CONSUMERS' PERCEPTION OF ATTRIBUTES AND RELATED BENEFITS OF SOY AND ITS CONSUMPTION IN GHANA

By

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DECLARATION

I hereby declare that this submission is my own work towards the M.PHIL and that, to the best of my knowledge , it contains no material preciously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ABSTRACT

Soybean is an important food and oil crop in Ghana, but little is known about the consumer perception of related benefits of soy products. A total of 370 respondents were interviewed with equal samples of 70 taken from Bimbilla, Yendi, Techiman, and Madina; while 45 each were selected from Ejura and Tilli respectively. In this study, four binary *logit* models were developed to assess the effects of socio demographic factors, perceived soy attributes and perceived soy health benefits on consumers' decision to participate and consumer soy products. Results from the four models show that among socio demographic factors, ethnicity, age, and income have a direct positive effect that significantly influence soy consumption while education significantly influences soy consumption in a positive way while price has a significantly negative influence, on soy consumption as expected. However, perceived convenience showed a negative significance, contrary to prior expectation. Furthermore, among the general health related variables, nutritional awareness and health motivation indicated positive influences on soy consumption and perceived soy health benefit respectively, while surprisingly health knowledge did not show any significance in determining consumption. This study therefore demonstrates that the soy food market can be segmented, based among others, on age, education, income, the individual's health motivation and nutritional awareness as well as certain attributes such as perceived taste and health benefits.

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LIST OF ACRONYMS

ABARE- AUSTRALIAN BUREAU OF AGRICULTURE AND RESOURCE ECONOMICS AND SCIENCE

ASA-AMERICAN SOYBEANS ASSOCIATION

ADRA-ADVENTIST DEVELOPMENT AND RELIEF AGENCY

CGC-CANADIAN GRAIN COMMISSION

CSIR-COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

CEO-CHIEF EXECUTIVE OFFICER

FAO-FOOD AND AGRICULTURAL ORGANIZATION

FDA-FOOD AND DRUGS ADMINISTRATION

GAEG-GHANA ANNUAL EXPORT GUIDE

ISB-INDIANA SOYBEANS BOARD

PIBA-PRIMARY INDUSTRY BANK OF AUSTRALIA

MOFA-MINISTRY OF FOOD AND AGRICULTURE

NADEP-NATIONAL AGRIBUSINESS DEVELOPMENT PROGRAM

NGO-NON-GOVERNMENTAL ORGANISATION

USAID-UNITED STATE AGENCY FOR INTERNATIONAL DEVELOPMENT

WISHH-WORLD INITIATIVE FOR SOY IN HUMAN HEALTH

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CHAPTER ONE: INTRODUCTION

1.0 Background to the Study

Soybean, scientifically called *Glycine max L*. is a monocotyledon which belongs to the *Legumenoesae.* The cultivated soybean is a *cultigen* believed to have originated from the north eastern China earlier than 1000BC. The spread of soybean from its indigenous land has been due to its adaptability and predominant utilization as food for humans or part of animal feed, as a medicinal plant, and recently used in industry (Dadson et al, 1998).

FAO reports in 2000 indicated a world wide production of over 160-million tons of soybean with USA being the largest producers of the crop, followed by Latin Americans, the Caribbean, Asia and Africa. Of this 160-million, sub-Saharan Africa cultivated about 817,000ha of land with soybeans which yielded about 990kg per ha of soybeans (FAO, 2006).

In 2004, the world produced 223 million tons of soybeans. Of this about 15–million was processed into other product other than oil while the rest was processed for oil. Again, Soybean represents about 60% of the world's annual oil seed production and over 70% of the annual oilseed trade. Furthermore, ABARES (Australian Bereau of Agriculture and Resource Economics and Sciences) estimated that in 1999 and 2000 the global soybean market had a value of US$ 32.581 billion excluding trade in oil and meal. Globally its production is dominated by the USA, China, and Brazil (PIBA, 2001).

In recent times, consumers are interested in foods that may help prevent or reduce the incidence of illness, for this reason, soybean has caught the attention of the world and now it is seen as a crop that could help to combat world hunger and also contribute to the prevention of chronic diseases. A case in reference is an increase in the consumption of soy foods and soy-based food ingredients which is reported to have almost doubled from

1998 to 2000 attributable to reported health benefits of soy including prevention of cancer, osteoporosis and coronary heart disease by the FDA (Food and Drugs Administration) and ADA(American Soybeans Association) from the early 1990's (Guisti et al., 2003).

Soybeans is noted by (PIBA, 2000) as a vital part of the international food aid programmes and as such are of increasing importance in satisfying developing countries' excess demand for food. Soybean is a staple food of great nutritional value. Its importance ranges from production of milk, oil processing, livestock feeds, industrial uses and human consumption (Addo and Oguntona, 1993).

To add to the above, soybean is a nutritional powerhouse capable of solving the protein-energy malnutrition problems in Ghana. It has a great potential in the development of three key sectors of the economy – Health, Agriculture and Industry. It is highly versatile with a fairly wide utilization base. There is however the need for more research and development and extension work to be done if its full potential is to be realized (Plahar, 2006).

For instance work by ADRA(Adventist Development and Relief Agency) Ghana funded by USAID (United States Agency for International Development) on soybean from 1997 to 2006 which was aimed at using soy in school feeding programmes to ensure adequate nutrition, promote a cheaper source of protein and improve enrolment in deprived-rural schools has helped children to develop taste and interest in eating soy foods which has increased awareness of soy foods, as well as increased enrolment, and also encouraged

parents to send their children to school in the participating localities. This move is expected to boost the demand for soy products and stimulate local production of soy.

Notable also is WISHH's (World Initiative for Soy in Human Health) 2006 report on the market study of the use of soy product by the food industry in Ghana which indicated that although the Ghanaian soy market is relatively new, people know about its nutritional and health benefits. It further indicated that awareness of soy as an ingredient and its various product forms was higher in female than in males. Also certain brands of soy milk were found to be mostly used by adults and a section of children. This broadens the consumer base of soy and soy products to cover almost all categories of people in terms of income, gender and age.

Additionally, production trends have increased due to the various promotion and utilization programmes embarked upon by MoFA and other government and non-governmental organizations. Figures available for average productions from the three northern regions alone from 2003 to 2005 are 10,733.5 MT for the Northern region, 7,673MT for Upper-east region and 3,095MT for the Upper-west region (WISHH, 2006). Also areas under cultivation are increasing steadily with a significant increase from 860ha in 2003 to 13517ha in 2008 in the Upper-east region alone (MoFA, 2009).

The soy crushing and processing industry is picking up gradually with an estimated 34,110MT in 2003 and rose to an estimated average of 47,727 in 2005 (WISHH, 2006). Aside all these positive achievements in the last decade, Ghana still imports significant quantities of soy and soy product as indicated in reports by WISHH in 2006 which shows that close to 20,000MT of soybeans, soy meal and oil were imported from 1999 to 2005.

1.1. Consumption of Soybeans and Soy Products in Ghana

Although there is not much literature on the consumer characteristics of soy and soy products in Ghana its consumption follows the general trends of product patronage in the country.

According to Plahar (2006) the major problems facing consumers of soybean are the presence of anti-nutritional factors (i.e. heat liable and heat stable factors) which can be eliminated by subjecting soybeans to processing techniques ranging from soaking, cooking, grinding and other available techniques. Consumers are however very much aware of soy and soy products although it is relatively new on the Ghanaian market.

Consumers of products in Ghana are growing more sophisticated in recent times and this makes the market continue to offer many opportunities for consumer-ready food products. The use of soybeans can effectively be promoted by critically identifying the two major groups of consumers that can patronize two groups of products comprising rural and peri-urban and urban dwellers. The rural and peri urban dwellers often opt for less packaged or unpackaged products while urban dwellers go in for well packaged products. The demand for consumer-ready soy products is however on the rise. This was indicated in WISHH's 2006 annual report which stated the growing market for soy products in Ghana, with the introduction and patronage of various soy milk and soybean edible oil brands.

The Ghanaian consumption patterns have changed towards western (i.e European and American) foods as result of urbanization, women working outside the home and shift in lifestyles of the large youth population. Middle-class incomes are also rising and there is higher demand for healthy foods. A growing concern among Ghanaian consumers with

regard to food safety and healthy diets are also increasing demand for higher quality products. As a result, domestic processors are developing and improving food products in order to meet the needs of this niche market.

The retail sector is also shifting to more western style shops and convenience stores and away from traditional open air markets. Ghana's retail food sector consists of supermarkets (accounting for 1 percent of total retail sales), convenience stores/small grocery stores (30 percent) and traditional open air markets dominating with (69 percent) (Ghana Annual Export Guide (GAEG) 2008). According to trade sources, retail food sales have grown about 10 percent annually. The soybean market can however grow by adequately exploring the use of its attributes, health and nutritional benefits to create a niche market since consumers are already aware of its nutritional and health importance as had been found by WISHH in their 2005 soybean market survey.

According to Nti and Larweh (2003) their experimentation of the sensory characteristics of soymilk indicated that consumers preferred coloured brands of the product. Again, in a similar sensory study on the flavour preference for dawadawa made from roasted and boiled soybean, carried out by Darkwa et al., 2003 revealed that consumers showed preference for the roasted soy technology. The price of soybean and its various products is however considered by Ghanaian as low as was stated by WISHH in their 2006 report on the market survey of soybean and soy products.

There are many soy products and a few are on demand by Ghanaian consumers on the market are shown below:

Figure 1.1 above shows from the left on the first row soy milk brands (Vita milk and Asaase Pa soya milk), next is UNIOIL a soy oil brand, followed by the Asaase Pa Soy khebab, then followed on the next row by the Asaase Pa Soy cheese commonly known as Wagashi in our local dialect, then soy ice-cream and soy bread on the last row. These products are considered by consumers as nutritious, healthy, convenient, tasty and relatively cheap relative to other milk, oil, meat, Flour products (WISHH, 2006**).**

Apart from the above, there are also a range of soy products comprising of soy powder and paste, weaning mix, soy biscuits, and dawadawa.

1.2 Problem Statement

Producers, processors and marketers of soy are faced with a challenge and a disincentive to produce and sell more due to some perception carried by consumers about soy product attributes such as taste, convenience, price, health, and nutrition awareness. These serve as major barriers hindering the smooth development of the nascent soy industry.

Unfamiliarity with taste and texture of soy product is one of the major attributes that is contributing to the shortcoming hitting the soy product market in Ghana. Moon et al., (2005) reported that soy food suffers from image problem especially with respect

to perception about taste. Soy, however, is a relatively new food crop on our market and consumers are not very much familiar with its taste in terms of its natural "beany" smell and texture especially with its oil, meat and milk. For instance, a perception is formed by consumers that soy foods are inadequate substitutes for animal foods, especially from a flavour point of view. This lack of adaptability has created the erroneous impression among most consumers that soy has an offensive flavour and is distasteful resulting in their avoidance of its consumption on normal bases and thus retarding the production and market development of the soy industry. This is in line with Charpman's (2004) findings which indicated that negative attitude towards the taste of soy food was a stumbling block to its consumption frequency.

Secondly, because of the relatively high cost incurred in terms of time and energy needed to turn raw soy food products for consumption compared with other legumes such as cowpea, consumers are reluctant in the soy market.

Also, concerning convenience in use of soy products as food; there is a lack of knowledge on how to incorporate it into familiar foods which tend to mitigate the purchase and subsequent consumption. This phenomenon pertains as a result of lack of exposure to soy foods and instructions on preparing low cost soy foods that can easily be included in their diets as noted by Wansink et al., (2005).

Thirdly, some soy products are thought of by consumers as very expensive. Soy oil and milk for instance are considered relatively expensive when compared with traditional vegetable cooking oils and milk from animal sources. According to Dahr and Foltz (2004) for instance, they reported that the mean price of soy milk per gallon was more than $8 compared to the $3 for skim/low fat milk. High prices of soy food products is an obstacle to efforts aimed at increasing consumer participation in the soy food market. This is essential because as reported by Glanz et al., (1998); consumers attach a lot of importance to taste and cost when buying food products.

Furthermore, although soy foods have great potential for providing consumers with healthy diets, consumer awareness is on the low side. The crust of the matter is that awareness about these health benefits is needed by enhancing their decision making towards soy foods. Consumers are inadequately informed about the perceived soy

health benefits. This is a hindrance to the growth in soy food consumption. According to Menrad (2003) and Roberfroid (2000) today's foods are not intended only to satisfy hunger and to provide necessary nutrients for humans only, but also prevent nutritional diseases and improve physical and mental well-being of the consumer. Again, more personal and specific soy health benefits as was suggested by Wansink et al., (2005) who reported that the impact of soy on health on soy consumption is enhanced when those benefits are personally relevant to consumers need to be pursued. This is lacking in the soy market today and education for the disadvantaged consumers' needs to be intensified in order to improve the niche market for foods.

Finally, in spite of the wide range of nutritional benefits soy and soy products present to the food industry, stemming from lack of adaptability and unfamiliarity with proper processing and utilization methods; consumers hold the perception that consumption of soy can lead to diarrhoea, indigestion and other gastric distresses. This is a major barrier holding back the expansion of the soy product market. According to Boetel and Liu (2003), it had been found that; nutrition and product safety worked simultaneously and are very important in consumers' purchase decisions. This is in line with findings by Jensen et al., (1992) who asserted that the effect of nutrition information on individual dietary behaviour may vary over time due to a heightening awareness of diet –disease relationships, improving attitude about healthy eating, and evolving knowledge of food composition that lead to better food choices

In spite of the demand and supply gap that has been created by the voracious and excessive consumption of food crops by the ever growing population in the country, soy and soy products has not thrived well to bridge the gap to guard against food insecurity, hunger, and malnutrition. Since demand for healthy foods exceeds supply, there is a growing pressure on the few staple food crops that provide adequate nutrition and health. This is due to the fact that greater quantities of the traditional food crops which are found on the domestic market are now threatened with inability to provide on sustainable basis to meet growing demands for nutrition and health as a result of population explosion.

It is against this background that the government of Ghana ADRA and other NGOs are promoting the production, utilization and marketing of soy and soy products in Ghana(WISHH, 2006). This offers small scale processors, investors, businessmen and

all stakeholders an economic incentive for investment in the soy product industry (Plahar, 2006). However, consumers have to attune to the consumption of soy products well in order to have well established niche market for the industry.

1.3 Research Questions

In line with the foregoing the following research questions therefore emerge:

- What socio-demographic factors influence consumers of soybeans in their purchase decisions?
- How do these socio-demographic factors combine with consumers' perception of the attributes of soy to shape their purchase decisions?
- Do perceived health benefits of soy mediate nutritional awareness, health knowledge, and health motivation in shaping the consumption behaviour?
- Do health factors such as nutritional awareness, health knowledge, and health motivation directly influence consumption behaviour of soybean?
- How do these factors impact/ influence the consumption intensity of consumers who participate in the soy market?

1.4.0 Objectives

The main objective of this research is to assess the consumers' perception of some attributes and related benefits of soybeans and how these work to shape its consumption decisions in Ghana.

1.5.1. Specific Objectives

The specific objectives are as follows:

- To determine the demographic factors that influence the consumption decisions of soy and soy products.

- To examine whether health benefits of soy mediate the influence of nutritional awareness, health knowledge, and health motivation in the decision making process of consumers of soy.
- To examine how the demographic, and health benefit factors as well as attributes of soy shape the consumers' decisions to participate in the soy market.
- To determine the soy consumption intensity of consumers who participate in the soy market.

1.5 Justification

This study seeks to establish soybean's importance in the functional food industry in Ghana by allowing consumers to make inputs by way of giving their perceptions of soybean attributes and related benefits derived from soy consumption.

The research will bring to light the magnitude of the significance of soy as a healthy and nutritious food that is capable of minimizing if not to eliminate the rising disease and malnutrition problems of our society in recent times. This will provide useful information for agriculturists, industry and health agencies in both the private and public sector in making decision bordering on production and processing, health, and nutrition development.

The document will also serve as a manual for marketers who may wish to promote the development of a niche market for soybean and its products.

The contribution of this study stated above has become very imperative for society and policy makers for the following reasons:

There is a growing demand among consumers for a variety of tasty, healthy, and convenient food products. This, thus, creates the right environment for the promotion of a functional food crop such as soybeans.

Again, our ageing population and increased health care costs are driving the search for ways to control one's own health through dietary choices and with minimal health professional involvement. This is supported by Clydesdale's report (1998) which posited that a new paradigm of self – care had arrived and that foods can provide health benefits that can co-exist with traditional medical approaches to disease treatment. Also, in a 2002 study conducted by the International Food Information Council on certain foods that had health benefits, 94% of consumers agreed that such foods had the ability to reduce the risk of disease or other health concerns and 85% were interested in learning more about the health benefits offered by functional foods. These go to confirm the need for soy promotion in Ghana.

Again, increasing nutritional awareness of Ghanaians and consumers in general about soy and soy products gives a clear indication of the growing consumer knowledge of the relation between diet and health.

Additionally, the advancement of food technology has also resulted in the phenomenon of introducing new components, products, processes, and packaging that has provided food industries like that of soybeans more opportunities for value addition. For example Abbadi et al., (2004) developed transgenic plant oils enriched with very long chain unsaturated fatty acids. This new paradigm opens new doors for efficient utilization of soybeans.

