PHYTOCHEMICAL ANALYSIS OF *Musa paradisiaca* AND *Dioscorea rotundata* USED IN THE PRESERVATION OF LOCAL DRINKS

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BEING A PROJECT WORK SUBMITTED TO THE
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TITLE

PHYTOCHEMICAL ANALYSIS OF *MUSA PARADISIACA* AND *DIOSCOREA ROTUNDATA* USED IN THE PRESERVATION OF LOCAL DRINKS

DECLARATION

I hereby declear that this research project entitled **"phytochemical analysis of *Musa paradisiaca* and *Dioscorea rotundata* Used in the preservation of local drinks"** was written by me and is a record of my own research work. It has not been presented before in any previous application for a higher degree. All references cited have been duly acknowledged.

Emmanuel Kingsley Chinedu ______________________

Sign

DEDICATION

This project research is dedicated to God Almighty and to my loving parents **Mr. & Mrs. Emmanuel Okafor**

APPROVAL PAGE

This is to certify that this research project entitled **"phytochemical analysis of *Musa paradisiaca* and *Dioscorea rotundata* Used in the preservation of local drinks"** is the original work of the researcher, Emmanuel Kingsley Chinedu with the registration number CH/10/1157 meets the regulations governing the award of Bachelor of Technology (B.TECH HONS) Pure Chemistry of the Modibbo Adama University of Technology, Yola and is approved for its contributions to knowledge.

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ABSTRACT

Plantain *Musa paradisiacal* is mainly grown in the tropical and subtropical countries and are widely used for its nutritional values all over the world. The fruits as well as the other parts of the plant were used to treat different diseases in human through traditional medicine. Plantain (*Musa paradisiaca*) peels are the major by-product of plantain fruits, constituting about 40% of the fruits but are presently under-utilized while Yam peel (*Diosorea rotundata*) constitutes about 6% the mass of yam tuber. Using methanol to extract the secondary metabolites and the results of the phytochemical analysis reveal the presence of Alkaloids, Tannins, flavonoids, saponins and glycoside in the two samples. The results also show the presence of terpenes in yam peel while Anthraquinones and steroids were absent in both samples. FTIR spectrophotometer was used to check the various chemical constituents present in the two samples. Hence results revealed the presence of alcohol, alkanes, alkenes, amine, aldehyde groups and many others. Flavanoid is well known for its antioxidant properties, alkaloids known to inhibit microbial growth in the samples and the presence of alcohol been a major component for preservation entails that the two samples (*Musa paradisiaca,* and *Diosorea rotundata*) could be used as preservatives in the preservation of local drinks.

Key words: *Musa paradisiaca, Diosorea rotundata* Traditional medicine, Phytochemical analysis, FTIR Spectrophotometer and Preservatives.

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CHAPTER ONE

INTRODUCTION

1.0 Background Of Study

Preservatives have been used since prehistoric times. Smoked meat for example had phenols and other chemicals that retard spoilage. The preservation of food has evolved greatly over the centuries and has been instrumental in increasing food security. The use of preservatives other than traditional oils, salt etc. in food began in the late 19^{th} century but was widespread until the 20^{th} century. Usage of food preservatives varies greatly from one country to another. Many developing countries that do not have strong government to regulate food additives face either harmful levels of preservation in foods or a complete avoidance of food that are considered unnatural or foreign. These countries have also proven useful in case studies surrounding chemical preservatives as they have been recently introduced. (Singh 2007)

Despite the recent outbreak of insecurity in almost all parts of the world, demographers have proven that human population is on the increase (over six billion people) just as food production is continually declining prior to people being forced to leave their homes (over twenty million people displaced) with Nigeria having the second highest number of displaced people on earth as a result of insurgency or in search of asylum hence the need to preserve food to meet with this growing population. (Adeolu et al. 2013)

The usefulness of food to man cannot be over emphasized; hence man's survival is to some large extent dependent on what he eats and how he eats them. Man in his quest to avoid spoilage have employed different methods examples include sun drying to remove moist, salting to inhibit microbial survival and growth and smoking. Technologies to conserve food that evolved over the years include boiling, freezing, refrigeration, pasteurization, dehydration, and a lot more. Just recently, nuclear radiation is now being used as food preservative technique; modified packaging techniques like vacuum packing and hypobaric packing also now work as food preservatives. (Titus 2013)

Food is one of the main basic human requirements of life and is sourced mainly from plants or animals (and other minor sources such as fungi e.g. mushroom and algae e.g. Spirulina). Generally, human foods are usually not consumed raw; rather, they undergo special processing treatments with or without heat to make them more palatable. The steps involved in the food processing treatments vary depending on the type of food being prepared. Where necessary, some nutritive additives essential for health are added. The process of adding additives in foods involves mixing together various ingredients before or during a heat-treatment step to give the food the intended flavour, taste, texture or appearance. (Titus 2013)

