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ECO-FRIENDLY PACKAGING IN RESTAURANTS IN ACCRA -

Application, Attitudes and Challenges

BY

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DECLARATION

I declare that I have wholly undertaken the study reported herein under the supervision of Mr. John Barimah and that except for portions where references have been dully cited, this declaration is the outcome of my research.

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ABSTRACT

The use of eco-friendly packaging in the food industry has the potential of ensuring the replacement of non- renewable resources with renewable materials and again reducing the burden of non-degradable waste on landfills. It also has the advantage of introducing innovativeness in the food sector. The application, attitudes and challenges of eco-friendly packaging in restaurants were investigated in this study. A cross sectional survey with a semi structured questionnaire was used. The work revealed 30.3% application of biodegradable food package mainly in the form of paper boxes and envelops for pastries and fried chicken. There was a positive attitude towards the introduction of a new packaging material which is eco-friendly. However, the awareness and communication needs to be increased. The restaurants perceived price (cost) of packaging, communication, awareness and marketing to be the likely challenges to the application of the technology. The ability of the packaging material to contain the food as best as the petrochemical alternative was cited. There is the potential to reduce petrochemical based waste packaging materials in the environment through the implementation of an innovative packaging technology in the food sector which serves every individual in the country considering the life style of the average Ghanaian.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

A Package is the container for a product which includes the color, labeling, shape, design, and materials used (Arens, 1996). The main function of a package is to protect a product against potential damages during handling, transportation, storage, and operation (Kuvykaite *et al*., 2009). A Package also plays a key role in making a customer decide to purchase or not to purchase a product. According to Van Dam and Van Trijp (1994), the impact of a product package has a great influence on consumer perception of the product and that a balance between this and personal gains inform purchasing of the food product. In the past in both developed and developing nations when considering packages, the dominating issue was the negative environmental impact. And the challenge has been material use and recycling possibilities (Rokka and Uusitalo 2008). Packaging is often still considered only as a burden for the environment and as irritating waste, which has taken over trash cans and landfills (Gronman *et al*., 2012). The continual use of plastic packaging, which are petroleum based, has had a lot of negative impact as a result of their non-biodegradability (Marsh and Bugusu, 2007). The use of plastics needs to be restricted or even be gradually abandoned to protect and conserve the ecology (Shah *et al*., 1995). Awareness in this regard, has directed the look for packages that are biodegradable and thus, eco-compatible. The concept of biodegradability has both user-friendly and eco-friendly attributes, and the raw materials are essentially obtained from either agricultural materials such as cellulose, starch, and proteins or marine food processing industry wastes such as chitin/chitosan (Singh *et al.*, 2012). These materials are biodegradable and have environmentally friendly products such as CO_2, H_2O and quality compost and thus constitute a turning point that needs to be capitalized (Song *et al*., 2009). Although total replacement of synthetic plastics with biodegradable ones may be impossible to achieve, applications in a sector like the food industry would significantly reduce the burden of this non-degradable packages on the environment (Siracusa *et al*., 2008). According to Gelici-Zeko *et al*. (2013), this innovative technology will present an extra cost which will be added to the consumer's expense and thus their awareness and acceptance is of paramount importance in the search for sustainable package which has become a challenge to governments at national and international levels. The major challenge is the ability to integrate the principle of sustainability in terms of packaging in the consumption pattern of the population as consumer trust has an important influence on the success of new products (Siegrist *et al*., 2007). Although it is not feasible to get all of the manufacturing sector to comply fully, applying this principle of sustainability in the food sector in terms of packaging is a very significant step in saving the environment from the menace of non-degradable packaging material. Endorsing Sustainable packaging means the developing and using package that results in improved retention. This means that packaging will be assessed from the main function, marketing, and then at the end of life and rebirth of the material. The aim is to improve the long viability and quality of life of the natural ecosystem (Robertson 2007). According to the Sustainable Packaging Coalition (2013), a sustainable package must meet the functional and economic needs of the present without compromising the ability of future generations to meet their own needs.

Reducing the use of resources and waste would be an important contribution toward mitigating global environmental inputs. With increase production efficiency in recent decades, thus creating more good service while using less resources, creating less waste and pollution (Barbiroli, 2006). However, the use of resources and waste has increased due to population growth and increased consumption (Giljum *et al.,* 2009, Kitzes *et al.*, 2008), therefore efficiency alone is not enough and it has been increasingly recognized as reported by works of Frye-Levine (2012), Korhonen and Seager (2008).

1.2 Problem statement

Plastic package waste, mostly from food have recently become a menace in the country. Of major concern in the plastic waste situation is the disposal culture of consumers, which is one of lack of care. All intervention methods for proper disposal have failed to put the situation on check (Agyenim-Boateng 1998). According to Mendelson and Polonsky (1995), green packaging is evolving as a major area of interest for the food industry as it may provide competitive advantages. However, in Ghana there is no formal documentation covering the application of eco-friendly packaging, in the food sector. This calls for great concern from all stakeholders more importantly the food sector which seems to produce a majority of the non-degradable solid waste found in our landfills.

1.3 Justification of work

This work will provide information on the application of eco-friendly packaging in the food sector (specifically restaurants), any efforts being made to get the food industries to make their packaging materials environmentally friendly and possible challenges, in the application of eco-friendly packaging.

1.4 Objective:

To establish the level of application, attitude and challenge of eco-friendly packaging in restaurants in Accra.

1.4.1 Specific objectives:

1. To determine the level of usage of biodegradable packaging in the restaurants.

2. To determine the attitude of restaurants towards the application of eco-friendly packaging.

3. To investigate any challenges the industry is facing or likely to face in terms of applying biodegradable packaging.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Current Food Packaging Issues

Several research works have proven that food packaging materials pose serious environmental pollution problems (Faller, 1990). Despite these concerns there is an increasing consumption of packaged products and this has been greatly related to modernization and the increase in the number of women at the labour market. According to Bech-Larsen (1996), traditional food packages pose less problems in terms of recyclability as compared with modern food packages. However, due to convenience and attractiveness, modern packaged foods tend to have gained more acceptance and use than the traditional ones since food packaging is important for the storage and use of the food unlike other packaged products. According to Harboe-Jepsen (1992), food packaging constitutes the highest percentage of household waste. This was based on the high percentage of household budget allocated for food and the fact that packaging forms a high proportion of the products weight and volume

2.2 Eco-friendly/Green/Sustainable packaging

According to the sustainable packaging coalition (2013), a sustainable package is one that presents the following features:

- Is beneficial, safe and healthy for individuals and communities throughout its life cycle.
- Meets market criteria for performance and cost.
- Is sourced, manufactured, transported, and recycled using renewable energy.
- Optimizes the use of renewable or recycled source materials.
- Is manufactured using clean production technologies and best practices.
- Is made from materials healthy throughout the life cycle.

- Is physically designed to optimize materials and energy.
- Is effectively recovered and utilized in biological and or industrial closed loop cycles.

The use of recycled or bio-based and renewable materials from well managed sources can contribute to sustainable material flows and help ensure the availability of materials for future generations (Sustainable Packaging Coalition, 2013).

Although the application of eco-friendly packaging may currently be limited to developing countries to keep the earth in existence, majority of the world population are living mainly in underdeveloped and developing countries and must make a commitment to sustainability as well. It is worth the hassle to establish the understanding, perceptions, attitudes and ecological concepts of consumers in eco packaging. The package is a first step in developing strategies to ensure the involvement of communities in developing countries and under developed countries of appreciating sustainability. Sustainability of eco packaging in the food sector means investigation into the food culture of the consumer. The success of product development or reformulation is consumer perception of the new product. Food scientists need to know whether the new or reformulated products can confer any advantages or provide better quality than the competitors or the original products (Meilgaard *et al*., 1999). Introduction of innovative packaging such as an eco-friendly package in the food sector needs to be treated similarly.

The environmentally conscious consumer has substantial knowledge of these packaging materials and make purchases based on their knowledge. In the work of Fernqvist and Ekelund (2014), it was reported that consumers endorsed paper bags as homely, nice and healthy as compared to plastic bags. Consumers in this study saw plastic bags as unnecessary and an injury to the environment which should be avoided despite their convenience in direct microwaving of the food product. Nordin and Selke (2010), in their work established that the consumer is the final determiner of the success of the package and that the designer of the package can influence only up to a point. This is to say that consumer based survey and interview of different group would be an appropriate way to get the consumer to acknowledge what they are being offered. The result from the consumer studies will be useful in choosing material and materials combination as well as shapes of package that will prevent loss of food (Gronman *et al.*, 2012).