Finally, this study will reveal that a better view and focus on the intensification of soy production and subsequent promotion, will not only help improve the food crop sub-sector but also help boost the livestock and poultry sectors' which are currently faced with huge demand deficits of soy meal and the resulting high protein demand deficit facing the nation as a whole.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter provides a review of the relevant literature that supports the theoretical and empirical framework of the research. The review covers soybeans as a crop, consumers' constraints and challenges in the use of soybeans and benefits of products and definitions of some variables

2.1 Soybeans as a Crop

The Soybean (*Glycine max* L.), is one of the oldest crops of China, and has been used by Chinese and other Oriental cultures for centuries in many forms as one of the most important sources of proteins and oil (Wilson, 1991). For this reason and due to many others (high protein yield per unit area than other crop), the soybean has caught the attention of the world and now it is seen as a crop that could help to combat world hunger. Most recently, interest in soybean has increased due to the presence of isoflavones, compounds that may play an important role in preventing and treating chronic diseases (Messina and Messina 1991; Messina et al., 1994; Kennedy 1995; Setchell 1998; Munro et al., 2003).

Wild types of soybeans were first introduced in the United States as a hay crop. Introductions from China, Manchuria, Korea and Japan have been important in developing cultivars for the United States. Modern breeding efforts to improve the agronomic traits, such as more erect growth, reduced lodging and increased seed size, have been primarily responsible for the development of soybeans into a crop of worldwide importance (Mullen 2003).

2.1.1 Agronomic Characteristics and Seed Morphology

The soybean belongs to the family Leguminosae, subfamily Papilionoideae, and genus Glycine, L. The cultivated form called *Glycine max* (L.) Merrill, grows as a summer annual. However, some related species are perennial in nature (Mullen 2003). The plant is bushy with height ranging 0.75 to 1.25 m, branching sparsely or densely, depending on cultivar and growing conditions (Liu, 1997b).

The flowers are white or violet (Howell and Cadwell 1978; Mullen 2003). The beans grow in pods that develop in clusters of 3 to 5 cm with each pod usually containing 2 or 3 beans. These beans are sometimes big or small, long, round or oval. The colour can also vary. Some are yellow, others are green but can also be brown and some are even black or with spots (Howell and Caldwell 1978; Mullen 2003).

One of the most important agronomic characteristics of soybeans is that it can take nitrogen from the air and convert it to a form usable by the soybean plant (ASA 2003), characteristic that will be explained later in more detail.

Hicks (1978) described clearly the seed morphology. The soybean seed is essentially devoid of endosperm and consists of a seed coat and a large, well-developed embryo that contains two pieces of cotyledons that function as food reserve structures.

The seed coat is marked with a hilum or seed scar that varies in shape from linear to oval. The coat protects the embryo from fungi and bacterial infection before and after planting. Besides cotyledons, the embryo has three other parts: radicle, hypocotyl, and epicotyls (Figure 2.1). The radicle and hypocotyl are located under the seed coat at one end of the hilum, just below the micropyle, which is a tiny hole formed by the integuments during 6 seed development. The third part, the epicotyl, is very small and placed between the pair of cotyledons (Figure 2.1). During germination, the radicle

becomes the primary root, whereas the hypocotyl lifts the cotyledons above the soil surface. The epicotyl is the main stem and growing point (Liu 1997b; Hicks 1978).

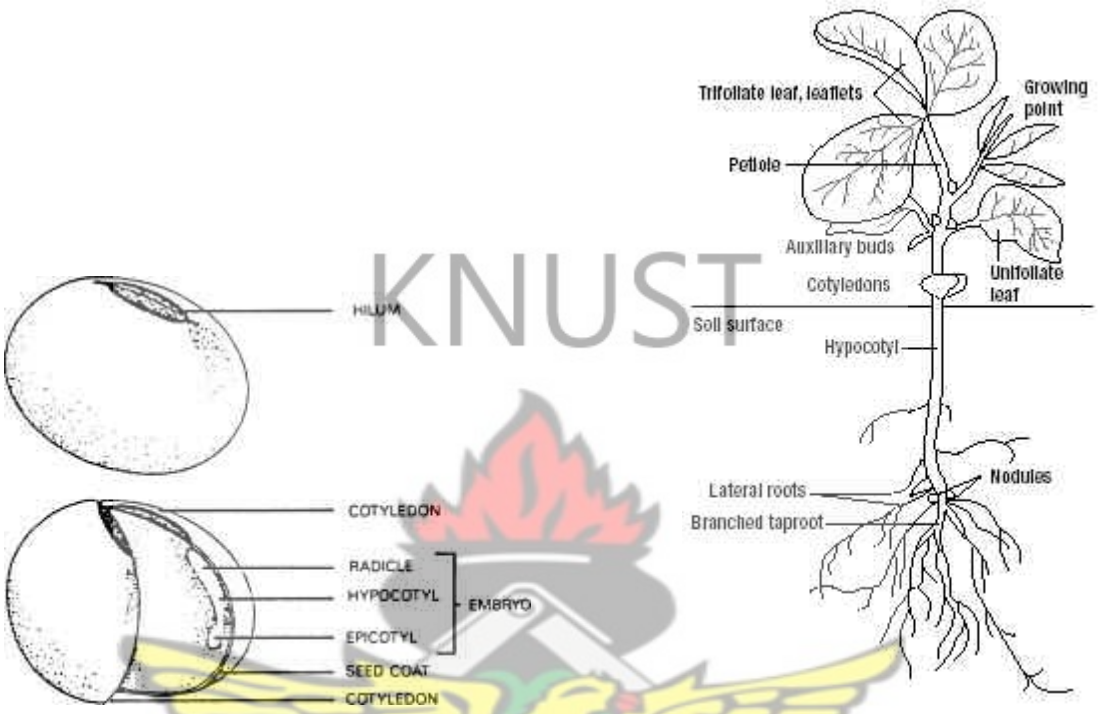


Figure 2.1: Structure of soybean seed and a soybean seedling
Source: MSU 2000, Roth and others 2003.

The seed of various soybean types can be yellow, green, black and several shades of brown, but most commercial cultivars are yellow. The seed colours are genetically controlled and, except for green, are carried in the testa, a leathery textured seed coat. The green colour of seeds may be carried in the cotyledons and/or testa. The outward appearance of the testa can vary from shiny to dull. Sometimes, depending on cultivar and environment, seed coats are etched, and partial cracks appear in the top layers of the seed coat (Mullen 2003).

2.1.2. Disease and Herbicide Resistance in Soybean

An herbicide-resistant crop is made to tolerate a specific herbicide. Roundup Ready soybeans (tolerant to Glyphosate) have been recently commercialized. Glyphosate (Roundup) is a non-selective herbicide that kills most annual and perennial grasses and broadleaf weeds. Recent advances in plant biotechnology have made it possible to insert a gene into soybeans to provide crop tolerance specifically to the herbicide Glyphosate (Reddy 2001; Padgette et al., 1996).

According to Reddy (2001), tolerance to glyphosate in soybean represents a revolutionary breakthrough in weed control technology, it is the most widely grown of all transgenic crops produced commercially in the world. In 2000, Roundup Ready soybeans were planted to 25.8 million hectares globally, which amounts to 58% of the total transgenic crop area. The United States soybean area planted with Roundup Ready soybean has increased from 2% in 1996 to 68% in 2001.

Advances in biotechnology have made it possible to transfer genes from organism to organism by means that bypass the normal sexual processes governing intraspecific inheritance. Isolated genes are moved into a crop plant in such a way that the genes are integrated into the chromosomes and expressed. A significant advantage is the fact that whole plants expressing a foreign gene can be regenerated from single transformed cells (Gianessi and Carpenter 2000). After being absorbed by plants, the herbicide glyphosate inhibits the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS). Glyphosate binds to EPSPS resulting in EPSPS's inhibition, causing the plant to starve for EPSP and the metabolic products derived from EPSP (Padgette, 1996).

Research to develop glyphosate tolerant plants began at Monsanto in the early 1980's. Simple selection as whole plants or cell cultures either with or without mutagenesis agents proved to be largely unsuccessful. Attempts to identify glyphosate tolerant plant EPSPS as well as extensive random mutagenesis efforts failed to identify EPSPS with adequate glyphosate tolerance (Wells, 1994). The ability to metabolize glyphosate is distributed widely among soil bacteria.

Research demonstrated that EPSPS from a number of bacteria exhibited tolerance to glyphosate (Padgette and et al., 1996). Monsanto scientists collected bacterial cultures from diverse sources and analysed them for their tolerance to glyphosate. One type of bacteria represented heavily in the screening was glyphosate-degrading bacteria. The rationale being that perhaps organisms that can grow in the presence of glyphosate and degrade the herbicide may also express naturally glyphosate-tolerant EPSPS. The EPSPS with the highest tolerance to glyphosate found in the screening was CP4 EPSPS from *Agrobacterium tumifacien* that demonstrated extremely high glyphosate tolerance (Padgette et al., 1996). The gene from CP4 EPSPS was cloned and introduced into soybeans (Padgette et al., 1995).

2.1.3 Harvesting, Drying and Storage

Harvesting soybean seeds after their development and maturation is a critical step in profitable soybean production. Although most soybeans are harvested at the dry mature stage, a very small portion is harvested at the immature stage in certain regions.

The immature seed is used as a vegetable or an ingredient for recipes (TeKrony et al., 1987; Keith and Delouche 1999).

Soybeans are considered dry mature when seed moisture reduces to less than 14% in the field. At this stage, seeds are ready for harvesting. The exact harvesting date depends on the cultivar, growing regions, planting date, and local weather conditions (Liu 1997b; Keith and Delouche 1999).

The moisture level in the seeds plays an important role for the seed preservation and quality. If moisture content after harvest is more than 14%, soybeans need to be dried in order to meet the quality standard of soybean trading, and retain the maximum quality of the grain. It is important to reach the desired moisture level not allowing the growth of bacteria and fungi, and also preventing germination of seeds (Keith and Delouche 1999).

Soybeans are stored at farms, elevators, and processing plants in various types of storage structures before being channelled to the next destination, and finally to processing. Soybeans are usually stored in steel tanks or concrete silos. Loss in quality of soybeans during storage results from the biological activity of seeds themselves, microbial activities, and attack by insects, mites and rodents. Quality loss is characterized by reduced seed viability and germination rate, coloration, reduced water absorption, compositional changes, and ultimately reduced quality of protein and oil (TeKrony et al., 1987; Keith and Delouche 1999). Storage conditions also affected isoflavone content in soybean seeds. Results indicated that soybeans stored at 84% relative humidity (RH) and 30 °C, present significant interconversion between aglycones and _-glucosides. The percentage of _- glucosides and malonylglucosides in total isoflavones decreased from 99% to 3% in 9 months. In contrast, the aglycones increased from 1% to 97% (Hou and Chang 2002). At 57% relative humidity (RH) and 20 °C, and ambient conditions, the glucoside forms increased with storage time,

but malonylglucosides tend to decrease. At refrigeration conditions (4 °C), isoflavone distribution had no significant changes during storage (Hou and Chang 2002).

2.1.4 Cultivar Identification and Utilisation

Selecting the correct cultivar is essential for successful soybean production.

Soybeans have great genotypic variations in terms of agronomic performance and characteristics, chemical composition, and physical appearance. Yield, disease and stress resistance, and maturity group are among the other variations relating to agronomic performance and characteristics (Liu 1997b; Roth and et al., 2003).

Compositional differences are reflected mainly in oil and protein content, fatty acid composition, and types of storage proteins. Physical appearance of the seeds includes seed size and shape, seed coat and hilum colour. Although some of these differences are determined by growing environments, others are genetic and stable and therefore can be used for cultivar identification (Liu 1997b)

The shape of the soybean seed varies from almost spherical to elongated and flat.

The industrial cultivars grown for oil are nearly spherical while the elongated cultivars are the ones used as a vegetable (Berk 1992; Liu 1997b). The surface of soybean seeds is often smooth, with variations from dull to shiny. Seed size is expressed as the number of seeds per unit volume or weight. Soybean seed weights vary greatly among cultivars, generally ranging in size from 7.6 to 30.3 g/100 seeds (Liu et al., 1995a). Industrial soybeans weigh from 18 to 20 g/ 100 seeds, and the seeds of "vegetable" cultivars are considerably larger (Berk 1992). The seed size is also controlled by environmental conditions. In general, soybeans plants grown under environmental stresses tend to have smaller seeds than those grown under normal

conditions. These stresses may come from nutrient deficiencies in the soil, water availability, diseases and pests (Liu 1997b).

In the United States commercial and industrial cultivars are yellow or yellow brown; and the presence of seeds of other colours in a lot are excluded by grading standards and considered a defect (Berk 1992; Liu 1997b). Hilum colour is also a major factor in cultivar identification, and as well as other physical appearances have become important factors in determining the type of food application for a particular soybean cultivar (Liu 1997b).

2.1.5 Food and Oil Forms of Soybeans

There are distinct differences in how the East and the West use soybeans. In the Far East, traditionally, soybeans are made into various foods for human consumption whereas in the West, most soybeans are crushed into oil and defatted meal (Liu 1997b). Because of this difference, in the U.S. soybean market, two major types of soybeans have emerged: oil beans and food beans; since there are two distinct types of soybean end uses and there is a strong effect of raw soybeans on yield and quality of final soy products (Liu 2001; Liu et al., 1995; Orthoefer and Liu 1995; Wilson 1995).

2.1.5.1 Oil-type Soybeans

Oil beans is the most commonly produced soybeans in the United States (ISB 2003). These beans are crushed for the oil and meal market. Although most soybean oil is refined for human consumption, defatted soy meal is mainly used as animal feed. A small portion of the meal is processed into soy protein products, including soy flour, concentrates, isolates, and textured soy protein. These products serve as functional and nutritional ingredients in various types of food, including baked goods, dairy and meat products, infant formula, and meat analogs (meat alternatives) (ISB, 2003).In

general, most oil beans have medium seed size, ranging between 3000 and 4000 seeds per pound, yellow or yellow brown seed coat, with hilum colour predominantly being black and imperfect black. Most oil beans have high oil content, medium-to-low protein content, and high field yield potential (Liu 2001, ISB, 2003).

Key quality factors for oil beans are oil content, protein content, and the fatty acid composition. Oil and protein content give quantitative estimates of the beans as a source of oil, and of the defatted meal as a source of protein for animal feed. The fatty acid composition provides information about the nutritional, physical and chemical characteristics of the oil extracted from the beans (CGC, 2002).

2.1.5.2 Food-type Soybeans

Food beans have been selected and bred over the past several decades for making into various types of soy foods for direct human consumption. They are called specialty or identity-preserved soybeans, and usually carry a premium price in the market for a trade-off in yield or other agronomic characteristics (ISB, 2003). They do not differ fundamentally from oil beans, except that they have a lighter seed coat and a clear hilum and are higher in protein and lower in oil (Liu, 1997b). Food beans are further classified into tofu beans, natto beans, sprout beans, and green vegetable soybeans. Most often, these beans are extra clean, with superior seed quality (U.S. Grade 1 or higher) (Liu, 2001; ISB, 2003).

Tofu beans are bred for soymilk and *Tofu* production. In general, they are higher in protein content (40% or higher, dry matter basis) and lower in oil content. Most *Tofu* beans have medium-to-large seed size (larger than 3600 seeds per pound or 12.6 grams per 100 seeds). However, large seeded soybeans are preferred because they are

visually appealing and have less hull in proportion to the whole soybean weight (Wang and Chang 1995; Liu, 2001; ISB, 2003).

Because seed colour affects visual appearance of soy foods, most *Tofu* beans have a clear hilum, light yellow to yellow seed coat, and light yellow cotyledons that result in a whiter soymilk or tofu product, which is visually more appealing to most consumers (Wang and Chang 1995). In contrast, manufacturers of *Natto,* an ethnic Japanese food of fermented whole soybeans, prefer small to extra small soybeans for better fermentation. These beans are called, appropriately, *Natto* beans (Liu, 2001; ISB, 2003). For sprout production, soybeans with medium seed size and high germination rate are preferred (Orthoefer and Liu, 1995; ISB, 2003). For consumption as a green vegetable, immature soybeans with large seed size, clear hilum, thin seed coat, high contents of sugar and free amino acids (to impart sweet and delicious taste), and tender texture (to have a better mouth feel) are preferred. They are known as *edamame* beans (Rackis et al., 1972; Orthoefer and Liu 1995; Liu, 2001).

For mature soybeans consumed in the form of either cooked or roasted whole beans called soy nuts, similar features would also be desirable, that is, large seed size, clear hilum, thin seed coat, and soft texture (Orthoefer and Liu 1995). Further improvements of food beans include low beany flavour, low lipoxygenase activities, high soluble protein fraction, high ratio of 11S/7S storage protein, low levels of oligosaccharides, and white cotyledon tissues (Liu, 1997).

2.2 Consumers' Constraints and Challenges in the Use of Soybeans

According to Plahar (2006) consumers are faced with the following constraints:

- Novelty and inertia to change
- Cannot be cooked and eaten like any other bean
- Long cooking time

- Unpalatability and beanie/rancid off-flavours
- The scenario of no utilization no production and no beans on the open market no utilization.
- Inadequate knowledge on appropriate processing techniques

2.2.1 Anti-nutritional factors

Several of the soybean proteins have been found to exert specific physiological effects. These are the trypsin inhibitors and the hemagglutinins (lectins) (Berk, 1992). Other anti-nutritional factors include Lipoxygenase enzyme and phytates.