To attain a balanced diet, it has been necessary to add to certain foodstuffs some ingredients missing in that particular diet such as salt, amino acids and vitamins. In cases where food is processed for future use or where there is a necessity to avoid spoilage by the action of microbes, special treatments such as smoking or salting are used to keep the food safe for long periods of time. The tendency to make foodstuffs more appealing and palatable has paved way for the incorporation of a variety of ingredients or some special treatments to impart a desired quality to foodstuffs. This tendency echoes the saying: ‘people first eat with their nose, then with their eyes and finally with their mouths’. Aroma, flavor, taste and appearance are all equally important in the appeal of foods. Food additives are substances incorporated in edible products in order to perform specific roles and functions, such as preservation of foodstuffs by either increasing shelf life or inhibiting the growth of harmful microbes. Other roles include imparting desired color, odour or a specific flavour to food.

Food additives may have a natural origin in the sense that they may be found existing naturally forming part of the indigenous components of the food, or they may be synthetic but replicas of substances found naturally in foodstuffs. They may also be entirely artificial, which implies that they are synthetically produced and are not copies of any compounds found in nature. There are a number of additives and preservatives commonly used in foods including antioxidants, acids, acid regulators and salts, emulsifiers, coloring agents, minerals and vitamins, stabilizers, thickeners, gelling agents, sweeteners and preservatives.

These different food additives have different roles to play in foods depending on their intended purpose. For instance, emulsifiers tend to give food a good texture as well as good homogeneity such that they make it possible for immiscible items such as water and oils to mix well without any separation, as is the case in ice-creams or mayonnaise (Suman *et al.* 2009). Stabilizers, thickeners and gelling agents provide strong texture and smoothness as well as an increase in viscosity (Quemener *et al*, 2000). Sweeteners are important as flavours, although there are other types of sweetener flavours which perform an important function In the diets of consumers with health problems such as diabetes (Hutteau *et al.* 1998).

Nutritive additives such as minerals, vitamins, essential amino acids, etc., are added to particular food products where they are missing (Nayak and Nair 2003) or in food stuffs specifically intended for people with deficiency of such additives, for example milk for babies (Ikem *et al*. 2002). Other additives such as antioxidants are needed for the prevention of fat and oil rancidity in baked foods by inhibiting the effects of oxygen on foods and also preventing the loss of flavour, thereby maintaining food palatability and wholesomeness. Acids and acidic regulators such as citric acid, vinegar and lactic acid are food additives to control food pH (levels of acidity or alkalinity) and they play an important role in the sharpening of flavours (Populinetal.2007), as preservative (Brul and Coote 1999) and as antioxidants. Some acids and acid regulators tend to release acids only when they are subjected to a heat treatment such as with some bakery products (e.g. acids produced by the leavening agents react with baking soda to make the bakery products rise during the baking process).

Coloring and color retention agents are added to foods to appease the eye of the consumer or beholder; they are also intended to maintain the colour of food in cases where it may fade. (MacDougall 1999). Generally speaking, the desire for a particular quality of food has resulted in the introduction of numerous additives with wide applications in different cultures and civilizations. Currently, many different types of food additives have been commercialized and are finding their way on to the markets worldwide (Baker2010). This trending business has contributed to the speedy growth in food processing and other related industries, where food additives are used en masse.

The economic success of food additives has further encouraged the advent of new technologies in the processing of foods. However, these new technologies and additives have brought other unwanted outcomes and are an issue of concern. Despite all the benefits and advantages of food additives and preservatives, there is still a potential danger of chemical adulteration of foods. Additives or preservatives in foods may themselves trigger other hormonal or chemical processes in the body that can generate negative physiological responses. The metabolites produced by additives may also cause side effects, because not all food additives enter the markets after being thoroughly studied to prove their safety (Skovgaard 2004). Although most food additives are considered safe, some are known to be carcinogenic or toxic. For these reasons, many food additives and preservatives are controlled and regulated by national and international health authorities. All food manufacturers must comply with the standards set by the relevant authorities without violating the maximum thresholds stated to ensure the safety of the final product to the consumers. In most cases, food processing industries must seek standard certification before using any new additive or preservative or before using any originally certified additive or preservative in a different way (Pinho *et al.* 2004; Skovgaard 2004).

1.2 What Is Food?

Different authors have different definition for food. Some see it in terms of the nutritional value added to the body when taken, others see it in terms of man's desire to meet satisfaction or quench taste. Another group of writers defined food as a basic necessity of life. None of these definitions are wrong hence they are all pointed towards the same direction. Basically, food can simply be defined as any substance or material eaten or drunk to provide nutrition for the body or for pleasure. It usually consist of plant or animal origin which contain essential nutrient such as carbohydrates, fats, protein, vitamins or mineral and is ingested by an organism to stimulate growth, produce energy and maintain life. All food products with the exception of the one growing in your kitchen garden has food preservatives in them, every manufacturer during processing add food preservatives in them. The aim is to avoid spoilage during the course of transportation.