The use of eco-packaging in the food industry has the potential to ensure two main benefits. The replacement of non-renewable resources with renewable material to achieve a sustainable packaging industry for the food sector and secondly reducing the burden of non-biodegradable waste on the limited landfills available is a laudable idea. According to Narayan (2006), it is expected that more than 80% of households in the United Kingdom will compost their green waste. Food retailers are also playing a significant role in the shift from non-biodegradable to degradable packaging. This is to enable them compost their expired products without the need to separate food from packaging material. Biodegradable packages end up in composts and are healthy to the ecosystem and this ensures sustainability (Narayan, 2006). This will ensure a neutral atmospheric carbon as carbon would now exist as carbon dioxide (CO_2) which becomes a source of carbon for plants (Srinivasa and Tharnathan, 2007). Research has indicated that the development of bio-based packaging material has the capacity of reducing the environmental impact that is presented by petroleum derived packaging. Detailed life cycle assessment (LCA) studies on bio-based packaging materials have revealed interesting conclusion. Patel and Narayan (2005), stated that available LCA studies and environmental assessments strongly support further development of bio-based polymers in food packaging.

2.2.1 Challenges to eco-friendly purchase

Schwepker and Cornwell (1991), in their study determined the factors that influenced consumers' intention to purchase eco-friendly packaged products. They suggested that consumers are more and more willing to accept and adapt to changes in their packaging consumption. Only a limited number of these determinants proved to be significant. Their results showed that psycho-sociological variables are much more important than socio-demographic variables to understand the environmentally concerned consumer. Some of the factors they came across that were a driving force to eco-friendly purchase behavior of consumers also included, internal locus of control, and the perception of pollution as a problem, attitude toward litter and attitude toward ecologically conscious living. Van Birgelen *et al*. (2009), in their work also showed that eco-friendly purchase and disposal decisions for beverages are related to the environmental awareness of consumers and their eco-friendly attitude. It was known from their work that consumers are ready to let go of almost all products attributes in favor of environmentally friendly packaging of beverages, except for taste and price. Koenig-Lewis *et al.* (2014), have also investigated consumers' emotional and rational evaluations of pro-environmental packaging and showed that purchase behavior was influenced by their love for the environment, and not by weighing the advantages they are likely to obtain from the innovative packaging.

Parguel *et al*. (2011), in their study suggested that there will be the need to engage the services of an independent body to issue certification to industries on their claim of eco-friendly activities to ensure credibility in the communication of eco friendliness. This according to their studies was the result of rampant false claims by some companies. Polonsky *et al*. (1998), also revealed similar suggestion confirming some companies participating in green washing campaign were misleading. Concerning the influence of the consumer perception on ecological cues, it appears that it has several effects on consumers' attitudes and behaviors toward a product. Giannelloni, (1998), has proven that perception of ecological cues has a positive effect on trust, brand evaluation, product evaluation, purchase intention, long-term brand loyalty and promoting behaviors. Incorporating these innovative packaging techniques into the food industry will be a success only if the consumer accepts them (Siegrist, 2008). Application of new technologies is another issue that affects public acceptance. Several studies investigated the consumer's acceptance of novel packaging technologies such as nanotechnology, bio-based, active and intelligent packaging. Puligundla *et al*. (2012), showed that most of the CO_2 sensors in intelligent packages are not suitable for food packaging application due to high equipment cost and energy input requirements. However, nanocomposites formulations in packages is being used in extrusion coating application for fruit juices and for the production of beer and carbonated beverages because of the improved shelf life and lower packaging cost (Rhim *et al*., 2013). Busolo and Lagaron (2012), showed that addition of oxygen scavenger compounds into packaging materials for food packaging have had a wider range of applications due to efficiency in production and convenience. Siegrist *et al*. (2007) and Siegrist (2008), pointed out that nanotechnology in packaging are seen among older consumers as more useful in other fields than its application in food. They showed much concern in nanotechnologies because of the fear of unknown and little knowledge and awareness they have of the technology (Rollin *et al*, 2011). According to Vandermoere *et al*. (2011), acceptance or rejection of nanotechnology in the food industry will be greatly influenced by consumer trust in government and regulatory agencies in the country. Petersen *et al*. (1999), stated that bio-based packaging materials are a sustainable alternative for existing plastics due to consumer pressure about environmental issues. The work of Laroche *et al.* (2001) revealed that consumers protect the environment by checking to confirm the packages of their purchased products are made of recyclable material or not. According to Rashid (2009), eco-labels are an important determinant of consumer's decision at the point of purchase. Roberts (2003), reported that consumers prefer incorporated intelligent package to sachet. This consumer negative attitude toward sachet according to him is due to the fear of accidental ingestion risk of the sachets. Mikkola *et al*. (1997), showed that 72 percent of consumers endorsed the use of oxygen scavengers in packaged pizza and sliced rye bread. The study also revealed that, about 40 percent of consumers were willing to pay at least ten pennies more for packages which contain oxygen absorber. Dainelli *et al*. (2008), showed that consumer do not believe that innovative packages will provide greater advantage. Literature has shown that, results are controversial and there is no general agreement about the consumers' attitudes towards innovative food packaging with ecological benefits.

High requirements are put on packaging systems that are used for foods, in particular with regard to the permeability of the packaging to water vapor and oxygen. The barrier properties that effectively protect sensitive foods are commonly achieved using multilayer films that are produced from crude oil based products. Expensive ethylene vinyl alcohol copolymer (EVOH) is usually used for the oxygen barrier layer.

2.2.2 Properties of agro-packaging materials

2.2.2.1 Protein-Based Packaging Material

The macroscopic properties of agro-based packaging materials and macromolecular protein three-dimensional structure are largely dependent on the interaction between the polymers and the solubility of protein-based materials in water is dependent on the specific gravity of molecular interactions in the network. Intermolecular bonds in water soluble materials are of lower energy than the interaction between polar groups and free water not involved in a network. The presence of chain entanglement, covalent intermolecular bonds, or many interactions may result in films that have little or no solubility in water (Fukushima and Van Buren 1970). For instance, covalent intermolecular cross-links in films of wheat gluten, or insolubilizing keratin. The mechanical properties of materials largely associated with the distribution and concentration of inter- and intramolecular interactions allowed by the primary and spatial structure. Cohesion of protein based material mainly depends on the specific weight of the intra- and intermolecular interactions, as well as by interactions with other components. For example, in soy-based films, hydrophobic interactions between proteins and lipids play an important role in the stability of the network (Farnum *et al.*, 1976). Cooperative phenomena in the generally accepted optimum thermodynamic stability of the systems. The effect of the interaction depending on likelihood of interaction and interaction energies. The mechanical properties of the films depend on important interactions that can stabilize networks. From a simple view, as covalent bonds stabilizing a network, or when the bond energy density is high, the films are very resistant and relatively elastic as is found in keratin based films. On the other hand, when the inter-protein interactions have low energy, films formed are easily dilated.

To a great extent gas and moisture barrier properties of films based on proteins are for many applications, such as controlling the gas exchange of fresh or oxidizable foods or moisture exchange with the external atmosphere is needed (Cuq *et al*., 1995b). Because of their relatively low water vapor barrier properties protein based films can be used alone as a protective barrier layer to reduce the moisture exchange for short term applications or in water and food.

The O_2 and CO_2 permeability of certain biopolymer based and synthetic films have been studied extensively by Abe (1994). Goldhan (2006), stated that the iron in its elemental form is being used as a commercial O_2 scavenger, and is incorporated into the packaging polymer or a polymer layer extruded as part of the package to maintain freshness of food by absorbing headspace O_2 or oxygen that enters the package. Shelfpluse Oxygen scavenger is owned by Albis Plastics and this is a polymer based additive that are incorporated directly to separate nonfood contact layer of the package (Ciba Archives, 2009). It can be incorporated either into an existing layer within the package or as a distinct scavenging layer. The benefits of this technology is that the scavenging activity is automatically triggered when it comes into contact with moisture present in the package either from filling or retorting. Protein based films have an excellent gas barrier property when dry. For example, Oxygen (O_2) permeability of wheat gluten film was 800 times higher than low density polyethylene and less than two times polyamide 6, a known high O_2 barrier polymer. When wet, the macromolecular chains are more mobile, leading to an increase in O_2 and CO_2 permeability. The development of packaging or edible films with selective permeability to gas has the potential of controlling respiratory exchange and improved conservation of fresh or minimally processed fruits and vegetables (Barron *et al.*, unpublished). The barrier properties of materials on the basis of proteins are dependent on the type of network and the density, and in particular the relationship and distribution of non-polar to polar amino acids (Guilbert and Graille, 1994). As protein composition and network organization structure allow some groups to freely move in the film, there is possible interaction with penetrating molecules. In general, free hydrophilic groups of proteins favor sorption and water vapor permeability than hydrophobic gas transfer (for example, nitrogen, oxygen). Edible films based on proteins have the potential of increasing the nutritional content of food (Krochta, 1992), the amount however, is not significant. Whey protein (biopolymer) food coatings have a high oxygen barrier and innovative approach for a sustainable food packaging and an excellent replacement for petroleum-based barrier layers. Large quantities are produced as a by-product of cheese production and this new application provides a high added value.

