

UNIVERSITY OF CAPE COAST

CONSUMER PERCEPTION OF GROUNDNUT QUALITY, AFLATOXIN
AWARENESS AND WILLINGNESS TO PAY FOR SAFE GROUNDNUTS IN
THE NORTHERN REGION, GHANA

BY

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CANDIDATE'S DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented before for another degree in this university or elsewhere.

Candidate's Signature:..... Date:

Name:.....

SUPERVISOR'S DECLARATION

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature: Date:.....

Name:.....

Co-Supervisor's Signature:..... Date:.....

Name:.....

ABSTRACT

The major purpose of this thesis is to measure the consumer perception of groundnut quality, their level of aflatoxin and willingness to pay for safe groundnuts in the Northern Region of Ghana. The major contribution of the report is to help protect groundnut consumers in the region from the menace of aflatoxins and promote consumption of safer groundnuts. The following objectives were embarked upon by the researcher: (1). To determine the consumer perception of good quality groundnuts (2). To determine the level of aflatoxin awareness among groundnut consumers and establish if it differs significantly among consumers at different levels of education. (3). To evaluate the relationship between the income level of households and their frequency of groundnut consumption. (4). To determine the percentage of consumers who will patronize groundnuts certified as safe for human consumptions at an extra cost of GH¢0.7 per 'bowl' or 'olonka (2088g). (5) To determine the factors which will significantly influence willingness of consumers to pay for certified groundnuts. The perception of consumers of groundnuts with respect to the conditions of groundnuts which expose them to aflatoxin contamination is low and hence they will accept groundnuts of low quality for household consumption. When it was measured, the level of awareness of aflatoxins was found to be very low in the Northern Region of Ghana. This level of awareness did not vary significantly among the mean awareness level of the different categories of residents in terms of their educational statuses.

The frequency of groundnut consumption by residents of Northern Region has an inverse relationship with the household income levels. Hence households with lower incomes tend to consume groundnuts more often than those with higher incomes.

In determining the factors which would influence consumer willingness to pay for groundnuts certified as safe for human consumption, the significant variables include the household income levels and the educational status of respondents.

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DEDICATION

To my father, Mr. Charles Awenluey Adama, my mother Mrs. Gifty Adama and all my siblings- Awentemi Zeniel, Akacha-wen Abu, Agoali-wen Adama, Akanaam Adama, Akpelie Adama, Awenlie Adama and Azebajiik Adama.

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LIST OF ACRONYMS

ANOVA:	Analysis of Variance
CDC:	Centre for Disease Control
CGIAR:	Consultative Group on International Agricultural Research
CV:	Contingent Valuation
CVM:	Contingent Valuation Methods
EC:	European Commission
EU:	European Union
FAO:	Food and Agricultural Organization
ICRISAT:	International Crops Research Institute for the Semi-Arid Tropics
IITA:	The International Institute of Tropical Agriculture
ITF:	International Trade Forum
NMP:	National Monitoring Programme
UHT:	Ultra Heat Treated
TLC:	Thin Layer Chromatography
UN:	United Nations

UNDP: United Nations Development Programme

USDA: United States Development Agency

WHO: World Health Organization

WTP: Willingness to Pay

CHAPTER ONE

INTRODUCTION

Background to the Study

According to the Food and Agricultural Organisation (FAO) (1996), food security is defined as physical and economic access to sufficient, safe and nutritious food to meet dietary needs. Food safety is an integral part of food security and is defined as protecting the food supply from microbial, chemical and physical hazards that may occur during all stages of food production including growing, harvesting, processing, transporting, retailing, distributing, preparing, storing and consumption, in order to prevent food-borne illnesses. Because of insufficient food to meet demand on the African continent, the majority of people are only concerned with satisfying hunger and do not give due attention to the safety of food.

Food and Agricultural Organization (1996) explained food safety as providing assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

FAO (2001) also asserted that food safety is becoming a dominant theme among the agricultural research and development community due to its linkage with national food security, agricultural and rural development and international agricultural trade. Conway and Toeniessen (2003) asserted that the safety of food and feed for human and animal consumption should be of topmost priority with regards to agricultural and food industries. Those involved in farming in sub-Saharan Africa constitute about 70% of the population, and food commodities are the major items of international trade for many West African countries. According to Bhat and Vashanti (1999), the quality and safety of food is important so that domestic and foreign markets are not compromised by the sale of low quality or unsafe food.

In 2005, FAO/WHO argued that it is imperative that food safety remains a concern in all situations in order to derive maximum benefit from even the little available food and strong political will and hence relevant food safety systems are essential from production to consumption. The two organizations again explained that resolution AFR/RC53/R5 of the WHO Regional Committee for Africa, urging countries to strengthen food safety programmes, was endorsed in 2003 and since then, many countries have initiated activities to improve food safety. This strategy on food safety consolidates past gains and provides a framework for protecting public health and economic development through reduction of the burden of food-borne diseases.

They also pointed out that persons suffering from diseases such as HIV/AIDS, tuberculosis, malaria, and other ailments which affect the African region are at a greater risk of being debilitated by unsafe food, as their immune systems are already compromised. Therefore they emphasized that the assurance of safe food is essential to improving the quality of life for those already affected by disease and similarly persons suffering from food-borne illness are more likely to contract other communicable diseases. Furthermore, food-borne diseases are one of the most important underlying factors for malnutrition.

In 1991, World Health Organisation (WHO) explained that food-borne diseases create an enormous burden on the economies of developing countries and consumer costs include medical, legal, and other expenses, as well as absenteeism at work and school. For many consumers who live at a subsistence level, the loss of income due to food-borne illness can perpetuate the cycle of poverty. Costs to national governments, as claimed, stem from increased demands on already overburdened and poorly funded healthcare systems in developing countries.

Aflatoxins, a group of toxins which are produced by certain mould, are known to contaminate groundnuts and make them unsafe for human consumption. When the aflatoxin level is beyond certain safe limits in groundnuts and maize, they pose health problems when consumed. In developed countries, tests are conducted to determine aflatoxin levels in groundnuts before they are imported to ensure consumer safety. However, in many developing countries including Ghana, there is no data as to whether consumers will patronize groundnuts with

safe levels of aflatoxins or not, since groundnuts tested and certified as safe for consumption are not yet on the market as compared to the markets of developed countries. There is also the issue of the level of aflatoxin awareness in developing countries which negatively influences food safety and food security since the level of awareness in many developing countries is low or non-existent altogether.

Statement of the Problem

Aflatoxins are potent carcinogens and immuno-suppressants; and produce several other effects collectively referred to as aflatoxicosis (Peers, Bosch, Kadldor, Linsell, & Plujmen, 1987; Ellis, Smith, Simpson & Oldham, 1991). They have a negative impact on human and animal health, and consequently, on national economics (Bhat & Vashanti, 1999). According to James *et al.*, (2004), poor knowledge of the aflatoxins and its health risks causes consumers to be exposed to the toxins through consumption of poor quality groundnuts. The International Institute of Tropical Agriculture (IITA) conducted an aflatoxin information campaign in 2003 in some West African countries, including Ghana, to determine the awareness of the health menace of consuming aflatoxins in foods. The study concluded that there is poor baseline information on aflatoxins among groundnut consumers (James *et al.*, 2004).

The researcher therefore investigated to find out what the level of aflatoxin awareness is among groundnut consumers in the Northern Region of

Ghana and their perception of groundnut quality with respect to aflatoxin contamination. Also, there is the issue of whether consumers will patronize safer groundnuts at an extra cost or not. Finally, data and information on the relationship between income levels of consumers and their frequency of groundnut consumption is not available. Nevertheless, this will be required in order to know the income category which is most at risk of aflatoxicosis.

Objectives of the Study

General Objective

The major objective of the study is to evaluate consumer perception of groundnut quality, level of aflatoxin awareness in groundnuts and willingness to pay for safer groundnuts in the Northern Region of Ghana.

Specific Objectives

The specific objectives are as follows:

1. To determine the level of consumer perception of good quality groundnuts in terms of the conditions which reduce groundnut quality by exposing them to aflatoxin contamination.

2. To determine the level of aflatoxin awareness among groundnut consumers and establish if it differs significantly among consumers at different levels of education.
3. To evaluate the relationship between the income level of households and their frequency of groundnut consumption.
4. To determine the percentage of consumers who will patronize groundnuts certified as safe for human consumptions at an extra cost of GH¢0.7 per 'bowl' or 'olonka (2088g).
5. To determine the factors which will significantly influence willingness of consumers to pay for safer groundnuts.

Research Questions

The questions to be answered by the research are as follows:

1. What is the level of consumer perception of good quality groundnut which is measured on the basis of groundnut conditions which expose them to aflatoxin contamination?
2. What is the level of aflatoxin awareness among groundnut consumers and does the level of aflatoxin awareness differ significantly among groundnut consumers in the region Northern Region of Ghana with different educational levels?

3. How is the income of households related with their frequency of consumption of groundnuts?
4. Which percentage of consumers will patronize groundnuts which have been tested and certified as safe for human consumption at GH¢0.70 higher than the current price per 'bowl' unit of groundnuts?
5. Which factors will significantly influence the WTP for the groundnuts tested and officially certified as safe for human consumption?

Research Variables

In measuring the consumer perception of groundnut quality, the variables used included the presence of foreign materials in the groundnuts, presence of broken and bruised groundnuts, shriveled nuts, insect-attacked kernels, colour, taste, mouldiness and dampness of groundnuts.

Level of formal education of respondents and their level of aflatoxin awareness were the variables used in determining the variation of aflatoxin awareness among consumers with different levels of education. The dependent variable in this estimation is the level of aflatoxin awareness and the independent variable is the educational status of respondents.

The variables involved in estimating the willingness of consumers to pay for groundnuts certified as safe for human consumption include the frequency of consumption of groundnuts, educational status, household income levels, level of

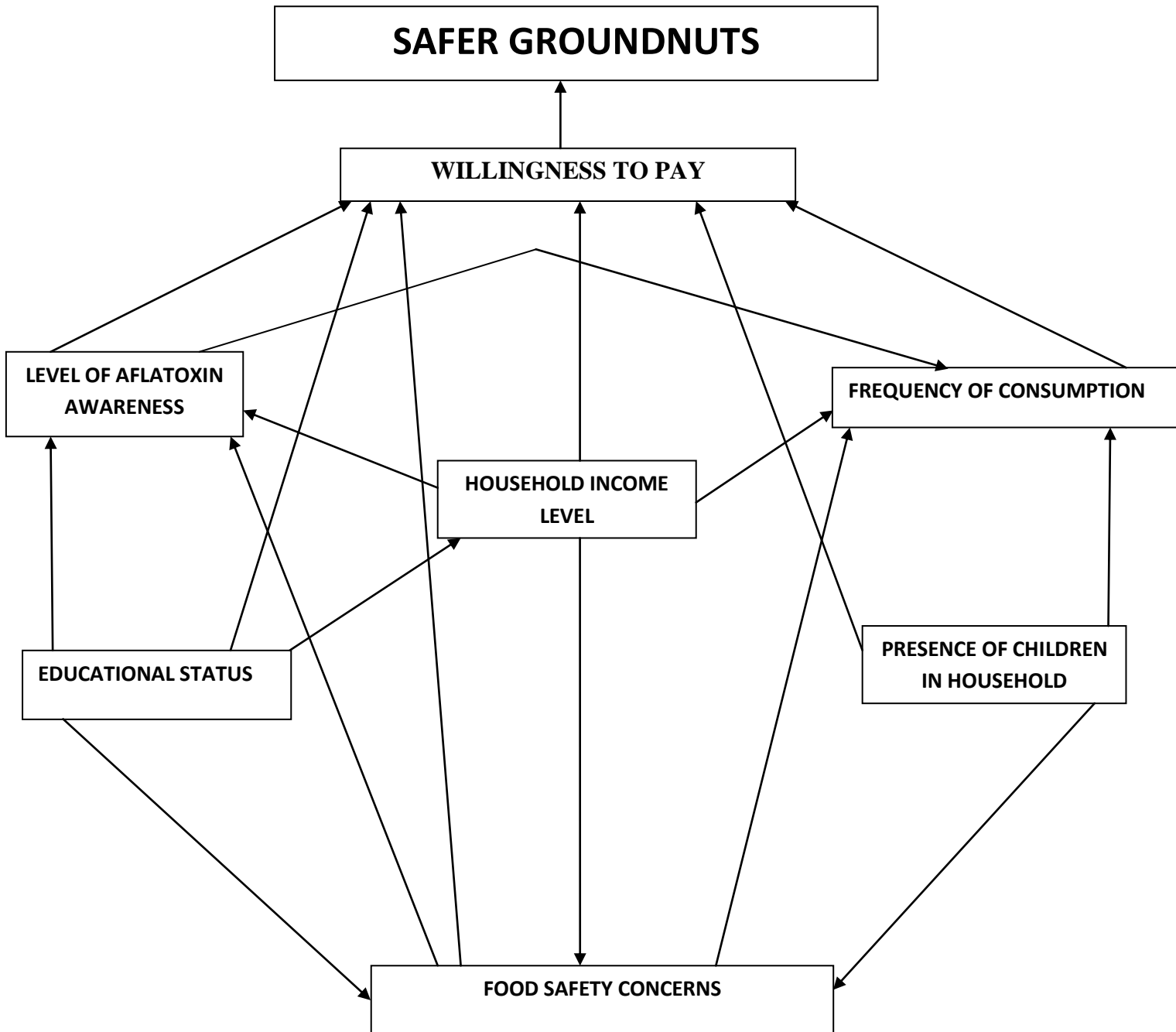
aflatoxin awareness, level of food safety awareness and the presence or absence of children in the household. These variables are the independent variables. The dependent variable is the consumers' willingness to pay for the groundnuts certified as safe from aflatoxin. Table 1 shows the details about the variables used in the study.

Table 1: Variables used in the study

Variable	Description	Type
X_I	Household income level	Continuous
X_S	Food safety concern	$X_S=1$ if concerned, 0 if otherwise
X_A	Level of aflatoxin awareness	$X_A=1$ if aware, 0 if otherwise
X_F	Frequency of consumption	Interval
X_E	Educational level	Ordinal
X_C	Presence of children in household.	$X_C=1$ if child/children present, 0 if otherwise.
Y	Willingness to pay	Dummy; $Y=1$ if willing, 0 if otherwise
P	Perception of groundnut quality	Ordinal.

Figure 1: Conceptual Framework

The figure below is the conceptual framework of the research topic under study



The conceptual framework (illustrated in figure 1) was developed to describe hypothesized determinants of concern about WTP for groundnuts certified as safe for consumption. This framework is derived from household production theory, which describes the determinants of household demand for products and product characteristics (Senaur, Asp and Kinsey, 1991). Socio-demographic variables such as educational level and number of children in the household influence household demand by altering the utility derived from goods and/or the costs of household production. In the framework, these socio-demographic variables influence concerns about food safety because they relate to consumer knowledge and/or perception of risk. Level of food safety concerns will influence frequency of consumption since increased concerns about food safety might either increase or reduce consumption of a food product. These variables also influence WTP for safety either directly, by influencing costs of avoiding illness, or indirectly, through their influence on food safety risks.

Income directly influences both frequency of consumption and WTP. Concern for food safety is differentiated from aflatoxin awareness because food safety concern is in the broader sense while aflatoxin awareness is with respect to groundnuts only. Thus, consumers might not be very concerned about food safety in general but be specifically interested in aflatoxin and its harmful effects. Food safety concern was modeled as a function of education level and presence of children (under age 13) in the household, total household income, and frequency of consumption. WTP was modeled as a function of educational level, income level, presence of children in the household, price of the commodity, food safety

concern, frequency of consumption and the level of aflatoxin awareness of respondents.

Hypotheses of the Study

The perception of consumers concerning groundnut quality is an important factor which influences their groundnut consumption habits in that a high perception of quality will encourage them consume high quality groundnuts as opposed to low quality groundnuts. According to the European Consensus on Development, (2006), level of education correlates positively with the level of awareness due to increased access to information.