Since food originate from plant and animals, it is important to note that several factions affect the availability of food hence the need to preserve and store these common fuel which keeps life going. Meanwhile in these research work, we shall employ the use of yam peel and plantain peel in the preservation of locally made drinks commonly called kwunun zaki hence also compare the preservative properties obtained in yam peel as well as plantain peel and subsequently see how these properties can be compared to the normal preservatives commonly obtained in our markets.

1.3 Reasons As To Why We Preserve Food.

I. To preserve the appearance of the food
II. To increase the shelf value of the food for storage
III. To preserve the natural characteristics of the food
IV. To inhibit microbial activities which results in spoilage

V. To checkmate food poisoning

1.4 Significance of Study.

At the end of this research, it will be observed that this research work is aimed at providing an alternative preservative that can be used in the preservation of our commonly produced local drinks other than the common preservatives obtained in our market.

1.5 Aim and Objectives.

I. To determine the phytochemical properties of yam peel.
II. To determine the phytochemical properties of plantain peel.
III. To determine if yam peel could be used as a preservative.
IV. To determine if plantain peel could be used as a preservative.
V. To determine the chemical constituents of both yam peel and plantain peel.

1.6 Scope and Limitation.

This project is limited to determination of preservative properties, tracking the phytochemicals of plantain peels and yam peels as it is being used in the preservation of locally made drinks.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoritical Framework

The idea of food preservation arises from the desire to maintain food quality, its physicochemical properties and maintain the functionality of its nutritious components without affecting the product itself (Farkas 1977). Throughout civilization, there has always been a need to preserve food for future use for a number of reasons, including: to maintain the integrity of food products; for replenishment of food supply during famine (food security); or preservation of food products to be transported for use in a different locality (Gould1995; Schellekens 1996; Peck 1997). Many methods and techniques including the use of classical or artificial preservative agents or naturally occurring antimicrobial biomolecules (‘natural’ preservatives) have been used. Artificial compounds include chemicals such weak organic acids. Natural preservative agents are derived from plants and other bio-preservatives are derived from the fermentation of lactic acid bacteria. Preservation techniques are numerous and generally differ from one food product or food class to another. In practice, a combination of techniques is sometimes preferred in order to achieve the desired preservation without tampering with safety or the integrity of the food product.

2.2 Food Preservatives.

Preservatives just as the name implies are substances added to food so as to preserve them from spoilage.It may be added to food to prevent the growth of fungi. Preservative food additives can be used alone or in conjunction with other methods of food preservation. Preservatives may be antimicrobial preservatives, which inhibit the growth of bacteria or fungi, including mold, or antioxidants such as oxygen absorbers, which inhibit the oxidation of food constituents. Common antimicrobial preservatives include calcium propionate, sodium nitrate, sodium nitrite, sulfites (sulfur dioxide, sodium bisulfite, potassium hydrogen sulfite, etc.) and disodium. The benefits and safety of many artificial food additives (including preservatives) is the subject of debate among academics and regulators specializing in food science, toxicology, and biology.

Natural substances such as salt, sugar, vinegar, alcohol, and diatomaceous earth are also used as traditional preservatives. Certain processes such as freezing, pickling, smoking and salting can also be used to preserve food. Another group of preservatives targets enzymes in fruits and vegetables that continue to metabolize after they are cut. For instance, citric and ascorbic acids from lemon or other citrus juice can inhibit the action of the enzyme phenolase which turns surfaces of cut apples and potatoes brown.

Most foods contain enzymes or natural chemicals, such as acids or alcohols that cause them to begin to lose desirable characteristics almost immediately after harvest or preparation. In addition, a host of environmental factors, such as heat and the presence of microorganisms, acts to change foodstuffs in ways that may harm the food product. Food preservation traditionally has three goals: the preservation of nutritional characteristics, the preservation of appearance, and a prolongation of the time that the food can be stored. Traditional methods of preservation usually aim to exclude air, moisture, and microorganisms, or to provide environments in which organisms that might cause spoilage cannot survive.

Among the earliest preservatives were sugar and salt (NaCl), which produced food environments of high osmotic pressure that denied bacteria the aqueous surroundings they needed to live and reproduce. Jams and jellies are preserved as solutions of high sugar content, and many meats (e.g., hams) and fish are still preserved by salting. Unlike other microorganisms, molds can often withstand the effects of high salt or sugar concentrations in foods. Fortunately, they seldom cause illness. Early methods of air removal included the sealing of foods inside containers (such as jars), or the covering of food surfaces with hot paraffin. The invention of canning by Nicolas Appert enabled commercial preparations of foodstuffs.