2.2.2.2 Forming Packaging Material from Proteins

Proteins have low moisture and a less or more ordered macromolecular network consequently result in non-uniform molecular interactions. The shape of proteins as well as the conditions in which the proteins are formed determine the likelihood of formation of intermolecular bonds. Glutenin and collagen for example are fibrous and have high molecular weight and have good film-forming properties and form films with good mechanical properties (Guilbert and Graille, 1994), while globular or pseudo-globular proteins like gliadin, glycinin, casein need to unfold before they can interact to form a network. According to Krull and Wall (1996), the functional properties of proteins cannot be determined by their primary structure. Three steps are required in the formation of a protein network

1) Rupture of low-energy intermolecular bonds that stabilize polymers in the primitive state,

2) Arrangement and orientation of polymer chains and

3) Formation of a three-dimensional network stabilized by new interactions and bonds after the agent that ruptured intermolecular bonds is removed.

The techniques used in making materials based on proteins are: the wet process based on dispersion of proteins, and a dry process based on the thermoplastic properties of proteins under low water conditions.

2.2.2.2.1 Wet Process

The wet method of producing protein based packaging materials has been studied extensively by Kester and Fennema (1986), Guilbert and Biquet (1989), Donhhowe and Fennema (1994). In the study a controlled laboratory condition is a requirement for the formation of thin films of protein solution. This process is often described as casting or spreading method. It was revealed that due to the variability in solubility of different proteins, no single procedure can be used for producing packaging material from proteins. However, the kinds of proteins and the proportions needed for the right interaction is known (Chou and Morr, 1979). For example, Fraser *et al*, (1972), disrupted intermolecular disulfide bonds in keratin to ensure homogeneous solutions.

Wall and Paulis (1978), Shewry and Miflin (1985) attributed zein protein solubility in water to its high nonpolar amino acids content about 46.6%. Protein solubility in water is also dependent on pH. Ionized polar amino acids are the reason for the high sensitivity of proteins to pH changes. Zein and keratin films form over a wide pH range because they have low ionized amino acids contents (10 and 10.7%, respectively), and thus are not sensitive to pH changes according to Okamoto (1978). Soy protein has high content of ionized amino acids and thus limit the range of pH over which their films are formed (Sian and Ishak 1990). In the work of Gennadios *et al. (*1994), film formation is based on separation of proteins from the solvent phase by precipitation or phase changes due to changes in solvent polarity, pH change of electrolyte, heat treatments, or drying.

Film formation by solvent removal is due to increased polymer concentration in the medium, inducing bonds and forming a three-dimensional network. Film is formed by collecting the lipoproteic skin formed after boiling heated protein, dispersions is due to polymerization of unfolded proteins by heating and solvent removal. This process is called coacervation when only one macromolecule is involved. Most protein-based agro-packaging materials have been fabricated by this process. Complex coacervation, however, have at least two oppositely charged macromolecules combined to yield an insoluble mixed polymer by the mechanism of charge neutralization. Association of proteins and chitosan is one example of a potentially interesting method of film formation. Water and ethanol and sometimes acetone constitutes the solvent for the formation of protein film solution. The functional properties of agro-packaging materials obtained by the wet process depend on protein concentration in solution, pH, additives, solvent polarity, drying rate, and temperature (Gontard *et al.*, 1992, Donhowe and Fennema, 1993a, Gennadios *et al*., 1993a).

2.2.2.2.2 Dry Process

The thermoplastic behavior of the proteins has been studied and used for the manufacture of packaging materials for food by thermo mechanical or thermal processes at low humidity conditions such that the drying process is similar to that of thermoplastic starch based materials (Savary, 1993 and Cuq *et al*., 1997b). The thermoplastic properties of the proteins set out in relation to the theory of glassy texture changes in the processing of thermoplastic polymers. The account of the glass transition is changed to metastable glassy state to a rubbery state unstable at a particular glass transition temperature. Physical properties of materials are induced by the glass transition temperatures especially thermal and mechanical properties (Van Krevelan, 1976). The molecular response of a glassy material as a system transforming from a metastable glassy state to an unsteady rubbery state corresponds to a general increase in disorder, free volume, and mobility of macromolecules (Ferry 1980, Cherian and Chinachoti 1996). The glass transition phenomenon is affected by macromolecule characteristics, such as flexibility, size, length of chains, size and polarity of lateral groups, molecular weight, presence of intermolecular covalent bonds or crystal organizations, and by presence and content of plasticizers (Slade and Levine 1993, Cherian *et al*., 1995). For instance, the glass transition temperature of wheat gluten is greatly affected by water content. According to Oudet (1994), thermoplastic polymers are macromolecules where lateral cohesion is only ensured by low-energy interactions sensitive to plasticizers and temperature changes. The glass transition behavior of proteins depends on type and density of intermolecular interactions. Proteins could thus be considered as partially thermoplastic polymers that could be changed in a reversible way from a rigid state to a soft state through a temperature increase or plasticizer addition. Plasticization (by water or polyhydroxy compounds) is critical for the interaction of proteins to form a continuous network from powdered raw materials. For instance, thermoplastic properties of collagen applied for film formation by extrusion are due to the lack of covalent intermolecular bonds in molecules. Numerous vegetable and animal proteins are commonly used as raw material for agro-packaging materials. Among them are the under listed proteins with their properties that give them the potential of being used as packaging material.

2.3.0 Proteins with the potential of being used as packaging materials

2.3.1. Corn Zein Protein

Park and Chinnan 1990, Aydt *et al.* (1991), Herald *et al.* (1996), studied the film forming properties of zein protein. Alcoholic aqueous dispersions which are water insoluble are dried to form the zein protein film that are bright and grease-resistant. They also studied how coatings of zein protein films are used to preserve fresh food to retain enriching vitamins, and for controlled release of medically active compounds. They are used to protect dried fruits and frozen or intermediate-moisture foods. Starch and zein mixtures have been studied and used for manufacturing of biodegradable plastics (Jane *et al*., 1994).

2.3.2. Wheat Gluten Proteins

Several research works have been done on the film-forming properties of wheat gluten proteins by Gennadios and Weller (1990), Park and Chinnan (1990), Aydt *et al* (1991), Gontard *et al*., (1996). These films are obtained by casting in a thin layer and then drying of aqueous alcoholic proteic solutions in acidic or basic conditions in the presence of disruptive agents such as sulfite. The skin formed after boiling protein solutions have also been used in the formation of wheat gluten films by Watanabe and Okamoto (1973) and also by extrusion of wheat protein in the presence of sulfite (Guilbert and Gontard, 1995). Films based on wheat gluten are not water-soluble, and their properties and applications are similar to those of zein films. However, there is the potential of causing problems for gluten-intolerant persons. This type of film has been used to encapsulate additives, improve quality of cereal products, and retain antimicrobial or antioxidant additives on food surfaces (Redl *et al*., 1996). It has good gas barrier properties to oxygen and carbon dioxide and this promoted its use in the preservation of fresh and minimally processed vegetables (Gontard *et al*., 1996). Biodegradable plastics that are molded have been produced from wheat proteins and cereal flours (Jane *et al*., 1994). The potential applications of gluten are very diverse: windows in envelopes, surface coatings on paper, biodegradable plastic films for agricultural uses, water-soluble bags with fertilizers, detergents, cosmetics, cigarette filters and additives (Guilbert and Gontard, 1995, Bietz and Lookhart, 1996), and molded objects.

2.3.3. Soy Proteins

Edible films have been produced in Asia from soy proteins traditionally by gathering lipoproteic skin formed after boiling soy milk. This is especially seen among the Yuba in Japan, Snyder and Kwon (1987). Proteins are the main constituents of these films. However, significant quantities of polysaccharides for example raffinose, and stachyose and globula lipids are also present. These combinations confer good mechanical properties but they are generally slightly water-resistant. Lipoproteic skin formed after boiling soya solutions have also been used in soy film production (Circle *et al*., 1964; Wu and Bates, 1973; Okamoto, 1978) and also through the casting solutions in thin layers and drying (Brandenburg *et al*., 1993; Gennadios *et al*., 1993b; Stuchell and Krochta, 1994). Several kinds of foods have been preserved using soy films. Biodegradable plastics have also been produced from soy isolate and concentrate by a thermomolding process (Jane *et al*., 1994).