2.2.2 Trypsin inhibitors: Protease inhibiting proteins are widespread in nature, but the trypsin inhibitors of soybeans are the best known and most thoroughly studied. Soybeans contain two types of trypsin inhibitors. Both bear the names of scientists who first isolated and characterized them. They are respectively known as the Kunitz inhibitor with a molecular weight in the range of 20,000, and the Bowman-Birk inhibitor, which is a much smaller polypeptide in the 8,000 Dalton range (Berk 1992; Liu 1997c). Both types consist of a number of differentiable proteins. The amino acid sequence and spatial structure of these proteins have been elucidated (Koide et al., 1973; Odani and Ikenaka 1973). Researchers found that raw soybeans or unheated soybean meal impaired growth when fed to young rats or chicks (Berk, 1992). This effect is completely eliminated when the soybean component is properly heated. Since trypsin inhibitors are also heat labile, it was concluded that their presence in the diet is responsible for the suppression of growth. In fact, growth is retarded if the inhibitors are added to diets containing heat-treated soybean meal (Kadake et al., 1973; Berk 1992). Inhibition of trypsin is not the only physiological effect of the trypsin inhibitors. It has been observed that their ingestion can result in increased pancreatic secretion

and hypertrophy of the pancreas (Chernick et al., 1948). Increased secretion of enzymes into the digestive tube represents an internal loss of protein (Green and Lyman 1972). Since the proteins excreted by the pancreas are particularly rich in sulphur containing amino acids, this internal loss could be especially important if the diet is marginal in methionine/cystine (Berk, 1992).

2.2.3 Hemagglutinins (Lectins):

The lectins, formerly known as hemagglutinins, are proteins that possess the ability to agglutinate red blood cells. The lectin found in raw soybeans has, apparently, no observable dietary effect, good or bad. Furthermore, it too is easily inactivated by heat (Berk, 1992).

2.2.4 Lipoxygenase enzymes

Soybeans, as all seeds, contain the enzyme systems necessary for germination. The most important enzyme in soybeans is lipoxygenase (LOX), this enzyme catalyses the oxidation of poly-unsaturated fatty acids by molecular oxygen, producing conjugated unsaturated fatty acid hydroperoxides. The enzyme also has an ability to form free radicals, which can then attack other constituents (Berk, 1992; Liu, 1997c). In plants, they are present in various organs and the highest activities are found in legume seeds (Whitaker, 1991). LOX in soybeans are of particular interest because they have been implicated as the principal cause of undesirable flavours, commonly known as “greeny” or “beany”, associated with soybean products. Numerous articles have been published on the identification and characterization of soybean LOXs and their roles in producing flavour compounds in soybean products, among which are Axelrod et al., (1981), Hildebrand et al., (1988), MacLeod and Ames (1988), Robinson et al., (1995), and Wilson (1996).

2.2.5. Phytates

Phytate is the calcium-magnesium-potassium salt of inositol hexaphosphoric acid commonly known as phytic acid. Phytate has an effect on the mineral bioavailability and protein solubility when present in animal feed and human food. It is well documented that the requirement for certain metals in laboratory animals is increased when soybeans are used as a source of protein in their diet (Weaver et al., 1984).

2.3 Nutritional Quality in soybean

2.3.1 Isoflavones and its Content in Soybean and Soybean Related Foods

Regarding to the phenolic compounds found in soybean, during the past several years, there has been much interest among clinicians and researchers in the potential role of soy foods in the preventing and treating chronic diseases. Increasing evidence has suggested that the isoflavones in soybeans might be the contributing factors (Akiyama et al., 1987; Adlercreutz et al., 1992a; Cassidy et al., 1994a; Anthony et al., 1996). The isoflavones occur predominantly as _-glucoside forms in plant and foods derived from these plants. Soybeans and soy foods can contain _-glucosides, 6”-Omalonylglucosides, and 6”-O-acetylglucosides in addition to the aglycones (Hendrich and Murphy 2001). Isoflavones have an extremely limited distribution in nature and soybean and soy foods can be considered the only natural dietary sources of these compounds (Coward et al., 1993; Messina 1997). It is not surprising therefore that some researchers found that blood and urinary isoflavone levels of Asian (Adlercreutz et al., 1993) and Western vegetarians (Adlercreutz et al., 1995) are 10-100 fold higher than those of individuals consuming typical Western diets

Raw soybeans typically contain 2000 to 4000 mg of isoflavones/Kg whereas the isoflavone content in soy foods, on a dry weight basis ranges from about 1000 to 3000 mg/Kg (Messina 1997).

Eldridge and Kwolek (1983) measured the anatomical distribution of soybean isoflavones in seeds. They found that different isoflavone concentrations are found in different parts of the seed; showing hypocotyls with the highest concentration (14,000 to 17,500 mg/Kg) followed by cotyledons (1580 to 3190 mg/Kg), whereas hulls showed the lowest concentration (100 to 200 mg/Kg).

Many researchers also evaluated the effect of different processing methods on the isoflavone composition of diverse soy products. In general, processing of soybeans for the manufacture of soy-containing food products increases the hydrolysis of isoflavone glucosides, resulting in higher concentrations of aglycones (Hutchins et al., 1995; Zhou and Erdman 1997).

Different processing methods are applied to soybeans to end up in different final products. For example, soymilk is produced by soaking finely ground soybeans in water. Another commonly consumed soy product is *tofu*, which is made by curdling fresh soymilk with a coagulant. Other commonly consumed foods are miso, a paste used in soups and sauces made by aging soybeans with rice or barley for 1 to 3 years; tempeh, a cake made by fermenting soybeans with rice or millet; and *natto*, a topping for rice and vegetables made by fermenting cooked whole soybeans and fried *tofu*. The fermentation of soybeans for products, such as *tempeh* and *natto*, will partially hydrolyze isoflavone glucosides giving them proportionally higher concentrations of aglycones (Hutchins et al., 1995).

Other researchers studied the mass balance of isoflavones during processing conditions. They found that manufacturing steps caused significant losses of

isoflavones (Wang and Murphy 1996). For example, in *tempeh* production, 12 and 49% of loss was due to soaking and heat processing respectively. In *tofu* processing, 44% loss was due to coagulation. Soy protein isolate production resulted in 53% loss by alkaline extraction. They also found that during *tempeh*, soymilk, and *tofu* production, malonyldaidzin and malonylgenistin decreased after soaking and cooking. In contrast, acetyldaidzin and acetylgenistin were generated during heat processing. They also found that, after the fermentation process in tempeh, daidzein and genistein concentrations increased as a result of fungal enzymatic hydrolysis. In the case of protein isolate processing, alkaline extraction caused the generation of daidzein and genistein, probably through alkaline hydrolysis. Toda et al., (2000) also studied the effect of processing methods in soybeans. They found that mild heating conditions (soaking) applied to soybeans showed similar isoflavone profile than raw soybeans, having the highest proportion of malonyl forms. On the other hand, stronger heating conditions (boiling and steaming) showed lower proportion of malonyl forms and higher non-acetylated _-glucoside forms. They also discovered that for a roasting process, a dry heating method, the proportion of acetyl forms increased.

2.3.2 Estrogenic / Antiestrogenic Activity

Phytoestrogens are a broad group of plant derived compounds of non-steroidalstructure that can behave as estrogen mimics (Setchell, 1998). A noticeable feature of the chemical structure of phytoestrogens is the presence of a phenolic ring that, with few exceptions, is a prerequisite for binding to the estrogen receptor (ER) (Leclerq and Heuson 1979).

2.3.3 Proteins in Soybeans and Related Foods

Proteins in soybean seeds contain all the essential amino acids required for human or animal nutrition, namely isoleucine, leucine, lysine, methionine, and cysteine, phenylalanine and tyrosine, threonine, tryptophan, valine and histidine, although they are limited in two major amino acids: methionine, followed by tryptophan (Zarkadas et al., 1993).

Like proteins of most leguminous plants, soy protein is low in sulfur-containing amino acids, with methionine being the most significant limiting amino acid, followed by cystine and threonine (Eggum and Beames 1983). However, soy protein contains sufficient lysine, which is deficient in most cereal proteins. This makes it particularly valuable to be combined with cereal proteins, as they are complementary with lysine and methionine.

Zarkadas et al., (1993) measured the amino acid profiles of soybean cultivars, and they obtained some general findings, like that glutamic amino acid is the most abundant amino acid. The acidic amino acids (glutamate and aspartate) constitute approximately one-fourth of the total amino acids present, compared to the basic amino acids (lysine, arginine, and histidine), which constitute one-fifth. The amino acids with hydrophobic side chains (glycine, alanine, valine, leucine, and isoleucine) account for a further 19 – 20% of the total protein compared the mean values of 9.1 – 9.8% for total aromatic amino acids (phenylalanine, tyrosine, and tryptophan). Mean values for proline accounts for a further 5.2-5.3%.

The amino acid composition of soybean protein does not differ considerably from one cultivar to another. Attempts to develop, genetically, soybean cultivars with a higher content of sulphur containing amino acids have not been successful (Berk 1992).

2.3.4 Carbohydrates in Soybeans and related Foods

Carbohydrates are the second largest component in soybeans. However the economic value of soy carbohydrates is considered much less important than soy protein and oil. Soybeans contain about 30% carbohydrates. These can be divided into two groups: soluble sugars (sucrose 5%, stachyose 4%, raffinose 1%) and insoluble fibre (20%) (Berk, 1992). Raffinose is a trisaccharide composed of galactose, glucose and fructose linked in that order. Stachyose is a tetrasaccharide with the following structure: galactose-galactose-glucose-fructose. Raffinose and stachyose are not broken down by the enzymes of the digestive track but are fermented by the microorganisms present in the intestine, resulting in the formation of intestinal gas. Flatulence, an inconvenience associated with the ingestion of pulses in general, is a factor that must be considered, sometimes, in the use of soybean products in human nutrition (Berk 1992; Liu 1997c). The insoluble fraction is a complex mixture of polysaccharides and their derivatives. The major part of this fraction consists of cell wall carbohydrates: cellulose, hemicelluloses and pectic substances. The insoluble carbohydrates are not digested by the enzymes of the gastro-intestinal track and can be characterized as dietary fibre. They absorb water and swell considerably. Unlike other legumes, soybeans contain very little starch (less than 1%) (Berk, 1992; Liu, 1997c).

2.3.5 Lipids in Soybeans and related Foods

During seed development, soybeans store their lipids, mainly in the form of triglycerides, in an organelle known as oil bodies. Triglycerides are neutral lipids, each consisting of three fatty acids and one glycerol that link the three acids. The functional properties, oxidative stability, as well as the nutritional value of edible oils in general and soybean oil in particular are all determined by their fatty acid composition, geometric configuration, and positional distribution. Most of the fatty acids from

soybeans are unsaturated. The highest percentage of fatty acids in soybean oil is linoleic acid, followed in decreasing order by oleic, palmitic, linolenic and stearic acid. Soybean also contains more minor fatty acids, including arachidic, behenic, palmitoleic, and myristic acid (Nawar, 1996).

During processing, components extracted from soybeans by organic solvents such as hexane are classified as crude oil. Major components of crude oil are triglycerides (or triacylglycerols) (96%). Minor components include phospholipids (2%), unsaponifiables materials (1.6%), free fatty acids (0.5%), minute amounts of carotenoid pigments, and trace metals. Unsaponifiable material consists of tocopherols, phytosterols, and hydrocarbons. The concentration of these minor compounds is reduced after typical oil processing (Berk 1992; Liu 1997c).

There is a large genetic variation in fatty acid composition of soybean oil, mainly resulting from plant breeding (Hammond and Glatz 1989). Also, the fatty acid composition depends on the cultivar and growing conditions (Berk 1992).

Soybean oil is classified as semi-drying oil in view of its high linoleic and linolenic acid content. The presence of three double bonds in the linolenic acid is responsible, in great part, for the stronger tendency of soybean oil to undergo oxidative deterioration, leading to the development of off-flavours (Berk 1992; Nawar 1996; Liu 1997c).

The phospholipids are surface-active substances located on the surface of the oil bodies. The relatively high content of phospholipids in soybean oil (two to three times higher than other common vegetable oils) is explained by the small size of the oil bodies, resulting in a larger surface per unit weight of lipids (Berk 1992).

Crude soybean oil contains 1 to 3% of phospholipids. Among the total phospholipids in soybeans, phosphatidyl choline is about 35%, phosphatidyl ethanolamine is about

25%, and phosphatidyl inositol is about 15%, phosphatidic acid is 5 to 10%, and the rest is a composite of all the minor phospholipid compounds (Liu, 1997c).

Although the phospholipid fraction of soybeans contains a number of distinct substances, the technical term lecithin is used to name the entire fraction. Lecithin is a valuable emulsifier and has much food, medical and industrial uses. Because of their emulsifying power, the bulk of phospholipids must be removed from the crude oil before refining. This is done through a process known as degumming, because the phospholipids are separated as hydrated gums (Berk 1992; Nawar 1996; Liu 1997c).

The unsaponifiables contain mainly tocopherols and sterols. They are partially removed in the course of deodorization. The free fatty acids and pigments are removed in the process of refining and bleaching. Thus the concentration of non-triglycerides is reduced in the refined oil to less than one percent (Berk 1992; Nawar 1996).

2.4 Consumer Perception Studies on Attribute and Benefits of Products

Consumers are becoming increasingly aware of enhanced soybean varieties (10% in 2008 compared to nine percent in 2007 and five percent in 2006), according to the United Soybean Board's nationwide survey in 2009. The report, "Consumer Attitudes About Nutrition: Insights Into Nutrition, Health and Soy foods," also suggests that this number may grow as more companies switch to enhanced soybean oils for improved product functionality, health, and nutrition. In recent years, a lot of studies have been done giving considerable attention to the impact of product attribute and benefit information on consumers' food dietary choices.

Public policy officials and investors need to know how product attribute information alters food consumption behaviour in order to effectively educate people for instance about diet-disease links in order to effectively promote a nascent industry like that of

soybeans. Yet, academic researchers have focused mainly on quantifying the effect of health information on health behaviours in general (Grossman, 1972,1976; Kenkel, 1991; Moorman and Matulich, 1993) and food dietary choices in particular (example, Putler and Frazao, 1991; Jensen et al, 1992; Variyam et al., 1999; Chern, 2002).

This study sets out to inquire whether perceived soy attributes and benefits from soy influence the consumption of soybean and soy products. Over the past decade, clinical research has demonstrated that soy foods provide various nutritional and health benefits relative to chronic diseases such as osteoporosis, heart disease, and cancer. For instance, Messina and Barnes (1995) found that the intake of soy foods produced anti-carcinogenic effects on breast and prostate cancers.

Research has also shown that individuals who consume 25 grams of soy protein a day may significantly lower their blood cholesterol (Anderson et al, 1995). In 1999, the Food and Drug Administration (FDA) in the United States recognized such health benefits by allowing food companies to use health claims on soy-based foods containing at least 6.25 grams of soy protein per serving (i.e., one-fourth of the recommended daily intake of 25 grams).

According to a consumer survey carried out by the Food Marketing Institute in 2000, 71% of the respondents believed nutrition was very important in their choice of foods next only to taste. Again, it was found from the survey, that nutrition and product safety are the two most important factors in a consumer purchase decision (Brenda et al., 2003).

Evidence indicates that increased knowledge and awareness of diet-disease links motivate consumers to reduce their intake of fat and cholesterol. For example, Brown and Schrader (1990) found consumers' knowledge about the role of cholesterol in heart

disease caused a significant drop in shell egg consumption. Chern et al, (1995) illustrated two beneficial consequences from the growing availability and awareness of health information: a stimulated demand for vegetable oils and a decrease in the intake of butter and lard. Other researchers have focused attention on the marketing impact of using health claims on food products.

Historically, FDA policy banned health claims on food products prior to 1985. However, the breakfast cereal industry began using health claims on its products to showcase the link between dietary fibre intake and the lowered risk of colon cancer. This prompted a review of FDA policy on health claims that eventually lifted the ban. The subsequent proliferation of carefully regulated health claims on food products has produced several positive outcomes. Ippolito and Mathios (1993) show that health claims significantly enhanced consumer knowledge about the fibre-cancer relationship, thereby increasing consumption of fibre rich cereals.

In a subsequent study, Ippolito and Mathios (1995) found additional support for the role of health claims: the consumption of fats and saturated fats decreased faster after 1985 when compared to the 1977-85 period. More recently, Mathios (1998) showcased the dysfunctional consequences associated with the elimination of health claims. Since cooking oils contain more fats than the threshold deemed acceptable, the Nutrition Labelling and Education Act (NLEA) of 1994 disallowed health claims for this food category. Previously, cooking oils lower in saturated fats and higher in monounsaturated fats were shown to be superior to other oils from a heart-health perspective. Using supermarket scanner data, Mathios (1998) found that consumers shifted purchases toward cooking oils higher in saturated fat and lower in monounsaturated fat in the post-NLEA environment.

Finally, Balasubramanian and Cole (2002) argue that consumers are more likely to purchase nutritionally desirable packaged foods if they tout health claims.

2.5 Definitions of Variables

2.5.1 Convenience

Candal (2001) stated that the degree to which consumers strive for convenience may be useful in understanding consumer behaviour towards product. Convenience enhances the chance that a product is purchased and, hence, consumed. Rappoport et al. (1993) showed that consumer preference for meals and snacks are highly correlated with perceived convenience of the product. Convenience is the ease with which consumers can obtain, handle, and use/prepare of soy and soy products.

2.5.2 Taste

Degal and Koster (1999); Degal et al., (2001); and Koster et al., (2004) indicated concerning implicit sensory memory that non-conscious decisions related highly to specific food stimuli. Taste as represented by flavour, aroma, and any other sensory characteristics may influence consumption of a product (Hinds et al., 2003). If consumers find the taste acceptable or pleasant they are likely to increase their budget share allocated for purchase of product. Moon et al. (1999) stated that taste appears to be a positive attribute influencing consumers' buying behaviour.

2.5.3 Price

The price of the product will influence the amount and frequency of purchase. Price affects the purchasing power of the individual buyer and his/her ability to purchase the product.