Indeed, the relationship between income level and WTP offers contradictory empirical evidence. Nayga (1997) in his report on the impact of nutritional labeling on consumer willingness to pay for nutritional labeling asserted that income level of consumers has no significant relationship with their willingness to pay for labeled products. He also stated that the level of education of consumers significantly affected their willingness to pay for labeled products in a positive manner. On the other hand, a greater degree of confidence in food supply was verified in higher income levels (Buzby, Ready & Skees, 1995). This would explain and determine, at the same time, the investment of a great proportion of income to purchasing food products perceived as safer and of better quality. (Govindasamy & Italy, 1999)

Van Ravenswaay (1995) noticed that there was a significant attitudinal difference towards funeral flowers depending on the educational level and the more educated the consumers are, the smaller the likelihood is to have a positive attitude towards funeral flowers. Misra, Huang and Ott (1991), obtained a negative correlation between education and fresh organic products consumption. Groff and Kreider (1993) observed that those consumers with lower educational instruction considered fresh organic products as of higher quality than conventional ones; and therefore, were willing to pay higher prices for them. Eom (1994) found that better educated consumers seem to be more reluctant to modifying their consumption habits, due to the relevance these people ascribe to the information concerning food risks of little or null probability of occurrence. He adds, as an explanation, that better educated people seem to understand scientific information related with food risks, and, therefore, are more skeptical about the alleged benefits that the less risky food would generate. Van Ravenswaay (1995) also affirmed that highly educated respondents can easily have access to trustful information sources about food risks and benefits and, generally speaking, they are less worried about these issues.

On the flip side of the coin, Rodríguez , Lupín and Lacaze, (2006) reported that better educated consumers who eat healthy food, and consider food control organisms as ‘inefficient’, are more likely to buy organic products. According to these results, educated people seem to be more exposed to diet and health information sources, and can better understand and process them.

Consumers acquire products based on food safety attributes. When purchasing food, consumers make their choices by comparing prices and qualities. Such choices are definitely conditioned by the uncertainty they perceive in relation to the different qualities offered. Throughout these last years, organic agriculture has undergone a remarkable expansion due, among other things, to the greater interest awoken in producers and consumers. Such interest arises from an awareness process that involves food safety concerns. These concerns are related with real or potential quality risk perceptions linked with technologies applied to food production and processing (Henson, 1996).

Henson (1996) asserts that an increase in concern for food safety serves to motivate consumers significantly enough to make them pay higher prices for foods they consider to be safer or healthier. Henson (1996) again stated that awareness of details of processes by which inorganic foods undergo causes consumers to refrain from patronizing such products to a large extent. He reported that consumers would take these actions in order to reduce their risk of food poisoning and remain healthy.

General Hypothesis

The following general hypothesis was derived from the literature;

An increase in the level of awareness of toxins in the groundnuts will increase with a higher educational attainment. The frequency of consumption of groundnuts is not significantly influenced by the level of income because from

observation, the higher the income level, the more consumers can afford to purchase other food product aside the groundnut and hence, the lower the frequency of consumption, all other things being equal.

The presence of children in a household will cause the consumer to purchase safer foods even at higher costs to keep the children healthy. Households will do this to prevent spending on medical expenses resulting from unsafe foods. This will increase their willingness to pay for safer groundnuts. Educational attainment will also influence WTP in that it makes consumers aware of health hazards of aflatoxins through increased access to information. This will motivate them to willingly pay for safer groundnuts at an additional cost. The more frequently a person consumes groundnuts, the more willing he will be to pay for safer groundnuts even at a higher price because he has developed a taste for the product. Thus consumers who frequently consume groundnuts will be willing to pay extra for safer groundnuts. A high level of aflatoxin awareness will cause consumers to willingly pay for safer groundnuts so as to ensure that they remain healthy and prevent aflatoxicosis. In general, an increase in the concern of food safety by consumers will lead to increase in their willingness to pay for safer foods at higher prices. Based on the conceptual framework and empirical reviews, the following specific hypotheses were formulated and tested at 0.05 alpha level where necessary;

Specific Hypotheses

1. **H₀**: Good quality groundnut as perceived by groundnut consumers in the Northern Region of Ghana does not indicate possible aflatoxin contamination.

H₁: Good quality of groundnut as perceived by groundnut consumers in Northern Region of Ghana indicates possible aflatoxin contamination.

2. **H₀**: The level of aflatoxin awareness among groundnut consumers in the Northern Region does not differ significantly among the different educational levels.

H₁: The level of aflatoxin awareness among groundnut consumers in the Northern Region of Ghana differs significantly among the different levels of education.

3. **H₀**: There is no relationship between the income level of groundnut consumers and their frequency of consumption of groundnuts.

H₁: There is a relationship between the income level of consumers and their frequency of groundnut consumption.

4. **H₀**: The proportion of groundnut consumers who are willing to pay for safer groundnuts will be similar to those not willing to pay for the product.

H₁: The proportion of groundnut consumers who are willing to pay for safer groundnuts will not be similar to those not willing to pay for the product.

5. **H₀**: Household income levels will not significantly influence the WTP of consumers for safer groundnuts at a higher cost.

H₁: Household income levels will significantly influence the WTP of consumers for safer groundnuts at a higher cost.

6. **H₀**: Presence of children in the household will not significantly influence consumer WTP for safer groundnuts.

H₁: Presence of children in the household will significantly influence consumer WTP for safer groundnuts.

7. **H₀**: WTP of consumers for safer groundnuts will not significantly be influenced by their educational levels.

H₁: WTP of consumers for safer groundnuts will significantly be influenced by their educational levels.

8. **H₀**: Consumers' frequency of consumption of groundnuts will not significantly influence their WTP for safer groundnuts

H₁: Consumers' frequency of consumption of groundnuts will significantly influence their WTP for safer groundnuts.

H₀: The WTP of consumers for safer groundnuts will not be significantly influenced by their level of aflatoxin awareness.

H₁: The WTP of consumers for safer groundnuts will significantly be influenced by their level of aflatoxin awareness.

9. **H₀**: Concern for food safety will not influence the WTP of consumers for safer groundnut significantly.

H₁: Concern for food safety will significantly influence the WTP of consumers for safer groundnuts.

Significance of the Study

Dixon (1999) explained that consuming food products that contain high levels of aflatoxins can cause the rapid onset of mycotoxicosis, a severe illness characterized by vomiting, abdominal pain, pulmonary edema, convulsions, coma, and in rare cases, death.

Since tests confirm that majority of West Africans are exposed to aflatoxin, this study seeks to measure the level of consumer awareness of the aflatoxin presence in groundnuts and thus, help formulate effective policies on educating consumers of this problem so as to reduce exposure to aflatoxins.

According to Villalobos (2005), diverse empirical studies have documented that certain market segments are willing to pay a higher price for food products when these contain particular differentiating quality attributes. Lack of information in the market with regard to consumer preferences and willingness to pay for good quality traditional food products makes decision making difficult for small family business in the rural sector, thus directly affecting the development of effective and efficient marketing strategies for this type of foods. This study will, in the light of this, inform policy on the perception of consumers of groundnut quality so that appropriate steps can be taken to provide consumer satisfaction where possible. The study will also furnish businesses with market information on consumer willingness to pay for safe groundnuts. By this information, businesses as well as government can make decisions regarding

testing and certification of groundnuts for sale on market to protect consumers while also making a profit on the sales.

After its completion, the results of this study will advice policy makers on the level of aflatoxin awareness among groundnut consumers and their willingness to pay for groundnuts tested and certified as safe for consumption. It will thus provide an impetus for government to institute aflatoxin testing programmes so as protect consumers since the level of consumer acceptance of the safer groundnuts would have been known already.

This study seeks to throw more light on the level of knowledge of consumers concerning aflatoxins and how willing they are to pay for groundnuts which have been certified as safe for consumption. It will also enable all stakeholders involved in the production, marketing and monitoring of food safety to know the measures to take so as to ensure consumer safety.

The study will finally provide information on whether education has an influence on the level of consumer awareness of aflatoxin hazards and thus make available an opportunity for modifying the educational curriculum to include this issue so as to help consumers better protect themselves from food poisoning through aflatoxin poisoning.

Limitations of the Study

1. The study did not actually measure the aflatoxin content in groundnuts but used conditions of the groundnuts such as mouldiness, broken and bruised nut, presence of foreign materials and insect attacks as well as shriveled nuts which according to literature predispose groundnuts to aflatoxin contamination to indicate the potential risk of aflatoxin presence.

Delimitations of the Study

1. This study is limited to the inhabitants of the Northern Region of Ghana only.
2. Only four out of 18 districts were included in the study. This was because of limited time and funds available to include more districts. For the same reason, two communities from each of the four districts were chosen. Twenty five households from each community were also included in the study. This is due to the homogeneity which exists among the various districts in terms of food consumption patterns and cultural values.
3. Only consumers who made food consumption decisions for their households were included in the study.

Definition of Terms

1. Aflatoxicosis is the poisoning that results from ingesting aflatoxins. Aflatoxicosis is characterized by liver cancer, stunted growth in children, vomiting, abdominal pain, pulmonary edema, convulsions, coma, and in some cases, death.
2. Safer groundnuts: Groundnuts with aflatoxin levels up to 0.15 parts per billion (ppb) only.
3. Good quality groundnuts: Groundnuts which are not shriveled, have no foreign materials in them, are not broken, bruised or mouldy, have fresh taste and normal texture and colour and not damp.
4. The additional cost per unit of safer groundnut was estimated to be Gh¢0.70p. There were other consumers who might have willed to pay even more for safer groundnuts and for others, even less but the researcher did not allow for this to be captured because of the method of contingent valuation (referendum) method used. This is one of the weaknesses of the referendum method.

The Study Area

Regional Profile

The Northern Region has a total land area of about 70,384 sq. km, which is 29% of the land area of Ghana. It is located between latitude 8 30” and 10 30”

N and lies completely in the savannah belt. It has Togo and La Cote D'Ivoire to the East and West respectively as its international neighbours. Further south, the region shares boundaries with Brong Ahafo and the Volta Regions, and to the north it shares borders with the two Upper Regions. It is divided into eighteen political/administrative districts headed by the sub-districts. Most of these correspond with the local council zones (Ghana Health Service, 2005).

Population Characteristics

The 2000 census report puts the population of the region as 1,820, 806. At a growth rate of 2.9 per annum the estimated population for 2005 is 2,090,399.

This population is characteristically distributed in small settlement with populations of 200-500 people. There are over 5,000 settlements in the Region, out of which 54.4% have population less than 200 people. The distances between settlements are far apart. A reasonable proportion of the population is in "overseas" areas in seven of the eighteen districts namely, East Gonja, West Gonja, West Mamprusi, Nanumba South, Gushegu, Karaga and Tolon/Kumbungu districts. These populations can only be accessed from neighboring regions/districts or only during the dry season. In the West Gonja and East Gonja districts, several villages are completely surrounded by the Volta Lake (Ghana Health Service, 2005).

Household Size and Composition

The typical household in the region has, on the average, seven (7) members. Of this number, 44.6 percent are children of the household head and 21.6 per cent are other relatives. The average household size varies from 6.1 in Savelugu-Nanton, to 9.6 in Gushiegu-Karaga. The Tamale municipality, the most urbanized district, has an average household size of 6.5.

The relatively high average household size in the region may be a reflection of the housing structure with several round huts belonging to different members of households on the same compound. The proportion of children in the household varies from 40.3 per cent in the Tamale municipality to 50.8 per cent in Saboba-Chereponi. The proportion of other relatives per households varies from 18.8 per cent in Nanumba to 24.7 per cent in the Yendi District. Thus, households in the region present the same level of structural and numerical complexity as will be expected in very traditional setting (Ghana Resource Centre, 2008).

Educational Attainment

At the national level, 38.0 per cent (33.1 % males and 44.5% females) of the population 6 years and older have never been to school. The district with the lowest percentage of the population that has never been to school is Tamale with 50.8 per cent (42.5% males and 59.0% females). On the other hand, Gushiegu-

Karaga has the highest proportion (84.3%) of the population that has never been to school (79.3 per cent males and 89.0 per cent of females).

Of the population that ever attended school, 47.5 per cent, made up of 43.6 per cent of males and 53.5 per cent of females, have attained primary school level.

About a fifth (21.7%) made up 22.2 per cent of males and 21.1 per cent of females, have attained middle/JSS level. Those who attained secondary/SSS level account for 13.3 per cent (3.7% males and 10.4% of females) and an additional 4.8 per cent (3.7% of males, 4.2% females) attained vocational/technical/commercial school level. About the same percentage of both males and females have attained post secondary school and tertiary levels; the corresponding proportions being 5.1% and 5.5% for males, and 3.9% and 4.6% for females, respectively. On the whole, the highest educational level attained by majority of the educated in the region, is the primary school (43.6% of males and 53.5% of females).

At the district level, the primary school remains the highest level of education attained by a significant proportion of the population, ranging from 33.8 % in Tamale to 52.4 % in West Mamprusi, for the males. The corresponding figures for the females vary between 43.6% in Tamale and 64.8% in Savelugu-Nanton. The middle/JSS level, which is the second highest educational level attained in the region, ranges from 17.8 % in Gushiegu-Karaga to 26.4 % in East Gonja for males. For example, the proportions that have attained middle/JSS level vary from 14.2 % in Gushiegu-Karaga to 25.4% in Tamale.

The male-female differential increases with higher levels in educational attainment. The proportion of females is higher than that of males for primary school attainment (53.5% and 43.6% respectively); and this is the case in all the districts. On the other hand, the proportion of males that have attained the middle/JSS level is higher than that of females in 11 of the 13 districts (the exceptions being Saboba-Chereponi and Tamale). Similarly, male attainment at the secondary/SSS level is appreciably higher than that of females in all the districts. While Gushiegu-Karaga is the only district in the region where the proportion of females (4.5%) is higher than that of males (4.3%) for the vocation/technical/commercial attainment, it is also one of two districts (the other being Zabzugu-Tatale), where the proportion of females is higher than that of males for the tertiary level.

The analysis shows that there is wide disparity between those who have never been to school at the national level (38.0%) and those in the region (72.3%). The disparity is great between females who have never been to school in the region (77.9%) and those at the national level (44.5%). It is therefore necessary to expedite the implementation of on-going programmes geared towards the improvement of educational facilities in the region to raise the educational attainment in the region, particularly with respect to female education. It is equally important to implement such programmes as will sustain the high achievement at the primary school level, particularly for females, through the JSS to higher levels (Ghana Resource Centre, 2008).

Employment Status

Nearly 68.0% of the economically active populations are classified as self-employed while 22.9% are unpaid family workers; only about 6.1% are employees. This regional pattern is also reflected in all the districts. For example, the proportion of the self-employed ranges from 50.8 per cent in Zabzugu-Tatale to 79.7 per cent in Savelugu-Nanton. The proportion of unpaid family workers varies from 5.2 per cent in the Tamale municipality to 45.3 per cent in Zabzugu-Tatale. The high level of unpaid family workers, recorded in some of the districts, is probably a reflection of the high proportion of the population in the agricultural sector (Ghana Resource Centre, 2008).

Economic Activities

Agriculture remains the predominant sector with over 90% of the productive age group being peasant farmers. Mechanized agriculture is possible on this terrain although limited in practice because of the high cost of inputs. However, the peasant farmer produces the bulk of the cereals, tubers and groundnuts in the region. Shea nut is the most important cash crop in the region. Cotton ginnery is perhaps the only industrial sector with a high output level. Notwithstanding the low activity in this sector the establishment of the Intermediate Technology Transfer Unit has been a booster to entrepreneurs who depends on it for the manufacture of spares, tools etc. for their light industries.

Leather tanning is also done on a large scale. A number of mining activities have sprung up in some districts notably Bole but this is still on low scale (Ghana Health Service, 2005).

Climate and Vegetation

Climate is the dominant factor in Ghana's physical environment. The natural environment of the study area is typical of Guinea Savannah woodland which is composed of trees of varying sizes and dispersed in a ground cover of tall perennial bench –grass and associated herbs (Runge-Metzger & Diehl, 1993). The climate of the region is relatively dry. The rainy season in Northern Ghana is mono-modal, starting in April/May and ending in September/October with an annual rainfall varying between 900 and 1100mm. The dry season starts in November and ends in March/April with maximum temperatures in December and January. The harmattan winds, which occur during the months of December to early February, have considerable effect on the temperatures in the region which may vary between 14⁰C at night and 40⁰C during the day. The main vegetation is classified as vast areas of grassland, interspersed with the guinea savannah woodland, characterized by drought-resistant trees such as the acacia, baobab, shea nut, dawadawa, mango and neem (Fosu, 1999).

CHAPTER TWO

LITERATURE REVIEW

General Overview

This section provides information on issues that have to do with the research topic under discussion. These pieces of information were obtained from journals, articles, the internet and published and unpublished research findings.