2.3.4. Peanuts and Cottonseed Proteins

Films and water-soluble pouches from peanut proteins are produced by collecting the lipoproteic skin after cooking peanut milk in the same manner as soy film formation (Aboagye and Stanley, 1985). Various crosslinking agents have been applied in the use of cotton seed proteins to form biodegradable films and this has been studied and developed extensively by Marquis *et al*., (1995, 1997).

2.3.5 Milk Proteins

Film formation by milk protein has been seen on processing equipment surfaces and at air-water interfaces during heating of nonfat milk (Mabesa *et al*., 1979). This forms transparent, flexible, and tasteless films. transglutaminases or peroxidases are used to catalyse the formation of covalent cross link to improve water resistance and to allow immobilization of active enzymes such as β-galactosidase, α-mannosidase (Motoki *et al*., 1987). These properties of caseins have been used to improve the appearance of numerous foods, to produce water-soluble bags, and to produce quality identification labels inserted under precut cheeses, to ensure the surface retention of additives on intermediate moisture foods, Avena-Bustillos *et al*., (1994).

2.3.6. Whey proteins

Whey proteins also produced transparent, flexible, colorless, and odorless films, such as those produced from caseins. Mahmoud and Savello (1992, 1993) have also produced films through enzymatic polymerization of whey proteins using transglutaminases. Lipoproteic skin formed after boiling whey dispersions have also been used in the making of whey films (McHugh *et al*., 1994). Network stabilization by disulfide covalent bonds partly affect the water solubility of whey protein films. The EU funded a Whey coating project and in this project it was reported that whey protein was an excellent film packaging material that films with excellent barrier properties and was economically feasible for industrial scale use. However, the coating of films with whey protein has up until now only been possible through a lacquering and laminating process and not through extrusion. By using extrusion coating or (co-extrusion, the energy-intensive lacquering process is avoided. These multilayer films will then also be able to undergo thermoforming, for example to manufacture meal trays. Both extrusion and thermoforming require the substrates to be thermoplastic. This is not a property that these proteins naturally possess (Schmid *et al.,* 2012)

2.3.7. Collagen and Gelatin

Collagen has been used in the meat industry to form edible coatings through extrusion (Hood, 1987). Collagen based materials have also been developed for medical uses (Cavallaro *et al*., 1994). Transparent, flexible, water-resistant, and impermeable to oxygen packaging films have been produced from gelatin according to Hebert and Holloway (1992). These films were made by cooling and drying an aqueous film-forming gelatin based solution. Gelatin films are commonly used in the pharmaceutical industry to coat tablets and capsules. Gelatin has also been used as a raw material for photographic films, and to microencapsulate aromas, vitamins, and sweeteners (Balassa and Fanger, 1971).

2.3.8 Keratin

Anker *et al.,* (1972) developed water-insoluble films based on keratin by casting and drying alkaline dispersions. The large amount of cystine in keratin favors formation of many disulfide bonds that could stabilize the proteic network (Gennadios *et al*., 1993c). However, because of their unpleasant mouth feel, edible coatings based on keratin have not found many applications (Daniels, 1973).

2.3.9. Egg Albumin Proteins

Egg albumins have been used to encapsulate organic hydrophobic compounds in cosmetics and foods by many patents (Baker *et al.,* 1972). Edible coatings based on egg albumins have been reported to reduce moisture loss from raisins in breakfast cereals and improved retention of additives to food surfaces (Bolin, 1976). Gennadios *et al*. (1996) reported that egg albumen forms films with excellent mechanical and water vapor barrier properties. Films appeared clearer and more transparent than films based on wheat, soy, or corn proteins. Possible applications include water-soluble bags meant for conditioning and protecting additive doses for applications in pharmaceutical or food industries.

2.3.10. Myofibrillar Proteins

Studies by Cuq *et al*., (1997a) have shown film-forming properties of fish myofibrillar proteins. The films obtained are water-insoluble, perfectly transparent, and have good mechanical and gas barrier properties close to that of polyethylene films (Gontard *et al.,* 1996). The thermoplastic properties of myofibrillar proteins by Cuq *et al*., (1997a), suggest industrial production of these films by the traditional processes usually applied to thermoplastic synthetic polymers. Other proteins have also been used for films, including proteins from rye, pea, barley, sorghum, rice, silk, fish, and serum albumin by the following researchers; Torres (1994), Viroben *et al*., (1994) and Shih (1996).

2.4.0 Carbohydrate based food packaging materials

Many studies have been directed to development of starch-based polymers to replace the use of petrochemical resources and thus reduce their environmental impact. Starch is mainly composed of two homopolymers of D-glucose: amylase, a mostly linear α- D (1, 4')-glucan and branched amylopectin, having the same backbone structure as amylose but with many α-1, 6'-linked branch points. There are a lot of hydroxyl groups on starch chains, two secondary hydroxyl groups at C-2 and C-3 of each glucose residue, as well as one primary hydroxyl group at C-6 when it is not linked. Several studies have established the hydrophilicity of starch. The hydroxyl groups on the starch chains gives them the ability to be reduced or oxidized and thus capable of forming hydrogen bonds, ethers and esters. Depending on the source of the starch different proportions of the amylose and amylopectin may be present. Amylose is soluble in water and forms a helical structure. Starch occurs naturally as discrete granules since the short branched amylopectin chains are able to form helical structures which crystallize. Starch granules exhibit hydrophilic properties and strong intermolecular association via hydrogen bonding formed by the hydroxyl groups on the granule surface. Due to the hydrophilic nature of starch, its internal interaction and morphology is easily changed by water molecules, and thereby its glass transit, the dimension and mechanical properties depend on the water content. On the other hand, the hydrophilicity of starch can be used to improve the degradation rate of some degradable hydrophobic polymers. Starch is totally biodegradable in a wide variety of environments. It can be hydrolyzed into glucose by microorganism or enzymes, and then metabolized into carbon dioxide and water. This carbon dioxide will recycle into starch again by plants using sunlight. Starch itself is poor in processability, also poor in the dimensional stability and mechanical properties for its end products. Therefore, native starch is not used directly in the production of biodegradable polymers (Ramesh *et al*., 1999).

Starch-based biodegradable polymers have been applied in edible film packaging in the food industry. The requirements for food packaging include reducing the food losses, keeping food fresh, enhancing organoleptic characteristics of food such as appearance, odor, and flavor, and providing food safety. The starch based biodegradable polymers can be a possible alternative for food packaging to overcome these disadvantages and keep the advantages of traditional packaging materials. However, the components in the conventional starch-based polymer packaging materials are not completely inert. The migration of substances into the food possibly happens, and the component that migrates into food may cause harm to the human body. In view of this, new starch-based packaging materials are being developed. For instance, a starch/clay nanocomposite food packaging material is developed, which can offer better mechanical property and lower migration of polymer and additives. Starch-based edible films are odorless, tasteless, colorless, non-toxic, and biodegradable. They display very low permeability to oxygen at low relative humidity and are proposed for food product protection to improve quality and shelf life without impairing consumer acceptability (Flores *et al*., 2007). In addition, starch can be transformed into a foamed material by using water steam to replace the polystyrene foam as packaging material. It can be pressed into trays or disposable dishes, which are able to dissolve in water and leave a non-toxic solution, then can be consumed by microbes in the environment (Siracusa *et al*., 2008). Evidently, the starch-based biodegradable polymers are attractive for food industry and will make great progress in the future (Pareta and Edirisinghe 2006).

2.4.1. Preparation of starch-based biodegradable polymers

Physical or chemical modification are carried out on starch in order to improve its properties, these include activities such as blending, derivation and graft copolymerization (Wang *et al*., 2008a). Usually, the components to blend with starch are aliphatic polyesters, polyvinyl alcohol (PVA) and biopolymers. The commonly used polyesters are poly (β-hydroxyalkanoates) (PHA), obtained by microbial synthesis, and polylactide (PLA) or poly (ε-caprolactone) (PCL), and derived from chemical polymerization. The goal of blending completely degradable polyester with low cost starch is to improve its cost competitiveness whilst maintaining other properties at an acceptable level. PLA is one of the most important biodegradable polyesters with many excellent properties and has been widely applied in many fields, especially for biomedical one. PLA possesses good biocompatibility and processability, as well as high strength and modulus (Lu *et al*., 2009).