2.5.4 Health knowledge

Many researchers have applied individual response data from surveys to assess whether consumers use health and nutrition information when making purchase decisions (Caswell and Mojduszka, 1996; Feick, Herrmann, and Warland, 1986; Ippolito and Mathios, 1993; Jensen and Kesavan, 1993; Mazis and Raymond, 1997; Wang, Fletcher, and Carley, 1995). Moorman and Matulich (1993), define health knowledge as the extent to which consumers have enduring health-related cognitive structures.

2.5.5 Health motivation

Moorman and Matulich (1993), again defined health motivation as consumers' goal-directed arousal to engage in preventive dietary health behaviours.

2.5.6 Nutritional awareness

Finally, nutritional awareness refers to consumers' awareness of the importance of dietary choices in preventing diseases. According to Boetel and Liu (2003) it had been found that; nutrition and product safety were important factors in a consumers' purchasing decision. They also indicated that the nutritional concerns were for particular nutrients, especially fat, cholesterol, and salt.

The effect of nutrition information on individual dietary behaviour may vary over time due to a heightening awareness of diet-disease relationships, improving attitudes about healthy eating, and an evolving knowledge of food compositions that lead to better food choices (Jensen, Kesavan, and Johnson, 1992; Kinnucan and Venkateswaran, 1990).

2.5.7 Perception and Attitude

Perception as defined in the Oxford Learner Dictionary as an act or faculty of perceiving or an intuitive recognition of truth or aesthetic quality which is initiated from the memory of the consumer as to which stimulus preference should be given in order to enjoy maximum utility or satisfaction from a purchased good or service. That is in other words the process by which people translate sensory impressions into coherent and unified view of the world around them.

Attitude towards a brand is derived from perception of a consumer of the attributes associated with the brand. According to Fishbein's postulation on attitude, beliefs are the only mediators of attitude formation and change. Attitude, defined here as an individual's internal evaluation of an object such as a branded product (i.e. soy and soy products) are considered a stable predisposition to predict consumers' behaviour towards a product.

Fishbein (1963, 1967; Fishbein and Ajzen 1975) presented perhaps the clearest theoretical exposition of the causal basis of attitudes. According to Fishbein and Ajzen (1975), "A person's attitude is a function of his salient beliefs at a given point in time." Beliefs are the subjective associations between any two discriminable concepts. Salient beliefs are those activated from memory and "considered" by the person in a given situation (Fishbein and Ajzen 1975, Olson, Kanwar, and Muderrisoglu 1979.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

This chapter describes the study area. It also presents type and sources of data, sample size and sampling techniques used in this study. Methods of data collection and analyses are presented and described. This is followed by the conceptual and analytical framework of the study. The empirical framework for the present study is also described.

3.1 Study Areas

3.1.1 Nanumba-North District (Bimbilla)

Bimbilla in the Nanumba- North District has a population structure characterized by people engaged in farming and trading of food crops such as soybean. They have a rich culture with soybeans and other grain and cereal intensively used for local delicacies for both household consumption and some for sale. Notable among such local preparations are Gabele, Soy dawadawa, Wagashie, Soy kebab and Soy Milk.

The Nanumba-North district, one of the study areas which is located on the eastern side of the Northern Region characterized with Guinea savannah vegetation. The district shares boundaries with East Gonja District to the west and south-west, and Yendi District to the north. To the east, it shares boundaries with Zabzugu/Tatali District and the Republic of Togo, and to the south east with the Volta Region. It covers a land area of 3220sq.km. Temperature in the district ranges from 29°C - 41°C. The district's total population is about 80,000 (2000 population and housing census) predominantly rural in nature and dominated by the youth. The main ethnic group is Dagomba. Most of the people resort to farming (i.e. tubers, cereals and legumes) as a

main stay occupation and a minor group engage in trading as a livelihood. The majorities of the inhabitants in this district eat outside home during the day and only cook in the household in the evenings when they have returned from their farms.

3.1.2 Yendi Municipality

Yendi Municipality has a population composition dominated by people engaged in farming and trading of grains and cereals such as soybean as well as other commodities. They also have rich way of life in respect to food with soybeans, cowpea and other grains predominantly utilized in delicacies for both household consumption and some for sale. Notable among such local preparations are Gabele, Soy dawadawa, Wagashie and Soy kebab.

The Municipality is located on the eastern corridors of the Northern Region between Latitude 9° – 35° North and 0° – 30° West and 0° – 15° East. The Yendi Municipality is cut through by the Greenwich Meridian. The Municipality shares boundaries with seven other districts; to the east, with Saboba/Chereponi and Zabzugu/Tatale, to the south, with Nanumba and East Gonja, to the West, with Tamale and Savelugu/Nanton and to the north, with Gushiegu/Karaga districts. It covers a land area of 5350sq.km. Temperature in the municipality ranges from 21°C - 36°C. The population of the district is 142,504 (2000 population and Housing census) and is varied in terms of ethnicity with the Dagomba constituting the majority. The other ethnic groups include Konkomba, Akan, Ewe, Basare, Moshie, Chokosi and Hausa. The population is largely rural. The main occupation of the residents in this municipality is farming and a minor group is into trading for a living.

3.1.3 Bawku-West District (Tilli)

Tilli in the Bawku-West district has a population made up of farmers of root and tubers crops, and cereals such as soybean. They have women groups as well as individuals that process most of the cereals and grains including soybeans into local foods such as Soy Dawadawa, Gabele and Tubani for sale but mostly for consumption.

The Bawku West district is located in the north-eastern section of the Upper East Region. Zebilla is the district capital. It is bordered to the north by the Republic of Burkina Faso, to the east by the Bawku East District, to the west by the Bolgatanga District and to the south by the East Mamprusi District. The natural vegetation is that of the savannah woodland and temperature ranges from 14°C to 35°C with an annual rainfall of 800mm. The major occupation of the people here is farming (i.e. cereals, legumes and vegetables). The population is principally rural. The main soy foods consumed in this area is the Soy Dawadawa, Gabele and Tubani which are locally prepared. Data from the regional level shows that only 21.2 per cent of the population (15 years and older) are literate in either English only (12.9%), both English and Ghanaian language (6.6%) or Ghanaian language only (1.7%).

3.1.4 Techiman Municipality

Techiman is a notable place for trading in many products and commodities having a broad range of cultures mixed up in the setting. Located here is one of the largest soy oil producers in Ghana (i.e. Ghana Nuts Company Limited). The consumption of soy oil , soy kebab, soy flour, and soy milk respectively are high in this municipality.

The Techiman Municipality is a strategically situated junction municipality with very good roads linking it not only to most of Ghana's major commercial centres. It covers a land area of 669.7 Km². According to the 2000 Population and Housing Census, the population of the Municipality stood at 174,600. The vegetation of the municipality is dual, comprising both savannah and forest, which allows for diversified farming in savannah and forest crops. The Techiman Municipality in general is regarded as an agricultural production corridor. This is largely attributed to the vast fertile lands, especially in the southern part of the Municipality. Located here also is one of the largest soy oil producers in Ghana (i.e. Ghana Nuts Company Limited). The predominant ethnic group in the Municipality is the Akan (64.4 %) this is followed by the Mole Dagbon (23.3%), Grusi (4.9%), Guan (1.9%), Ewe (1.4%), Mende (1.4%) with Gurma and other tribes constituting (2.1%). The natives, Brong's constitute about 75 % of the Akan group.

3.1.5 Ejura/Sekyedumase District

Ejura in the Ejura Sekyedumase District has a population structure characterized by people whose main occupations are farming and trading of cereals, grains and tubers as well as other commodities. They produce and utilize soybeans into products such as soy kebab, soy dawadawa, and soy milk which they both sell and consume.

The district is located within longitudes 1˚5W and 1˚39' W and latitudes 7˚9' N and 7˚36'N. It has a large land size of about 1,782.2sq.km. (690.781sq.miles). It is located in the Northern part of the Ashanti Region and is bounded in the north by Atebubu and Nkoranza districts (both in the Brong Ahafo region), on the west by Offinso district, on the East by Sekyere East district and the south by Sekyere West and Afigya Sekyere district. Ejura-Sekyedumase lies within the transitional zone of the

semi-deciduous forest and Guinea Savannah zones. Therefore the vegetation consists of tall grasses interspersed with short fire resistant tree species. The district has a population of about 88,753 people. The population is principally rural with the main occupation of residents being farming. There is also a well-established market place which boosts trading and so most of the people also engage in trading especially food commodities.

3.1.6 Ga-East Municipality

Farming is the major economic activity for about 55% of the economically active population. About 70% of the rural population depends on agriculture as their main source of livelihood with small holders. They engage in cultivating grains and cereals and process a greater part. There are quite a number of agro processing companies in the municipality. For instance, Ceresoy Company Limited in Madina process soy in breakfast beverages. The soy products that are most prominent here include soy oil, soy milk, soy kebab, and soy flour.

The Ga-East Municipal Assembly is located in the northern part of the Greater Accra Region with Abokobi as the capital. The Assembly is bordered on the west by the Ga West Municipal Assembly (GWMA), on the east by the Adenta Municipal Assembly (AdMA), the south by Accra Metropolitan Assembly (AMA) and the north by the Akwapim South District Assembly. The area is has prevalent temperatures ranging from 25°C to 28.5°C with the vegetation being typically coastal thicket and grassland. The 2000 National Population and Housing census puts the Municipal Assembly's population at 161,873. The population is concentrated mainly along the urban and peri-urban areas of the municipality particularly along the border with AMA to the south. These include Madina, Dome, Taifa and Haatso just to mention a few.

3.2 Population, sample size and Sampling Technique

The areas involved in this survey have an estimated population of about 713,000 inhabitants. (Ghana Population and Housing Census, 2000). The sample size for the research is three hundred and seventy (370). This comprises three hundred household consumers, thirty mid-wives, thirty processors and retailers, and ten supermarkets. In all, three hundred and seventy respondents were interviewed in the present study. The main sampling technique employed in this study was purposive sampling technique. This was followed by simple random sampling procedure. Purposive sampling technique was employed because some geographic areas are more major producers and consumers of soy foods and products. The target population for the research was households, processors and individual consumers from the following districts and metropolitan areas (i.e. Bimbilla in the Nanumba-north district, Yendi municipality, (Tilli) in the Bawku West district, Techiman Municipality, Ejura in the Ejurasekyedumase district, and Madina in the Ga East Municipality).

3.3 Type and Source of Data

Both primary and secondary data were employed in this research. The primary data comprises sampled views from respondents that were collected by using questionnaires. The secondary data were also obtained from information already available at Bimbilla in the Nanumba North district, Yendi Municipality, Tilli in the Bawku West, Techiman municipal, Ejura in the Ejurasekyedumase district, and Madina in the Ga-East Municipality where they were available. The respondents were interviewed using structured and semi-structured questionnaires. The questionnaires included both open and close ended questions. The open ended questions were

purposely for qualitative data whilst the close ended questions were mainly for quantitative data.

3.4 Methods of Data Collection

The primary data collected for this study were obtained by interviewing with structured questionnaires. The questionnaires were administered between December, 2009 and Feburary 2010. At the first stage, the districts and municipalities were grouped under four major areas. This was done according to the geographical locations (i.e. Northern Belt, Middle Belt, and the Southern Belt) where soy foods and products were predominant in these in Ghana. The six main areas are Bimbilla, Yendi, Tilli, Techiman, Ejura and Madina where soy produced and processed into soy food products. Households, processors and retailers and, mid-wives and individual consumers of soy food products found in these areas. The second stage was a visit paid to these areas to do an exploratory study to these areas to people involved in all level in the chain of production to marketing of soy and soy-based products (i.e. SEND Ghana, an NGO in Bimbilla in the Northern Region who support out-grower farmers with inputs such as credit, viable seeds and fertilizers as well as buy and help farmers in training with regards to processing and utilization of soy; Ghana Nuts in Techiman in the Brong-Ahafo Region who process soy into cooking oil and Ceresoy Company Limited in Madina in the Ga East Municipality, producers of soy beverage foods. During these visits dates were fixed for pretesting of questionnaires and data collection. The third stage was the pretesting of sample questionnaires for soy and soy food product consumers, processors and producers. The fourth stage was the administration of main questionnaires.

3.5 Method of Data Analysis

This section examines the theoretical and analytical framework of the various methods that will be used to analyse the data.

3.5.1 Theoretical Frameworks

The traditional utility maximization framework fails to shed light on the role of a product's attributes in collectively shaping its market demand, but a framework developed by Lancaster (1971) in a related domain offers valuable insights. Specifically, Lancaster's characteristics model proposes that utility is derived from the characteristics of the goods. Ladd and Suvannunt (1976) extended Lancaster's model in their consumer goods characteristics model (CGCM) to identify two properties: (a) the price of a product is a sum of the marginal implicit value of its attributes, and (b) consumer demand for a product is influenced by the level of its attributes as well as price and income. The first property gave rise to hedonic price models (e.g., Umevehr and Bard, 1993; Espinosa and Goodwin, 1991). The second property was modified by Van Ravenswaay and Hoehn (1991) for the single-product case and applied by Baker and Crosbie (1993) to evaluate consumer preferences for food safety. The study relies on this modified CGCM model to derive the soy food demand function (Y) for a consumer t:

$$Y_t = Y_t\,(C, P_1, P, m). \qquad (1)$$

Equation (1) states that consumers' purchasing decisions for a soy food are determined by its price (P_1), a vector of prices of related goods (P), income (m), and a vector of its other (nonprice) characteristics (C). The CGCM model appears more realistic than conventional demand models that ignore the impact of product attributes

on market demand. Nevertheless, the CGCM model raises two issues: (a) whether the attributes are objectively measurable, and (b) whether consumers are knowledgeable about such attributes. The first issue may be problematic particularly for credence products, defined as goods whose attributes cannot be objectively evaluated even after consumption (e.g., a patient with a surgically implanted stent in her carotid artery cannot realistically evaluate the stent's quality or efficacy).

With respect to the second issue, consumers are less likely to know about certain attributes, particularly those that lack search properties. For example, soy-based foods possess a nutritional attribute (isoflavones) that reduces the risk of coronary heart disease. Although the level of the isoflavones can be measured objectively, consumers may or may not be aware of the link between isoflavones and reduced risk of heart disease. When consumers are ignorant about this link, the level of isoflavones has no impact on the demand for soy foods.

For these reasons, perceived attribute levels are more appropriate determinants of soy food consumption behaviour than objectively determined attribute levels. Specifically, Fishbein's multi-attribute model serves as an ideal conceptual framework linking consumers' perceptions of soy attributes to their behaviours and attitudes (Fishbein, 1967; Ajzen and Fishbein, 1980). Equation (2) expresses the multi-attribute model in a concise form:

$$Attitude_t = \sum \beta i Ai \qquad (2)$$

The model posits that a consumer's attitude toward an object is a function of (a) the importance of the attributes (βi) associated with the object, and (b) beliefs (Ai) that the object possesses those attributes.

Assuming consumers' attitudes toward soy foods are related to soy consumption, we substitute A with C in soy demand equation (1) to obtain:

$$Y_t = Y_t(P_i, A, P, m) \qquad (3)$$

Now equation (3) represents a conceptual model that integrates the CGCM with consumers' perceptions of such characteristics. Parameters associated with the vector A are equivalent to the importance of attributes (βi) in equation (2). The integrated model can be viewed as a special case of equation (1) which is more appropriate for studying experience or credence goods.

3.5.2 Analytical Framework

The study seeks to establish the relationship between consumers' perception of attributes and related benefits of soy products and their socio-demographics factors as explanatory to their consumption behaviour as a dependent variable. To this end, the Lancasters Characteristic Model and Fishbein's Multi-attribute Model will be used to analyse perception of characteristics of soy and soy products and consequently attitude of consumers. Consumers' buying intentions and subsequent consumption will be assessed with a multinomial *logit* model which will specifically be used to establish the effect of perception of soy attributes/associated benefits and socio-demographic characteristics of consumers on consumption behaviour (i.e. purchasing

decision and subsequent consumption). Statistical tools such as SPSS will be used for descriptive analyses whiles EVIEWS will be used for econometric analyses (i.e. the estimation of parameters and finding the log likelihood etc.).

3.5.3 The *Logit* Model

The logit model is preferred over other categorical variable estimation techniques (Maddala, 1983) and is a better procedure for capturing the magnitude of the independent variable effect for qualitative dependent variables than the probit models (Amamiya, 1983). The logit is estimated using maximum likelihood estimation as it results in large-sample properties of consistency and asymptotic normality of the parameter estimates.

The influence of consumers' perception attributes/benefits of soy and soy products on their consumption behaviour will be analyzed with the simple *logit* model. According to Gensch and Recker (1979) and McFadden 1974 individual will prefer the choice alternative with the greatest utility. The probability (P_i) that an individual will select an alternative is given by:

$$log_e \frac{P_i}{P_j} = a_{oi} - a_{oj} + \sum_{n=1}^{N} a_n (X_{ni} - X_{nj})$$

Where;

i = 1, 2, ..., M - 1 (multinomial case), P_i = probability of selecting alternative i, M = number of alternatives, N = number of attributes or variables, X_{ni} = value of nth attribute for alternative i, and $a's$ = parameters to be estimated.

