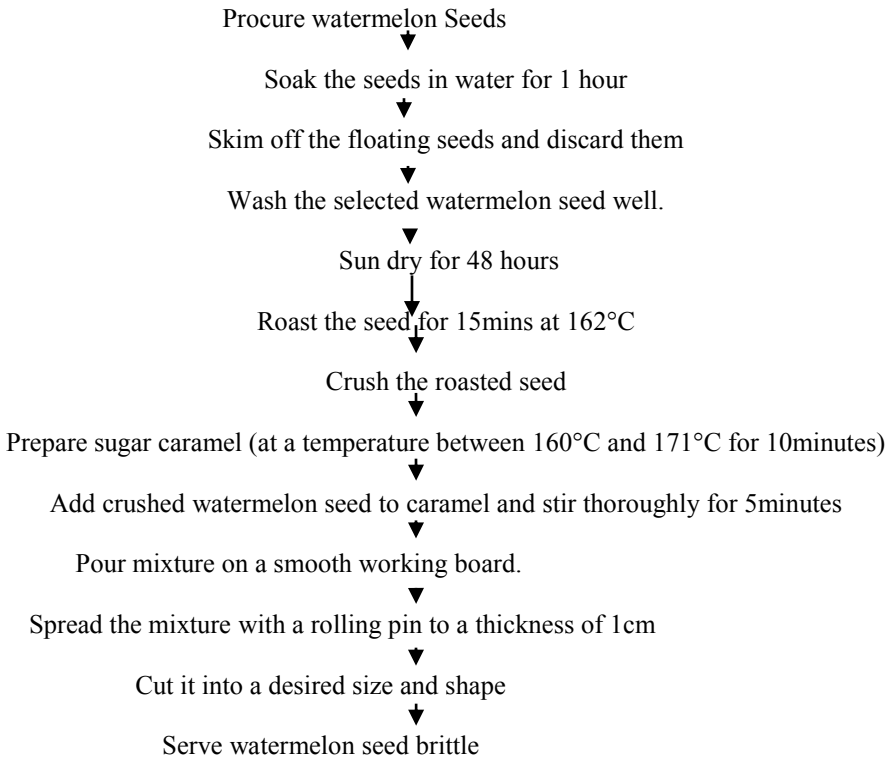

Figure 1: Flow chart of water melon brittle preparation

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Plate 1: 100% Watermelon Seed Brittle

Source: Field Data, 2018

Plate 2: 50% Watermelon Seed and 50% Groundnut Brittle

Plate 3: 70% Watermelon Seed and 30% Groundnut Brittle

Sensory evaluation of the three products

Three products below were prepared and sent to the field for sensory analysis. These were watermelon seed brittle, mixed watermelon seed and groundnut brittle and groundnut brittle. Respondents were asked to compare the three products based on colour, appearance, taste, flavour and texture. The study put the sensory characteristics on a Hedonic Rating Scale 9-1 [12, 13]. These were: Liked extremely 9, Liked very much 8, Liked moderately 7, Liked slightly 6, Neither liked nor disliked 5, Disliked slightly 4, Disliked moderately 3, Disliked very much 2 and Disliked extremely 1 respectively.

Statistical Analysis

Data were analyzed using the software, Statistical Package for Social Sciences (SPSS) version 22.00 (SPSS inc., Chicago), IL, USA.

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RESULTS AND DISCUSSION

Table 2 Background characteristics of respondents

Demographic Characteristics	Frequency (%)
Age	
15-25 years	5 (10)
26-35 years	10 (20)
36-45 years	21 (42)
46-55 years	8 (16)
56+ years	6 (12)
Gender	
Male	10 (20)
Female	40 (80)
Educational Status	
None	3 (6)
Basic Educ.	8 (16)
SHS	23 (46)
Tertiary	16 (32)

Source: *Field Data, 2018*

The characteristics of respondents' background have a crucial role to play in a research study. One such characteristic is the age distribution of respondents. In adult research, it is assumed that, the older the age distribution, the higher the reliability of the feedback. In the current study, the age distribution ranged between 15years to 60years with an average age of 31years. From Table 2, it was noted that, persons between the ages of 36-45years were the highest accounting for about 21 out of the total of 50 respondents' while persons between the age ranges of 15-25years recorded the lowest of 5. Knowing the age range and the mean age gives an impression about the categories of people used in the study in terms of their experiences which may also give credibility to the results obtained from the study.

In terms of gender, 40 of the respondents where females while males accounted for 10. The implication is that, the gender dynamics in the current study reflects the national statistics of Ghana in which females have been sampled more than men in all surveys. For instance, in all the Ghana Demographic and Health Surveys (GDHS) women have been sampled more than men (GDHS, 1988, 1993, 1998, 2003, 2008 and 2014). In the 2014 GDHS, out of a total sample of 14,005 respondents, 9,396 were women as against 4,609 men. This gender dynamics is also in line with the 2010 National Population and Housing Census report which revealed that, the sex composition of Ghana was 51.2% for women as against of 48.8% for men.