2.5 Types of Eco-friendly Packaging

Recyclable, reusable and biodegradable are the different forms of eco-friendly packaging. Glass, metal and plastic containers constitute the recyclable and the reusable types of eco-friendly packaging material

Reusable packaging are containers which could be refilled after they have been emptied of their content. It involves washing or cleaning, inspecting and refilling. The inspection conducted in this process is mostly through visual inspection and in few cases machines are being used for the detection of foreign bodies (Castle, 1994). This type of packaging is mostly applied in the beverage sector. Effective inspection of all containers is the challenge with this type of package.

With recyclable packaging, the packages are sorted, cleaned and crushed down to their monomers, purified and formed into the desired end product. Glass, metal and plastic packages are the materials that usually fall under this category. The challenge with recycling is the cost involved in sorting as well as the energy involved in this long process (Begley and Hollifield, 1994). Again there is also the issue of chemical transformation and accumulation of additives especially for plastics of which health issues have been raised. Also different plastics cannot be blended together due to compatibility issues (Dalzell, 1994).

2.5.1 Biodegradable packaging

These consist of both compostable and edible package (film). In recent times bio-based food packaging materials are being used commercially on a major scale are based on cellulose. However, materials based on proteins, starch, polylactate are also being used (Weber *et al.*, 2010). Biopolymers have attracted considerable attention due to an increased interest in sustainable development. Most reports on the formation and properties of biopolymer films are focused on their application as edible films. However, several works have been carried out which present compostable packages for commercial use in the food sector. The development of nanocomposites is a new strategy towards the improvement of physical properties of polymers, including mechanical strength, thermal stability, and gas barrier properties (Arora and Padua, 2009).

2.5.2 Advantages of Eco-friendly Packaging

2.5.2.1 Better for Environment

The most obvious benefit of eco-friendly packaging is in relation to the environment. Eco friendly packaging is usually made from renewable materials, reducing wastage of our natural resources in production. Again, the manufacturing process tend to, further reduce resources used and minimizes the negative impact companies have on the environment (EPA, 2002). Ingredients, such as soy ink, used in eco-friendly packaging tend to save the environment in that it has low levels of volatile organic compounds (commonly referred to as VOCs), substances which are harmful to the environment and are found in traditional inks.

2.5.2.2 Easy Disposal

In addition to minimizing the environmental impact when manufacturing it, eco-friendly packaging also tends to be better for the environment after it has served its purpose. Depending on the particular type of packaging use, it is either recycled or composted. This means consumers as well as hospitality facilities can compost their leftovers without having to separate the package from the food. This can then be turned into fuel for plants. In situations where compost piles are unavailable, the remnants could be buried with the assurance that it will biodegrade within a short period of time. In this same sense there is also the benefit of carbon neutrality as inorganic carbon in the form of carbon dioxide (CO_2) is converted by plants to organic carbon through photosynthesis. Again, anaerobic decomposition of these bio-based waste will produce landfill gas which could be trapped and used in the production of energy (Song *et al.,* 2009: EPA 2006).

2.5.2.3 Versatile

In addition to its benefit to the environment, eco-friendly packaging is versatile in its application, having appropriate design for every major industry that standard packaging is involved. From packaging baked goods, meats, agricultural produce, cosmetics, hospitality items, or electronic devices.

2.5.2.4 Improved image

A final advantage of environmentally friendly packaging is its potential to enhance brand image. With the current danger the environment is likely to face and some already occurring consumers are more likely to purchase brands that offer them product with eco-friendly package. To the environmentally conscious consumer, such companies are a responsible company. There is therefore, improved image which will lead to an increase in sales and consequently promote business profits.

2.5.2.5 No harmful plastics

The current packaging materials contain plastic and this type of packaging is greatly contributing to global warming and other environmental issues. Using eco-friendly packaging has the high probability of reducing the harmful effects of these plastics. Being Petrochemical base, and from non-renewable source these plastics, require large amounts of energy during production (Marsh and Bugusu, 2007). When petrochemical plastics are discarded they litter farms, roads and waterways. There is also the issue of Bisphenol A in plastics leaching into food and its likely health concerns (Ruthann *et al.*, 2011). This health concern will not be an issue with eco-friendly packaging.

2.5.3 Disadvantage of Eco-Friendly Packaging

Limited availability, ability to perform effectively and cost of production are issues with biobased food packaging materials (Sorentino *et al*., 2007). The challenge of cost and availability and which could be solved through increased production volume of both raw material and processing which means a reduction in cost. In the countries that are applying eco-friendly packaging, cost has declined and will continually decline as production volumes increase (Marsh and Bugusu 2007).

CHAPTER THREE

3.0 Materials and Methods

3.1.0 Materials

- Paper based questionnaire was applied in this study to be able to gather data for analysis for the purpose of this research (Appendix B).
- Google map of Accra was used to demarcate the region into four areas
- Information on food service industries in Accra and their locations was obtained from the Food and Drugs Authority of Ghana.

3.2.0 Method

3.2.1 Demarcation of greater Accra

Greater Accra was demarcated in four parts as follows: Accra central, Accra north, Accra east and Accra west, according to the Google map of Accra. Restaurants were picked randomly from these areas of the region and data gathered on the packaging applications.

3.2.2 Sampling procedure

Forty (40) restaurants were selected purposefully from the one thousand one hundred and fifty (1150) registered restaurants according to the Food and Drugs Authority. Out of this number, 33 responses were obtained after questionnaire distribution (Appendix A).

3.2.3. Questionnaire Distribution

Sampled restaurants were visited and questionnaire were distributed to them. Questionnaires were filled by the managers of the sampled restaurants. About three-fourth of distributed questionnaire was filled same day whiles the rest were collected the next day or a day convenient for the facility manager. Questionnaire were filled in the form of an interview for managers that had difficulty with the English language. Some of the questionnaires were filled independently by facility managers. Questionnaire used can be found in Apppendix B.

3.2.4. Statistical analysis

Frequency, percentages and correlations from the results were generated using SPSS analysis software version 16.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Application of Biodegradable Packaging

4.1.1 Type of Packaging used by the Restaurants

The respondents were asked about the type of packaging they use in their facilities. The types of package, mentioned were; take away packs (Styrofoam), 81.8% usage, carrier rubber bag, 91%, disposable plastic bowls (including ice cream bowls, salad packs plastic cups), 48.4%, paper box and envelop 33.3% and aluminum foil 9.1% usage by facilities. Paper bag and paper box were used only as part of the packaging for snacks. Although biodegradable, none of the facilities used paper as the only packaging for food. It was always used together with non-degradable plastics. For most of the facilities that used paper package it was only because that was the type of packaging that contains and keep the food better. The respondent facilities were comfortable with their various packages since they have not had any issues with regards to complains from their consumers. Unlike the work of Fernqvist and Ekelund *(*2014), where consumers rejected plastic packaging and described it as unnecessary despite the appreciation of its convenience in terms of ease of microwaving. The Ghanaian consumer has not shown or expressed any concern in this regard probably due to lack of knowledge and understanding. And could be the reason why facilities are very comfortable with the use of plastic packaging despite the menace they are likely to cause the environment.

4.1.2 Materials for Packaging

Table 1: Types of Packaging Materials Used

Packaging Material	Frequency	Percentage
Chemically degradable	2	6.06^{a}
Biodegradable (paper)	10	33.3^{b}
Non degradable	22	66.6^{c}
Total	33	100.0

Values with different superscripts are significantly different at 95% confidence level

The most common type of packaging material used in the facilities was non-degradable representing 66% of facilities visited. About 30% of the facilities used bio-degradable material based packaging, while about 6% indicated chemically degradable which is the least used in the industry. Statistically there was a significant difference (C.I 95%) in the use of degradable and non-degradable packaging in the food restaurants. (Refer to appendix C). Analysis of result showed that majority of the packaging materials used in the facilities are non-degradable and since there are no recycling procedures in separating waste packaging materials they all end up in trash cans and eventually in landfills and environment. This has been the challenge in years since the turn from traditional packaging to the petrochemical based packaging materials in the food service industry especially. This situation created by petrochemical based packaging material used in food has been reported by several authors both home and abroad and the particular case of Ghana has been reported in the works of Adarkwa and Edmund (1993), Agyenim-Boateng (1998).