Groundnuts

According to Putman (2007), cultivated groundnut (*Arachis hypogaea* L.), originated in South America (Bolivia and adjoining countries) and is now grown throughout the tropical and warm temperate regions of the world. He explained that this crop was grown widely by native peoples of the New World at the time of European expansion in the sixteenth century and was subsequently taken to Europe, Africa, Asia, and the Pacific Island.

There are two main types of groundnuts: the American groundnut (*Arachis Hypogaea*), and the African groundnut, the Bambara nut (*Voandzeia*

subterranae). There are four main types of the American groundnut also known as peanuts. These are Runner, Virginia, Spanish and Valencia and each of these types is distinctive in size, flavor, and nutritional composition. The Runner type has uniform attractive kernel size and is high yielding. They are mainly used in manufacturing peanut butter. The Virginia type has the largest kernels and account for most of the groundnuts roasted and processed in-the-shell. The Spanish-type groundnuts are characterized by smaller kernels covered with a reddish-brown skin. They have a higher oil content than the other types of groundnuts which is advantageous when crushing for oil. They are very sweet groundnuts and are usually roasted and sold in-the-shell. Valencias usually have three or more small kernels to a pod and are covered in a bright-red-skin. They are very sweet groundnut and are also usually roasted and sold in-the-shell (Amber & Katrina, 2004).

Wright *et al.*, (2006) reported that there are two vegetative types (growth habit) of groundnuts: runner and bunch. They explained that the runner groundnuts have a spreading growth habit because lateral branches are long and grow close to the ground and the bunch type grows mostly erect stems and does not spread out like the runner type. The groundnut seed is called a kernel, and then a “peg” or reproductive stem grows down from the flower and enters the soil. The groundnuts pod forms at the end of this peg. The groundnuts leaf is made up of four leaflets. Groundnuts are harvested by digging them partially dry in the field and then combing them. As the groundnuts are dug, the vines are shaken to remove excess dirt and then the groundnuts vines are inverted so that groundnuts

are exposed to the sunlight for quick drying. After drying in the field, the nuts are removed from the vine with a groundnuts combine, picker or by manual picking. Groundnuts are partially dried by natural drying in the field before combing. Groundnuts are mostly stored at moisture content of 10 percent or less.

Importance of Groundnuts

Groundnut is a major cash crop in Northern Ghana and plays a major role in the diet of the citizens of Ghana. It serves as a major source of vegetable protein and is used extensively in many dishes. Roasted groundnut in combination with bananas is a popular snack in the country. Groundnut butter is used extensively in the preparation of soups in homes and also as bread spread. The kernels are pressed for the extraction of vegetable oil. This activity is a major source of income for rural women. Groundnut cake derived after the extraction of the oil is also used in the manufacture of local delicacies that are rich in proteins. Groundnut hay after plucking of the pods is either left on the farm or carried home as livestock feed. In some urban localities, groundnut hay serves as an additional source of income to the farmer since the product is on sale in the market (Tsigbey, ., Bailey & Nutsugah, 2001). All parts of the groundnuts plant can be used.

The groundnut, grown primarily for human consumption, has several uses as whole seeds or is processed to make peanut butter, oil, and other products. The

seed contains 25% to 32% protein (average of 25% digestible protein) and 42% to 52% oil. A pound of groundnuts is high in food energy and provides approximately the same energy value as 2 pounds of beef, 1.5 pounds of Cheddar cheese, 9 pints of milk, or 36 medium-size eggs (Woodroof, 1983). Amber and Katrina (2004) reported that groundnut is considered a women's crop in Africa. It was originally grown by women to supplement their family diets with protein. However, groundnut production is a way through which women earn cash income and participate in the economy. Consequently, this increases women's agency and empowerment. Women in Africa also value groundnut production for many reasons, including sending children to school using profits from sales, providing a high energy and protein food source for their children, oil for cooking, and a source of high quality feed for cattle. Groundnut production gives an opportunity for these women to generate additional cash income from oil. It is useful in the treatment of hemophilia. Also, groundnuts can cure stomatitis, prevent diarrhea and benefit growing children, pregnant mothers and nursing mothers.

Teynor (1991) asserted that non-food products such as soaps, medicines, cosmetics, and lubricants can be made from groundnuts. The vines with leaves are excellent high protein hay for horses and ruminant livestock. The pods or shells serve as high fibre roughage in livestock feed, fuel (fireplace "logs"), mulch, and are used in manufacturing particle board or fertilizer.

The Nature and Occurrence of Aflatoxins

Aflatoxins are extremely potent carcinogenic and mutagenic substances that first came into the public spotlight-and were formally identified – in the early 1960s following the deaths of more than 100,000 young turkeys on a poultry farm in England. The so called Turkey X diseases was eventually tied to high levels of aflatoxin in Brazilian groundnut meal imported as a feed ingredient (United States Department of Agriculture, 1998). Aflatoxins are mycotoxins produced by certain fungi, especially, *Aspergillus flavus* and *Aspergillus parasiticus* which grow on food and feed crops such as corn, sorghum, wheat, barley, groundnut, and other legumes and oil seeds (Akiyama, Goda, Tamaka, & Toyoda, 2001). According to FAO (1991), only a few mycotoxins, particularly those affecting cereals (maize, wheat, barley, oats, and rice) and groundnuts, are considered to be significant for humans. The United States Department of Agriculture (USDA) in 1998 asserted that five broad groups of mycotoxins – aflatoxin, vomitoxin, ochratoxin A, fumonisin, and zearalenone- are commonly found in food and feed grains and that amongst mycotoxins, probably the most widely recognized risk comes from aflatoxins. There are four naturally occurring aflatoxins namely, aflatoxin B₁, B₂, G₁ and G₂ (Garrido, Iha, Santos & Duarte, 2003). According to United Nations Development Programme and the Food and Agricultural Organization (2000), these four different naturally occurring aflatoxins are poisonous and can all be found in food. However Food and Agricultural Organization and World Health Organization (1977) made it clear that aflatoxin B₁ is the most toxic and common aflatoxin and that aflatoxin B₁ is generally present in corn and corn

products, groundnuts and groundnut products, cottonseed milk, and tree nuts such as Brazil nuts, pecans, pistachio nuts, and walnuts.

Although aflatoxins were first discovered as contaminants of groundnuts and groundnuts products, it is also known that maize is also an important source of aflatoxin exposure due to the wide consumption of maize and maize products (Rodricks, 1981). Bankole, Mabekoje and Enikumehin (2003) reported that low levels of aflatoxin have been reported in soybeans and aflatoxin residues have been found in fluid milk and non-fat dry milk and other food products for which mycotoxin contamination has been reported in the sub-region include dried yam chips, tiger nut, melon seeds and stored herbal plants. Garner (1993) explained that the growth and aflatoxin production by aflatoxigenic moulds depends on several factors including the storage temperature, moisture content and water activity of the product with minimum, optimum and maximum growth temperature ranges being $6^{\circ}\text{C} - 8^{\circ}\text{C}$, $36^{\circ}\text{C} - 38^{\circ}\text{C}$ and $44^{\circ}\text{C} - 46^{\circ}\text{C}$ respectively. Aflatoxin production occurs in groundnut kernels when the *Aspergillus flavus/parasiticus* fungus is present under conditions of lowered water activity and favourable temperature ($25^{\circ} - 32^{\circ}\text{C}$) (Dorner, Cole, & Blanshenship, 1998). *Aspergillus flavus* is considered primarily a storage fungus although it can produce aflatoxin in the field under certain conditions. Pieces of groundnuts are more likely to be substrate for aflatoxin production than whole nuts in good conditions. Anything that damages the seed coat and allows the fungus access into the carbohydrate-rich endosperm increases the risk of fungal proliferation and aflatoxin production (Rosalind, 1999). Detached and over-mature pods are also

highly vulnerable to invasion by soil insects, *Aspergillus* fungi and consequently aflatoxin contamination (Cole, Sanders, Donner, & Blankenship, 1989).

Aflatoxins and Health

Mycotoxins, when inhaled or absorbed, cause lowered performance, sickness or death in humans and animals (Bhat & Vashanti, 1999). Exposure to mycotoxins can produce both acute and chronic toxicities ranging from death to deleterious effects on the central nervous, cardiovascular and pulmonary systems, and the alimentary tract. Mycotoxins may also be carcinogenic, mutagenic, teratogenic and immunosuppressive (FAO, 2001). Acute exposure to aflatoxins can result in aflatoxicosis, which manifests as severe, acute hepatotoxicity with a case fatality rate of approximately 25% (Cullen & Newberne 1994). Azziz-Baumgartner *et al.*, (2005) reported that the 2004 outbreak of acute aflatoxicosis in Kenya was one of the most severe episodes of human aflatoxin poisoning in history. According to them, a total of 317 cases were reported by 20th July 2004, with a case fatality rate of 39%. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (2000) clearly states that consumption of aflatoxins by human beings can lead to liver cancer and that person's chances of contracting cancer are compounded significantly if he/she carries the hepatitis B virus (the virus that causes jaundice), as do an estimated 20 million people in India.

According to researchers, people who inadvertently consume a large quantity of the contaminated food can get very sick, especially if they do so regularly. This is because the toxin in large quantities can cause potentially fatal problems in the liver and intestines (Xinhua News Agency, 2007). The dose and duration of exposure of aflatoxin clearly have a major effect on the toxicology and may cause a range of consequences which include acute illness and death, usually through liver cirrhosis for large doses and nutritional and immunological consequences for chronic sub lethal doses. All doses of aflatoxin have a cumulative effect on the risk of cancer (Jonathan *et al.*, 2004). Continuous exposure to aflatoxin has been shown to stunt growth and even contribute to infant mortality when coinciding with kwashiorkor, a form of malnutrition caused by dietary deficiency of protein and other nutrients. The insidious combination of impaired development and undernourishment accounts for about half of the 4.5 million deaths of children under the age of 5 occurring annually in sub-Saharan Africa (Science of Africa, 2005). Aflatoxins do their damage by suppressing the immune response system. They affect poultry and, when present in cattle fodder, the yield and quality of milk (ICRISAT, 2000). In addition to direct risks to humans from consumption of mycotoxin-contaminated grains, there are indirect risks to those who consume animal products containing residues of carcinogenic mycotoxins.

Mycotoxins can be detected in meat milk, and eggs from animal that have consumed feed ingredients containing mycotoxins, and many developed countries have tolerance standards for mycotoxin residues in these products. Another

concern related to the consumption of mycotoxin-contaminated feed by livestock is the potential for economic losses from animal health and productivity problems. Aflatoxins in feed are known to be associated with liver damage in animals, reduced milk and egg production, poor weight gain, and recurrent infections due to immunity suppression. The young of any particular species are most vulnerable, but the degree of susceptibility varies by species (UNDP, 1998).

Aflatoxin levels permitted by some regulatory bodies

Consumers in the developed world are now well aware of the carcinogenic effects of aflatoxins, and will therefore shy away from a product from any supplier that has aflatoxin beyond the acceptance level. Exports of agricultural products particularly groundnuts from developing countries have dropped considerably in recent years resulting in major economic losses to producing countries (Otsuki, John & Mirvat, 2001b). For overall sanitary precaution principles, the European Union enacted very severe aflatoxin tolerance standards of 2µg/kg for aflatoxin B₁ and 4µg/kg total aflatoxins for nuts and cereals for human consumption and this came into effect from January 2001 (Dimanchie, 2001). The European Commission (EC) proposed a harmonization of maximum acceptable level of aflatoxins in certain foodstuffs. The standard ranged from 4 parts per billion (ppb) in cereal, edible nuts, and dried fruit, to 10 ppb for nuts that are subject to further processing was set at 15 ppb (8 ppb for B₁) and for other nuts and dried fruits subject to further processing 10 ppb (5 ppb for aflatoxin B₁).

For cereals, dried fruits, and nuts intended for direct human consumption, the standard was much more stringent and was set at 4 ppb (2 ppb for B₁) (Otsuki, Wilson & Sewadeh, 2001a).

Consumer Behaviour

One "official" definition of consumer behavior is "The study of individuals, groups, or organizations and the processes they use to select, secure, use, and dispose of products, services, experiences, or ideas to satisfy needs and the impacts that these processes have on the consumer and society." Consumer behavior involves the psychological processes that consumers go through in recognizing needs, finding ways to solve these needs, making purchase decisions (example, whether or not to purchase a product and, if so, which brand and where), interpret information, make plans, and implement these plans.

Consumer behavior also involves the use and disposal of products as well as the study of how they are purchased. Product use is often of great interest to the marketer, because this may influence how a product is best positioned or how increased consumption can be encouraged. Consumer behavior involves services and ideas as well as tangible products. The impact of consumer behavior on society is also of relevance. For example, aggressive marketing of high fat foods, or aggressive marketing of easy credit, may have serious repercussions for the national health and economy.

There are many applications of consumer behavior but the most obvious is for marketing strategy, that is, for making better marketing campaigns. For example, by understanding that consumers are more receptive to food advertising when they are hungry, marketers learn to schedule snack advertisements late in the afternoon. By understanding that new products are usually initially adopted by a few consumers and only spread later, and then only gradually, to the rest of the population, marketers learn that companies that introduce new products must be well financed so that they can stay afloat until their products become a commercial success, and it is important to please initial customers, since they will in turn influence many subsequent customers' brand choices

Often, cultural influences are taken for granted, but they are significant. An American will usually not bargain with a store owner. This, however, is a common practice in much of the World. Physical factors also influence our behavior. Consumers are more likely to buy a soft drink when they are thirsty, for example, and food manufacturers have found that it is more effective to advertise their products on the radio in the late afternoon when people are getting hungry. A person's self-image will also tend to influence what he or she will buy—an upwardly mobile manager may buy a flashy car to project an image of success. Social factors also influence what the consumers buy—often, consumers seek to imitate others whom they admire, and may buy the same brands. The social environment can include both the mainstream culture (e.g., Americans are more likely to have corn flakes or ham and eggs for breakfast than to have rice, which

is preferred in many Asian countries) and a subculture (e.g., rap music often appeals to a segment within the population that seeks to distinguish itself from the mainstream population). Thus, sneaker manufacturers are eager to have their products worn by admired athletes. Finally, consumer behavior is influenced by learning—you try a hamburger and learn that it satisfies your hunger and tastes good, and the next time you are hungry, you may consider another hamburger (Lars, 2009).

Dimensions of Food Quality

Quality of food is an extremely important aspect of human life as it is directly related to health of a person. Sallis (1992) sees quality as consistent conformance to a standard. However, according to Zugarranmurdi (2003), the definition of good quality food, however, may vary depending upon the type of food and the individual's food preferences. Some of the important features of quality include wholesomeness, freshness, nutritional value, texture, colour, fragrance, and flavor, Garvin, (1988), asserts that on the production side, the manufacturing-based definition of quality gives emphasis on conformance to requirements, design, or specification. On the consumer side, user-based definition gives emphasis on capacity to satisfy wants and how well the product fits patterns of consumer preferences. The emphasis of each definition depends on the importance given to various quality dimensions that go into the making of a food product. To many consumers safe food means that there will be no danger

from harmful elements such as pathogenic micro-organisms, naturally occurring toxins and other potentially harmful chemicals. The presence of micro-organisms in food poses the greatest threat to human health compared to all forms of contamination (Rouf, 2004). Garvin (1988) provides the following dimension of food quality.

Performance: Performance refers to primary operating characteristics of a product. Spanish variety of groundnuts must contain a high amount of oil when it is crushed compared to other groundnut varieties. Similarly, an ice-cream that melts faster than a competing brand would be ranked lower on performance dimension. Grapes exported to European Union have to have sweetness within a given range of brix. Else, their quality will be considered low based on performance dimension.

Features: Features are secondary characteristics that supplement a product's basic functioning. Coffee powder sold in glass jars which can be used later for storing kitchen items, or selling orange juice in tetra-packs enhancing convenient use are examples of features dimension of food products.

Reliability: Reliability reflects the probability of a product's malfunctioning or failing within a specified period of time. This dimension is more applicable to durable food items than items consumed instantly. Pickles, peanut butter and jams are eaten over a period of time. The brands which get spoiled more often than others will rank lower on this dimension.

Safety: Safety is one of the most important dimensions of food quality. If a food item is spoiled, its safety dimension is easily recognizable. However, food products can contain microbial, toxic and/or physical contaminants which are not recognizable before consumption. Consumers either fall sick after consumption of a food product or long term effects of repeated consumption of a product could be hazardous to health. Liver cancer due to presence of salmonella bacteria in meat products, or long-term carcinogenic effects of presence of pesticide residues on fresh and processed vegetables are some of the examples.