The study found that, about 70% of the respondents were married and about 3% separated as shown on Table 2. Even though there variations in the percentage of married women and men between the results of the current study and the national data, the trends are the same. For instance, the Ghana Living Standard Survey Round 6 has equally reported that, about 39.4% of the Ghanaian population are married as against 5.6% widowed. Moreover, the respondents' ethnic relations were also studied and it was noted that, about 70% of the respondents were Akans, 20% were from the Northern Regions of Ghana and 8% of the respondents were from the Ga and other tribes classified accounted for 12% as demonstrated on Table 4.1. The ethnic relations results of the current study is in conformity to the national ethnicity composition as the Akans form about 47.5% even though the percentage figures differs (Population and Housing Census, 2010).

The educational status of respondents was analysed into: No education attendance, basic education, senior high education or its equivalent and tertiary education attainments. The study found that, about 20% of the respondents had basic education, 35% had tertiary education, 50% had senior high education and 5% had never attended formal school in their life. The 2010 population and housing census reports that, about 44.6% of Ghanaians have attained education below

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middle school living certificate (MSLC) or Basic Education Certificate Examination (BECE). The document further mentioned that, while about 21% had attained MSLC/BECE, only about 14.7% have acquired Senior High School (SHS) or Tertiary Education. Therefore the result of the current study is contrary to the national educational attainment statistics data.

Table 3 Awareness of Respondents on the Uses of Fruit Seeds in Ghana

Category	Freq	Percentage (%)
People who are aware fruit seeds are useful	35	70
People who are not aware fruits seeds are useful	10	20
Not Sure	5	10
Total	50	100

Source: *Field Data, 2018.*

About 70 % of the respondents asserted that, they are aware fruit seeds are useful as shown Table 3. [14], discuss how fruits seed have been universally promoted as healthy. According to the authors, the usefulness of fruit seed has been documented by the Dietary Guidelines for America 2010. Therefore fruits seed have been held up as very useful due to the numerous concentrations of vitamins, mineral, electrolytes, phytochemicals and antioxidants.

Table 4 Respondents who have actually used fruits in Ghana

Category	Freq	Percentage
Respondents who have used fruits seeds before	25	50
Respondents who have not used fruits seeds before	15	30
Not Sure	10	20
Total	50	100

Source: Field Data, 2018.

An enquiry into the uses of fruit seed shown that, about 50 % of the respondents have use fruit seed before as shown on the Table 4. The International Tropical Network (2010) has mentioned that close to about 80% of the global population has used fruit seed either as food or as medicinal. The importance of fruit seed to the health is therefore noted. Among such fruit seeds are the African Oil Bean**,** Prekese (*Tetrapleura tetraptera*) and the African Mango *(Irvingia gabonensis*)

Table 5: Awareness of Developing Edible Product from Watermelon Seeds

Watermelon Seed Status	Freq.	Percentage (%)
Watermelon Seeds are edible	33	66
Watermelon Seeds are not edible	10	20
Can't tell	7	14
Total	50	100

Source: *Field Data, 2018.*

Respondents were asked of their awareness of the usage of watermelon seed in preparing an edible product. It was found that, 33 (66 %) of the respondents signed up that, watermelon seeds are useful. They asserted that, the seeds are either used as food or for medicinal. According to the respondents, they are aware watermelon seeds contains many vitamins and mineral salts that they may not be able to mention as lay persons. A study has established that, watermelon seeds are packed with nutrients including fatty acids, essential proteins and lots of minerals. The study further revealed that, Around 100 gram of watermelon

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seeds provide around 600 calories same as having 10 loaves of bread. Around 400 calories come from fats in watermelon seeds. Fat content in 100 gram of watermelon seeds is around 80% of daily dietary requirement of fats. Around one third of watermelon seeds is proteins, mainly highly essential proteins like lysine [15]. These findings are therefore in accordance with the previous findings of [16] who also reported the potential edible uses of watermelon seed.

Table 6: Ever Used Watermelon Seed to Prepare any Product for Consumption

Category	Freq.	Percentage (%)
Respondents who have used watermelon seed before	13	26
Respondents who have not used watermelon seed before	37	74
Total	50	100

Source: *Field Data, 2018.*

However, of the 37 (74 %) respondents who have not used the watermelon seed to prepare a product for consumption before, 33 of them believed watermelon seeds can be used to develop other products. Truly, their assertion was confirmed by the report of [17], who disclosed that, watermelon seeds oil is used for soap, cosmetics, foam and firing of industrial boilers that are used in animal feed formulation.