4.1.3 Brands with Similar Packaging Materials

Respondents indicated that they use similar packaging with other brands in their line of production. The brands mentioned were, Frankies, Zoo zoo restaurant, Baritax, Ashanti Home Touch, Bassalisa, Champion restaurant, Alisa hotel In their line of production, Le bijou, Chicken republic, Fizzles, African concrete product restaurant, VIP food joint, Quick paste, Oriental delight, Work inn restaurant, Hommey's palace and Pork inn. These are restaurants not visited but were mentioned to use similar packaging material as respondent restaurants. These facilities use mainly Styrofoam take out packs, rubber carrier bags and disposable plastic bowls. This response confirm that the facilities are not really doing anything different from each other in terms of packaging. There is no competition in the packaging used in the food service sector probably because the consumers in this sector accept these types of packaging material that is readily available on the market or again because it is the cheapest to use. This is contrary to the work of Polonsky *et al.* (1998) where green packaging serves as a marketing tool for competing brands. Parguel *et al.* (2011) also suggested setting a body to prevent industries from misleading consumers with their claim on green packaging.

4.1.4 Different brands in the line of production

Respondents indicated that they use different packaging with other brands in their line of production. The brands were mentioned as KFC, Papaye, Dela home cooks and Barcelos. These brands have paper based packaging incorporated into their overall packaging. The paper packaging are used for the packaging of chicken, potato chips and pastries. In these facilities only a few were aware of the fact that paper packaging aside its beauty had other beneficial use of being composted alongside scrap and rotten food. The food retailer in Ghana has no intention of seeking packaging suppliers to present them with degradable alternatives to the current non degradable ones they are using, probably due to lack of knowledge on the degradable options or their existence. Food retailers in some developed and developing countries insist on biodegradable packaging for their food so as to have the convenience of composting their package together with scrap food and ones they are unable to sell (Narayan, 2006).

4.2. Environmental impact of petrochemical based food packaging

4.2.1 Impact of petrochemical based food packaging materials

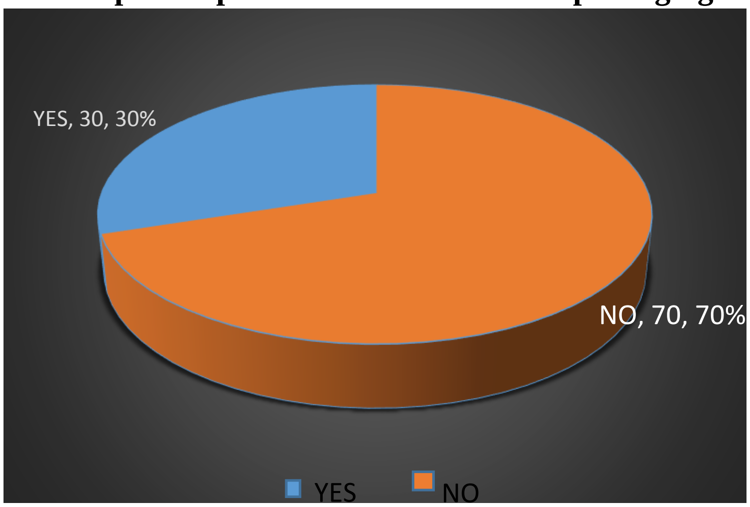

Fig 1: Impact of petrochemical based food packaging materials on the environment

The respondents were asked if they see petrochemical based food packaging materials impacting negatively on the environment in the next years to come. According to 70% of the respondents, they do not see the use of petrochemical food packaging materials impacting negatively on the environment while 30% of the respondents indicated that they see the use of petrochemical food packaging materials impacting negatively on the environment. Majority of facilities saying no negative implication to petrochemical based packaging material could be due to the convenience they have developed towards the use of Styrofoam materials and the fear of the unknown (biodegradable alternatives presenting the same packaging benefits), as has been stated in the work of Rollin *et al.* (2011). It could also due to lack of awareness of the non-degrading nature of petrochemical base packaging waste. In which case more education should be carried out to relay the effect of the current food packaging waste and the need for a biodegradable alternative. As stated by Agyenim-Boateng, (1998), the attitude of the Ghanaian consumer is one of lack of care for the environment and thus stringent measures must be set to get suppliers and users to comply with sustainability with their food packaging.

4.2.2 Food packaging as a major non degrading land fill waste

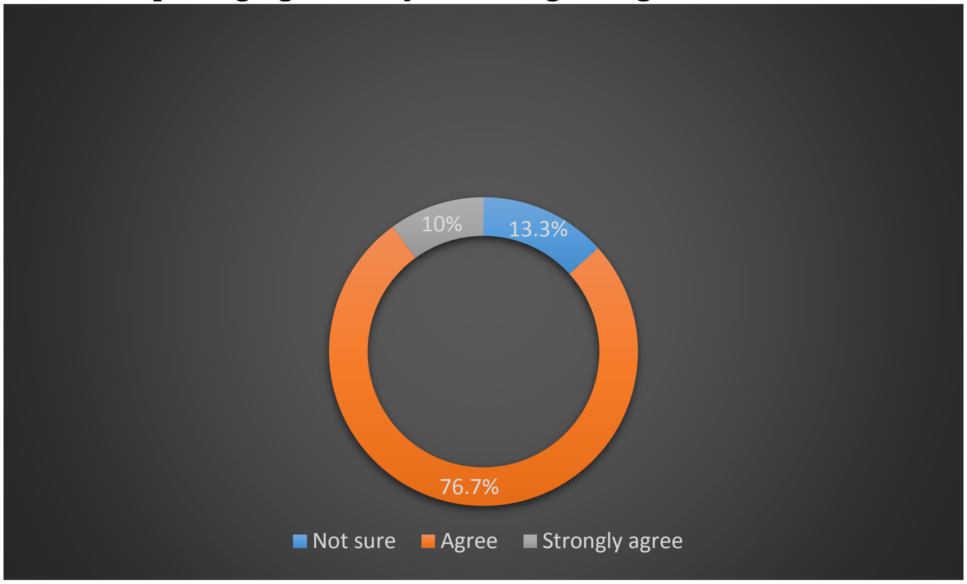

Fig 2. Contribution of non-degrading food packaging waste to landfill

The respondents were asked if the packaging from food contributes a majority of the non-degrading waste in landfills. About 77% of the respondents agreed with the statement, 13% were not sure while 10% strongly agreed. This means that majority of the respondents perceive that the packaging from food contributes a majority of non-degrading waste in landfills. This is similar to the findings of Adarkwa and Edmund (1993) that plastic wastes from food packaging constitute the majority of non-degrading waste on our landfills. Harboe-Jepsen (1992) also reported that packaging from food constitutes a high percentage of household waste, therefore if this high percentage is non-degradable it implies high non-degradable waste on landfills. It will be appropriate, therefore, to get the industry moving in the direction of current innovative stage of the food industry.

4.2.3 Facilities rating of the negative impact of food packaging on environment.

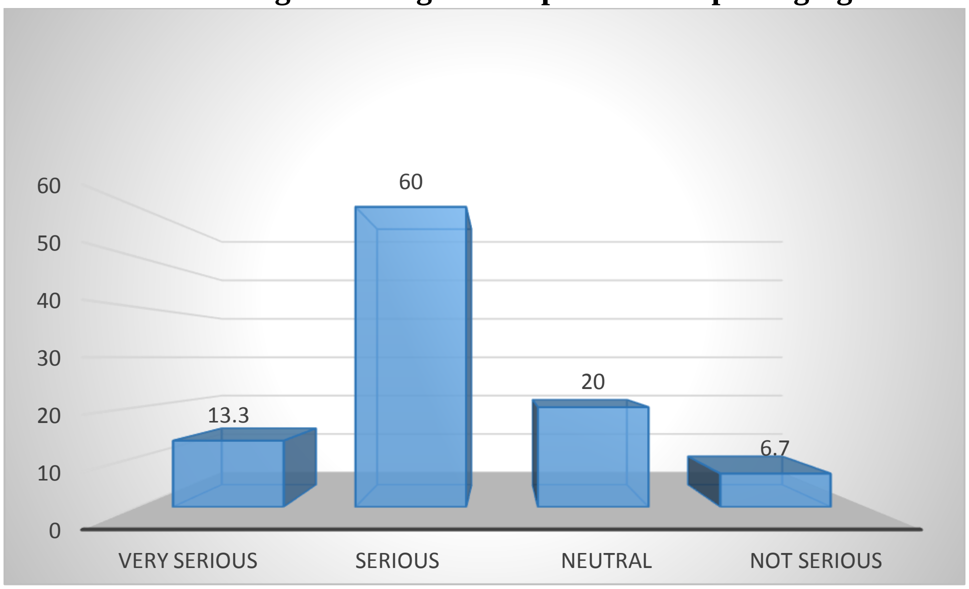

Fig 3. Negative impact of food packaging waste on the environment

The respondents were asked how their facility rates the negative impact of current packaging materials being used in the sector of the food service industry on the environment. About 60% of the respondents indicated a serious impact, 20% of the respondents indicated that they were neutral, 13% indicated that it was very serious while 7% indicated that it was not serious. This means that majority of the respondents perceive the current packaging materials being used in the sector to have serious negative impact. The level of appreciation of the negative impact of packaging materials is a motivating step to the introduction of biodegradable packaging to the food facilities. The negative impact of petrochemical packaging in the food sector of Ghana has been reported by several works including the work done by Kumasi Metropolitan Assembly,

(1995) and the World Bank (1995) which state the increased levels of plastic waste particularly from food and how the surrounding villages are being swallowed by these waste materials.