In a much simplified version, Barein (2008) stated that if P is a probability, then $(P/1-P)$ is the corresponding odds, and the logit of the probability is the logarithm of the odds; similarly the difference between the logits of two probabilities is the logarithm of the odds ratio (*Y*), thus providing an equation for writing the correct combination of odds-ratios only by adding and subtracting:

$$\log(Y) = \log(P_1/1-P_1/$$

$$P_2/1-P_2) = \log(P_1/1-P_1) - \log(P_2/1-P_2) = logit(P_1) - logit(P_2)$$

3.5.4 Empirical Models

PSHB = f (HK, HM, NA, INC, EDU, SEX, AGE, ETH)

SCB (Y) = f (PSHB, PP, PT, PC, HK, HM, NA, INC, EDU, SEX, AGE, ETH)

SCB (Y) = f (PSHB, PP, PT, PC, INC, EDU, SEX, AGE, ETH)

SCB (Y) = f (PSHB, PP, PT, PC)

SCB (Y) represents soy consumption behaviour, PSHB = Perceived soy health benefit, PP = Perceived price, PT = Perceived taste, PC = Perceived convenience, HK = Health knowledge, HM = Health motivation, NA = Nutritional awareness, INC = Income, EDU = Education, GEN = Gender, AGE = Age, ETH = Ethnic background.

The empirical models for Soy Consumption Behaviour are given as follows:

SCB (Y) = *Logit* (P_i) = $(Pi/1-Pi) =$

$$\beta_1 PSHB + \beta_2 PP + \beta_3 PT + \beta_4 PC + \beta_5 HK + \beta_6 HM + \beta_7 NA + \beta_8 INC + \beta_9 EDU + \beta_{1o} AGE + \beta_{11} SEX + \beta_{12} ETH + \varepsilon_t$$

..... *(1)*

SCB (Y) = *Logit* (P_i) =

$$P_i/1-P_i) = \alpha_1 PSHB + \alpha_2 PP + \alpha_3 PT + \alpha_4 PC + \alpha_5 INC + \alpha_6 EDU + \alpha_7 AGE + \alpha_8 SEX + \alpha_9 ETH + u_t$$

..... *(2)*

SCB (Y) = *Logit* $(P_i) = (P_i/1 - P_i) = \partial_1 PSHB + \partial_2 PP + \partial_3 PT + \partial_4 PC + e_t$

……..... *(3)*

It is anticipated that perceived health benefit is an endogenous construct in the soy consumption behaviour model which mediates the effects of health factors comprising health knowledge, health motivation and nutritional awareness and socio-demographic characteristics of consumers and is represented below as:

PSHB = *Logit*

$$P_i) = (P_i/1 - P_i) = \emptyset_1 HM + \emptyset_2 HK + \emptyset_3 NA + \emptyset_4 INC + \emptyset_5 EDU + \emptyset_6 AGE + \emptyset_7 SEX + \emptyset_8 ETH + \mu_t$$

..... *(4)*

Where;

$\varepsilon_t, u_t, e_t, and\ \mu_t$ *are error terms in equations* $(1), (2), (3), and\ (4)$ ***respectively.***

$\beta, \alpha, \partial, and\ \emptyset$ *are parameters in equations* $(1), (2), (3), and\ (4)$ ***respectively.***

Expected signs of parameters in equation (1) – (4):

(1):

$\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 > 0, \beta_5 > 0, \beta_6 > 0, \beta_7 > 0, \beta_8 > 0, \beta_9 > 0, \beta_{10} = unknown, \beta_{11} = unknown, \beta_{12} = unknown.$

(2):

$\alpha_1 > 0, \alpha_2 < 0, \alpha_3 > 0, \alpha_4 > 0, \alpha_4 > 0, \alpha_5 > 0, \alpha_6 > 0, \alpha_7 = unknown, \alpha_8 = unknown, \alpha_9 = unknown.$

(3): $\partial_1 > 0, \partial_2 < 0, \partial_3 > 0, \partial_4 > 0, \partial_5 > 0.$

(4):

$\emptyset_1 > 0, \emptyset_2 > 0, \emptyset_3 > 0, \emptyset_4 < 0, \emptyset_5 > 0, \emptyset_6 = unknown, \emptyset_7 = unknown, \emptyset_8 = unknown.$

Equations: (1), (2), (3), and (4) are then summarized respectively as follows:

$$P_e = logit(P_{ei}) = (P_{ei}/1 - P_{ei}) = \beta_i X_i + \varepsilon_i \quad \text{..... (5)}$$

$$P_e = logit\,(P_{ei}) = (P_{ei}/1 - P_{ei}) = \alpha_i X_i + u_i \quad \text{..... (6)}$$

$$P_e = logit(P_{ei}) = (P_{ei}/1 - P_{ei}) = \partial_i X_i + e_i \quad \text{..... (7)}$$

$$P_e = logit(P_{ei}) = (P_{ei}/1 - P_{ei}) = \emptyset_i X_i + \mu_i \quad \text{..... (8)}$$

Where;

$i = 1, 2, 3, \ldots\ldots\ldots\ldots n$

$X = explanatory\ variables.$

3.5.5 Statistical Hypotheses

Ho: Perceived soy health benefits has no positive effect on the choice and use of soy and soy products

H1: Perceived soy health benefits has positive effect on the choice and use of soy and soy products

Ho: Perceived taste has no direct influence on the choice and use of soy and soy products.

H1: Perceived taste has direct influence on the choice and use of soy and soy products.

Ho: Perceived convenience has no strong influence on the choice and use of soy and soy products.

H1: Perceived convenience has strong influence on the choice and use of soy and soy products.

Ho: Income level has no direct effect on the choice and use of soy and soy products.

H1: Income level has a direct effect on the choice and use of soy and soy products.

Ho: Educational level has no strong effect on the choice and use of soy and soy products.

H1: Educational level has a strong effect on the choice and use of soy and soy products.

Ho: Ethnic background has no direct effect on the choice and use of soy and soy products.

H1: Ethnic background has a direct effect on the choice and use of soy and soy products.

Ho: Sex has no direct influence on the choice and use of soy and soy products.

H1: Sex has a direct influence on the choice and use of soy and soy products.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

In this chapter, the results of the study are tabulated and discussed. First, a descriptive analysis of the variables used in the present study is presented. Here, the endogenous variables, soy consumption behaviour (i.e. participation and frequency of consumption) and the perceived soy health benefits, are first presented. This is followed by the description of respondents' socio-demographic characteristics and the exogenous variables used in the study. Also, the results of the analysis of the empirical models in the present study are presented and discussed.

Table 4.1: Variable Definition of Socio-demographic and Soy Consumption Behaviour and their Sample Statistics

Variable	Definition	Mean	SD	Min	Max	Range
AGE	Age of respondents (years)	38.88	15.03	16	86	70
INC	Households' average income per month (Ghana cedis)	2.24	1.60	1	5	4
EDU	Educational Level of respondents	2.26	1.43	1	5	4
SEX	Sex of respondent	-	-	-	-	-
ETH	Ethnicity of respondents	-	-	-	-	-
SC	Soy Consumption Frequency	1.01	0.09	1	2	1

SD denotes standard deviation; *Min* and *Max* denote minimum and maximum respectively.

Source: Survey Data, 2010

4.1 Indicators of Internal Consistency in Scales Used to Measure Conceptual Constructs

Four broad attributes of soy food are considered in this study: price, taste, convenience, and health benefits. The survey instrument incorporated questions measuring respondents' perceptions of these attributes. Perceptions about soy health benefits were measured as a composite index (Crobach's $\alpha = 0.7$) based on responses to the following three statements on a five point scale (1-strongly agree to 5-strongly disagree): Soy foods are lower in cholesterol (b) help retain bone mass, thereby reducing fragile bone condition, and (c) they are good for women during menopause.

Perceived convenience was measured by the sum of the sum of three items rated on a four point scale: (a) Soy based foods are convenient when they have been processed and packaged already, (b) Recipes for soy foods are easy to handle or prepare, and (c) I know how to prepare soy-based foods.

Perceived Price and perceived taste were measured with six and ten items respectively. These items were rated on six and seven point scales respectively (i.e. from 1-very cheap to 6-very expensive for price and from 1- very tasteful to 7-very distasteful for tastes). Crobach's α values was (0.69) for both variables

The health knowledge construct was measured using an instrument drawn from Moorman and Matulich (1993) who defines health knowledge as the extent to which consumers have enduring health related cognitive structure. This instrument was mimicked to suit the respondent in our local settings where literacy is low. Here respondents were asked to link their intake of fruits, vegetables, salt, bones, and meat and fish to their health benefits (i.e. provision of vitamins, addition of fibre, provision of minerals, anti-cancer power, maintain ion balance, regulates blood pressure,

increase bone mass, provision of calcium, ensure strong teeth, promotes growth, and provides essential amino acids). An index was constructed for health knowledge by adding all correct answers for each respondent. Fourteen correct answers in total, was required for a respondent with full health knowledge while 0 indicated no health knowledge.

Health motivation, defined as consumers' goal-directed arousal to engage in preventive dietary health behaviours (Moorman and Matulich, 1993). In this study health motivation was operationalized specifically in relation to dietary behaviour and measured using responses to the following statements (a) I read nutrition labels on food items very carefully, (b) I listen to nutrition nutritional levels in advertisements very carefully (c) I consulted a dietician in the past year, (d) I have changed my diet in the past year due to the risks of certain diseases. Responses from these statements were averaged to obtain an index of health motivation.

Nutritional awareness refers to consumers' awareness of the importance of dietary choices in preventing diseases. This construct was measured with the following four items: (a) I am very concerned about the amount of salt in my diet, (b) I eat a lot of fresh fruits, (c) I eat a lot of fresh vegetables, and (d) I am actively trying to consume less fat in my diet. Responses to these statement items were averaged to obtain an index of nutritional awareness. A four-point scale ranging from (1-strongly agree to 4-strongly disagree) was adopted in measuring the response items for both health motivation and nutritional awareness.

Although some authors suggest that reliability level of 0.7 is preferable (Nunnally, 1978), others argue that it is just a rule of thumb. Alpha (α) level of less than 0.7 and even less has been reported in literature of Hatcher, 1994. This implies that the

Crobach alpha (α) values in table 4.2 for perceived convenience and nutritional awareness even though low, are both acceptable.

Table 4.2: Description and Summary Statistics of Soy Attributes and General Health Related Variables in Model

Construct	Definition	No. of Items	Number of respondents	Cronbach's Alpha (α)	Mean Score	Standard Deviation
PSHB	Perceived Soy Health Benefit	3	230	0.70	2.19	0.1
PC	Perceived Convenience	2	353	0.43	2.54	0.004
PP	Perceive Price	6	236	0.69	2.60	0.20
PT	Perceived Taste	9	173	0.69	2.62	0.05
HM	Health Motivation	4	352	0.58	2.38	0.23
NA	Nutritional Awareness	5	355	0.34	1.10	0.15
HK	Health knowledge	2	354	-	0.19	0.39

Source: ***Survey Data, 2010***

4.2 Descriptive Analysis of Endogenous Variables

In this section, soy consumption behaviour of respondents in the study areas is first analysed and described. This is followed by the analysis and description of the participation and frequency of consumption of soy products of the respondents.

Table 4.3: T-test Between Soy Consumption Behaviour and each of the Independent Variables Used in the study.

Variable	Difference of Mean	Standard Error	t-Statistic
AGE	-37.87	0.78	-48.52***
SEX	- 0.66	0.025	-25.97***
EDU	-1.65	0.075	-21.89***
ETH	-1.83	0.07	-26.15***
INC	-1.23	0.06	-21.96***
PSHB	-1.10	0.04	-28.40***
PC	-1.20	0.04	-30.99***
PT	-1.72	0.03	-50.62***
PP	-1.58	0.04	-40.40***
HK	0.82	0.02	38.46***
HM	-1.37	0.04	-32.07***
NA	-1.09	0.03	-41.55***

***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level and * denotes significance at the 10 percent level.

Source: Survey Data, 2010

Table 4.4: T-test Between Perceived Soy Health Benefit and each of the General Health Related and other Socio-demographic Variables Used in the Study.

Variable	Difference of Mean	Standard Error	t-Statistic
AGE	-3.678	0.761	-47.112***
SEX	0.433	0.048	9.099***
EDU	-0.568	0.894	-6.36***
ETH	-0.734	0.074	-9.88***
INC	-0.136	0.725	-1.87**
HK	1.912	0.044	43.70***

HM	-0.277	0.561	-4.93***
NA	0.009	0.432	0.208

Source: Survey Data, 2010

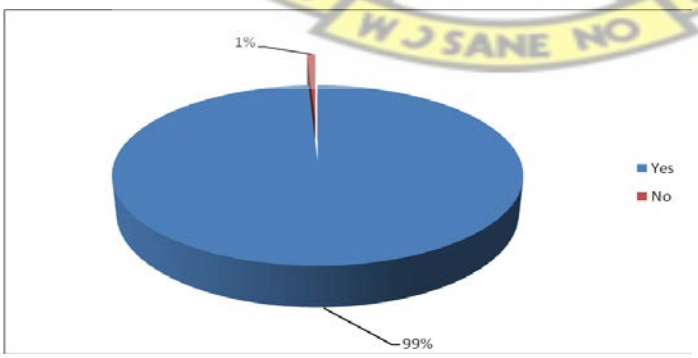
***denotes significance at the 1 percent level; ** denotes significance at the 5 percent level and * denotes significance at the 10 percent level.

4.3 Participation and Consumption Frequency of Soy Products by Respondents

Soy food consumption behaviour is defined here as monthly consumption frequency of soy products including soy kebab, soy dawadawa, soy flour, soy milk, maize soy mix, Soy oil and other household recipes.

With a sample size of 370 respondents, 99 percent of the respondents representing 366 in number are personal consumers of soy foods and the remaining 1 percent representing 4 in number are non-soy consumers but purchase soy products for relations. A pie chart depicting this distribution is shown in figure 4.1. Also from table 1, the mean soy consumption frequency is 1.01 and figure 4.2 depicts that, consumption rate of less than five times in a month is most dominated.

Figure 4.1: Consumption of Soy Products

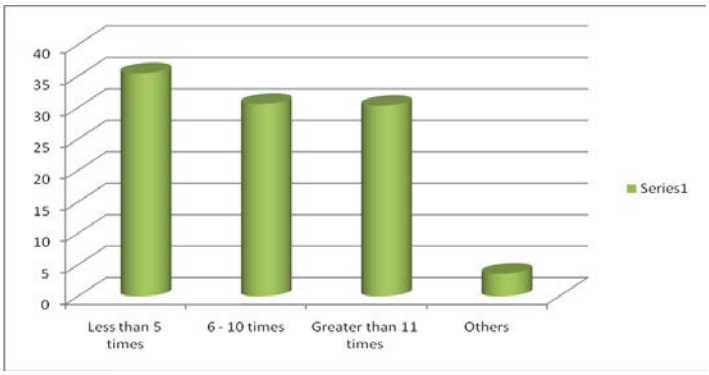


Source: Survey Data, 2010

Figure 4.2 below, shows by category the number of times in a month in which respondents' household consumes soy-based foods. Deriving from the graph, more than 30 percent of households consume soy products less than five times a month while less than 30 percent respondents consume it between six to ten times in a month. With a frequency of 11 to 30 times, the figure reveals that another less than 30 percent shows such consumption while those who consume more than once a day are less than 10 percent. A number of reasons have been given by the respondents for this seemingly low patronage and frequency of use of soy based foods or product. Among the prominent factors are: lack of familiarity with the steps in preparing soy foods and the peculiar "*beany*" scent associated with some of the soy products. Also, others deemed that, some of the soy based products are too expensive. The present study makes a major contribution to minimize this problem by scientifically and empirically identifying the factors that are likely to influence respondents' participation and consumption frequency positively in the soy food market.

For each of the seven food categories presented, table 4.5 presents the proportion of respondents reporting non-zero frequency of consumption. Soy kebab and soy dawadawa exhibited the greatest market penetration with 231 (21.4%) and 198 (18.3%) respectively, followed by soy oil 162 (15.0%), soy flour 161 (14.9%), soy milk 133 (12.3%), maize soy mix 121 (11.2%) and other traditional soy products 75 (6.9%).

Figure 4.2: Frequency of Soy Products Consumption



Source: ***Survey Data, 2010***

Table 4.5: Soy Products Consumption Frequency

Products	Count	% of Responses	% of Respondents
Soy Kebab	231	21.4	63.5
Soy Dawadawa	198	18.3	54.4
Soy Flour	161	14.9	44.2
Soy Milk	133	12.3	36.5
Maize Soy Mix	121	11.2	33.2
Soy Oil	162	15.0	44.5
Other Soy Products	75	6.9	20.6
Total	1081	100	297

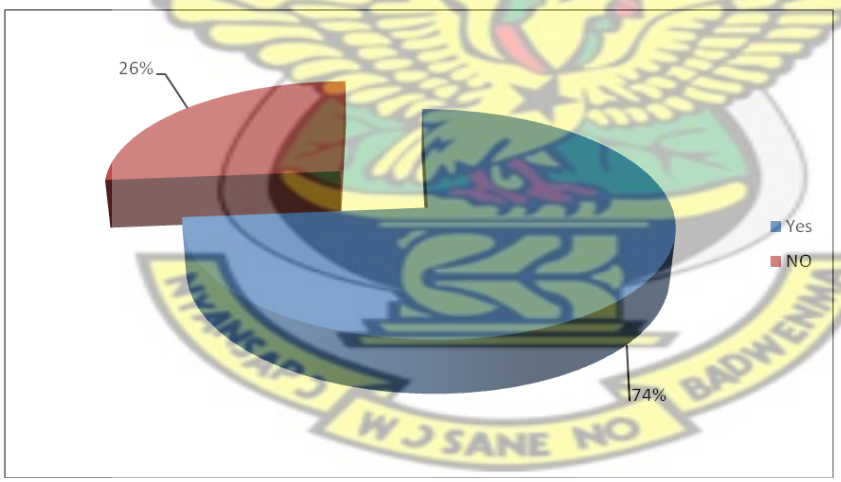
Source: Survey Data, 2010

4.4 Respondents' Perceived Soy Health Benefits

The pie chart in figure 4.3 shows the distribution of respondents' perception of soy health benefits. As noted, about three-quarters (75%) of them perceived that soy foods are beneficial to their health while the remaining quarter (25%) do not perceive any health benefits upon consumption of soy foods. This gives an indication that most

consumers (i.e. more than two-third) of soy foods do so based on the health benefits derived from it. It was therefore not surprising to learn that some soy processing companies such as the Ghana Nuts in Techiman explaining that, consumers take delight in more soy oil at the expense of other cooking oils because of its potential efficacy towards reduction in coronary heart diseases such as hypertension. To explain further, table 4.6 demonstrate an interesting scenario. Out of the 359 respondents who show strong preference for soy consumption, more than three-quarters indicate full awareness of soy products health benefits. On the other hand, only less than 25 percent show their ignorance of the products' health benefits. Even though, the table shows that 3 respondents do not show their preference to soy consumption, 1 was much aware of the health benefit while 2 were not.