In response to a prize offered by Napoleon in 1795, Appert developed a method of canning and preserving fruits and vegetables in glass containers for sea voyages. His process was used commercially in 1910 by Peter Durand in England, using metal cans. During the earliest days of canning, some persons (including some Arctic explorers) probably died as a result of exposure to the lead that was once used to solder cans. Modern techniques of air removal include vacuum sealing and the use of plastic wrappings. Chemical preservatives include free radical scavengers (also known as antioxidants), such as vitamin C and compounds such as BHA (butylated hydroxyanisole), and bacterial growth inhibitors, such as benzoic acid, sulfur dioxide, and sodium nitrite ($NaNO_2$). Ethanol (CH_3CH_2OH) has long been used as a preservative, both of itself (as in wine), and of other foods (e.g. fruits stored in brandy). Some chemical preservatives may be harmful: Sulfur dioxide (often used to preserve wines) is irritating to the bronchial tubes of persons who have asthma, and nitrites have been implicated as carcinogens.

After Louis Pasteur proved that it was the presence of bacteria that caused food to spoil, there was a tendency to consider all microorganisms harmful. But in fact, microbial action is responsible for the production and preservation of some foods. The action of microbes is a part of the production of cheese and some flavouring agents. Sauerkraut is both processed. The irradiation of foods has the advantage of enabling food packaging and preparation in which there is less person-to-food contact, thus decreasing the possibility of contamination and decreasing the need for chemical preservatives, some of which may be harmful. The ionizing radiation that is used to irradiate foods, wherein the foods are exposed to bursts of high-intensity x-rays or streams of electrons, disrupts bacterial DNA.

Some persons have objected to the irradiation of foods because of an (unfounded) fear of radioactivity. As pathogens such as virulent strains of coliform bacteria have caused food poisoning, the irradiation of animal carcasses and, in particular, of hamburger during its preparation has become more desirable. Irradiation currently extends the shelf life of foods such as strawberries. Irradiation does not make foods radioactive, but may cause changes in food color or texture.

2.3 Sequestrants As Foodadditives

Sequestrants normally perform the function of preservative in foods. Most of the sequestrant compounds are organic or inorganic salt such as calcium disodium ethylene diaminetetra-acetate (EDTA), gluconodelta-lactone, sodium gluconate, potassium gluconate, sodium tripolyphosphate and sodium hexametaphosphate.

Salts such as EDTA, which is a synthetic chelating or sequestrating agent, are known to form strong complexes with cations thus making them good agents for use in food systems as stabilizers and sequestrants (Winter1999). This salt also possesses other health benefits when incorporated in foods; it has anti microbial activities due to the fact that it chelates with cations, which are essential elements needed for microbial growth, thus limiting their availability to pathogens. EDTA is also known to sequestrate with especially divalent cations which bridge lipopolysaccharides and other membrane biomolecules, destabilising the bacterial cytoplasmic membrane (Vaara 1992; Banin *et al*. 2006). In all these phenomena, EDTA also plays the role of food preservative.

Other sequestrants such as cholazol H, which has been reported to be a chemically functionalised insoluble fibre (Wilson *et al.* 1998) and GT16-239, an alkylated, cross-linked poly (allylamine) and cholestyramine (Wilson *et al*. 1998) are also useful because they are capable of forming chelation with bile acids in the intestine, thereby hindering their absorption. This triggers the liver to increase the production of bile in order to replace the bile that was not absorbed because It has been bound to sequestrants. One of the raw materials for the synthesis of bile inside the body is cholesterol; this means that cholesterol is taken from the blood circulation, hence providing a health benefit.

Cyclodextrins are also used in the food industry as important food additives which perform many functions such as: protection of lipophilic ingredients in foodstuffs which are oxygen sensitive and photosensitive; solubilisation of vitamins and food colouring agents; and stabilisation of fragrances and flavourings. Cyclodextrins are also sequestrants and used to complex food items such aspartame, glycyrrhizin and rubusoside (sweeteners), thereby stabilising them and enhancing their tastes and flavours (Singh *et al*. 2002). Moreover, -cyclodextrins have been reported to bind cholesterol and eliminate it from the body (Kwak *et al.* 2004; Jung *et al.* 2008). As preservatives, cyclodextrins are useful in the food industry as packaging materials. They reduce the possibility of organic volatile contamination and are also good in terms of controlling the diffusion and transmission rates of the materials used for packaging without affecting the food quality (Wood 2001).

Micro-organisms which bring about food spoilage are ubiquitous. Once they are exposed to favourable growth conditions of temperature, air and moisture, pH and nutrient supply, they can multiply very fast. Preservatives are included in foods to alter the environmental conditions such that growth of moulds and bacteria is discouraged, thus preventing food spoilage.