Conformance: Conformance is the degree to which a product's design and operating characteristics meet pre-established standards. There are all kinds of specifications that need to be adhered to for food products. These specifications may involve a permissible range of variation for a particular parameter. For example, there always will be a permissible range of acidity level and salt concentration for pickles that maintains a standard taste and prevents spoilage as well. Control charts can be used to monitor conformance to the specifications. Similarly, Codex standard for maximum permissible level for aflatoxin in groundnut is 15 ppb, much less than the Indian standard of 30 ppb. In fact, European Union standard is too strict at 5 ppb, creating a non tariff barrier to groundnut exports.

Durability: In manufacturing sector, durability means amount of use one gets from a product before it physically deteriorates. However, in food industry, a product cannot be used repeatedly. It has to be used either at once or in parts.

Thus, durability in the context of food products reflects its shelf life. For example, the newly development Ultra Heat Treated (UHT) milk has a shelf life of more than three months as compared to regular milk. In vegetables, different varieties have different shelf lives.

Aesthetics: This dimension of quality is closely related to the user-based definition of quality. How a product looks, feels, tastes and/or smells is clearly a matter of personal judgment and a reflection of personal preferences. Nevertheless, there appears to be some uniformity in consumers' ranking of products on the basis of aesthetics. Study by Bonner and Nelson (1985) shows that high quality of food was most often associated with attributes such as 'rich/full flavour', 'tastes fresh', 'good aroma' and 'looks appetizing.' Brands that were clearly differentiated on the basis of these characteristics were the ones which were most successful in establishing strong market positions.

Perceived Quality: Consumers do not always possess all information about the product attributes. Hence, perception of quality in terms of images advertising and brand names becomes critical (Satish, 2001).

Consumer Perceptions of Quality

In order to design products that will be accepted by consumers, it is necessary to translate consumer demands into product specifications that are actionable from the producer's point of view. This is especially complex for food

because the way consumers perceive expected quality before a purchase is often different from the way quality is perceived after consumption. Producers find it more important to know how the objective market perceives quality and value (Cardello, 1995).

The fact that there are different definitions of quality stems from the diversity of perspectives from which quality has been tackled (Steenkamp, 1990). Quality can be dealt with from a technical or a productive point of view, as well as from a consumer, a strategic or a metaphysical viewpoint, among others. In studying and analyzing the evolution of the quality concept, Reeves and Bednar (1994) provided a framework considering the concept from four different points of view: as excellence or superiority; as value; as conforming to specifications; and as meeting or exceeding customer expectations. Steenkamp's (1989) concept of perceived quality attempts to mediate between objective product characteristics and consumer preferences. It stressed that perceived quality may differ from objective quality, and that consumers use cues to evaluate quality. The concept implies that individual assessments of quality are personal and situational, and that they are often based on incomplete information (Holm & Kildevang, 1996).

Since perceived quality is an abstract construct and is of a multi-dimensional nature, the development of mensuration scales is a question of vital importance, for both researchers and practitioners. Some authors have underlined the interest of developing generalizable scales to services or to food products (Parasuraman, Zeithaml & Berry, 1998). Bonner and Nelson (1985) made it clear

that many authors recognize the interest of scales directed to a product or specific service and the fact that the intrinsic attributes are specific to each product means that choosing one specific product is recommendable. Levitt (1981) indicates that universal notions of perceived quality constructs may be vain or useless, and Babakus and Boller (1992) suggest that quality is specific of a single good or service.

Background to the Dimension of Perceived Quality

Grunert (1997) pointed out that, within the behaviourally oriented analysis of consumer food choice, several approaches can be distinguished: the economics of information approach (Nelson, 1974), the multi-attribute approaches, hierarchical models (Grunert, 1989) and means-end chain theory (Jaeger & MacFie, 2001). But the most notable attempts to integrate these various approaches into a unified framework for analyzing the quality perception process for food products have been the contributions of Grunert, Hartvig, Madsen and Baadsqaard, (1996). These authors integrate the more restricted approaches mentioned, and their models consider the relationship between technical product specifications, expected quality and experienced quality.

Intrinsic and Extrinsic Attributes of a Product's Quality

The perceived quality (consumer's overall evaluation) is the result both of the expected quality and the experienced quality. Grunert, Hartvig , Madsen and Baadsqaard, (1996) considered that expected quality is based on a number of perceived quality cues, which may be both physical characteristics of the product (intrinsic quality cues) and other characteristics such as brand name, price, advertisement, labeling, etc. (extrinsic quality cues). And the technical product specifications (physiological characteristics of the product) affect both expected quality (through intrinsic quality cues) and experienced quality (through sensory characteristics) (Bello & Calvo, 2000).

According to Olson and Jacoby (1972) there are two types of attributes, or variables: intrinsic and extrinsic. These two types of variables have given rise to two different lines of research into perceptions of quality. One of them assumes that perceptions of quality are based on one or more extrinsic attributes (Olson, 1977). Others however, base perception of quality on intrinsic attributes. Steenkamp (1990) approached perceptions of quality by integrating both lines of research and dealing with preference formation, purchase intention and perception of quality. Intrinsic attributes are related to the physical composition of the products. They cannot be altered without changing the nature of the product itself and they are specific to each product. They cease to exist when the product is consumed (Olson, 1977). An interesting yardstick for determining the intrinsic attributes by which to evaluate quality in goods and services is the classification

that Nelson (1974) established for the properties of goods, differentiating three types of properties among consumer goods:

1. **Search properties:** attributes a consumer can determine before actually purchasing a product
2. **Experience properties:** the attributes that can only be discerned after purchase or during consumption.
3. **Credence properties:** represent the characteristics that may be impossible to evaluate even after purchase and consumption. In many cases consumers need to have sufficient know-how and practice in order to evaluate the quality of a specific product or service.

There are certain attributes that can be classified as being search properties, but a food's value never ceases to exist before it has been consumed. The expert will know what the level of quality is or should be, but the purchaser will not, since a minimum amount of knowledge is required. These differing degrees of information between sellers (and experts) and buyers generate a problem known as "asymmetric information" (Akerlof, 1970).

Quality Control Mechanism

The quality of any commodity determines its prospect and in most cases quantity demanded for such commodity. A good quality product attracts the attention of the buyers even at premium prices while poor quality attracts total

rejection or rebate pricing. Therefore, good quality products compete favourably in the international market, and a country whose export commodity is of good quality sells at premium prices and has the advantage of retaining its buyers. Thus, the process of ensuring adherence to quality and standards often commence from the farm gates, marketing chain and the final check test carried out at the ports by relevant inspection agencies. Generally, a produce destined for export has to be of acceptable quality in the target market. Most often, products acceptable in the local market might not enjoy the same patronage in the foreign market. The exporter would have to adapt his product in terms of quality, packaging and labeling to the dictates and requirements of a foreign market (Sasore, 2005).

Groundnut Quality Control and Certification Plan

The new monitoring system for quality control and certification is centered on the following structures, each with a precise set of tasks:

- **Laboratories within the industrial units:** implementation of a sampling and analysis plan at each stage of production (self-monitoring to check the aflatoxin content of sorted nuts, with a second sorting if necessary of obtain finished products that meet the market's aflatoxin standards);
- **The national reference laboratory:** monitoring of aflatoxin in lots for export (analysis of samples obtained from the industry labs; certification

that the lots are compliant; following fumigation, the certified lots are precisely labeled and packed into containers for exportation);

- **Independent bodies:** product quality validation and awarding of the label. For the implementation of the control and certification plan, legislative texts and regulations should be drawn up. This committee, made up of representatives from the various departments of the central government and partners in the industry, should write up a new decree covering the generic definition of groundnuts, physical and sanitary standards, labeling for traceability, quantitative monitoring, certification and labeling of products in accordance with standards (Hanak, Boutrif, Fabre & Pineiro, 2000).

Appropriate Laboratory Methods for Developing Countries for Aflatoxin Detection

Current methods allow for the detection of aflatoxin and aflatoxin metabolites at very low concentration in food and biological media, however, the application of these methods within developing countries is limited by practical considerations, such as resources and infrastructure.

Methods for testing food and biological specimens need to be adapted to fit the surveillance and epidemiologic needs of developing countries. A simple screening method, adapted for developing countries, would benefit subsistence farmers as well as public health and agriculture institutions. Furthermore, these

institutions would also benefit from sustainable yet reliable confirmatory methods for use in centralized laboratories.

Field Methods

Simple and inexpensive field screening methods are available to determine that food is sufficiently free of aflatoxins, but currently lack direct applicability to aflatoxin contamination issues in developing countries. Field methods can be performed with minimal training or equipment and can be performed on-site (i.e. at a farm or grain silo). Field methods for aflatoxin analysis allow for rapid confirmation or exclusion of possible exposure at a reasonable cost, thus allowing officials to quickly determine whether further evaluation and intervention is necessary.

Such methods would prove beneficial in developing countries given that the remote location of villages and long distances to a centralized laboratory make it impractical to take samples from villages, analyze them in the laboratory, and then travel back to the village to deliver the results.

Improving the cost, durability, ease of transport, and usability of field methods (e.g., simplicity of use, use in the absence of electricity) is necessary to optimize the public health approach to aflatoxin exposure in developing countries. One field method which could be useful involves dipsticks, which are developed to measure up to the cut-off value for aflatoxins in food that corresponds with

trade agreements or regulations (Delmulle & De Saeger 2005). However, cut-off values in developed countries are markedly lower than typical food levels in developing countries. Such field test could prove effective if the cut-off value was adjusted based on chronic exposure, health effects, and action levels necessary for developing countries. Field methods for the analysis of biological samples have not been developed. However, the same concept of using dipsticks can be applied to field tests for biological specimens.

Laboratory Methods

Laboratory methods, which are more precise yet also more labor intensive and costly, can be used to confirm results of field tests. These methods require instrumentation of techniques not suited to working on-site. They require regular maintenance of instrumentation, training of personnel, and a ready supply of reagents and materials (Trucksess & Wood 1994). The best laboratory method for testing either food or biological specimen is one that balances the need for quick, accurate results with further refinement to improve their usability in developing countries. Thin layer chromatography (TLC) is a well-suited laboratory method for testing food samples, given its reliability and simplicity (Stroka and Anklam, 2000; Shepherd and Sewram, 2004), however, it is labour intensive and limited in the number of samples tested in a day. An alternative for food analysis is the VICAM AflaTest® immunoaffinity fluorometric method, which is less intensive and faster, but also more expensive (VICAM 2001).

Early Warning System for Developing Countries

In order to prevent future outbreaks, developing countries need an early warning system which is able to detect potential food contamination events with adverse health effects. Centre for Disease Control (CDC) in 2001 asserted that public health surveillance is the ongoing, systematic collection, analysis interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health.

Important characteristics of any surveillance system include simplicity, flexibility, data quality, acceptability, sensitivity, positive predictive value representativeness, timeliness, and stability. CDC (2001) further explained that to create an effective and sustainable system, health surveillance and food and biological monitoring strategies must be adapted to meet the needs of developing countries. Early warning signs need to be validated and a response protocol needs to be developed.

Previous outbreaks in Kenya have been identified by physicians noticing an increase in cases of jaundice despite a lack of any organized or official reporting system (Azziz-Baumgartner *et al.*, 2005). While a national reporting system for jaundice would prove beneficial for developing countries, the baseline rate of jaundice and all its possible causes are not known. In addition, aflatoxicosis confirmation tests using biological markers are limited. An early warning system should also involve monitoring aflatoxin levels in food sources of individuals in order to prevent or reduce the health impact.

Monitoring aflatoxin levels in food or individuals to identify those at risk of disease is more difficult than monitoring rates of jaundice. However, food and biological monitoring may identify susceptibility sooner and allow for a more timely intervention. To maximize resources, monitoring or surveillance should target high-risk areas or populations and the most appropriate specimen – food, urine, or serum, - should be collected. A rapid, field test that analyzes aflatoxin adducts in biological samples would be ideal for an early warning system that incorporates bio-monitoring. Ultimately an early warning system should rely on multiple sources of information and triggers that would set in motion various responses for preventing or reducing an outbreak of aflatoxicosis. Triggers for action could also be based upon other factors which indicate or influence aflatoxin contamination, such as reporting of death among livestock or domestic animals which are often given lower quality grain. Modeling of aflatoxin contamination based on weather conditions from planting to post-harvest could also serve as a trigger (de la Campa & Hocker., 2005).

Baseline Levels of Exposure:

Although a few studies have provided estimates of daily exposure to aflatoxins during non-outbreak period, more information is needed concerning baseline levels of chronic exposure for vulnerable populations. This would allow for a better quantification of the health risks associated with chronic exposure and for a better estimate of the level of aflatoxin exposure necessary to trigger an

outbreak. Such knowledge will enable the public health community to understand health effects associated with chronic exposure and allow for the evaluation of future public and agricultural interventions (Park & Kim 2004).

Aflatoxin and International Trade

Gross returns from the sale of groundnuts are based not only on yield but also on seed grade and levels of aflatoxin contamination (Rachaputi, Wright, & Kroschi, 2002). With competition high, exporters cannot afford to neglect issues related to groundnut quality and public health concerns. Quality is the key to being chosen as suppliers. This translates as being able to provide, on a regular basis, the required quantities of groundnuts, meeting quality specifications and standards that reflect both consumer health concerns and manufacturers' needs for further processing into food products (International Trade Forum, 2001). Aflatoxin has attracted attention as a chemical weapon, and there is military interest in protecting people from exposure either as a precursor to infectious biological weapons or as a "panic" weapon (Shane, 1993). The National Monitoring Programme (NMP) in 2004 realized that an ideal situation of absolute elimination of aflatoxins contamination of groundnuts can never be achieved, at least not yet, and many countries and the international community, have attempted to lower exposure by imposing regulatory limits that are as low as reasonable achievable.

Quality specifications and requirements exist for groundnuts and various groundnut products. Non-compliance to quality specifications and requirements in importing markets leads to costly rejections or claims and could result in the banning of trade with the non-complaint origin. Many groundnut-importing countries have placed limits on the levels of aflatoxin permissible in groundnuts and groundnut products. Countries depending on export of aflatoxin-susceptible commodities, example groundnuts, are obliged to establish export limits that meet importers' requirements. This leads to economic loss if the requirements are not met by the exporting countries and economic losses also occur where the requirements are too strict. Where a local food is also an export item, exportation of the most wholesome food may lead to local consumption of more contaminated foods. In part, this augments the risk of toxic effects in the indigenous population. Some maximum possible levels of aflatoxin in imported groundnut for human consumption and livestock and poultry feed in some important importing countries are shown in table 2 (International Trade Forum, 2001).

Table 2: Aflatoxin Tolerance Limits As set by some Groundnut Importing Countries (in microgram per kilogram of groundnuts ($\mu\text{g kg}^{-1}$)).

Maximum permissible level ($\mu\text{g kg}^{-1}$),			
	Aflatoxin type	Foodstuffs	Livestock feed
Belgium	B ₁	5	25
France	B ₁	1	20
Germany	B ₁	2	20
Ireland	B ₁	5	20
The Netherlands	B ₁	0	20
Sweden	B ₁ , B ₂ , G ₁ , G ₂	5	10
UK	B ₁ , B ₂ , G ₁ , G ₂	4	20
USA	B ₁ , B ₂ , G ₁ , G ₂	20	20

Source: Freeman *et al.*, 1999, ICRISAT

Considering the significance of the aflatoxins, several countries including the FAO (1996) (Codex Alimentarius Committee) have set the tolerance limits for groundnuts and its extractions. India and the United States of America have set 20 microgram per kilogram (μgkg^{-1}) of seed meant for human consumption as tolerance limit. The European Union formulated the following limits of aflatoxin for various categories of groundnuts as show in table 3.

Table 3: Aflatoxin Limits for Various Categories of Groundnuts (in microgram per kilogram of product).

Purpose	Tolerance limit (μgkg^{-1})	
	B ₁	B ₁ +G ₁ +B ₂ +G ₂
Groundnut for direct consumption	2	4
Groundnut for further processing	5	10
Milk and milk products	0.05	-

Source: Freeman *et al.*, 1999, ICRISAT

The loss arising from rejection is not limited to the value of the product. It also includes transportation and other export costs, all of which are incurred by the exporter. Compliance requirements on exporters impose non-trivial costs especially on developing countries, such as the cost of upgrading production systems, processing and storage equipment, and quality control stations (Henson & Caswell, 1999). Aflatoxins further damage the well-being of Africa's rural families by limiting exports of groundnuts and maize in particular. Grain-importing countries maintain high food quality standards, with especially strict controls on aflatoxin content. African food and feed products showing levels of contamination above the acceptable limits cannot penetrate major markets, resulting in significant loss of agricultural income (Science of Africa, 2005).