Figure 4.3: Perceived Soy Health Benefits



Source: Survey Data, 2010

Table 4.6: Cross Tabulation of Consumption of Soy Products and Perceived Health Benefits

Perceived Soy Health Benefits	Yes	No	Total
Consumption of Soy Products			
Yes	**264**	**95**	**359**
No	**1**	**2**	**3**
Total	**265**	**97**	**362**

4.4 Respondent's Socio-demographic Characteristics

Here, the consumer's socio-demographic characteristics are analysed and described using cross tabulations, pie charts, and bar charts.

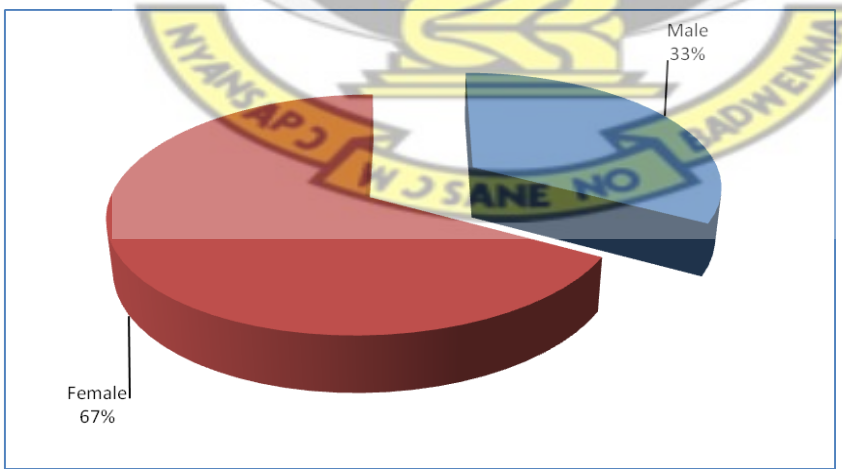
4.5.1: Sex of Respondents

From figure 4.4, it was noted that about 248 (67 percent) of respondents in the study are females while 122 (33 percent) are males. Table 4.7 illustrates the relationship between sex and soy consumption. It explains that, all female consumers (248) did report participation in the soy food market; whilst there was zero non-participation. Furthermore, out of the 122 male respondents, 119 (about 97%) consumed soy foods, whilst 3 did not directly consume. This may suggest that females having been entrusted with the duty of cooking in our societies are more conscious such that when it comes to meal planning they are more involved and concerned about health in their nutritional and food choices than men.

With regards to sex and awareness of soy health benefit derived from its intake, Table 4.8, demonstrates that, of a total of 242 female consumers 184 did use soy products based on this premise; whilst 58 did not. Moreover, 81 out of the 120 male respondents indicate consumption of soy products based on health benefit; whilst 39 did not.

The expected sign of sex was unknown. However, from table 4.3 and 4.4, sex is likely to influence soy consumption (SC) and perceive soy health benefits (PSHB). This is because, the mean difference test between soy consumption (SC) and sex gives a t-statistics of (-25.97) and is significant at 1%. However, a positive t-statistics of (9.099) was obtained when sex and perceived health benefit was computed indicating significance at 1 percent. This might be attributable to the fact that females are more likely to perceive health benefit as a factor in their food choices and consumption than males. This is important for designing effective market segments for soy food products.

Figure 4.4: Sex of Respondents



Source: Survey Data, 2010

Table 4.7: Cross Tabulation of Sex and Consumption of Soy Products

Consumption of Soy Products	Yes	No	Total
Sex			
Females	248	0	248
Males	119	3	122
Total	367	3	370

Source: *Survey Data, 2010*

Table 4.8: Cross Tabulation of Sex and Perceived Soy Health Benefits

Perceived Soy Health Benefits	Yes	No	Total
Sex			
Females	184	58	242
Males	81	39	120
Total	265	97	362

Source: *Survey Data, 2010*

4.5.2. Age of Respondents

From Table 4.1, the mean age of respondents in the present study is 38.88 years. The minimum age is 16 years with 86 years being the maximum age. This gives a range of 70 years.

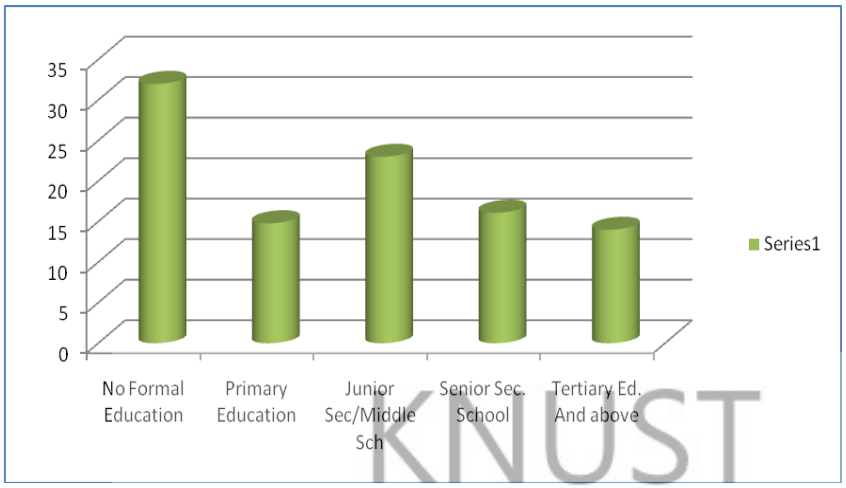
As depicted from table 3 and 4, age has a t-statistic of -48.52 and -47.112 respectively. Being significant at 1 percent in both cases, it is likely to influence respondents' soy consumption (SC) and their perceived health benefits (PSHB). Age's *a priori* sign is unknown.

4.5.3. Educational Level of Respondents

Respondent's level of education is very important and can be a factor in increasing the consumption and the frequency of use of soy based products. From table 4.1, the mean level of respondent education is 2.26 which fall close to the second category (i.e. primary education); with the minimum being 1 representing no formal education and a maximum of 5 representing respondents having education at the tertiary level and/ above. Furthermore, table 4.7 shows that 117 of the 366 respondents of participants in the soy food market had no formal education, 54 of them had primary education, 84 had junior Secondary/ Middle School, 59 Senior Secondary Education and the remaining 52 had education at the tertiary and/ above. With these statistics, it suggests that most of the locations being surveyed had low literacy levels. Consequently, it was not surprise to decode from table 4.6 a high proportion of the respondents (97) who do not have knowledge about soy health benefit. Table 4.9 below depicts a high educational influence on soy consumption. Out of the many respondents only 3 without any formal education did not personally consume soy based foods

From table 4.2 above, respondent's education is likely to influence the consumption of soy foods. This is because its t-statistic is -21.89 and significant at 1 percent.

Figure 4.5: Respondents' Educational Level



***Source:** Survey Data, 2010*

Table 4.9: Cross Tabulation of Educational Level and Soy Products Consumption

Soy Products Consumption	Yes	No	Total
Educational Level			
No Formal Education	**114**	**3**	**117**
Primary Education	**54**	**0**	**54**
Junior Sec./Middle School	**84**	**0**	**84**
Senior Sec. School	**59**	**0**	**59**
Tertiary Edu. and Above	**52**	**0**	**52**
Total	**363**	**3**	**366**

Source: Survey Data, 2010

From the survey responses, reference to table 4.10, with respect to educational and perceived health benefits of soy foods, 265 consumed soy based foods based on the perceived health benefits while 93 of them did not perceive any health benefits. Out of this 93, close to half of the number (i.e. 46) had no formal education. This gives a strong implication and indication for the soy industry to carry out public information on health benefit of soy consumption in a way to address the gap in education; which means communicating to the disadvantaged with less or no education.

Table 4.10: Cross Tabulation of Educational Level and Perceived Soy Health Benefits

Perceived Soy Health Benefits	Yes	No	Total
Educational Level			
No Formal Education	**68**	**46**	**114**
Primary Education	**41**	**11**	**52**
Junior Sec./Middle School	**70**	**12**	**82**
Senior Sec. School	**44**	**15**	**59**
Tertiary Edu. and Above	**42**	**9**	**51**
Total	**265**	**93**	**358**

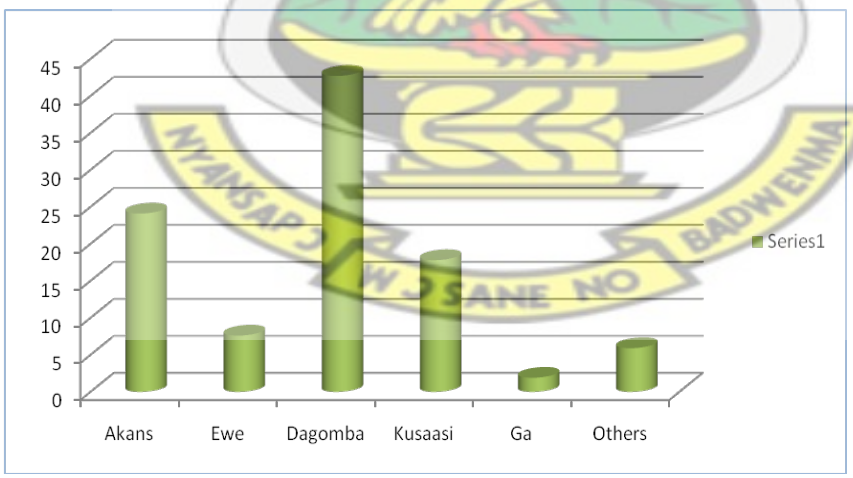
Source: Survey Data, 2010

4.5.4. Ethnic Background of Respondents

The bar chart below (figure 4.6) shows the distribution of ethnic background in the study areas. It reveals nearly 43% of respondents were Dagombas, 24% of them being

Akans whilst 17.5% of them Kusaasi. The rest are 7.5% representing Ewe, 6% forming other foreign tribes and 2% representing Ga. Ethnicity also has the tendency to influence soy consumption behavior according to the t-statistic of -26.153 at 1% level of significance as referenced from table 4.3. Also as shown from table 4.10, Out of 362 respondents who participated in the soy food market, 265 perceived soy health benefits as key to determining their consumption, while 97 did not perceive any benefits. Out of the 265 respondents, 84 of them were Dagomba, 76 were Akan, 26 were Ewe, 47 were Kusaasi, 15 other foreign tribes and 7 for Gas. No reason was given to the trend but a critical look at the proportion of the sub-sample representing respondents who are Dagombas indicates a low literacy rate among respondents. Generally Dagombas dominated the survey data because of the fact that three Dagomba dominated areas were chosen in northern Ghana and three other areas in the middle and southern parts of the country.

Figure 4.6: Respondents' Ethnic Background



Source: Survey Data, 2010

Table 4.11: Cross Tabulation of Ethnicity and Soy Products Consumption

Soy Products Consumption Ethnicity	Yes	No	Total
Akan	89	0	89 (24%)
Ewe	28	0	28 (7.54%)
Dagomba	155	3	158 (43%)
Kusaasi	66	0	66 (17.5%)
Ga	7	0	7 (2%)
Others	22	0	22 (6%)
Total	367	3	370 (100%)

Source: *Survey Data, 2010*

Table 4.12: Cross Tabulation of Ethnicity and Perceived Soy Health Benefits

Perceived Soy Health Benefits Ethnicity	Yes	No	Total
Akan	76	11	87
Ewe	26	2	28
Dagomba	84	69	153
Kusaasi	47	8	65

Ga	**7**	**0**	**7**
Others	**15**	**7**	**22**
Total	**265**	**97**	**362**

Source: Survey Data, 2010

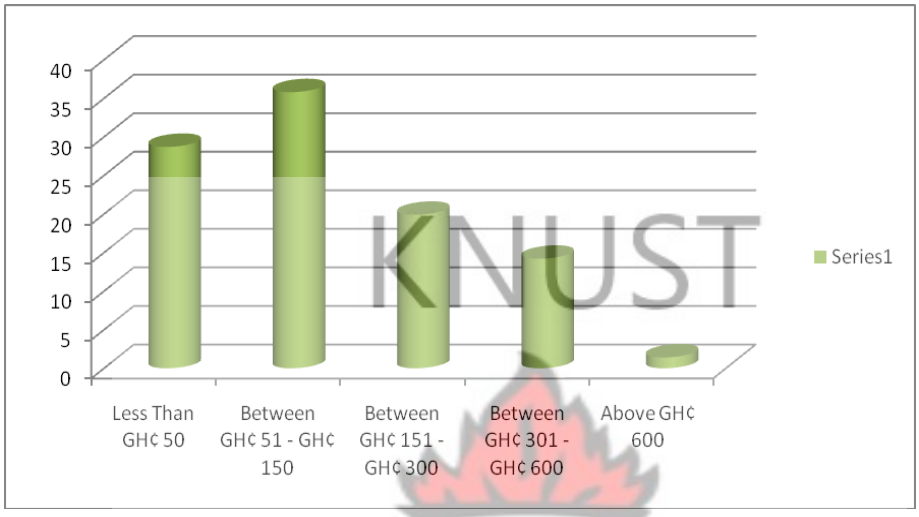
4.5.5. Income Level of Respondents

Figure 4.7 below gives a pictorial presentation of the patterns of income distribution of respondents who participated in the survey. This shows that the highest participating income group was those in the range of GH¢50 to GH¢150 (forming 35.8% of the respondents), closely followed by those receiving less than GH¢50 monthly (representing 28.7% of total respondents) and then the least participating group being those who receive more than GH¢600(forming 1.4% of the total respondents).

With a total of 366 respondents who participated in the soy food market; the following income categories were identified. 105 households reported that they received less than GH¢50 average income monthly, 131 received between GH¢51 and GH¢150, 73 received an average monthly income of GH¢151- GH¢300, 52 earned between GH¢301- GH¢600 and 5 received from GH¢601- GH¢1000 and above. Also, out of a total of 366 respondents 363 consume soy food products because of their income status while 3 did not. Moreover with regards to the t-statistics of (-21.96) significant at 1% as shown in table 4.3, it is an indication that income levels will be likely to have a significant influence on soy consumption. Table 4.4 on the other hand, also illustrates a t-statistic value of -1.87 significant at 5%. The results means

that income might have a significant influence on perceived health benefit of soy products.

Figure 4.7: Respondents' Average Income



***Source:** Survey Data, 2010*

Table 4.13: Cross Tabulation of Income of Respondents and Consumption of Soy foods

Consumption of Soy foods / Income of Respondents	Yes	No	Total
Less than GH¢50	103	2	105
GH¢51- GH¢150	130	1	131
GH¢151- GH¢300	73	0	73
GH¢301- GH¢600	52	0	52
GH¢601- GH¢1000 and above	5	0	5

Total	**363**	**3**	**366**

Source: Survey Data, 2010

4.6 Perceived Attributes of Soy Foods/Products

Results of the descriptive analysis of perceived attributes of soy foods are also presented in the forms of pie charts and cross tabulations. For each of the attributes, a pie chart depicting the distribution of whether or not respondents consume soy foods based on that particular attribute and cross tabulations showing its effect on both soy consumption behaviour (SC) and the perceived soy health benefit (PSHB) is illustrated and discussed.

4.6.1 Respondents' Perception of the Convenience on Soy Product Consumption

Perceived convenience which describes the ease in handling and preparation of soy foods and products ready for consumption received diverse responses in the survey. Figure 4.8 shows clearly that most participants in the soy food market do not perceive soy foods as convenient as depicted by the 71% respondents who expressed aversion for its convenience while only about 29% like and perceive soy foods as convenient. Again from table 4.14, the combined effect of perceived soy health benefits and perceived convenience added very little to improving consumers' perception about convenience soy products. As indicated in the table, only (29.69%) will participate based on their perception that soy foods are healthy and convenient while more than two-thirds (i.e. 70.31%) of them do not. Also, 186 out of 251 respondents will consume soy foods based only on the perceived soy health benefits obtained from soy products while 65 respondents will consume soy foods irrespective of the convenience or the perceived health benefit it offers them. Additionally, from table

4.3, a t-statistic of (-30.99) significant at 1% level indicates that perceive health benefit is likely to influence soy consumption. However this influence is negative instead of the expected positive effect. Also from table 15, all 106 respondents will consume soy foods because of combined effect perceived convenience and the specific kind of soy product. None of the respondent will consume soy food based on convenience alone as shown in the same row of the table 15. Moreover, 256 respondents indicated that they consume soy food based on the kind of soy product alone; with only 3 respondents showing that they will consume soy foods even without the influence of both convenience and the specific kind of soy products.