2.4 Natural Food Preservatives

Natural food preservatives are generally favoured by consumers due to their perceived safety as opposed to artificial preservatives. Living organisms (animals, plants as well as microorganisms) contain various molecules with antimicrobial properties which have evolved as host defence mechanisms and have potential application in the food industry as preservatives. Most if not all preservatives categorised as natural also perform a number of other important functions, for example, as antioxidants, flavourings or as antibacterials. Such preservatives tend to prolong the shelf life of many foodstuffs such as meat and meat product.

Examples of natural preservative compounds include lactoperoxidase found in milk, lysozyme found in egg white, saponins and flavonoids which are extracts from herbs and spices, bacteriocins extracted from lactic acid bacteria, plant-derived antimicrobial compounds, microbial-derived compounds (mainly lytic enzymes), chitosan found in shrimp shells and chitosan-saccharide derivatives (e.g. chitosan-mint, chitosan-glucose and xylanglucose).

2.5 Plant phenolic extracts

Plants contain phenolic compounds that play a role as preservatives in foodstuffs. Even the essential oils discussed in the previous section, especially those which possess the strongest antimicrobial activity, are composed of phenolic functionality such as carvacrol, eugenol (2-methoxy-4-(2-propenyl) phenol) and thymol (Farag *et al.* 1989; Thoroski et al. 1989; Cosentino *et al.* 1999; Dorman and Deans 2000; Juliano et al. 2000; Lambert *et al.* 2001). The mechanism of action of these phenolic compounds is believed to involve the disruption of the cytoplasmic membrane.

Phytochemicals are compounds which occur naturally in plants, form part of plants defense mechanisms against diseases. They are classified into primary and secondary, based on their activity in plant metabolism. The primary ones comprise of sugars, amino acids, proteins and chlorophyll, while secondary ones include the phenolic compounds such as tannins, flavonoids, flavonols, alkaloids, saponins, proanthocyanidins, etc. These phenolic compounds have been reported to possess considerable antimicrobial properties, which is attributed to their redox properties. Thus the antimicrobial properties of plants have been attributed to the presence of these secondary metabolites

Alkaloids are the largest group of secondary metabolites and are the most efficient therapeutic plant phytochemicals, comprising basically of nitrogen bases synthesized from amino acid building blocks. Pure isolated alkaloids and their synthetic derivatives are used as basic medicinal agents because of their analgesic, antispasmodic and antibacterial properties. Flavonoids are important class of polyphenols in the plant kingdom. Structurally, they are made of more than one benzene ring. Reports have it that they are potent water soluble antioxidants. In addition, flavonoids have also been reported to possess antimicrobial and anti-inflammatory properties. Cordell et al. reported that alkaloids and flavonoids are responsible for the antifungal activities in higher plants.

Tannins are secondary metabolites of plants of high molecularweight that are responsible for the astringent taste of foods and drinks. They bind to proteins, carbohydrates, gelatins and alkaloids, and are classified as active antimicrobial compounds**.** In terms of solubility, they are soluble in water and alchohol. Tannin rich medicinal plants are used as healing agents in a number of diseases. In Ayurveda, formulations based on tannin-rich plants have been used for the treatment of diseases like leucorrhoea, rhinnorhoea, healing of wounds and diarrhea.

Saponins are regarded as high molecular weight compounds, in which a sugar molecule is combined with triterpene or steroid aglycone. The two major types of saponin are the steroidal and triterpene saponins. They are mostly amorphous in nature, soluble in alcohol and water, but insoluble in non-polar solvents like benzene and n-hexane. Although saponins could cause hemolysis of blood when ingested in high concentrations, they also possess therapeutic potentials such as cholesterol lowering and anti-cancerous activities. As observed in this study, the aqueous extracts of the peels of the yam varieties extracted their saponins better than the ethanolic extracts. Some saponins like diosgenyl exert a large amount of biological functions, such as antifungal, anti-bacterial and anticancer activities.

2.6 Chemistry Of Food And Its Preservatives

Since it is probable that many reactions to food additives are not diagnosed, the exact rate of reactions is not known. However, various studies estimate that the rate is probably less than 1% of adults, and up to 2% of children. There are many types of reactions that can occur as a result of food additives. Some of these reactions suggest an allergic cause while many others do not appear to be allergic, but rather an intolerance. Reports of reactions to food additives have included the following: Skin, urticaria/angioedema, atopic dermatitis, sweating, itching, flushing, gastrointestinal, abdominal pain, nausea/vomiting, diarrhea, respiratory, asthma symptoms, cough, rhinitis, musculoskeletal, muscle aches, joint aches, fatigue, weakness, neurologic, behavior and mood changes, attention deficit and hyperactivity disorder, migraine headaches, numbness, cardiac, palpitations and arrhythmias.