According to FAO/WHO (2005), contamination of groundnuts by aflatoxin in Africa is endemic and due to the high contamination of groundnuts in Sub-Saharan Africa (SSA) by aflatoxin, export of the commodity in the past two

decades was reduced by up to 20%. Studies have shown that about 20 to 25% of the groundnut produced in Asia and SSA contains aflatoxin beyond statutory limits, thereby exposing people to uncontrolled amounts of aflatoxin. This situation has contributed to 70% reduction in groundnut exports from Asia and SSA, with significant impacts on livelihoods (Freeman *et al.*, 1999). Groundnut export from African countries in general has been declining since the 1960s. Countries that are able to ensure safe food can take advantage of international trade opportunities, thereby increasing income levels. For example, Kenya was able to increase its fish exports to the EU from 742 metric tons in 1999 to 2818 tons in 2001 as a result of strengthening their food safety measures (FAO/WHO, 2005).

Commodities Susceptible To Aflatoxin Contamination

Groundnuts cultivated in Northern Nigeria were contaminated with aflatoxin levels up to 2000 μ g/kg (McDonald, 1964). The condition of the shells was found to be of importance in relation to fungal conditions and *Aspergillus flavus* was commonly associated with kernels from broken pods and that most toxic samples come from this grades of pod. Damage to shells, which occur while the crop is in ground, was found to predispose the kennels to contamination with aflatoxins (McDonald & Harkness, 1965). According to Awuah and Kpodo (1996), groundnut samples from 21 selected markets in the 10 regions of Ghana yielded high aflatoxin levels and the fungus was associated with 31.7% of

damaged kernels compared to 12.8% of undamaged kernels. They also realized that total aflatoxin levels ranged from 5.7 to 22,168 ppb in the damaged kernel samples. However, aflatoxin was not detected in 50% of undamaged kernel samples and very low, mostly ranging from 0.1 to 12.2 ppb in samples that tested positive for aflatoxins.

Akano and Atanda (1990) found aflatoxin B₁ concentrations in the range of 20-455 µg/kg in groundnut cake ('kulikuli') purchased from markets in Ibadan, Oyo State, Nigeria. Adebajo and Idowu (1994) reported that most of the corn groundnut snack ('donkwa') contained aflatoxin above 30µg/kg immediately after preparation. Yameogo and Kassamba (1999) reported that seeds of groundnuts from Burkina Faso inoculated with *Aspergillus flavus* excreted all the four major aflatoxins, which peaked at 170 ppb after 6 days. Aflatoxin formation in groundnut is favoured by prolonged end of season drought and associated elevated temperature (Rachaputi, Wright & Kroschi, 2002).

Maize provides an excellent substrate for mould growth and mycotoxin contamination. All the maize samples collected from silos and warehouses in Ghana contained aflatoxin at levels ranging from 20 to 355µg/kg, while fermented maize dough collected from major processing sites contained aflatoxin levels of 0.7 to 313µg/kg (Awuah & Kpodo, 1996). Bouraima, Ayi-Fanou, Kora, Sanni and Creppy, (1993) found aflatoxin B₁ level up to 14µg/kg and aflatoxin G₁ level up to 58µg/kg in stored maize from Benin. Setamou, Cardwell, Schulthess and Hell (1997) found that the percentage of samples contaminated with aflatoxin

was 42.5% in 1994 and 30% in 1995 in pre-harvest maize from Benin. Udoh Cardwel and Ikotun, (2000) reported that 33% of maize samples from different ecological zones of Nigeria were contaminated with aflatoxins. Hell, Cardwell, Setamou and Poehling, (2000) found that the percentage of maize samples with more than 5 µg/kg aflatoxin levels was between 9.9% and 32.2% in the different ecozones of Benin before storage, but that this increased to 15.0% and 32.2% after six months storage.

Aflatoxin was detected in 98% of samples of dried yam chips surveyed in Benin with levels ranging from 2.2 to 220µg/kg and a mean value of 14µg/kg (Bassa, Mestres, Hell, Vernia & Cardwell, 2001). Aflatoxin B₁ was detected in 22% of yam chips in Ogun and Oyo States of Nigeria (Bankole & Mabekoje, 2003), while in a larger survey conducted later, 54.2% of dried yam chips were contaminated with aflatoxin B₁ (4-186 µg/kg; mean = 23 µg/kg), 32.3% with aflatoxin B₂ (2-55 µg/kg), while 5.2% were positive for aflatoxin G₁ (4-18 µg/g), and two samples tested positive for aflatoxin G₂ (Bankole & Adebajo, 2003).

Adebajo (1993) reported the presence of aflatoxins in tiger nut (*Cyperus esculentus*) at toxicologically unsafe levels. Bankole and Esegbe (1996) detected aflatoxins in 35% of tiger nut with concentrations ranging from 10-120 µg/kg collected from different parts of Nigeria, and the incidence of *A. flavus* and aflatoxin contamination was found to be correlated. Efuntoye (1996) reported the fungal contamination of herbal drug plants stored for sale in Ibadan, and demonstrated the mycotoxin producing ability of the isolates on artificial medium.

The problem with mycotoxin contamination in herbal plants is that they are consumed directly, unlike other products such as maize and groundnuts, which may undergo some processing before eating. In a recent survey, 27% of melon seed samples from farmers' stores contained aflatoxin B₁ with mean levels of 14µg/kg in the forest and 11µg/kg in savanna of Nigeria (Bankole & Adebajo, 2004). Rice has also been known to favour aflatoxin production. A recent survey in UK shows that retail rice was contaminated with aflatoxin, though at toxicologically 'safe levels' (Food Standard Agency, 2002).

Factors that Promote the Proliferation of Aflatoxin

Mycotoxin contamination is favoured by stress factors during plant growth, late harvesting of crops, high ambient humidity preventing thorough drying, unscientific storage practices and lack of awareness (Bankole, Mabekoje, & Enikuomhin, 2003). According to Bhat and Vashanti (2003), tropical conditions such as high temperatures and moisture, monsoons, unseasonal rains during harvest, and flash floods lead to fungal proliferation and production of mycotoxins. Detached and over-mature pods are also highly vulnerable to invasion by soil insects, *Aspergillus* fungi and consequently aflatoxin contamination (Cole, Sanders, Donner & Blankenship, 1989). Poor harvesting practices, improper storage, and less than optimal conditions during transport and marketing can also contribute to fungal growth and increase the risk of mycotoxin production (Bhat & Vashanti, 2003). Groundnuts become tainted with aflatoxins

during storage under hot, moist conditions that promote fungal growth. Insects feeding on the stored groundnuts spread the aflatoxin-producing soil fungi and damage the shells that protect the edible kernels (Harder, 2005). Crops grown and stored under such conditions as droughts and floods are more susceptible to mycotoxin contamination (FAO/WHO, 2005). Aflatoxin contamination is also promoted by stress or damage to the crop due to drought before harvest, insect activity, poor timing of harvest, rains at and after harvest, and inadequate drying of the crop before storage (Hawkins, Windham, & Williams, 2005; Hell, Cardwell, Setamou & Poehling 2000). Factors that affect aflatoxin contamination include the climate of the region, the genotype of the affect aflatoxin contamination include the climate of the region, the genotype of the crop planted, soil type, minimum and maximum daily temperature, and daily net evaporation (Fandohan, Gnonlonfin, Hell, Marasas & Wringfield, 2005).

State of Aflatoxin Control and Detoxification in Africa

Mycotoxins attract worldwide attention because of the significant economic losses associated with their impact on human health, animal productivity and trade (Centre for Technical and Agricultural and Rural Cooperation, 1997). According to WHO (1991), up to 25% of the world's food crops are significantly contaminated with mycotoxins. In most African countries where technological advances in agriculture still lag behind, pre and post-harvest treatment of crops is not stringent enough to discourage fungal infection, growth

and subsequent production of mycotoxins (Sabanda, Marovatsanga & Pestka, 1997). It has been observed that in most African countries the best quality groundnuts are exported and what is left for local consumption is not monitored for quality. The reason for which the groundnuts are not monitored for quality was attributed to the high costs involved in sample collection, reagents, expendables and standards acquisition (Cardwell, Hounsa & Egal, 2001) and this works to the detriment of consumer health. Many countries are still struggling to set up prevention, control and surveillance strategies to curb the incidence of mycotoxins in foods (Sabanda, Marovatsanga & Pestka, 1997). There is lack of established specifications for aflatoxins in complementary foods for infants and young children in most African countries. According to Agag (2004), there are only three countries in Africa with standards namely, 0 $\mu\text{g}/\text{kg}$ and 20 $\mu\text{g}/\text{kg}$ maximum tolerable levels for aflatoxin B₁ in infant and young children foods, and all foodstuffs respectively in Nigeria, and 10 $\mu\text{g}/\text{kg}$ of total aflatoxin in all foodstuffs in Egypt and South Africa. He further reports that short comings may hinder routine monitoring of foods for aflatoxin contamination which may have negative ramifications for child growth and immune competence. The additional cost of cereals and legumes following sorting may make cereal-legume-based complementary foods unaffordable to most mothers.

Reducing Aflatoxin Contamination

Contamination can occur any time from pre-harvest to storage. Pre-harvest infection is significant in the semi-arid tropics, especially when end-of-season drought occurs. Poor post-harvest conditions in warm humid areas and bad harvesting and storage practices lead to rapid development of the fungi and higher levels of toxins. This is especially true in developing countries where preventive measures are frequently ignored (ICRISAT, 2000). To minimize aflatoxins in stored groundnuts, a suite of recommended farming practices are advocated by Harder (2005). These include hand sorting groundnuts and discarding visibly mouldy or damage done; sun drying the groundnuts on fibre mats rather than directly on the ground to reduce contact with ground moisture; storing groundnuts in sacks made from breathable natural fibers than moisture-retaining plastic; storing the sacks on wooden pales to avoid contact it the ground; and treating the ground beneath the pallets with insecticide.

Xinhua New Agency (2007), asserted that ICRISAT (2000), backed by the Consultative Group on International Agricultural Research (CGIAR) (2007), devised a kit to enable fast, affordable and easy testing of crops for the deadly poison, aflatoxin, which makes them unfit for human consumption or export. This, he said, would provide considerable health benefits to local consumers as well as reduce the rejection of exported commodities due to high aflatoxin levels. It also mentioned that testing groundnuts has worked as a monitoring tool to

ensure that buyers do not get produce with higher aflatoxin concentrations than their market requirements or specifications

Aflatoxin Awareness campaigns

According to the Centre for Disease Control and Prevention (CDCP) (2004), raising awareness of aflatoxins and disseminating relevant information to individuals is an important part of any intervention strategy. During the 2005 Kenya outbreak, individuals who reported receiving information on maize drying and storage through a awareness campaign implemented by the Food and Agricultural Organization, the Ministry of Health, and the Ministry of Agriculture had lower serum aflatoxin levels than those who did not receive this information. James (2005) recommends that awareness campaigns should utilize systems that are in place already for disseminating information to subsistence farmers. He adds that such campaigns should also include the dissemination of information to non-governmental organizations, public service associations, health care providers, and schools. Given diversity in culture and remote location of villages, multiple means for disseminating information as part of an awareness campaign may be necessary to reach a broad range of people. Populations not receiving messages from current campaigns and appropriate methods for reaching those populations needs to be identified. Reasons for failure or unwillingness to adopt recommendations should also be identified (James, 2005).

Analysis of Food and Biological Specimens

The knowledge of the relationship between aflatoxin concentrations in food or biological specimens and potential health outcomes is central to quantifying and mitigating the aflatoxin burden in the developing world. From the standpoint of improving public health, the goals of laboratory testing in toxicology include establishing a baseline in humans and the environment (e.g. foods, communities, individuals), monitoring exposure, confirming exposure or diagnosis of poisoning, excluding other causes of disease, monitoring the effectiveness of prevention interventions, and guiding therapeutic interventions (van Egmond, 2002).

Recommended International Code of Hygienic Practice for Groundnuts (Peanuts)

Table 4 is a table from Recommended International Code of Hygienic Practices of Groundnuts (1979) that contains the recommended minimum requirements of hygiene from on-farm handling through transportation, storage, in-shell operations, commercial shelling of groundnuts till it gets to the consumers. It covers all types and forms of raw, dried groundnuts (peanuts) in-shell and shelled groundnuts.

Table 4: Recommended Requirements of Hygienic Handling of Groundnuts

<u>Function</u>	<u>Recommended practice</u>
Harvesting	Harvest at right time, do not allow accumulation of waste.
Irrigation control	Use good quality water for irrigation
Pest and disease	Treatment with chemical, physical or biological agents should be controlled.
Curing	Expose pods to sun and wind for maximum drying to prevent mould growth.
Equipment and containers	Containers to be used permit easy and thorough cleaning
Protection	Protect nuts from rodents and other pests, store in covered containers. Avoid humid environment.
Transportation	Conveyances should permit thorough cleaning and treatment with pesticides. Bulk transport should be well ventilated with dry air.
Purchasing	Monitor the quality of groundnut lots offered
Receiving	The transport vehicle should be examined for cleanliness insect infestation, dampness or unusual

odours. The appearance of the groundnuts should be observed during unloading. If they are wet to touch, insect infested, insect damaged, or contain an unusual amount of dirt, they should not be commingled with known good groundnuts in warehouse.

Storage Thoroughly cleaned warehouse of all debris and fumigate/treat with pesticides before use. Storage center should keep out moisture and be well ventilated.

Shelling Maximum possible amount of foreign material, loose shell and loose kernels should be removed before shelling. All foreign materials should be removed from the shelled nuts.

Grading The groundnuts should be size-graded after shelling

Sorting This may be done by hand picking or photo-electric sorting machines. Foreign materials and defective kernels such as mouldy, discoloured, rancid, decayed, shriveled, insect, or otherwise damaged should be bagged separately and tagged as unsuitable for human or animal consumption.

Rejected groundnuts should be destroyed or separated from edible products.

Sorted groundnuts should be checked by regular aflatoxin analysis of the sorted groundnuts stream or of finished products

Source: CAC/RCP, (1979)

Contingent Valuation

The contingent valuation (CV) method was first proposed by Ciriacy-Wantrup in 1947 as a way to value natural resources. By the 1970s, the CV method was being used more often in tests to determine the method's validity, studying subjects such as air pollution, hunting, reduced health risks in various situations, and water quality. By the 1980s, organisations such as the United States Environmental Protection Agency (EPA) were beginning to accept the CV method as a valid assessment tool (Hanemann, 1994; Mitchell & Carson, 1989).

Contingent valuation method (CVM) is a non-market valuation method that is used to value specific changes from the status quo. CVM estimates total value to an individual.

Environmental economists often use it to value environmental policies, for instance it is used in determining willingness to pay to assure that there is not

another oil spill of the Exxon Valdez magnitude in the U.S as reported by National Oceanic and Atmospheric Administration (NAOO) in 2007. CVM is a stated-preference technique. Specifically, individuals are asked about the status quo versus some alternative state of the world, and information is elicited about how the individual “feels” about the alternative relative to the status quo, and their WTP, if anything, for the alternative.

Contingent Valuation Methods

Contingent valuation studies tackle many different subjects, such as the environment (Alberini, Maureen, Alan, & Tsu-Tan, 1997), consumer marketing (Bjorner, 2004), and government services such as health care (Golan and Shechter, 1993). There are a few common ways of performing a CV analysis. The following information is from Mitchell and Carson (1989) and Boyle and Bishop (1998) who address four of these methods: bidding, payment card, dichotomous choice, and referendum.

Bidding (Iterative Bidding): In this method, participants are asked if they are willing to pay Z dollar amount for a program that has been described in a hypothetical market scenario. If the participant answers “yes”, then the dollar amount is raised until a “no” is received. Then the dollar amount is decreased in smaller increment until a “yes” is received again. Advantages of this method include that the participants are able to examine the answer they have given and

modify it if they choose. However, the starting point at which the bidding is begun may influence the participant's answer as well. Some researchers have attempted to get around this bias by allowing the participant to name the starting bid.