When results in figures 1, 2 and 3 were compared, a moderately strong correlation existed between rating of the current negative impact of food package and the contribution to land fill waste at 99% confidence interval. Again, a negative correlation was found between petrochemical food based packaging and impact on landfills at 99% confidence interval. This is to say that although the restaurants rated the impact of food package as negative, they see this to have nothing to do with its contribution to the major landfill waste. This result infers that the restaurants see sources other than waste packaging from their operations to contribute to land fill issues in the country. This outcome is similar to the work of Nordin and Selke (2010). At 95% confidence interval there was a fairly positive correlation between the negative impact on the environment and petrochemical food based packaging material. Therefore, interventions could be designed from here as suggested in the work of Fernqvist and Ekelund (2009). This would introduce innovation into the food packaging industry and save the environment as well (Appendix C).

4.3. Attitude towards eco-friendly packaging (biodegradable food package)

4.3.1 Attitudes of restaurant to eco-friendly packaging

Table 2: Attitudes on eco-friendly packaging

Statement	Strongly disagree%	Disagree %	Not sure %	Agree %	Strongly agree %
Including biodegradable package in vision	0.0	6.7	6.6	66.7	20.0
Promotion of eco-friendly food package	3.3	10.0	6.7	53.3	26.7
Education of distributors and consumers	0.0	0.0	6.7	56.7	36.6
Rejection due to package price increase	16.7	50.0	20.0	3.3	10.0

From the responses above, majority of the respondents (66.7%) agree and 20% strongly agree that the food service industries must make it a part of their vision to use bio-degradable packaging materials. It is not surprising to see majority of the facility operators endorsing vision biodegradable packaging since of all the degradable options they have, the bio based option is more appropriate for their type of business which deals with perishable products. With the option of biodegradability of packaging material they can compost their scrap food, deteriorated food stuff together with deformed, waste and spoilt packaging which could also be another source of income generation for the facilities.

Majority of the respondent restaurants (53.5%) agreed while 26.7% strongly agree that the foods with eco-friendly packaging must be promoted. The high level of response for promotion of biodegradable was probably due to the fact that they appreciate the importance of this type of packaging in terms of sustainability and the wish to apply it themselves. Again it could be because they could see a marketing advantage in the use of biodegradable packaging as reported by Narayan in (2006).

When asked about educating both consumers and facilities on eco-friendly food packaging and the need for it, more than 90% of the respondent agreed that both the supplier and consumers must be educated to insist on eco-friendly packaging of food. Previous and later questions in this survey have revealed that awareness and understanding of the practicability of eco-friendly packaging is lacking among facility operators on one part and the consumer on another part as in the work of Van Birgelen *et al*. (2009). Education, taking into consideration both parties, will be a step in the right direction in the successful implementation of sustainable packaging in the food sector. However, the facilities should be the first point of change since they are in direct contact with the consumer and the consumer patronizes services they are provided with little or no resistance.

Majority of the respondent facilities disagree that the application of biodegradable packaging in the food service industry should be rejected outright by the consumer. This could probably be due to the realization of benefits of eco-friendly packaging to the food sector and the environment at large and again due to the realization of the existence of such packaging materials. This probable consciousness by the facilities has been described in the works of Schwepker and Cornwell (1991) and Van Birgelen *et al.* (2009).

The percentage calling for rejection was few and could probably be as a result of the fear of the unknown (fear to use a technology they have not much information). Facilities calling for non-rejection gives an open door to the application of eco-friendly packaging mainly biodegradable and again an opportunity for packaging suppliers and the environment to go eco-friendly.

4.4 Challenges facing the industry in terms of applying biodegradable packaging

4.4.1 Factors influencing the application of eco-friendly packaging

Table 3: Response on Factors influencing the application of eco-friendly packaging

Factors	**Very likely %**	**Likely %**	**Not sure %**	**Unlikely %**
Product price	26.7	53.3	13.3	6.7
Awareness of eco packaged food	16.7	59.9	16.7	6.7
Communicating eco packaged food	16.7	70.0	10.0	3.3
Marketing eco-friendly packaged food	20.0	43.3	30.0	6.7

Responses indicate that all the factors mentioned are likely in one way or the other to influence the application of eco innovative packaging. The price factor recorded the highest probably because of eco-friendly packaging being new. Again, the cost of equipment installation at the initial stage may be a factor that could probably deter suppliers from producing and facilities from purchasing. This is in line with the findings of Puligundla *et al*., 2012, who stated that energy input as well as equipment acquisition reduce the suitability of application of innovative packaging in the food service industry. Communicating eco-packaged food will also be a limiting factor because the consumer in this part of the world is not environmentally conscious enough to be persuaded to pay more to conserve the environment. Once there are cheaper alternatives to the same product they will go for the less priced food unaware or aware of the implications. Communicating eco-friendliness will be an added advantage to companies and brands image (Polonsky *et al*., 1998). To ensure credibility claims on eco-friendly Parguel *et al*. (2011), suggested certification for the claim on eco-friendliness.

Awareness and marketing are likely to affect the application since it will be difficult to get the consumer to patronize if they are unaware of the existence of any such packaging and the practicability and the convenience of what is being sold to them. The concern of consumer purchasing has been reported in the work of Van Birgelen *et al*. (2009), that eco-friendly purchase and disposal decisions for food and beverages are related to the environmental awareness of consumers and their eco-friendly attitude. However, the Ghanaian consumer consistently has not shown any concern for the environment through the non-compliance with most of the strategies to protect the environment (as has been reported by Agyenim-Boateng 1998). The food service industry therefore probably is the best target to control the type of waste that comes from packaging material.

When correlated (Appendix C) a positive relationship resulted from the awareness of eco-friendly package and marketing of eco-packed food, and communicating eco-packaged food (C.I 99%). This means that restaurants would be able to communicate well and market their products if their awareness level is high (r=0.547) as reported earlier by Van Birgelen *et al., (*2009). A low positive correlation was found between product price and marketing (r=0.198) as well as communicating. This means that price has a minimal effect on the marketing and communication of eco packaged food. And this observation is in line with work done by Schwepker and Cornwell (1991), where psycho-sociological factors to a more significant determinant in the acceptance of change in the packaging needs of consumers than socio-demographic factors.

4.4.2 Challenges in the application of eco-friendly packaging material by restaurants

The respondents were asked if they perceived any other likely challenges apart from the factors they have already given in their response above. From the qualitative responses received, they are likely to face one or more of the following challenges: product price increment, low sales due to non-awareness of eco-friendly packaging to the consumers, resistance to change from the consumer, unavailability of such packaging materials, lack of education and knowledge on these materials. However, about 58% of the responses centered on the cost of the packaging material which they felt will be high compared to the current ones they are used to and unavailable in the country. Some of their statements included;

"Eco-friendly packaging will make the product expensive since the high price of the packaging materials will be added to the cost of the product".

"Consumers in our part of the world do not really look out for this type of packaging so there would not be any competitive advantage in marketing our product as eco-friendly".

"Will this new packaging be able to keep the food like the current ones we are using"?

Clearly the statements of their probable challenges are all one of education on the feasibility, the ability of the packaging to present the same advantages and at a minimal cost. Eco-packaging materials being new to the industry will present the challenges mentioned, nonetheless, these challenges should not be a limiting factor preventing the industry from using the innovative packaging material since these challenges have been encountered and resolved in the same sector in different countries. In other parts of the world where consumer groups exist compelling food retailers and distributors to present them with packaging material that is both user and environmentally friendly for their food, competition is created and facilities and manufacturers market themselves as eco-friendly companies.