A diagnosis of allergy to food additives is suspected when a person experiences various reactions to prepared foods or when eating at restaurants, but not from foods prepared at home. Various seemingly unrelated foods might in fact have common ingredients, such as food colorings or preservatives. Once a food or food additive is suspected, allergy testing (using skin testing or RAST) may be possible to certain natural substances such as annatto, carmine, and saffron. Testing for synthetic substances is not possible or reliable, and therefore a trial of a preservative-free diet may support a diagnosis of food additive reactions.

In many instances, the only way to truly diagnose an adverse reaction to food additives is for the person to undergo an oral challenge with the suspected additive under close supervision of an allergist. Tartrazine also known as FD&C Yellow, tartrazine has been suspected as the cause of many reactions, including urticaria (hives), asthma and other illness. Recent studies have disproven the thought that aspirin-allergic asthmatics were especially sensitive to tartrazine. Other studies suggest a role of tartrazine as worsening atopic dermatitis. Carmine is a red food coloring made from a dried insect called Dactylopius occus Coasta, which can be found on prickly pear cactus plants. This coloring is also found in various cosmetics, drinks, red yoghurt and popsicles.

Reactions to carmine are probably due to allergic antibodies. Annatto is a yellow food coloring made from the seeds of a South American tree, Bixia orellana. This additive has been found to cause allergic reactions, including anaphylaxis and urticaria / angioedema. Saffron is a yellow food coloring, obtained from the flower of the Crocus sativa plant, and has been reported as a cause of anaphylaxis. Many other food colorings are less common, but possible, causes of adverse reactions. These include sunset yellow (yellow), amaranth (red), erythrosine (red), and quinoline yellow, among others. Antioxidants such as BHA (butylated hydroxyanisole) and BHT (butylated hydroxytoluene) are added to prevent the spoilage of fats and oils. Both BHA and BHT are suspected of causing urticaria and angioedema.

Lecithin is an emulsifier made from soyabeans and eggs, and may contain soyabean proteins. Reactions to soy lecithin are rare, even in soy-allergic people, since the level of this additive is usually very low in most foods. Various gums are used as food additives and function as emulsifiers and stabilizers. Major gums include guar, tragacanth, xanthan, carageenan, acacia (Arabic) and locust bean. Many of these gums are known to worsen asthma, particularly in the occupational setting, when airborne, others are known to cause allergic reactions when present in foods.

Monosodium Glutamate (MSG) is a flavor enhancer added to various foods, and also occurs naturally. Reactions to MSG have been called the “Chinese Restaurant Syndrome,” and symptoms include numbness on the back of the neck, shoulders and arms, weakness and palpitations. Other symptoms include facial pressure/tightness, headaches, nausea, chest pain and drowsiness. MSG is also suspected of worsening asthma symptoms. Spices are the aromatic part of various weeds, flowers, roots, barks and trees. Because they are derived from plants, spices have the ability to cause allergic reactions, just like pollens, fruits and vegetables. The most common spices used include chili peppers, celery, caraway, cinnamon, coriander, garlic, mace, onion, paprika, parsley and pepper. Aspartame is a sweetener used in many sugar free foods and drinks. This food additive has been suspected of causing such symptoms as headaches, seizures and urticaria.

2.7 Plantain Peel

Plantain (*Musa parasidiasca)* belongs to the natural order, plantaginaceae which contains more than 200 species, twenty-five or thirty of which have been reported. The common plantain (Plantango major) has broad, irregular oval leaves, abruptly contracted at the base into a long broad, channelled footstalk. The fully grown blade is 1.3–2.4 meters long and about two- third as broad, usually smooth, with several parallel veins. Plantain grows more than any other plant in compacted soils, is abundant beside paths, roadside and other areas with frequent soil compaction. It is also common in grassland and as a weed among crops. It is wind pollinated and propagates primarily by seeds which are held on the long narrow spikes which rise well above the foliage. The large diversity that occurred in plantain has resulted in a variety of cultivars. The number of plantain cultivars has been reported to vary from one country to another. Swennen (1990) observed that at least 116 plantain cultivars exist in different parts of West and Central Africa. In Nigeria alone, more than 20 cultivars have been reported, although only a few are important commercially Swennen (1990).

Plantain is a major starch crop of importance in the human tropical zone of Africa, Asia, Central and South America. It is undoubtedly one of the oldest cultivated fruits in West and Central Africa. It is consumed as an energy yielding food and desert. It has been estimated that plantains and other bananas provide nearly 60 million people in Africa with more than 200 calories (food energy) per day. Fruits such as plantain are an important contribution to the diets of many low and middle class people in many African settings (Stover and Simmonds, 1987).