Payment Card: Participants are asked to give one WTP response based on the hypothetical market scenario they are given by using a payment card to select the value that most represents their WTP for the program. The payment card is not necessarily an actual card, but is a series of values for the respondent to choose from that start with zero and increase. Depending on how the payment card is being used, participants may also see various dollar amounts highlighted on the payment card, called anchors, that represent appropriate choices for individuals who have a particular characteristic (such as certain household income). The payment card method is useful because it eliminates the problem of suggesting a particular value as the 'starting point' that is found when using the bidding method. However, using anchors on the payment card may also affect respondents' selection of WTP values.

Dichotomous Choice: In this method, sometimes called 'take-it-or-leave-it', after participants have read the hypothetical market scenario, they are then given a randomly assigned WTP value and asked if they would be willing to pay that value. Participants are not given any other choices, and provide a yes or no response. Each WTP value in the set is offered to the same number of people and consequently this method can take a longer amount of time to complete than other

methods. Additionally, only qualitative analysis can be performed, as participants do not respond with a WTP value. Occasionally, the dichotomous choice survey may include an opportunity for a second response where participants are given a pre-selected random higher or lower value depending on whether they respond yes or no to the first question.

Referendum: The referendum method is similar to the dichotomous choice method. In the referendum method, participants are given a hypothetical market scenario and asked whether or not they would vote yes or no for the proposal where it to be considered on an actual ballot. Additionally, some referendum studies compare hypothetical referendum decisions and actual referendum decisions. For example, Johnston in 2006 performed a study regarding installation of a public water system, finding that the participants' hypothetical voting preferences and actual voting preferences were almost identical. An advantage of the referendum model is that it is familiar to many participants in both format and context (voting in a referendum is a frequent way to determine the value of a specific program of provision to a group of individuals). A hypothetical referendum CV survey may also be preferable over an actual referendum in some instances, as the CV survey may be more able to obtain responses from all demographics in the population (Mitchell & Carson, 1989).

In comparing these methods (iterative bidding, payment card, and dichotomous choice), Boyle and Bishop (1998) find that none of the three stands

out as a “better” method, and they recognize problems with each method. In their study, iterative bidding contained a starting point bias problem, the payment cards had an anchor bias, and both the payment cards and the dichotomous choice methods had an interviewer effect.

Measuring WTP by applying the Contingent Valuation Method (CVM)

Contingent valuation method creates a hypothetical market situation for a given good or service. It tends to quantify the value consumers confer to products by associating that value with the sum of money they are willing to pay. (Kawagoe & Fukunaga, 2001). Researches conducted by CVM offer a specific survey design, especially when they inquire about WTP. They solicit information about consumption behaviour, risks perceptions and experiences, and socio-demographic information. (Mitchell & Carson, 1989). Respondents face a hypothetical purchasing situation in which they have to answer how much money they are willing to pay for a given product, or if they are willing to pay a certain premium, expressed either as a sum of money or as a percentage above the reference price. Before asking respondents, the researcher must define the different price premiums (so called “starting points”). A frequent way of so doing is by conducting a pilot test. Still, other criteria such as iterative selection (Cooper, 1993), random premiums definition (Gil, Gracia & Sánchez, 2000) or questions based on the effective prices at the survey’s points (Ara, 2002) are also common.

Challenges of Contingent Valuation Methods

According to Johnston (2006), it should be noted that there are a few worries about the CVM. Some concerns which he raised have been numbered below.

1. Individuals do not necessarily have a strong incentive to think seriously about their answer because they will not be penalized for answering foolishly.
2. Individuals who take such questions seriously might have an incentive to lie (distort their answer – the bias can go in either direction). Not taking the question seriously adds noise to the data, not bias. Lying adds bias. Bias is a bigger concern than noise.

Johnston (2006) also raises the following concerns about the CVM;

1. Respondents do not understand what they're being asked to value
2. It is hypothetical and may not be taken seriously because no budget constraint is actually experienced by respondents.
3. Strategic bias – problem if the results are too realistic (trade-off between bias and variance)
4. Starting point bias
5. Warm glow effect- people simply “purchase moral satisfaction” with big, but unreal answers.

CHAPTER THREE

METHODOLOGY

General Overview

This section of the thesis provides information on the study area, research design, study population and sampling procedures used. Information about the sample size, instrumentation, pilot study and data collection as well as the types of data analyses conducted have also been provided in this chapter. The rationales behind the analyses conducted have also been explained.

Research Design

The design that was used to research the topic under investigation is the descriptive survey method. Descriptive survey design method entails sampling views from many respondents so as to determine the presence or absence of variation and estimate relationship between variables. The results are then used to make generalizations about the population from which the sample was taken. This

method, descriptive survey design, was used because the study serves as a preliminary study and seeks to provide the background information required about the issue under study as recommended by Sarantakos (1998). Also, descriptive survey design was used because data was to be collected at one point in time only and this method, according to Alan (2004), is best suited for that purpose.

Study Population and Units of Enquiry

The study involved the population of groundnut consumers in the Northern Region of Ghana. The population of groundnut consumers included all persons who were major food consumption decision makers in terms of selection of food for household consumption and also involved in making food consumption decisions (specifically for groundnuts) for themselves and/or their families and had done so for at least two years. The units of enquiry was made up of one of the members from each selected household who was responsible for making decisions concerning buying and cooking of meals for the household. They necessarily were above the age of eighteen and had bought food for their households for at least two years.

Sampling Procedure

Selection of districts

Stratified random sampling was used in general from selection of districts through selection of communities to selection of households. However, the lottery method of simple random sampling was used at each stage of the selection process. In selecting the four districts where data was to be collected, the lottery simple random sampling method was used. A numbered list of the districts in the Northern Region was made and the lottery method of simple random sampling was then employed in obtaining the four districts from the sampling frame.

Four districts out of a total of eighteen in the region were chosen

The procedure is listed below:

- 1.** The sampling frame of the districts in the Northern Region of Ghana was made.
- 2.** The researcher then substituted the listed names in the sampling frame for numbered marbles so that each marble corresponded to a district's name from the sampling frame.
- 3.** The marbles were then thoroughly mixed and one removed from the box. The number of this marble was registered and the corresponding name in the sampling frame was ascertained. This was the first district selected. This procedure was repeated to obtain the remaining three districts for the purpose of data collection.

The sampling frame of the districts in the Northern Region of Ghana is listed below.

1. Bole District
2. Bunkpurugu-Yunyoo District
3. Central Gonja District
4. East Gonja District
5. East Mamprusi District
6. Gushiegu District
7. Karaga District
8. Nanumba North District
9. Nanumba South District
10. Saboba/Chereponi District
11. Savelugu/Nanton District
12. Sawla-Tuna-Kalba District
13. Tamale Municipal District
14. Tolon/Kumbungu District
15. West Gonja District
16. Yendi District
17. Zabzugu/Tatale District

Selection of communities

In selecting the study areas in the districts selected, a sampling frame of the number of communities in each district was obtained from the Ministry of Food and Agriculture. The lottery method of simple random sampling was again used to select two communities from each district. From these communities, data was collected.

Selection of households

In the selection of households from the selected communities, simple random sampling was used again. Twenty five (25) households were selected from each of two communities per district using the lottery method of simple random sampling. The sampling frame of the households was obtained by recording the name of each household and giving it a number. From this list, the sample of households was obtained. One (1) respondent from each household was selected for the study.

Selection of respondents

The respondents in the selected households were selected using purposive sampling technique. In selecting respondents from the households, one respondent from each household was selected. This included only persons who were usually

involved in the purchasing food for the household and were above the age of 18. In addition, the respondents who had been involved in this activity for at least two (2) years were necessarily interviewed to improve accuracy of results and ensure the provision of detailed information during the interview process. One respondent from each household was chosen for the purpose of data collection.

Sample Size

The larger the sample size, the smaller the magnitude of errors through sampling and the higher the probability that the sample will be representative of the population. This is the case when the sample is chosen randomly. According to Stevens (1996), about fifteen (15) subjects of cases per predictor are needed for a reliable equation in regression analysis. Since there are six (6) independent variables in the logistic regression equation, two hundred (200) respondents were chosen to ensure a smaller sampling error and make the sample representative of the population. The 200 respondents selected included fifty (50) respondents from each of four (4) selected districts in the region.

Instrumentation

The study employed the use of structural and validated interview schedule for the collection of primary data. This instrument was chosen because from literature, majority of the subjects in the study population have no formal education and therefore data collection using this tool was better suited for it. This

instrument also provides uniform information, which assures comparability of data and requires fewer interviewing skill (Sarandakos, 1998). This is another reason why the interview schedule was chosen as the instrument of research. While the face validity of the questionnaire was ensured by the researcher, the content validity was ensured by the major supervisor. The interview schedule was semi-structured to help explore issues that bore on the phenomenon under study. The questions were asked in the local dialect by the researcher to the understanding of the respondent where necessary to ensure that responses were adequate and satisfactory. In designing the instrument, a thorough literature search to identify concepts and variables used in similar past studies was conducted and modified to the goal of the present study. The instrument comprised of a mix of open-ended and closed-ended questions as recommended by Maddox (1985). The first part of the questionnaire (section 1) comprised of the questions for measuring perception of groundnut quality and the second section also measured level of aflatoxin awareness. The third part of the questionnaire measured food safety concerns. Finally, the fourth section measured groundnut consumption frequency, income levels, willingness to pay and socio-demographic characteristics.

Data and Sources

The study relied on both primary and secondary data. Primary data were gathered using an interview schedule which was both in-depth and semi

structured. Secondary data was obtained through published and unpublished works in books, journals, newspapers, internet, brochures, magazines and policy as well as conference papers and working papers that treated aspects of the research topic under investigation.

Pre-testing and Pilot Study

Pre-testing of the instruments was done in a randomly selected district (Tamale metropolis) after the districts where data was to be collected had been selected. The purpose of the pre-test was to determine if any errors were made in the writing of the survey, if any questions or statements were double barreled, and if the survey was leading or misleading in any way. In addition, the pre-test was conducted to detect any issues that were not anticipated and to assess several issues, including:

1. The clarity of the scenario describing the quality of groundnuts.
2. Whether survey respondents understood the WTP questions or not.
3. Whether survey respondents understood the issue of aflatoxins in groundnuts or not.
4. Whether the order and wording of the questions elicited the desired responses for each question.
5. To determine an average additional cost which consumers are willing to pay for a 'bowl' of groundnuts which has been tested and certified as safe

for consumption in terms of aflatoxin levels. To achieve this, a focus group discussion was held and members present were told the health implications of consuming aflatoxin-contaminated groundnuts. Their responses on how much they would agree to pay for safe groundnuts if they had access to it were then solicited from each of the forty members present. The result of the pilot study was then used to correctly structure items in the interview schedule in order to enhance its validity.

Data Collection Procedure

Four field assistants were selected by the researcher to aid in data collection. They were trained by the researcher to understand the objectives of the study and the purpose and procedure of the interview process. They were also trained to have a common understanding of the questions in the interview schedule and to ask the questions to the understanding of the respondents. The field assistants were selected based on their knowledge of the local language, previous research experience and ability to understand and write in the local dialect and English. The instruments were explained to the respondents in their local dialects which include Dagbani and Mampruni as well as Hausa. Responses were then recorded in English by the field assistants for easy use by the researcher.

Data Processing and Analysis

Descriptive statistics obtained from the summary of data in the form of frequencies and means was used to analyze the data obtained. For a more quantitative assessment, logistic regression analysis, analysis of variance, and correlation analysis were performed. Statistical Product and Service Solutions (SPSS), a statistical data analysis software, was used to process the data at various stages of the analyses. The specific analytical tools which were used in the study for each objective stated are briefly described below.

Perception of Groundnut Quality

The perception of a group of people with regard to a specific food item will influence their food consumption habits. According to Parasuraman *et al.*, (1998) to measure the perception of food quality, a menstruation scale should be developed based on some parameters. In measuring the perception of groundnut quality among consumers in the Northern Region therefore, some parameters were used based on their ability to predispose the groundnuts to aflatoxin or indicate the presence or absence of aflatoxins in the groundnuts. The parameters are shown in table 5. Also, these were used since they are the extrinsic properties of groundnuts (Grunert *et al.*, 1996) and have an effect of causing the intrinsic properties of the product to be of low quality. This causes the food to be unsafe for consumption considering the possibility of aflatoxin contamination.

Table 5: Variables used in Measuring Groundnut Quality

Quality attribute
Groundnuts which have a change in taste
Groundnuts which have changed colour
Mouldy groundnuts
Broken and bruised groundnuts
Insect-attacked groundnuts
Shriveled groundnuts
Groundnuts stored damp
Groundnuts which contain foreign materials (twigs, leaves, dead insects, sand etc)

The variables in table 5 are conditions necessary for aflatoxin contamination in groundnuts and aflatoxin reduces the quality of groundnuts by making them unhealthy for human consumption. The absence of these variables in groundnuts reduces aflatoxin contamination. In measuring the perception of respondents concerning groundnut quality, the variables shown in table 5 were used. Respondents decided whether they would accept each of these variables for consumption purposes or not. The responses were then categorized into a four-point Likert scale. The table for interpreting the scale has been shown in table 6.

Table 6: Scale for Measuring Consumer Perception of Quality

Ratings	Indices of groundnut accepted	Classification
1	1-2	Very positive perception
2	3-4	Positive perception
3	5-6	Negative perception
4	7-8	Very negative perception

Source: Ron, (1991).

In the table 6, a consumer who accepts one or two of the eight variables is classified as having a very positive perception of groundnut quality and for a respondent who agrees to consumer groundnuts with three or four of the eight variables is classified as having a positive perception of groundnut quality. Also, a respondent who accepts five or six of the eight variables has a negative perception of groundnut quality and one who accepts the presence of seven or all eight of the variables is classified as having very negative perception.

In measuring the level of aflatoxin awareness among respondents, the indices used are shown in table 7.

Table 7: Indices used in measuring level of aflatoxin awareness

Indices used in measuring aflatoxin awareness

1. Knowledge of toxins called aflatoxins which develop in groundnuts
 2. Moulds in groundnuts producing aflatoxins
 3. Aflatoxins being harmful to human health
 4. Broken and bruised groundnuts promoting the development and proliferation of aflatoxins
 5. Insect-attacked groundnuts promote aflatoxins
 6. Presence of foreign material in groundnuts resulting in development of aflatoxins
 7. Shriveled groundnuts usually contain high levels of aflatoxins
 8. Damp groundnuts promote aflatoxin development and contamination
 9. High levels of aflatoxins in groundnuts can cause death through food poisoning
 10. Aflatoxins cause liver cancer
 11. Aflatoxins cause stunted growth in children ('kwashiorkor')
 12. Aflatoxin levels in groundnuts can be reduced by sorting unwholesome kernels out.
-

In computing the level of aflatoxin awareness for each educational level, means were used. However, in measuring the relationship between the level of education of respondents and their level of aflatoxin awareness, one-way

between-grounds analysis of variance (ANOVA) was used to test whether there were differences in the level of education and also tell where the differences existed, if any, and the level of significance. Both variables were measured on an ordinal scale. This is also as prescribed by Pallant (2005)

In determining the relationship between the household income levels of respondents and their frequency of groundnut consumption, correlation was used. Since the respondents were randomly chosen, Pearson product moment correlation was used to measure the relationship between the income level of households and their frequency of groundnut consumption. Person product moment correlation was also used since both variables were measured on ordinal scales. This is as prescribed by Pallant (2005).

There are a number of different methods to use to calculate consumers' willingness to pay for different goods. In this research, the contingent valuation method was used. Specifically, the referendum method was used in obtaining information on consumers' willingness to pay for groundnuts tested and certified as safe for consumption in terms of the level of aflatoxin presence in the lot. This was used since the objective bothered on acceptance or rejection of only one phenomenon (WTP) at a predetermined price. This is as prescribed by Mitchell and Carson (1989).

Binary logistic regression analytical tool that was used to analyze the consumer willingness to pay (WTP) for the certified groundnuts after the referendum method was used to obtain the responses. In estimating consumer

willingness to pay, the following variables were included as independent variables in the study; educational background, income level, presence or absence of children in the family, frequency of consumption and concerns about food safety.

The logistic regression equation for the estimation of willingness to pay for the improved groundnut is as follows;

Willingness to pay (WTP) = Dependent variables (dichotomous = high or low) = Y

Independent variables = income level, educational background, presence of children, food safety concerns, frequency of consumption, level of aflatoxin awareness.