4.5 Company vision on eco-friendly packaging

4.5.1 Company vision in going eco-friendly

The respondents were asked if their company had a vision of going eco-friendly as far as packaging is concerned. Majority of the restaurants (72%) indicated that their company had no vision in terms of going eco-friendly with packaging, whereas 7% of facilities visited indicated they have no eco-friendly vision. However, some aspects of their packaging was eco-friendly mainly in the form of paper packaging. Only few (21%) of the facilities visited were able to indicate the company's vision in terms of going eco-friendly as far as packaging was concerned. Some of the statements made with regards to eco-friendly vision include:

"We hope to use eco-friendly materials in all our activities within the next five years"

"We believe proper packaging helps our brand very well and boost our sales".

"The company supports the use of eco-friendly packaging to help protect the environment from pollution"

Despite these statements, biodegradable packaging only constitutes a lesser part of their packaging material usage. This means that education and other measures must be put in place for the application of biodegradable packaging by the facilities. Unlike the work of Fernqvist and Ekelund (2014), where consumers were on the lookout for biodegradable alternatives to their food package, the Ghanaian consumer is comfortable with which ever package they are presented with so far as it keeps their food safe. Thus, facilities can have a vision on going eco-friendly with their packaging and ten years down the line nothing will be achieved because at the end of the day the consumer, who is their number one priority is satisfied with the petrochemical packaging. In this setting, therefore, the facilities should be the first point to ensure the use of biodegradable packaging by insisting more sustainable packaging from suppliers.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

In Ghana, paper packaging is the only eco-friendly packaging used in the food service facilities and this constitutes 30% of the total package use. It is applied in aspects such as pastries and fried chicken because it keeps the food better. Styrofoam packs and aluminium foils are being used majorly in the food service business basically due to availability, lower cost and ability to contain food better.

The food service facilities basically appreciate the benefits of using biodegradable packaging for food. However, they are not aware of its existence on the local market even if they want to make use of them. This research reveals that eco-friendly packaging is appreciated to a great extent, as 86.7% of all the restaurants visited disagreed with rejecting biodegradable package because of the likely increase in cost of production. This means measures could be put in place through the consensus of all those involved to get the industry to use eco-friendly packaging

All facilities visited perceived increased cost in their operation due to the price of packaging material to be the most important challenge limiting their ability to apply biodegradable packaging. Although they also acknowledged the fact that biodegradable food packages are available and have the ability to contain the food just like the petrochemical alternatives there may be possible challenges to the application of eco-friendly packaging.

5.2. RECOMMENDATION

Education and awareness need to be carried out first at the facility level then to manufacturers on the need for eco-friendly packaging in the food sector in the form of renewable materials from plant source and from bioplastics. Since various sectors of the food industry have associations they can be contacted and the way forward presented to them. Seminars could be conducted with resource persons addressing the possible fears that facility operators are likely to face and best possible ways to handle such challenges. Manufacturers of packaging materials for the food sector should also be contacted and their role in the whole change presented to them.

Demographic influence on the application of biodegradable package by facilities which was not investigated in this work could also be investigated.

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APPENDIX A:

Facilities Visited

The table below shows the list of Restaurants visited

Facility / Restaurant Name	Location
1. Dutchy restaurant	Mamprobi
2. Homey's palace	Odorkor
3. Jovix fast food	Dansoman
4. Julifort kitchen	Dansoman
5. Las Palmas	Odorkor
6. Masco foods limited(KFC)	Dansoman
7. Mr Biggs restaurant	Dansoman
8. Sizzler restaurant limited	Dansoman
9. VIP food joint	Dansoman
10. Wok inn restaurant limited	Laterbiokorshie

ACCRA EAST	
Facility/Restaurant Name	Location
1. Anaba's catering services	Airport residential
2. Bamboo restaurant and bar	Lashibi
3. Basilissa limited	Labone
4. Bravo's kitchen	Lashibi
5. Cassba enterprise	Airport residential
6. Frampep joint	Airport residential
7. Istanbul hospitality co. limited	Labone
8. Juniors end restaurant	Airport residiential
9. Pepper's lounge	Labone
10. Southern fried chicken	Labadi

ACCRA NORTH	
Facility/Restaurant Name	Location
1. Akesi catering 2. Eat right vegetarian restaurant 3. Home taste 4. Hot and taste bakery and restaurant 5. La cuisine D'or 6. Le bijou 7. Mawuli special local foods 8. Morning glory restaurant 9. Oakland fast food 10. Odo rise food and services 11. Oriental delight 12. Urban taste restaurant	North kaneshie Bubiashie Dzorwulu Kokomlemle Kokomlemle North kaneshie Kanshie Achimota North kaneshie Kokmlemle North kaneshie Dzorwulu

Accra central	
Name of Reataurant/facility	Location
1. Annkas eatery	Asylum down
2. Barcelos	Osu
3. Champion dishes	Adabraka
4. Chicken Nlick reastaurant	Osu
5. De Roy's cuisine	Osu
6. Favourite fast food	Osu
7. Food corner limited	Osu
8. Mango fast food Ghana ltd	Osu

9. Regal Chinese restaurant 10. Sizzler restaurant	Osu Osu

APPENDIX B: Questionnaire

Company name:

1. What type of packaging do you use in your process
    a.
    b.
    c
    d.

2. Which of the following materials is your packaging materials made of
a. Chemically degradable
b. Biodegradable
c. Non degradable
d. Other (specify)
3. Which other brands in your line of production uses similar packaging as you.
    a.
    b.
    c.
    d.
    e.

4. Which brands in your line of production uses packaging different from yours
a.
b.
c.
d.
5. Do you see petrochemical based food packaging materials impacting negatively on the environment in the next years to come?
    a. Yes
    b. no

6. How do you agree or disagree with the following statement: packaging from food contributes a majority of non degrading waste in landfills.

Strongly disagree	**disagree**	**Not sure**	**Agree**	**Strongly agree**

7. How would your company rate the seriousness of current packaging materials being used in your sector of the food industry on the environment?

Very serious	**serious**	**Neutral**	**Not serious**	**Not very serious**

8. To what extent do you agree or disagree with the following statements

	Strongly disagre	**Disagree**	**Not sure**	**Agree**	**Strongly agree**

	e				
Food industries must make it a part of their vision to use biodegradable packaging materials					
Foods with eco-friendly packaging must be promoted					
Distributers and consumers must be educated to insist on eco-friendly packaging of food					
Application of biodegradable packaging in the food industry will increase prices of food and should be rejected outright by the consumer					

9. How are the factors below likely to influence your application of eco-friendly packaging

Factor	**Very likely**	**likel y**	**Not sure**	**unlikel y**	**Very unlikel y**
Product price					
Awareness of eco packaged food					
communicating eco packaged food					
Marketing eco-friendly packaged food					

10. In your opinion what are the challenges in the application of eco-friendly packaging material in the food production sector.
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11. What is your company's vision in going eco-friendly as far as packaging is concerned.
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……….

APPENDIX C: Statistical Tables

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
packaging material	33	2.64	.603	.105

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
packaging material	25.115	32	.000	2.636	2.42	2.85

Correlation 1

			do you see petrochemical based food packaging materials impacting negatively on the environment in the next years to come	packaging from food contributes a majority of non degrable waste in landfills	rate the negativity of current packaging materials being used n the sector
Spearman's rho	do you see petrochemical based food packaging materials impacting negatively on the environment in the next years to come	Correlation Coefficient	1.000	-.445**	.417*
		Sig. (2-tailed)	.	.010	.016
		N	33	33	33
	packaging from food contributes a majority of non degradable waste in landfills	Correlation Coefficient	-.445**	1.000	-.617**
		Sig. (2-tailed)	.010	.	.000
		N	33	33	33
	rate the negativity of current packaging materials being used in the sector	Correlation Coefficient	.417*	-.617**	1.000
		Sig. (2-tailed)	.016	.000	.
		N	33	33	33

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation 2

			awareness of eco packaged food	marketing eco-friendly packaged	communicating eco-packaged food	product price
Spearman's rho	awareness of eco packaged food	Correlation Coefficient	1.000	.564**	.547**	.086
		Sig. (2-tailed)	.	.001	.001	.634
		N	33	33	33	33
	marketing eco-friendly packaged	Correlation Coefficient	.564**	1.000	.595**	.198
		Sig. (2-tailed)	.001	.	.000	.270
		N	33	33	33	33
	communicating eco packaged food	Correlation Coefficient	.547**	.595**	1.000	.180
		Sig. (2-tailed)	.001	.000	.	.315
		N	33	33	33	33
	product price	Correlation Coefficient	.086	.198	.180	1.000
		Sig. (2-tailed)	.634	.270	.315	.
		N	33	33	33	33

**. Correlation is significant at the 0.01 level (2-tailed).