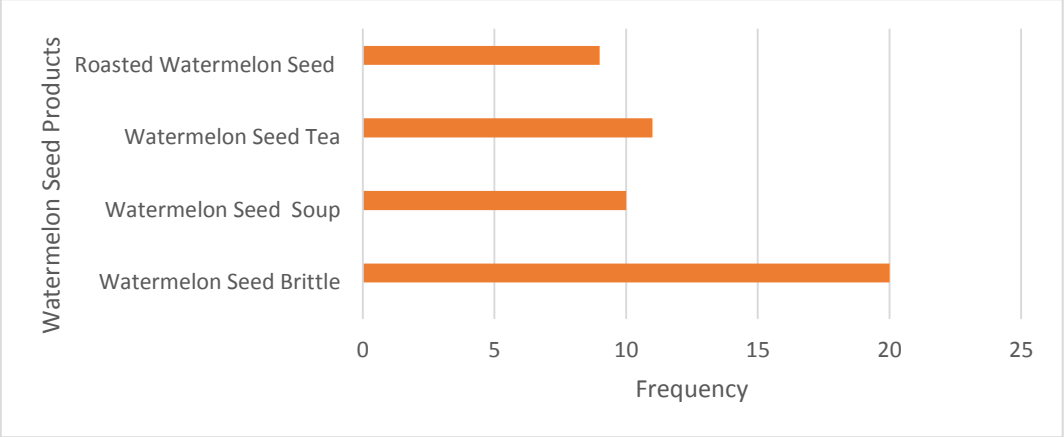

Figure 2: Percentage of People Who Identified At least One Product made from Watermelon Seeds
Source: *Field Data, 2018.*

Respondents were asked to identify one food products that is prepared from watermelon seeds. It was revealed that, 20 (40%) of the respondents identified that brittle is made from watermelon seed as shown on Figure 2. Respondents revealed that, watermelon seed can be used to develop watermelon seed tea, watermelon seed soup and roasted watermelon. Equally, other studies have revealed that, watermelon seeds can be used for watermelon seed protein bars, watermelon seed granola, watermelon seed snacks, watermelon seed flour, watermelon seed cooking oil and oil for production of cosmetics [18, 19, 20]

Table 7 Comparison of Sensory Characteristic by Respondents

Type of Brittle	Colour (Visual system) Average Score	Appearance (Visual system) Average Score	Taste (Gustatory system) Average Score	Flavour (Olfactory System) Average Score	Texture (Tactile & auditory system) Average Score	Overall Acceptability
TC-1	6.5	6.2	7.6	7.1	8.1	35.5
DA-1	6.2	5.7	7.4	7.6	6.3	33.2
BC-1	7.2	6.7	7.9	8.4	5.9	36.1

Source: *Field Data, 2018.*

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TC-1= Watermelon seed brittle
DA-1= Mixed watermelon seed and groundnut brittle
BC-1= Groundnut brittle

The overall acceptability results in Table 7 shows that, respondents liked groundnut brittle most (36.1) and closely followed by watermelon seed brittle (35.5). In general, the respondent mentioned that, there were not many differences between the three products.

Table 8 Reasons for Sensory Score of the three Products

Type of Brittle	Colour	Appearance	Taste	Flavour	Texture
Watermelon seed brittle	*Darker than groundnut brittle *Not bright like groundnut	*A bit shinny * attractive	*Taste not so much good like groundnut brittle *	*Has a good flavour	*Very fibrous *Takes a bit of effort during mastication for the brittle to be soft in the mouth
Watermelon seed and groundnut mix brittle	*Mixed colours seen *A bit darker than groundnut brittle	*Not shinny *Less attractive	*Taste not so much good like groundnut brittle	* Has a good flavour	*Not so much fibrous
Groundnut brittle	*Colour brighter than the two other products	* Very shinny * Very attractive	* Taste so sweet	* Has very good flavour than the two other products	*Not fibrous * Very gummy when chewing

Source: *Field Data, 2018.*

Respondents assigned various reasons for the sensory score of each of the three products under comparison. From Table 8, respondents assessed the colour, appearance, taste, flavour and texture. The respondents asserted that, the colour of groundnut brittle is brighter than the other two products. They also mentioned that, watermelon brittle has good flavour and very fibrous. Others also mentioned that, the texture of watermelon brittle was hard when chewing. In terms of appearance, respondents mentioned that, the groundnut brittle has the brightest colour.

CONCLUSION

The study noted that, greater numbers of people are aware of the use of watermelon seeds.

However, only few people had actually used water melon seeds to prepare a product before. The sensory analysis by the respondents showed that, groundnut brittle is the most liked product. The 2nd most liked product is watermelon seed brittle. The overall acceptability ratings for groundnut brittle and watermelon seed brittle by the respondents were too close portraying that, respondents did not notice much difference between the two products. However, there was a bit of sensory differences of mixed groundnut and watermelon seed brittle from the other two products. Product **C** containing 70% crushed watermelon seed and 30% groundnut was accepted as very good in terms of taste, flavour, appearance, texture and colour. The acceptability of the watermelon seed brittle was also noticed by the nature of comments given by respondents after the qualitative analysis.

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