Log odds (Y=1) = $b_0 + b_1X_1 + \dots + B_Y X_Y$ or

Log P[(Y=1)/P(Y=0)] = $b_0 + b_1X_1 + b_2X_E + b_3X_S + b_5X_F + b_6X_A$

$P(y=1) = \exp(b_0 + b_1X_1 + b_2X_E + b_3X_C + b_4X_S + b_5X_F + b_6X_A) /$

$[1 - \exp(b_0 + b_1X_1 + b_2X_E + b_3X_C + b_4X_S + b_5X_F + b_6X_A)]$

Where Y=1 means consumer is willing to pay a higher amount for quality

And Y=0 means the consumer is not willing to pay a higher price for higher quality

P=probability

b_0 =constant

b_n = regression coefficients and

X_1 = household income level

X_S = food safety concern

X_A = level of aflatoxin awareness

X_F = frequency of consumption

X_E = educational level

X_C = presence or absence of children in the household.

CHAPTER FOUR

RESULT AND DISCUSSION

General Overview

This section provides details about the results obtained from the analyses conducted. The information has been tabulated to make it easy to understand. The tables have also been discussed to throw more light on the results obtained. The first part shows the results and discussion for consumer perceptions of groundnut quality and the second part is on the differences in aflatoxin awareness levels among the different educational statuses. The next part deals with the results and discussion on the relationship between income levels of households and their frequency of consumption of groundnuts. The final part also provides details of the results and discussions on the willingness of consumers to pay for groundnuts tested and certified as safe for human consumption.

Perception of Groundnut Quality

Table 8: Frequency Distribution of Consumer Perception of Groundnut Quality

Perception of groundnut	Frequency	Percentage quality
Very positive	11	5.5
Positive	50	25.1
Negative	110	55.3
Very negative	28	14.1
Total	199	100

n= 200 Source: Field Survey Data, 2008 Scale 1 = Very good
2 = Good, 3=Bad, 4=Very bad

From table 8, it can be realized that a majority (55.3%) of the respondents in the study area have a negative perception of groundnut quality in terms of the factors which influence the aflatoxin levels in groundnuts. 25.1% of them have positive perception of groundnut quality and only 5.5% of them have very positive perception.

The results indicated that 55.3% of the respondents will accept groundnuts which do have between five or six out of the eight indices used to measure groundnut quality. This result is contradictory to the report by Bonner and Nelson

(1985) who asserted that high quality of food is most often associated with attributes such as 'rich/full flavour', 'tastes fresh', 'good aroma' and 'looks appetizing.' This is because in this case, majority (55.3%) of the consumers did not measure the quality of the groundnuts on similar parameters. However according to Holm and Kildevang (1996), individual assessments of quality are personal and situational, and that they are often based on incomplete information about the products they purchase. This may be the reason for this choice by the majority of respondents. This category, the majority, will therefore accept such groundnuts as good for consumption purposes. Hence these groups of consumers are therefore not likely to be protected from the negative aflatoxin effects through their groundnut consumption habits. It may be concluded that a majority of the consumers are at a great risk of aflatoxin contamination. This perception of the majority (55.3%) of the respondents could thus be responsible for the incidence of aflatoxicosis in the region.

This is followed by 25.1% of them having a positive perception of groundnut quality. This group will reject only groundnuts which have up to three or four of the indices used to measure perception of groundnut quality. This result shows that up to a quarter of the entire group have a positive perception of groundnut quality and hence will be less exposed to aflatoxins through their groundnut consumption habits than the first group. However, this does not completely offer protection against aflatoxicosis for these residents but only reduces the likelihood of contamination which they may encounter.

Fourteen point one percent (14.1%) of the respondents had a very negative perception of groundnut quality and would therefore accept groundnuts which contained up to seven or all eight indices used to measure perception of quality of groundnuts as good for consumption by their households. This category of respondents is at the highest risk of aflatoxicosis infection due to the perception they hold with regards to groundnut quality. This category will virtually discard no groundnuts at all irrespective of the condition of the groundnuts as far as the parameters for measurement of quality in this study are concerned.

The group which is most protected from the negative implications of consuming aflatoxin contaminated groundnuts is made up of only 5.5% of the total respondents interviewed. This group will reject groundnuts which contain one or two of the variables which project the possible presence of aflatoxin in groundnuts. Their perception of groundnut quality will influence their consumption habits and hence the risk of aflatoxicosis is reduced. This group however consists of only 5.5% of the entire group and this shows that the groundnut consumption habits of groundnut consumers in the region will largely expose majority of the respondents to aflatoxin contamination.

According to Harder (2005), the factors that were used to measure the perception of groundnut quality, when present in groundnuts, increase the level of aflatoxin contamination and proliferation in the groundnuts to a large extent. The perception of groundnut quality that the consumers generally hold therefore plays an important role in their groundnut consumption decisions which could result in

the negative health implication some of which include cancer of the liver, stunted growth and increased prevalence of hepatitis and low immune strength against HIV infection among others.

Aflatoxin Awareness and Level of Education

A one-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of level of educational attainment on the level of groundnut aflatoxin awareness among the residents of the Northern Region of Ghana. Subjects were divided into four groups according to their level of educational attainment.

Table 9 briefly describes the number of people in the four categories of educational backgrounds that were interviewed in the study with respect to their number, mean levels of awareness and the minimum and maximum levels of aflatoxin awareness.

Table 9: Mean Levels of Aflatoxin Awareness by level of Education

Total awareness

Educational Status	n	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
No formal education	102	1.3235	0.51052	0.05055	1.2233	1.4238	1.00	3.00
Primary education	42	1.4762	0.63392	0.09782	1.2786	1.6737	1.00	3.00
Secondary education	39	1.3846	0.63310	0.10138	1.1794	1.5898	1.00	3.00
Tertiary education	11	1.5455	0.93420	0.28167	0.9179	2.1731	1.00	4.00
Total	194	1.3814	0.59258	0.04255	1.2975	1.4654	1.00	4.00

Source: Survey, 2008. Scale: 1=Very low awareness, 2=Low awareness, 3=High awareness, 4= Very high awareness.

Table 9 shows that 102 respondents had no formal education, 42 had primary school education, 39 had secondary school education and 11 had tertiary education. The mean levels of aflatoxin awareness for each of these categories of respondents as measured on a four-point Likert scale are 1.323, 1.476, 1.385 and 1.546 respectively. Clearly, the results show that all of the groups had very low levels of aflatoxin awareness with those who attained tertiary education having the highest mean of 1.546. Table 9 also shows that for respondents with no formal education, with primary education and with secondary education, the minimum level of aflatoxin awareness is 3 which also corresponds to high level of

awareness for those with tertiary education is 4 which signifies a very high level of aflatoxin awareness.

Homogeneity of Variance

Table 10 shows the results for the test of homogeneity of variance. Homogeneity of variance is an assumption which must be satisfied for a successful analysis of variance to be conducted (Pallant, 2005).

Table 10: Test of Homogeneity of Variance

Total aflatoxin awareness

Levene Statistic	df1	df2	Sig
3.471	3	190	0.087

P<0.05 Source: Field Survey Data, 2008

Levene Test of Homogeneity of Variance was carried out to determine whether the variance in scores of level of aflatoxin awareness is the same for each of the four groups (according to level of educational attainment).

From the test of homogeneity of variance in table 10, it can be seen that the level of significance is 0.087. This is greater than the 0.05 level of significance and hence implies that the assumption of homogeneity of variance

has not been violated by the study. This is as recommended by Pallant (2005) who asserted that for Levene test of homogeneity of variance, a non-significant figure is indicative of a non-violation of the homogeneity of variance assumption employed in the analysis of variance (ANOVA).

Analysis of Variance (ANOVA)

Table 11 shows the results of the one-way between-groups analysis of variance (ANOVA) that was conducted to determine the effect of different educational levels on the level of aflatoxin awareness.

Table 11: One-Way Between-Groups ANOVA between Level of Education and Level of Aflatoxin Awareness

Total awareness					
	Sum of				
	Squares	df	Mean Square	F	Sig.
Between Groups	1.015	3	.338	.963	.411
Within Groups	66.758	190	.351		
Total	67.773	193			

p>0.05 Source: Field Survey Data, 2008.

From the ANOVA (table 11), the level of significant difference between the groups 0.411 This is a non significant figure as it is greater the 0.05 level of

significance recommended by Pallant (2005). No post hoc analysis was conducted because the differences in the means of the different groups in terms of levels of education are not significant.

The lack of significance in the differences in means among the four groups of educational levels concerning the level of aflatoxin awareness indicates that no group is significantly more aware of aflatoxins in groundnuts than the other. According to the European Consensus on Development, (2006), level of education correlates positively with the level of awareness due to increased access to information. It is therefore expected that the level of aflatoxin awareness should increase with increasing level of educational attainment since people with formal education are more exposed to information in general and in this case, on food safety issues than those with lower levels of educational and no formal educational attainment. The results obtained in this study does not agree with the report of the European Consensus on Development (2006).

The results from the analysis imply that consumers in the study area, irrespective of their education level, have a very low level of aflatoxin awareness. This means that the issue of aflatoxin contamination of foods, specifically groundnuts, is relatively unknown by consumers even across the educational levels in the region. However, according to Centre for Disease Control and Prevention (2004), groundnut consumers who received education regarding aflatoxins recorded lower levels of aflatoxin poisoning in Kenya. It is important therefore that education and creation of awareness of aflatoxins and their health

implications as well as the means through which consumers can prevent contamination of foods be made available to consumers. This will help to improve public health in the region by reducing the risk of aflatoxicosis.

Household Income and Frequency of Consumption of Groundnuts

This section shows information obtained on the mean levels of household income, and frequency of groundnut consumption, the results for the Pearson Product moment correlation between level of household income and the frequency of consumption of groundnuts. The section seeks to explore the relationship between income levels of households and their frequency of groundnut consumption. Pearson product moment correlation was used because according to Vijay (2000), it is used to estimate the strength and direction of the relationship between two interval variables and the both of the variables used in this respect were measured on interval scales.

Table 12 shows the means of household income and frequency of consumption of groundnuts.

Table 12: Mean Household Income Levels (GH¢) and Frequency of Consumption of Groundnuts (per week).

	Mean	Std. Deviation	n
Household income level	202.21	97.554	196
Frequency of consumption of groundnuts (per week)	5.42	1.959	198

Sources: Field Survey Data, 2008

From the table 12, the mean level of household income among residents of the Northern Region of Ghana is Gh¢202.21p and the average frequency of consumption of groundnuts per week is 5.42 which is approximately 5 days out of every 7. According to Jonathan *et al.*, (2004) the dose and duration of exposure of aflatoxin clearly have major effects on the toxicology and may cause a range of consequences which include acute illness and death. They also asserted that all doses of aflatoxin have a cumulative effect on the risk of cancer and hence the higher the frequency of consumption of low quality groundnuts, the higher the likelihood of aflatoxicosis.

Pearson Product Moment Correlation between House Income Level and Frequency of Consumption of Groundnuts

The table 13 shows the relationship between income level and the average frequency of consumption of groundnuts in the Northern Region of Ghana. The results displayed in table 13 are the results obtained from Pearson product movement correlation. According to Vijay (2000), Pearson product moment correlation is used for determining the strength of the relationship between two interval variables and the two variables in this case were measured on interval scales accordingly. Also, the variables were obtained from a sample which was randomly chosen from the population, hence the suitability of Pearson product moment correlation for the analysis.

Table 13: Pearson Product Moment Correlation between Household Income and Average Frequency of Groundnut Consumption.

		Household income level	Frequency of consumption of Groundnuts
Household income level	Pearson Correlation	1	-0.461
	Sig. (2-tailed)		-0.041
	N	196	196
Frequency of consumption of groundnuts	Pearson Correlation	-0.461	1
	Sig. (2-tailed)	-0.041	
	N	196	198

p>0.05 Source: Field Survey Data. 2008

From table 13, the correlation coefficient obtained from the correlation between household income level and average frequency of groundnut consumption was found to be -0.461. According to Cohen (1988), a correlation coefficient between 0.030 to 0.49 has medium strength whether it carries a negative sign or not. This suggests that the relationship between the two variables has moderate strength. Also, Pallant (2005) asserts that a negative correlation coefficient is indicative of an inverse relationship between the two variables.

The coefficient of determination gives an indication of the amount of variance shared by the two variables. According to Pallant (2005), it is the square of the correlation co-efficient. From the table 13, it is equal to 0.2125 and this means that 21.25% of variance is shared between the two variables. Also, the level of significance between the two variables is 0.041. This means that the relationship between the two variables is significant at the 95% confidence level.

In conclusion, the relationship between income level of households and their frequency of groundnut consumption was established to be inversely related and to have moderate strength. Hence with increasing income levels of households, there will be decreasing level of consumption of groundnuts. This contradicts the assertion by Chakraborty and Ulijaszek (2008) when they made it known that for a staple food, an increase in the income levels of consumers results in an increase in their frequency of consumption of the staple.

The result also implies that low income earners in the study area consume groundnuts more frequently than high income earners. Therefore, the low income earners are at a greater risk of aflatoxin poisoning from groundnut consumption since generally, this group of consumers have a low perception of groundnut quality and in addition, have a generally low level of awareness of aflatoxin presence in groundnuts. According to Xinhua News Agency (2007), as consumers frequently consume low quality groundnuts, the potential for aflatoxin poisoning increases significantly.

Willingness of Consumers to Pay For Groundnuts Certified as Safe for Consumption.

In this section, the percentage of consumers who will accept to pay Gh¢0.70p more for the same unit (one “bowl”) of groundnuts which has been certified as safer for consumption after testing is discussed. This average willingness to pay figure of GH70p was obtained during the pilot study. Respondent who were selected for the pilot study volunteered the amounts they would willingly pay for safer groundnuts and the average was then computed.

The section also shows the factors which will significantly play a role in WTP for the commodity. In doing this, a binary logistic regression has been used with WTP as dependent variable and educational level, food safety concerns, level of aflatoxin awareness, perception of groundnut quality, income level and the presence or absence of children below 13 years at the household were used as the independent variables. The results from the analysis are presented and discussed below in the overall model fit, classification tables and variables in equation tables.

Table 14: Frequency Distribution of Consumers' Willingness to Pay for Safe Groundnuts at an Extra Cost of GH¢0.7

Willingness to pay	Frequency	Percent
Willing	115	57.8
Not willing	81	40.7
Total	196	98.5

Source: Field Survey Data, 2008.

From table 14, it can be that more than half (57.8%) of respondents interviewed responded affirmatively to the payment for safe groundnuts at a higher price (GH¢0.7 extra) than they currently pay for the same unit of groundnuts (one 'bowl'). Hence the issue of patronage of the product when introduced will not be a problem as more than half of the respondents have willingly accepted to pay for it even at the extra cost involved. This shows that the more than half of the consumers are very much concerned about their health and are prepared to part with some extra money to ensure that they become or remain healthy. This finding refutes the report by FAO in 1996 which asserted that majority of Africans do not give attention to food safety but are rather only concerned about satisfying hunger.

Table 15: Chi-square Test of Goodness of fit of Willingness to Pay

	Willingness to Pay
Chi-square	5.898
df	1
Asymp. Sig	.015

P<0.05 Source: Field Survey Data, 2008

According to Pallant (2005), the chi-square test of goodness of fit is used to explore the proportion of cases that fall into the various categories of a single variable- in this case WTP. From the results obtained in the table, the significance level is 0.015. this is less than the 0.05 theoretical level set for the test and therefore indicates that the level of difference between respondents who are willing to pay for the safe groundnuts and those not willing to pay for it are significantly different and therefore not due to chance.

Overall Model Fit

The overall model fit was conducted to determine the extent to which the model performs using the Hosmer and Lemeshow test. The results for this analysis are shown in table 16.

Table 16: Hosmer and Lemeshow Test of Model Fit

Step	Chi-square	df	sig
1	6.957	8	.541

P<0.05 Source: Field Survey Data, 2008

The result obtained from the Hosmer and Lemeshow Test of model fit indicates as shown in table 16 that the level of significance of the model is 0.541 with a degree of freedom of 8 and a chi-square value of 6.957. The level of significance obtained (0.541) is greater than the 0.05 level of confidence usually set. This, according to Pallant (2005), is an indication of model fitness. Hence, the model used in the estimation of the willingness to pay in this analysis is an appropriate fit.

Model Summary

In explaining the extent of variability in the dependent variable (WTP) which is explained by the independent variables, pseudo R-squares were computed. Table 17 shows the values of the pseudo R-square values obtained.