Fig: 1 *picture of unripe plantain*

source: Mohammad et al (2011) Journal of Applied Pharmaceutical Science 01 (05); 2011: 14-20

Musa paradisiaca is a herbaceous plant (up to 9 m long) with a robust treelike pseudo- stem, a crown of large elongated oval deep-green leaves (up to 365 cm in length and 61 cm in width), with a prominent midrib each plant produces a single inflorescence like drooping spike, and large bracts opening in succession, ovate, 15-20 cm long, concave, dark red in color and somewhat fleshy. Fruits are oblong, fleshy, 5-7cm long in wild form and longer in the cultivated varieties. *Musa sapientum* is a treelike perennial herb that grows 5 - 9 m in height, with tuberous rhizome, hard, long pseudo stem. The inflorescence is big with a reddish brown bract and is eaten as vegetables. The ripe fruits are sweet, juicy and full of seeds and the peel is thicker than other banana.

The demand for plantain fruit within the country is high, with supply struggling to meet demand. This has hampered the status of this crop as a foreign exchange earner. It remains an important staple food, source of revenue, as well as the raw material for industries producing value added products in many parts of Nigeria. Plantain occupies a strategic role in rapid food production, being a perennial ratoon crop with a short gestation period (Ayoola, 2011). It is a major source of carbohydrate for more than 50 million people. In Nigeria, all stages of the fruit (from immature to overripe) are used as a source of food in one form or the other. The immature fruits are peeled, sliced, dried and made into powder and consumed as ‘plantain fufu’. The mature fruits (ripe or unripe) are consumed boiled, steamed, baked, pounded, roasted, or sliced and fried into chips. Overripe plantains are processed into beer or spiced with chili pepper, fried with palm oil and served as snacks (‘dodo-ikire ’). Industrially, plantain fruits serve as composite in the making of baby food (‘ Babena ’ and ‘ Soyamusa ’), bread, biscuit and others (Ogazi, 1996). Plantain bract has medicinal applications in bronchitis, dysentery and on ulcers; cooked plantain bracts are given to diabetics (Morton, 1987) and culinary uses (edible) in many Asian countries; from India to the Phillippines (Peter, 2011).

2.7.1 Taxonomy of plantain.

The table below shows the binomial nomenclature system of classification.

Table 2.1 Taxonomical classification

Classification	Name
Kingdom	**Plantea**
Division	**Magnoliophyta**
Class	**Liliopsida**
Order	**Zingiberales**
Family	**Musaceae**
Genus	***Musa***
Species	***paradisiacal***

Source; Mohammad *et.al* (2011) Journal of Applied Pharmaceutical Science 01 (05); 2011: 14-20

2.7.2 Cultivation and Distribution.

In different countries about 300 varieties of plantain are grown, of which a vast majority have been growing in Asian, Indo- Malaysian and Australian tropics and are now widely found throughout the tropical and subtropical countries. India, Philippines, China, Ecuador, Brazil, Indonesia, Mexico, Costa Rica, Colombia, Thailand are the top plantain producing countries. It is extensively grown and cultivated as a fruit plant all over Bangladesh. The plantain grows almost everywhere in the country throughout the year.

2.7.3 Traditional Uses

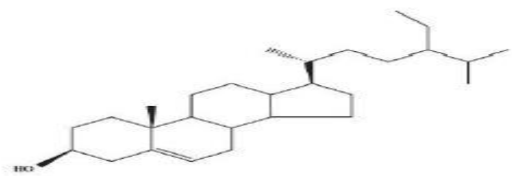
The fruit of *M. paradisiaca* and *M. sapientum* is traditionally used in diarrhoea (unripe), dysentery, intestinal lesions in ulcerative colitis, diabetes (unripe), in sprue, uremia, nephritis, gout, hypertension, cardiac disease (Ghani, 2003; Khare, 2007). *M. spaientum* is also used in the treatment of excess menstruation with Canna indica L. var. speciosa (Partha, 2007). Banana leaves (ashes) are used in eczema (Okoli, 2007), as cool dressings for blister and burns (Ghani, 2003). The plant is also used in inflammation, pain and snakebite (Coe and Anderson, 1999).