Figure 4.8: Respondents' Perception of Convenience as a Determinant in Soy Product Consumption

***Source:** Survey Data, 2010*

Table 4.14: Cross Tabulation of Perceived Convenience and Perceived Soy Health Benefits

Perceived Soy Health Benefits / Perceived Convenience	Yes	No	Total
Yes	74	32	106 (29.69)
No	186	65	251 (70.31)
Total	260	97	357 (100.0)

Source: *Survey Data, 2010*

Table 4.15: Cross Tabulation of Perceived Convenience and Consumption of Soy Products

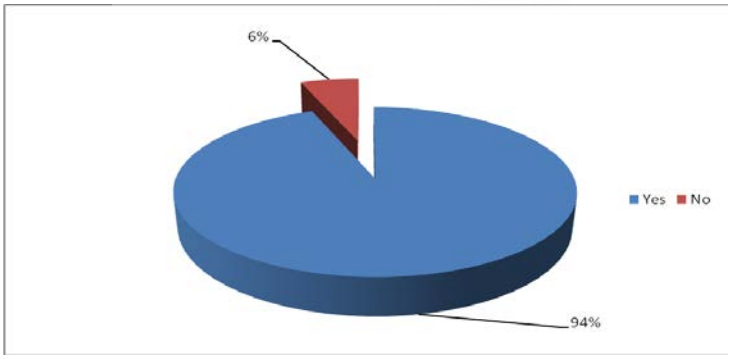
Consumption Soy Products / Perceived Convenience	Yes	No	Total
Yes	106	0	106
No	256	3	259
Total	362	3	365

Source: Survey Data, 2010

4.6.2 Respondents' Perception of the Influence of Taste on Soy Product Consumption

Responses on perceived taste as pertaining to flavour, colour and other sensory characteristics of soy foods were also received from respondents in the survey. From figure 4.9, 94% of them perceived taste as an attribute of soy that drives their consumption of soy foods while only 4% do not. Contrary to this analysis, as shown in table 4.3, the t-statistic of (-50.62) significant at 1% is an indication that perceive taste is likely to influence soy food consumption negatively. Also, from table 4.15, 341 out of 344 respondents consume soy foods based on perceived taste and the specific kind of soy product and 3 consume it based on perceived taste alone. Again only 21 respondents will consume soy product without giving consideration to the taste attribute. Moreover, from table 4.16, 250 out of 337 respondents will consume soy foods based on both perceived taste and perceived soy health benefits while 87 will consume soy foods based on perceived taste alone. Only 12 out of 397 respondents will consume soy foods based perceived soy health benefits alone. This suggests that taste of soy products may impacts soy consumption more strongly than health claims.

Figure 4.9: Respondents' Perception of Taste as a Determinant in Soy Product Consumption



Source: Survey Data, 2010

Table 4.16: Respondents' Perceived Taste and Consumption of Soy Products

Consumption of soy products	Yes	No	Total
Perceived Taste			
Yes	**341**	**3**	**344**
No	**21**	**0**	**21**
Total	**362**	**3**	**365**

Source: *Survey Data, 2010*

Table 4.17: Respondents' Perceived Taste and Consumption of Soy Products

Perceived Soy Health Benefits	Yes	No	Total
Perceived Taste			
Yes	**250**	**87**	**337**
No	**12**	**8**	**20**
Total	**262**	**95**	**359**

Source: *Survey Data, 2010*

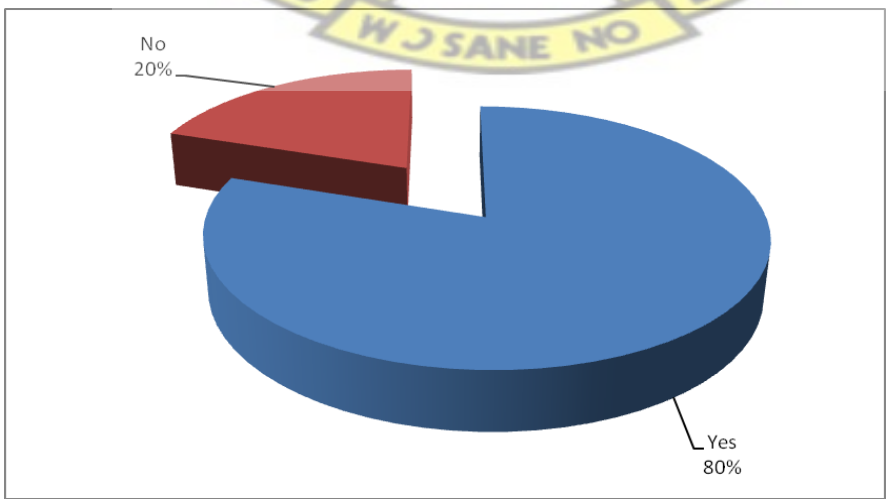
4.6.3 Respondents' Perception of the Influence of Price on Soy Product Consumption

Responses on perceived price which is a determinant of the purchasing power of consumers and influences the amount and frequency of purchases of a product were obtained from respondents. From the pie chart in figure 4.10, 80% of respondent

perceived soy food to be moderately price and inexpensive while 20% of them think otherwise. Referring to table 4.3, perceived price has a t-statistic of (-40.40) at 1% significant level. This shows that price of soy foods is likely to affect purchases. It has the expected negative sign which is implies increasing prices is accompanied with reduction in the purchasing power of the consumer. With a total of 295 as shown in table 4.17, 294 respondents will consume soy foods based on both perceived price and the specific kind of soy product. Only 1 will consume it based on perceive price alone which creates segment soy products based on price. Also 71 of them will consume soy foods based on the specific soy product alone. Only 2 out of the 368 respondents will consume soy foods without due consideration to the two factors.

Moreover, as indicated in table 4.18, 211 out of 287 respondents will consume soy products based on both perceived price and perceived soy health benefits. 76 however will consume soy food based on the perceived price alone. Again, 52 respondents will consume soy foods based on perceived health alone while 21 will consume soy product based irrespective of the influence of price and health claims.

Figure 4.10: Respondents' Perception of Price as a Determinant in Soy Product Consumption



Source: Survey Data, 2010

Table 4.18: Respondents' Perceived Price and Consumption of Soy Products

Consumption of soy products	Yes	No	Total
Perceived Price			
Yes	**294**	**1**	**295**
No	**71**	**2**	**73**
Total	**365**	**3**	**368**

Source: *Survey Data, 2010*

Table 4.19: Respondents' Perceived Price and Perceived Soy Health Benefits

Perceived Soy Health Benefits	Yes	No	Total
Perceived Price			
Yes	**211**	**76**	**287**
No	**52**	**21**	**73**
Total	**263**	**97**	**360**

Source: Survey Data, **2010**

4.7 Respondents General Health Related Variables as a Determinant in Soy Products Consumption

This section also captures the illustrations of discrete distributions and effects of the general health related variables on both the soy consumption behaviour (SC)

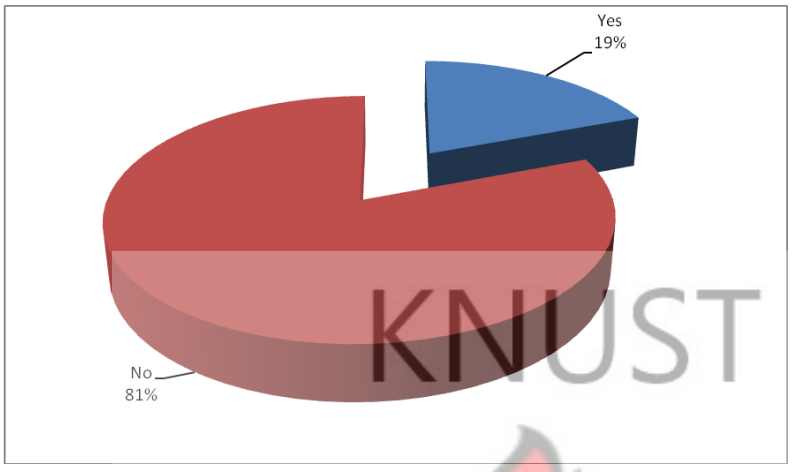
and perceived soy health benefits (PSHB). This has been portrayed in pie charts and cross tabulations respectively.

4.7.1 Health Knowledge as a Determinant in Soy Products Consumption

Responses on health knowledge which refers to the extent to which respondents have enduring health related cognitive structures were obtained. As indicated in figure 4.11 only (19.2%) of the respondents had much knowledge in food-health matters compared to an overwhelming (80.2%) of the respondent who have no or little health knowledge with respect to what they consume. Also, from table 4.3, a t-statistic of (38.46) which is significant at 1% was obtained indicating its likely positive influence on soy food consumption which is expected. Moreover as depicted in table 4.4 health knowledge also had a mean difference value of (43.70) at 1% significant level which also reveals a positive relationship. This gives an indication of how advertisements and information on soy foods from the soy industries should be carried-out to reach this great number of disadvantaged consumers.

Also from table 20, all 71 respondents will consume soy foods based on their health knowledge and the specific kind of soy product, with none willing to consume soy foods based on their health knowledge alone. Additionally, 296 respondents will consume soy foods only based on the specific kind of soy products involved while 3 respondents will consume soy foods irrespective of the influence of both factors. Again, 58 respondents consume soy foods based on the influence of health knowledge and perceived health benefits alone. 13 respondents will however consume soy foods based on their health knowledge alone while 207 will consume it based on the perceived health benefits alone. Out of the 362 respondents also, only 84 will consume soy foods irrespective of their level of health knowledge or perceived health benefits obtained from soy product consumption.

Figure 4.11: Respondents' Health Knowledge of Food Products



Source: *Survey Data, 2010*

Table 4.20: Respondents' Health Knowledge and Consumption of Soy Products

Consumption of Soy Products Health Knowledge	Yes	No	Total
Yes	71	0	71
No	296	3	259
Total	367	3	370

Source: Survey Data, 2010

Table 4.21: Respondents' Health Knowledge and Perceived Soy Health Benefits

Perceived Soy Health Benefits	Yes	No	Total
Health Knowledge			
Yes	**58**	**13**	**71**
No	**207**	**84**	**291**
Total	**265**	**97**	**362**

Source: ***Survey Data, 2010***

4.7.2 Health Motivation as a Determinant in Soy Products Consumption

Response on consumers' health motivation which refers to their goal-directed arousal to engage in preventive dietary health behaviours was also obtained. As shown in figure 4.12 (42%) of respondents consumed soy foods because they believed it will reduce the risk of them being predisposed to certain diseases while more than halve of the respondents (i.e. 58%) thought their consumption was not based on that premise. From tables 4.3 and 4.4 t-statistic values of (-32.07) and (-4.93) both significant at 1% level were obtained respectively. The indication is that health motivation of consumer is likely to influence soy consumption behaviour but not in the positive direction as envisaged. Also, from table 4.19, all the 154 respondents will consume soy foods based on both health motivation and the specific of soy product while 210 respondents out of 213 will consume soy foods based on the specific kind of soy product alone with only 3 respondents who will consume it without the influence of any of the products. Moreover, from table 20, 116 out of 151 will consume soy foods

based on health motivation while 35 of them consume soy foods based on the influence of health motivation alone. However concerning those who will consume soy foods based on perceived health knowledge alone, out of 208 respondents 147 will participate in the soy food market while 61 will consume soy foods irrespective health motivation and perceived health benefits. Health motivation in this instance has very little or no influence on consumers in the soy food market with particular reference to table 19.

Figure 4.12: Respondents Health Motivation in Food Choices

***Source:** Survey Data, 2010*

Table 4.22: Respondents' Health Motivation and Consumption of Soy Products

Consumption of soy products	Yes	No	Total
Health Motivation			
Yes	**154**	**0**	**154**
No	**210**	**3**	**213**
Total	**364**	**3**	**367**

Source: Survey Data, 2010

Table 4.23: Respondents' Health Motivation and Perceived Soy Health Benefits

Perceived Soy Health Benefit	**Yes**	**No**	**Total**
Health Motivation			
Yes	**116**	**35**	**151**
No	**147**	**61**	**208**
Total	**263**	**96**	**359**

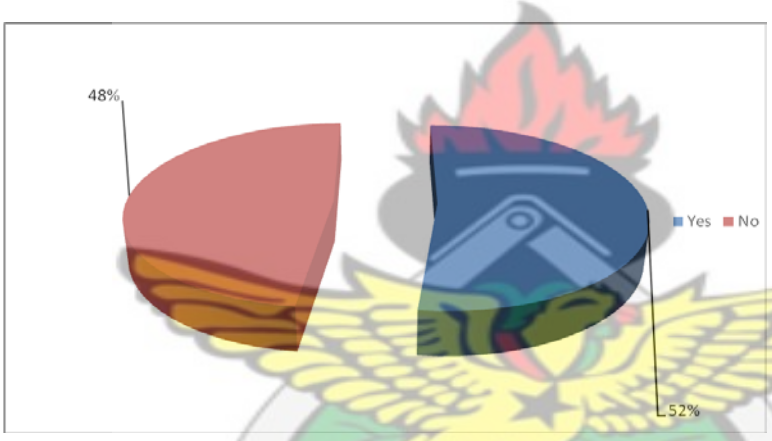
Source: ***Survey Data, 2010***

4.7.3 Nutritional Awareness as a Determinant in Soy Products Consumption

Responses on nutritional awareness which represents consumers awareness of the dietary choices in preventing diseases was also captured in the survey. Here as shown in figure 4.13 (52%) choose food items based on their awareness of their ability to prevent diseases while (48%) of participant do not factor in disease prevention in their food choices. From table 3 nutritional awareness is likely to influence soy consumption behaviour negatively because the t-statistic shows a value of (-41.55) significant at 1%. Contrary to this, it is not likely to influence soy consumption via the perceived soy health benefit construct since it from table 4.4 it is reveals that t-statistic of 0.28 is not significant even at 10% level. Also, from table 21, all 190 respondents consume soy foods based on nutritional motivation and the specific kind of soy product. In addition, out of 176 respondents, 173 consume soy food based on the kind of soy product alone while three of them consumed it without the influence of any of these two factors. None of the respondents will however consume soy foods

based on nutritional awareness alone. Furthermore, as indicated in table 22, 146 respondents will consume soy foods based on the joint influence of nutritional awareness and perceived health benefits while 35 out of the 185 respondents will consume soy foods based nutritional awareness alone. 116 however will consume soy foods based on the health related benefits they may derive from it while 57 respondents consume soy foods without giving consideration to nutrition and health claims.

Figure 4.13: Respondents' Awareness of Nutritional Content of Products



***Source:** Survey Data, 2010*

Table 4.24: Respondents' Nutritional Awareness and Consumption of Soy Products

Consumption of soy products	Yes	No	Total
Nutritional Awareness			
Yes	**190**	**0**	**190**
No	**173**	**3**	**176**

Total	**363**	**3**	**366**

Source: Survey Data, 2010

Table 4.25: Respondents' Nutritional Awareness and Perceived Soy Health Benefits

Perceived Soy Health Benefits	**Yes**	**No**	**Total**
Nutritional Awareness			
Yes	**146**	**39**	**185**
No	**116**	**57**	**173**
Total	**262**	**96**	**358**

Source: Survey Data, 2010

4.8 Results from Model Estimation

Estimates of the parameters (i.e. odds ratios) of exogenous variables of the three *Binary Logit* Models relating to the soy consumption behaviour and one endogenous construct on perceived soy health benefits are presented and discussed. Based on collinearity diagnostic test (Belsley et al., 1980) there was the presence/evidence of multicollinearlity which was dealt with by refining the data used, dropping some variables from the original model, placing restrictions on others, and squaring some others.

Table 4.26: Binary Logit for Socio-Demographic Variables and Perceived Soy attributes that influence Soy Consumption Behaviours

SC	Odds Ratio	Std. Err.	Z-Statistics	P>Z
AGE	-0.1638**	0.0838	-1.9565	0.050
ETH	2.6325*	1.4435	1.8237	0.068
SEX	2.6888	1.9190	1.4011	0.161
INC	3.8268**	1.8865	2.0285	0.043
PC	-2.8353*	-1.6522	-1.7161	0.086
PT	-0.1563	0.2598	0.5795	0.562
PSHB	0.5600	0.9283	0.6033	0.546
HK	-6.2901	6.6690	-0.9431	0.346
NA	3.8302*	2.3409	1.6362	0.102

Log likelihood = -8.101

Number of observations = 369

Sum of Squared Residuals (R^2) = 1.64

** denotes significance at 5 percent level and * denotes significance at 10 percent level.

Source: Author's Computation

The odds ratios estimates in the table (4.26) links the effects of the socio-demographic factor, perceived soy attributes and two of the general health related variables on the soy consumption behaviour of respondent.

While age variables in other models are positive, the results in this model shows that AGE^2 which was generated as a results of evidence multicollinearity in the original model has a decreasing influence on soy consumption. This indicates that a one year increase in age decreases the likelihood of soy consumption by 0.164 units contrary to prior expectation.

Consistent with prior expectation high income households are more likely to participate in the soy food market. This result might be related to the findings of Rodolfo M. And Nayga Jr. (1998) who revealed that higher income individuals are more likely to try low fat, low cholesterol foods than lower income individuals. Again Nagya (1996) and Rimal (2001) reported that income affected significantly and positively on consumer use of information regarding undesirable nutrition factors such as fat, calories and cholesterol. Additionally, Moon et al., (1999) showed that concern about fat content in food items among Bulgarian households was positively related with income.