Table 17: Model summary

Step	-2 Log likelihood	Cox &Snell R-Square	Nagelkerke-R Square
1	244.783 ^a	0.360	0.481

Source: Field Survey Data, 2008

The Cox and Snell R-Square values explain the extent of variation in the dependent variable explained by the model. From the table 17, the Cox and Snell R-Square value is 0.360 and the Nagelkerke-Square value is 0.481. These figures mean that between 36.0% and 48.1% of the variability in the dependent variable is explained by this set independent variables.

Classification of Cases

The cases were classified in the analysis to determine the percentage of cases in the model that were correctly classified. This provides an indication of how well the model is able to predict the correct category (willing to pay/not willing to pay) for each case. In the table 18, the cases were classified with the constant alone in the model.

Table 18: Classification of Cases with the Constant alone in the Model

		Predicted			
		Willingness to pay		Percentage	
Observed		Willing	Not willing	Correct	
Step 0	Willingness to pay	Willing	113	0	100.0
		Not willing	77	0	.0
Over all Percentage					59.5

Sources: Field Survey Data, 2008

From table 18, it can be seen that the model correctly classified 59.5% of the cases overall when the constant alone was included in it.

The classification table (table 19) shows the percentage of correctly classified cases by the model when all the independent variables were included in it.

Table 19: Classified Table with all the Independent Variables included in the Model

		Predicted		
		Willingness to pay		Percentage
Observed		Willing	Not willing	Correct
Step 1	Willingness to pay Willing	99	14	87.6
	Not willing	58	19	24.7
Overall Percentage				62.1

Source: Field Survey Data, 2008

The table 19 shows that the percentage of correctly classified cases in the model when the independent variable was including in it is 62.1%. This is an improvement over the 59.5% that was obtained when the independent variables were not included in the model. Hence, the model with the independent variables in it performs better than that with the constant only in it.

Variables in the Equation

Table 20 shows information about the contribution or importance of our predictor variables in predicting the dependent variable. It provides information on the particular variables which significantly influence the willingness of consumers to pay for groundnuts tested and certified as safe for consumption with respect to the aflatoxin content.

Table 20: Variables in the Equation

Variable	B	S.E.	Wald	Df	Sig	95.0% C.I for EXP(B)		
						Exp(B)	Lower	Upper
Aflatoxin Awareness	.367	.261	1.981	1	.159	1.444	.866	2.409
Food safety Concerns	.051	.295	.030	1	.862	1.053	.590	1.877
Household Income level	.001	.001	1.473	1	.047	1.061	.999	1.075
Consumption Frequency	-.061	.082	.551	1	.225	1.063	.904	1.250
Educational Status	.433	.183	5.614	1	.018	1.649	1.453	1.928
Presence of Children	1.568	1.344	1.361	1	.243	.208	.015	2.905
Constant	.563	1.562	.130	1	.719	1.756		

p>0.05, Source: Field Survey Data, 2008

From table 20, two variables in the model contribute significantly to its predictive ability. The levels of significance for these variables are below the 0.05 significance level and hence are significant. These are the educational status, and household income levels of respondents. The level of significance for educational status of respondents is 0.018 and 0.047 for household income levels.

The level of significance for the other variables included in the study (which are not significant at the 0.05 level of significance) are 0.159, 0.862, 0.225 and 0.243 for level of aflatoxin awareness, food safety concerns, frequency of consumption and presence of children in the household of respondents respectively.

In totality therefore, in order to measure the WTP of consumers for groundnuts certified as safe for consumption based on the aflatoxin level, the most important predictors are the household income levels and the educational status of respondents.

The column labeled B in table 20 provides the values used in the equation to calculate the probability of a case falling into a specific category. The positive Bs indicate that an increase in the variable with that B will result in an increased probability of the person answering 'Yes' to the dependent variable (WTP). A negative B means that an increase in the value of the independent variable will result in a decreased probability of the person being willing to pay for the groundnuts tested for aflatoxins and certified as safe for consumption (Pallant, 2005).

Using the recommendation by Pallant (2005) as a yardstick, it implies that an increase in the income levels of households will result in an increased probability of consumers being willing to pay for the certified commodity since it has a positive B. This finding confirms the report by (Buzby , Ready & Skees., 1995) that an increase in the income levels of consumers will let them opt for

safer foods on the market in order to remain healthy. It also confirms the assertion by Govindasamy and Italy, (1999) that the higher consumer's income, the more willing he/she will be to invest resources into purchasing foods perceived as safer for consumption. The implication in this study is that if groundnuts have been certified as safe for human consumption at an extra cost of Gh¢ 0.70p, it will be patronized by household within higher income brackets than those with lower income. To make it possible for all households to consume the product if introduced, it will be necessary that the additional cost for the quality be minimized to the barest minimum to make it affordable to even the households with low incomes to consume. To ensure this, the government of Ghana and other stakeholders such as Non-Governmental Organisations could subsidize the cost of testing the groundnuts for aflatoxins.

The willingness to pay for the good quality groundnuts if introduced will also increase with increasing levels of education. This confirms the report by Rodríguez, Lupín and Lacaze, (2006) when he asserted that educated people are more exposed to diet and health information sources and as a result, they can better understand and process them and therefore are more willing to pay for such food products. To ensure that all the consumers of groundnuts benefit from the safer groundnuts, it will be necessary that people with low levels of formal educational and those with no formal education be provided with information on the new product and the benefits of patronizing such a product. This information can be made available by information services in the country either through the

radio stations, community educational programs with the collaboration of the Ministry of Health, Ministry of Information and other stakeholders.

Also, an increase in educational level of residents will result in an increase in the probability of consumers to patronize the product.

Odd Ratios

The odds ratio, according to Tabachnick and Fidell (2001), is the increase (or decreases if the ratio is less than one) in odds of being in one outcome category when the value of the predictor increases by one unit. The odds ratio for the two significant variables in predicting willingness to pay are 1.061 for level of household income and 1.649 for educational status.

The odds ratio for each of the two significant variables, household income level and educational status, had a 95% confidence interval of between 0.999 and 1.075, and between 1.453 and 1.928 respectively. Since the value 1.000 is not found in any of these confidence intervals, it means that the possibility of equal responses (YES/NO) is absent. This is shown by the odds ratio of 1.649 as shown in table 20.

Therefore in conclusion, majority of the respondents (57.8%) are willing to pay the extra cost of GH¢0.7p for the same unit of groundnuts (1 'bowl') than are those not willing to pay.

Also, the significant factors in predicting consumer willingness to pay for groundnuts tested and certified as safe for consumption at the extra cost of GH¢0.7p include their household income level and their educational status. Increasing household income levels and educational status will both tend to increase the willingness of consumers to pay for the groundnuts.

From the results obtained in the Variables in the Equation Table (Table 20) the logistic regression equation for determining the willingness to pay of respondents for groundnuts certified as safe for consumption is as follows:

$$P(y=1) = \frac{\exp(0.563 + 0.001X_1 + 0.433X_E + 1.568X_C + 0.051X_S - 0.061X_F + 0.367X_A)}{[1 + \exp(0.563 + 0.001X_1 + 0.433X_E + 1.568X_C + 0.051X_S - 0.061X_F + 0.367X_A)]}$$

Where

P=probability

Y=1 is the case where the respondent is willing to pay for the safe groundnuts.

P=probability

b_n = regression coefficients and

X_1 = household income level

X_S = food safety concern

X_A = level of aflatoxin awareness

X_F =frequency of consumption

X_E =educational level

X_C = presence of children in the household.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

General Overview

This final chapter is divided into three sections. The first section summarizes how the study was conducted and the findings of the study.

Conclusions based on the results obtained are also drawn and have been documented in the second section. In the final section, recommendations have been suggested based on the results obtained and the conclusions drawn. Some areas have been suggested for further studies.

Summary

The research design that was used during the study is the descriptive survey design and the units of enquiry included groundnuts consumers who make food consumption decisions for their households. A total of 200 respondents were interviewed. These were selected using simple random sampling technique. By this method, four districts were selected and two communities from each district

were chosen. Twenty five households were also chosen from each community to give a total 200 households from which the respondents were chosen. The pre-test of the interview survey instrument was conducted in Tamale Metropolitan District to correct errors in it. Four field assistants were employed to help collect data and data was analysed using SPSS data analysis software.

In measuring consumer perception of groundnut quality, the variables used include mouldiness of groundnuts, presence of foreign materials in the lot, broken and bruised groundnuts, change in colour of the groundnuts, change in taste of the groundnuts, insect attacks on the groundnuts, shriveled nuts and groundnuts stored damp. Consumers decided whether they would accept each one of these variables in groundnuts for consumption purposes or not. The responses were then coded into a four-point Likert scale (which ranged from 'Very good' to 'Very bad perception) and the results were then analyzed using frequencies and percentages.

In measuring the level of aflatoxin awareness, means and standard deviation were used. For the level of awareness among the different educational levels, analysis of variance (ANOVA) was used with educational status as the independent variable and level of aflatoxin awareness as the dependent variable.

Pearson product moment correlation was used to measure the relationship between income level of households and their frequency of consumption of groundnuts.

In measuring the proportion of consumers willing to pay for groundnuts certified as safe for consumption, percentage and frequencies were used. However, in determining the factors which significantly contribute to consumer willingness to pay for the product, logistic regression was used.

Conclusion

1. From the results obtained, the weighted mean for the perception of groundnut quality in terms of the aflatoxin predisposing factors is 2.69. It can therefore be concluded that consumer perception of groundnut quality is not even equal to the average perception of 3.00.

Therefore it may be concluded that there is a negative perception of groundnut quality among groundnut consumers in the Northern Region of Ghana because their perception of groundnut quality is not informed by the condition of groundnuts which exposes them to, and promotes to accept low quality groundnuts for consumption purposes and significantly increase the risk of aflatoxin poisoning in the region.

2. The results from the research indicated that 50.3% of the respondents had no formal education, 23.1% had primary education, 17.6% had secondary education and 9.0% had tertiary education. However, after the analysis, the results showed that the mean level of aflatoxin awareness is 2.57 on a scale of 1-5 with 1 representing least level of awareness and 4, the highest

level of awareness. The results of the ANOVA showed that the level of aflatoxin awareness among the different levels of education was not significantly different. The study therefore concludes that the level of aflatoxin awareness in the Northern Region of Ghana is low and there is no correlation between the level of aflatoxin awareness and educational attainment.

3. Spearman Rank Order correlation showed that the correlation coefficient from the analysis is -0.32 Cohen's convention shows that the relationship has medium strength and the coefficient shows that the relationship between income level of groundnut consumers and their frequency of consumption is inversely related. Hence, the higher the income levels of consumers, the lower the level of consumption of groundnuts.

In conclusion therefore, there is a moderately strong relationship between the frequency of consumption of groundnuts in the study area and the level of household income. Higher levels of household income tend to correspond with lower frequency of consumption.

4. Finally, the results from the analysis showed that about 59% of the respondents were willing to pay for a safe groundnut product. The variables which were included in determining the willingness to pay of respondents included their level of food safety concerns, level of aflatoxin awareness, level of education, frequency of consumption and number of children in the household.

From the analysis, two of the variables were found to be significant in determining the willingness pay of respondents. These are the income levels and educational levels of respondents. The significance of these variables were found to be 0.047 and 0.018 respectively.

In conclusion therefore, among the factors which will influence the willingness of consumers to pay for groundnut certified as safe for consumption, the most important will be income levels of respondents and their levels of educational attainment.

Recommendations

1. There is need for awareness creation on aflatoxin presence and groundnut quality among groundnut consumers in the Northern Region of Ghana. This is to ensure consumer protection. To achieve this, the Ministry of Food and Agriculture in collaboration with Ministry of Health, Food and Drugs Board, Ghana Standards Board and Ministry of Education should educate consumers on what to look out for in the groundnuts so as to avoid the risk of aflatoxicosis.
2. In terms of the risk of aflatoxin poisoning, the most vulnerable category of consumers are the low income earners. To protect this vulnerable group of people, the Ghana Standard Board should introduce aflatoxin-tested and certified safe groundnut on the market at

affordable price for the low income earning households to be able to afford.

3. Private individuals, enterprises and organizations should go into marketing of safer groundnuts in the area since the consumers in the area are willing to pay extra for quality groundnut.

Suggested areas for Further Research

Based on the study, some suggestions have been made for further studies and research. These have been listed below briefly.

1. Further research should be conducted to determine how education on aflatoxin contamination of groundnuts can be promoted in the region.
2. Research should be carried out in the region to determine the point in the groundnut marketing chain where aflatoxin contamination usually takes place.
3. Studies should be conducted by research scientists to determine the most economically viable way of testing groundnuts for aflatoxin in the region.

4. Research efforts should be conducted on the effect of packaging on the groundnut and its acceptability after it has been introduced onto the market.
5. Further studies should be conducted to know the tastes and preferences of those who move away from groundnut consumption of groundnuts with increasing income to know the substitutes they move onto and whether such products also have aflatoxins in them so that that category can be educated on the toxins.
6. Research should be geared towards testing other foods on the market and along the marketing chain for aflatoxins so as to determine which foods are potentially unsafe for consumers and for appropriate actions to be taken to control such occurrence.

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APPENDIX

Appendix 1:

Table 21: Cohen's Convention (1988) for determining Effect Size and its Interpretation

Effect size	Interpretation
0.01	Small effect
0.06	Medium effect
0.14	Large effect

UNIVERSITY OF CAPE COAST

DEPARTMENT OF AGRICULTURAL ECONOMICS

AND EXTENTION

CONSUMER PERCEPTION AND WILLINGNESS TO PAY FOR GOOD

QUALITY GROUNDNUTS

Dear Sir/Madam

The interview schedule below is part of a study on the above stated topic by the researcher, a student of the Department of Agricultural Economics and Extension, University of Cape Coast. I would be very grateful if you spared time to answer the questions to the best of your ability. Please be aware that this is purely an academic exercise and your responses to the questions below are important to the outcome of the study. Thank you in advance of your time.

Section 1 Perception of Groundnut Quality

How would you rate the quality of groundnuts with the following characteristics in terms of suitability for human consumption?

Perception	good	Bad
Groundnuts which have a change in taste		

Groundnuts which have changed colour		
Mouldy groundnuts		
Broken and bruised groundnuts		
Insect-attacked groundnuts		
Shriveled groundnuts		
Groundnuts which contains foreign materials (twigs, leaves, dead insects, sand etc.)		
Groundnuts stored damp		

Section 2: Level of Aflatoxin Awareness

State whether you are aware of the following or not aware

Level of Aflatoxin Awareness	Aware	Not aware
I have knowledge of toxins called aflatoxins which develop in groundnuts		
Mould in groundnuts produce aflatoxins		
Aflatoxins are harmful to human health		
Broken and bruised groundnuts promote development and proliferation		

of aflatoxins		
Insect-attacked groundnuts promote aflatoxin development		
Presence of foreign materials in groundnuts can result in development of aflatoxins		
Shriveled groundnuts usually in groundnuts high levels proliferation		
Dam groundnuts promote aflatoxin development and proliferation		
High levels of aflatoxins in groundnuts can cause death		
Aflatoxins cause liver cancer		
Aflatoxins cause stunted growth in children ('kwashiokor')		
Aflatoxins levels in groundnuts can be reduced by thorough sorting		

Section 3: Food Safety Concerns

To which extent do you agree with the following statement?

	Yes	No
I always purchase foods which have been well preserved		
I always ensure that food is hygienic before consuming it		

I do not consume food which does not look fresh		
I always check the expiry date of processed foods before I purchase them		
I do not cook mouldy foods for my family		
I sort out poor quality foods before consumption		
I often dry damp foods well before storing them		
I store food in clean containers only		
I discard all spoilt foods		
I prefer organically produced foods to inorganic foods		

Section 4

Frequency of consumption of groundnuts

How many times on average do you consume groundnuts per week?

.....

Willingness to pay

Would you pay GH¢0.70p extra for the same quantity of groundnuts if it was tasted and certified as safe for consumption in terms of the level of aflatoxin contamination?.

A. YES []

B. NO []

Expenditure of respondent

How much on average do you spend of the following?

- 1. Transportation/week
- 2. Food/week
- 3. Fuel wood/week
- 4. Gas/ month
- 5. Soap/week
- 6. Cloths/year
- 7. Rent/month
- 8. Water/month
- 9. Electricity/month
- 10. Health/month

11. Recreation/week

12. Community activities/week.....

13. Savings/month

14. School fees

15. Others

Demographic Characteristics

1. Gender A. Male [] B. Female []

2. Highest level of formal education

A. None [] B. Primary [] C. Secondary [] D. Tertiary []

3. Family size

4. Number of children below of age 13 in the family
.....

5. Name of district