Contrary to prior expectation that respondents' perceived convenience of soy food was more likely to positively influence their participation and consumption of soy food, perceived convenience had negative likelihood on soy food consumption. This might probably be due to the perception about cooking convenience which is relevant in explaining constraints in the consumption of soy based foods. Supporting the statement explaining this result was a finding by Kilcast et al., (1995) who showed that convenience in preparation and consumption can increase the consumption of fruits and vegetables among the low vegetable consumers. Soy food products that incorporate convenience in preparation and consumption (e.g. frozen products) are likely to be better accepted by non-participant or low frequency consumers.

Nutritional awareness was consistent with prior expectation that the more conscious consumers are on dietary choices in disease prevention the more likely they will participate in the soy food market. This result might be related to the findings of Capps and Schmitz (1991) and Rimal et al., (2001) in discussing health and nutritional factors in food analysis and Yen and Chern (1992) in investigating the impact of nutritional information on demand for dairy product which indicated that health and nutritional concern have a significant effect on food demand.

Table 4.27: Binary Logit for Soy Consumption Behaviour and Perceived Soy Attributes

SC	Odds Ratio	Std. Err.	Z-Statistics	P>Z
PSHB	0.447**	0.192	2.334	0.0196
PC	-0.038	0.099	-0.385	0.7001
PT	0.716***	0.171	4.199	0.0000
PP	-0.149**	0.076	-1.978	0.0478

Log likelihood = -20.407

Number of Observations = 370

Sum of Squared Residuals (R^2) = 3.88

*** denotes significance at 1 percent level, ** denotes significance at 5 percent level and * denotes significance at 10 percent level.

***Source:** Author's Computation*

Table (4.27) is the result from the model the links the impacts of perceived soy attributes to soy consumption behaviour. Perceived health benefit index had a statistically significant effect on consumption of soy food products. That is, consumers who perceived beneficial health attributes in soy food products were more likely to participate in the soy food market as well as increase consumption frequency.

This result is consistent with previous studies addressing the impact of health information on food choices (Jensen, 1995; Ippolito and Mathios, 1990; Capps and Schmitz, 1991; Brown and Schrader, 1990.). Also, more specifically, Moon, Balasubramanian and Rimal (2005) showed that consumers' perceived health benefits of soy foods significantly increase the likelihood of consuming soy foods.

Tastefulness was essential to increase participation and consumption of soy food products as perceived taste has a relevant in explaining the likelihood respondents consuming soy foods. This result is consistent with findings from other studies that have shown importance of taste in selecting food items. Acceptance of soy yogurt for instance, was found to be significantly lower than traditional milk yogurt primarily due to taste factor among college students in northern Louisiana (Wu et al., 2005). Rimal and Fletcher (2000) reported that attitudes toward in-shell peanuts was influenced by attributes such as fat, taste, and healthiness and that taste were the only attribute influencing consumer purchase decisions. According to Glanz et al., (1998), taste and costs are of more importance to consumers while selecting food than nutritional concerns. It is, therefore, important to promote soy food products as being tasty and convenient in addition to being nutritious.

Perceived price shows estimate that is consistent with prior expectation of it being negatively linked to the likelihood of consumer participating in soy consumption. This result is related to findings by Dahr and Foltz (2004) who reported that the mean price of soy milk per gallon was more than $8 compared to the $3 for skim/low fat milk. Prices of soy food products may be an obstacle in increasing participation in soy food market.

Perceived convenience was however surprisingly not significant in explaining the soy

consumption behaviour in this model.

Table 4.28: Binary Logit for Soy Consumption Behaviour, Socio-demographic Characteristics and Perceived Soy Attributes of Respondents

SC	Odds Ratio	Std. Err.	Z-Statistics	P>Z
AGE	-0.1063*	0.058	-1.830	0.067
ETH	0.5052 **	0.263	1.924	0.054
INC	2.8630**	1.249	2.293	0.022
PSHB	0.7331	0.870	0.843	0.400
PP	-1.2360*	0.705	-1.753	0.080
PT	2.1056**	0.966	2.179	0.029
PC	-0.2832	1.063	-0.266	0.790

Log likelihood = - 9.188

Number of Observation = 370

Sum of Squared Residuals (R^2) = 1.587

** denotes significance at 5 percent level and * denotes significance at 10 percent level.

Source: Author's Computation

The third model relates the socio-demographic factors and the perceived soy attributes to soy consumption behaviour. Results from this model are shown in table (4.28) which is almost similar to the results in the two models discussed earlier. This is terms of signs of significant exogenous variables. All the socio-demographic factors that showed significance in the table (4.26) still maintained their signs but declined in magnitude. As shown in table (4.28), age dropped from 0.164 to 0.106, followed by ethnicity from 2.633 to 0.505 and then income from 3.827 to 2.863. This shows that the socio-demographic factors impact strongly via the soy consumption behaviour

when they combined with both the perceived soy attributes and general health related variables than when they act with the perceived soy attribute alone. On this basis of the extent of influence of the socio-demographic factors implies that consumers will be more responsive to consuming more soy food products if soy marketers can utilize communicating to these categories of consumers with both perceived soy attributes and general health related variables involved. The reverse is true for the changes in magnitudes of perceived soy attribute variables. These have stronger influence on consumption behaviour when they act alone to determine consumption (i.e. perceived taste increases from 0.716 to 2.106 and perceived price from 0.149 to 1.236).

Table 4.29: Binary Logit for Perceived Soy Health Benefits and Socio-Demographic Characteristics and General Health Related Factors of Respondents

PSHB	Odds Ratio	Std. Err.	Z-Statistics	P>Z
AGE	0.0010***	0.0003	3.4013	0.0007
EDU	0.4825**	0.2355	2.0489	0.0405
ETH	0.4008**	1.1990	2.0053	0.0449
SEX	-0.5489	0.4609	-1.1910	0.2336
INC	0.0091	0.0193	0.4692	0.6389
HK	0.3623	1.7901	0.2024	0.8396
HM	0.1875***	0.0604	3.1043	0 .0019
NA	-0.0373	0.4292	-0.0869	0.9308

Log likelihood = - 41.338

Number of Observations = 367

Sum of Squared Residuals (R^2) = 10.36

** denotes significance at 5 percent level and * denotes significance at 10 percent level.

Source: Author's Computation

Results of the model that relate perceived soy health benefit to socio-demographic factors and general health related variables are shown in table (4.26). This model hypothesizes that consumer perceptions of soy health benefits are influenced by their general knowledge, motivation, nutritional awareness and socio-demographic characteristics. Estimated results however supports only general health motivation as the only health related factor significant in influencing the perceived soy health benefits. This means that consumers with greater health motivation are more likely to perceive soy health benefits. This supports findings by Menrad (2003) and Roberfroid (2000b) who indicated that today's foods are not intended to only satisfy hunger and to provide necessary nutrients for humans but also prevent nutrition-related diseases and improve physical and mental well-being of the consumer. Therefore consumers of soy food products view them in the light of their disease preventing attribute as an important factor in deciding whether or not to participate in the market. Interestingly general health knowledge had a positive odds ratio but was not statistically significant in explaining perceived soy health benefit. This result implies that consumers might necessarily not need general health knowledge in order to purchase a functional food like foods from soy but rather focus on the personal and specific health benefits in order to participate in a functional food market. This phenomenon was reported by Wansink et al., (2005) who asserted that the impact of soy health benefit on soy consumption is enhanced when those benefits are personally relevant.

Such benefit perceptions differ across socio-demographic profiles. Specifically, respondents with high education are more likely to perceive health benefit from soy foods. This outcome is consistent with conclusions made by Grossman and Kaestner (1997) who reported that there was positive relationship between education and

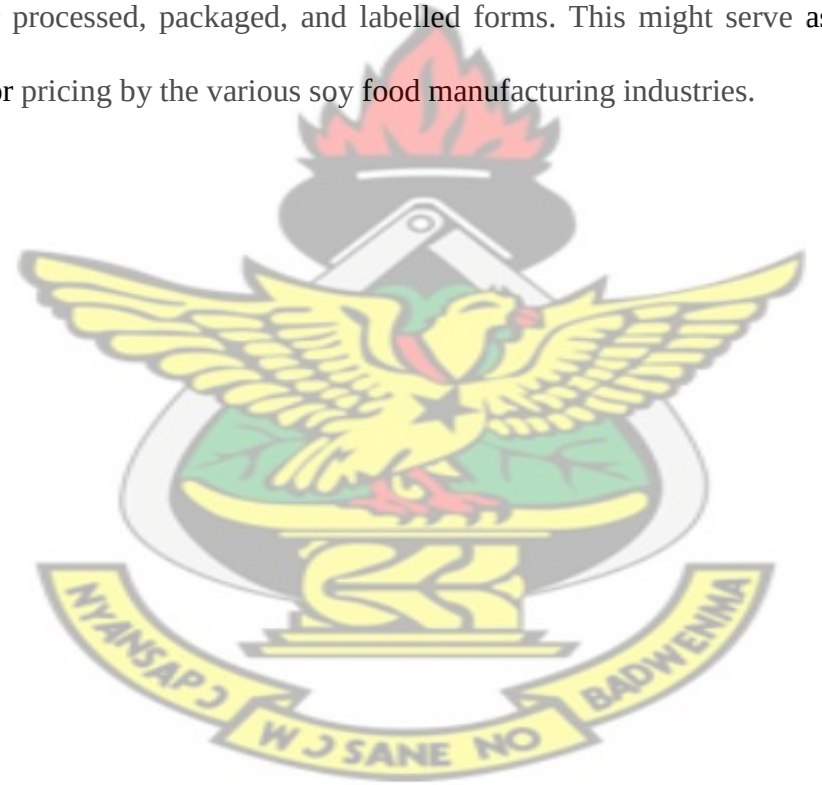
health. This shows that a person with more education is better able maintain a healthy life style than a person with less education. Also better education enhances the access to nutrition information, thus increasing the likelihood of nutritional considerations while making food selections. This underlies the reason for positive likelihood between education and perceived soy health benefit. Older respondents also tend to see greater health benefits from soy foods. This result may be buttressed with reported health concern in previous studies related to older consumers. For instance Lin (1995) found that older meal planners were more concerned about food safety. Likewise according to Nayga (1996) older consumers were likely to utilize nutritional information about health benefits, fat, and cholesterol content on food packages compared to younger consumers. This is because the aged tend to desire improvement in their eating habits in their later years of life (Kotilainen et al., 2006; Roberfroid, 2000).

In reference to Appendix 1 which depicts consumers' preference for the various forms of soy products, majority of them representing about 60% of the respondents preferred processed, packaged and labelled, followed by 25% of respondents who showed interest for only processed and packaged forms of soy products whiles only about 10% willing to buy soy products that are not packaged and labelled. This attests to the fact that Ghanaians are becoming more aware packaging and labelling of food products and thereby have a growing interest for food quality issues.

Also from Appendix 2 an interesting scenario crops up in respect to the points of purchase of soy product preferred by respondents. Out of the total of 347 respondents 142 representing 40% of the total responses opted to buy from convenience stores, followed closely by a little above 30% of them who preferred obtaining soy products from traditional open air retailers and 20% of them liked to purchase soy products

from supermarkets. Only less than 1% suggested other purchasing points such as restaurants, drinking spots and hospitals. This results deviate from GAEG (2008) findings which indicated that the traditional open air retailers dominated product point of purchase. Contrary to the finding that supermarket product patronage was 1%, 20% of respondents will patronize soy food products from supermarkets, which gives an indication of consumers growing awareness of food quality and point of purchase issues in Ghana.

Finally Appendix 3 shows the hypothetical prices quoted for the various soy products in their processed, packaged, and labelled forms. This might serve as an important basis for pricing by the various soy food manufacturing industries.



CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Summary and Conclusions

The study evaluated the effects of perceived attributes, health factors and socio-demographic characteristics of respondents on market participation and consumption decisions.

The perceived attributes included health benefit of soy food products, convenience in consumption and preparation, tastefulness and price. Lancaster's Characteristic model was combined with Fishbein's multi-attribute model to develop a soy demand function that included perceived attributes of soy food. Health factors comprised of health knowledge which was assessed by indexing the score of correct answers to six nutrition-health linked question which in total solicited 14 correct answers from each respondent; nutritional awareness which was captured with four questions solicited respondents concern on the preferred amounts of salt, fat, fruits and vegetables they included in their diet, and health motivation which was measured with four questions which demanded answers on a four point-scale ranging from strongly agree to strongly disagree. The socio-demographic characteristics of respondents included age, education, income, ethnicity, and sex.

Four Logit models were used to estimate the effects of each independent variable on participation and consumption of soy food product.

The result imply that the following households/ individuals are more likely to participate and consume soy food products: households with high incomes, those with higher education, those who are Older rather than young consumers, those in the following ethnic groups (i.e. Dagombas, followed by Akans and then Kusaasis), those

who perceive soy food products as tasty, those who perceive soy foods as healthy, those who are conscious about gaining nutritional information on food products through health motivation and finally those inclined to consuming food items based on their disease preventing abilities.

In conclusion, the study demonstrates that soy food market can be segmented based on age, education, income and ethnic background for the socio-demographic characteristics involved; health motivation and nutritional awareness for the health factors; and perceived taste and health benefits for attributes of soy considered.

5.1 Recommendations

To keep up with current trends in consumer demand for soy food products, an understanding of the associated consumer and product characteristics is needed. Due to the increasing concern about nutrition and health, the food and agribusiness industries are continually interested in creating a vast array of concepts that appeal to specific consumers. The motivation for this study was therefore imperative to identify the profile of individuals or households who are more likely to participate and consume soy food products.

This study is therefore intended to provide information which is useful for policy makers, producers, processors and marketers of soy and soy food products who want to anticipate market trends in the soy product industry. Based on this premise and on findings from the study, the following recommendations are proposed:

- Soy food processors and manufacturers selling soy-based products should tailor their products to the tastes of the individuals who are most likely to buy their products to boost sales. For example, based on the empirical findings soy foods

may be targeted to old consumers with high education and high income. Conversely, it can be inferred that less educated young consumers in low income households will be less receptive to marketing campaigns that promote soy food products.

- Both public policy agencies and the soy industry must endeavour to improve consumers' motivation. Results from the study shows that this variable act in conjunction with perceived soy health benefits construct to determine the likelihood of participation and consumption of soy food products. This variable which is related to diet-disease awareness suggests that an effective marketing tool may be to highlight the disease element of poor nutrition. Marketers can therefore capitalize on this issue in their advertising and promotion campaigns.
- It is important to recognise that less educated consumers may be disadvantaged with regards to learning about the health benefit of soy. From a public policy point of view, this may require deploying resources to sensitize such consumers about the health benefits of soy food products.
- Finally it is also recommended that government and other stakeholders interested in investing in the soy industry should do so via the consideration of the producer price incentive component purchasing, processing and utilization channels to boost the interest of producers (farmers) to cultivate more, and to provide more employment avenues for the unemployed.

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APPENDIX

Appendix 1: Respondents Preferred Forms of Soy Products

Type of Product	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Processed, Packaged and Labelled	214	57.8	59.0	59.0
Processed and Packaged but not labelled	89	24.1	24.5	83.5
Processed and Partly Packaged	29	7.8	8.0	91.5
Processed but not Packaged	19	5.1	5.2	96.7
None of the above	12	3.2	3.3	100.0
Total	363	98.1	100.0	
Missing Non Response	6	1.6		
Not Applicable	1	.3		
Total	7	1.9		
Total	370	100.0		

Appendix 2: Respondent's Preferred Point of Sale for the Product Selected above

Place	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Supermarket	73	19.7	21.0	21.0
Convenient Stores	142	38.4	40.9	62.0
Open air retailers	129	34.9	37.2	99.1

Others	3	.8	.9	100.0
Total	347	93.8	100.0	
Missing Non Response	19	5.1		
Not Applicable	4	1.1		
Total	23	6.2		
Total	370	100.0		

Appendix 3: Proposed Prices for the Various Soy Products

Preferred Price	No.	Range	Min.	Max.	Mean	Std. Deviation
Respondent Offer for Processed but Unpackaged Soy Kebab	334	8	1	9	1.22	.694
Respondent Offer for Processed and Packaged Soy Kebab	334	4	1	5	1.44	.673
Respondent Offer for Processed, Packaged and Labelled Soy Kebab	333	5	1	6	1.70	.900
Respondent Offer for Processed but Unpackaged Soy Dawadawa	312	6	0	6	1.22	.683
Respondent Offer for Processed and Packaged Soy Dawadawa	312	22	1	22	1.51	1.468
Respondent Offer for Processed,	312	7	1	8	1.69	1.059

Packaged and Labelled Soy Dawadawa						
Respondent Offer for Processed but Unpackaged Soy Flour	319	4	0	4	1.16	.448
Respondent Offer for Processed and Packaged Soy Flour	318	4	1	5	1.39	.610
Respondent Offer for Processed ,Packaged and Labelled Soy Flour	318	5	1	6	1.64	.837
Respondent Offer for Processed but Unpackaged Soy Milk	384	5	0	5	1.21	.588
Respondent Offer for Processed and Packaged Soy Milk	285	8	0	8	1.46	.804
Respondent Offer for Processed, Packaged and Labelled Soy Milk	285	5	1	6	1.67	.858
Respondent Offer for Processed but Unpackaged Maize-Soy Mix	294	4	0	5	1.32	.660
Respondent Offer for Processed and Packaged Maize-Soy Mix	294	5	1	6	1.57	.818
Respondent Offer for Processed, Packaged and Labelled Maize-Soy Mix	294	5	1	6	1.79	.968
Respondent Offer for Processed but Unpackaged Soy Oil	294	3	1	4	1.35	.640

Respondent Offer for Processed and Packaged Soy Oil	294	4	1	4	1.63	.743
Respondent Offer for Processed ,Packaged and Labelled Soy Oil	298	4	1	5	1.86	.896
Valid N (listwise)	247