2.7.4 Phytochemicals Present In Plantain Peels.

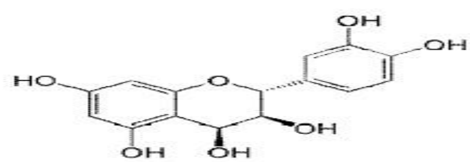
Laboratory analysis carried out from previous research works have shown that the vitamins (A, B and C) and phytochemicals (alkaloids, flavonoids, phenols, saponins, phytates, tannins and oxalates) content of the peel. Vitamins A, B and C content of the vegetable were determined using AOAC (1995) method. Tannins, oxalates and phytates were determined using the method described by Sofowora (1982), Trease and Evans (1989). Alkaloids, flavonoids, saponins and phenols were determined using AOAC (1995) method. Carbohydrates have been isolated from *M. sapientum* (Anhwange, 2008). Catecholamines such as norepinephrine, serotonin, dopamine (Waalkes *et al.*, 1958; Vettorazz, 1974), tryptophan, indole compounds (Shanmugavelu and Rangaswami, 1962), pectin have been found in the pulp. Several flavonoids and related compounds (Leucocyanidin, quercetin and its 3-O- galactoside, 3-O-glucoside, and 3-O-rhamnosyl glucoside) were isolated from the unripe pulp of plantain (Lewis *et al.,* 1999; Lewis and Shaw, 2001; Ragasa *et al.*, 2007). Serotonin, nor-epinephrine, tryptophan, indole compounds, tannin, starch, iron, crystallisable and non-crystallisable sugars, vitamin C, B-vitamins, albuminoids, fats, mineral salts have been found in the fruit pulp of *M. paradisiaca* and *M. sapientum* (Ghani, 2003).

Acyl steryl glycosides such as sitoindoside-I, sitoindoside-II, sitoindoside-III, sitoindoside-IV and steryl glycosides such as sitosterol gentiobioside, sitosterol myo-inosityl- β-D-glucoside have been isolated from fruits of M. paradisiaca (Ghoshal, 1985). Jang et al. (2002) isolated a bicyclic diarylheptanoid,rel-(3S,4aR,10bR)-8-hydroxy-3-(4-hydroxyphenyl) -9-methoxy-4a,5,6,10b-tetrahydro-3H-naphtho[2,1-b]pyran, and 1,2-dihydro-1,2,3-trihydroxy-9-(4-methoxyphenyl) phenalene, hydroxyanigorufone, 2-(4-hydroxyphenyl) naphthalic anhydride, 1,7-bis (4-hydroxyphenyl) hepta-4(E), 6(E)-dien-3-one. Ragasa et al. (2007) reported the isolation of several triterpenes such as cyclomusalenol, cyclomusalenone, 24-methylenecycloartanol, stigmast-7-methylenecycloartanol, stigmast -7-en-3-ol, lanosterol and amyrin. An antihypertensive principle, 7, 8-dihydroxy-3-methylisochroman4-one, was isolated from the fruit peel of M. sapientum (Qian et al., 2007). Cycloartane triterpenes such as 3-

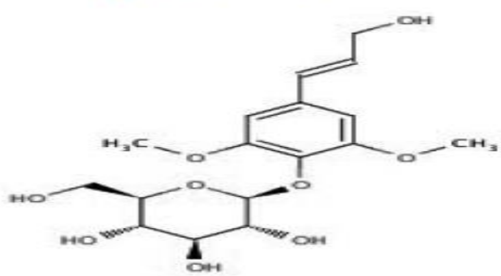
epicycloeucalenol, 3-epicyclomusalenol, 24- methylenepollinastanone, 28-norcyclomusalenone, 24-oxo-29- norcycloartanone have been isolated from the fruit peel of M. sapientum (Akihisa et al., 1998). Cellulose, hemicelluloses, arginine, aspartic acid, glutamic acid, leucine, valine, phenylalanine and threonine have been isolated from pulp and peel of M. paradisiaca (Ketiku, 1973; Emaga et al., 2007). Hemiterpenoid glucoside (1,1-dimethylallyl alcohol), syringin, (6S, 9R)-roseoside, benzyl alcohol glucoside, (24R)-4α,l4 α,24-trimethyl-Sacholesta-8,25(27)-dien-3β-o1 have been isolated from flower of M. paradisiaca (Martin et al., 2000).



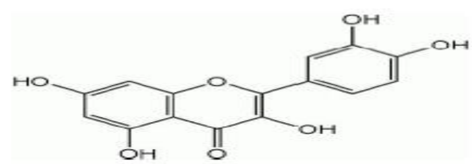
β-Sitosterol



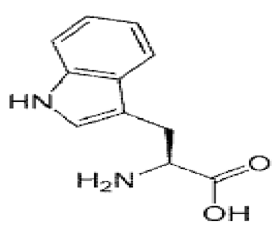
Leucocyanidin



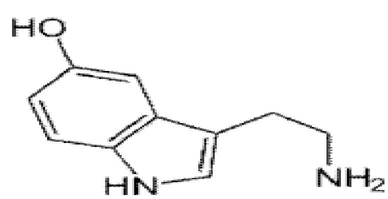
Syringin



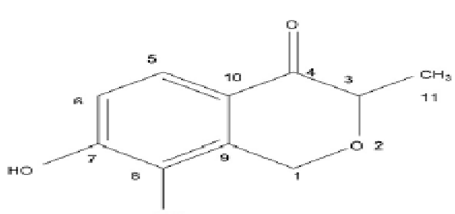
Quercetin



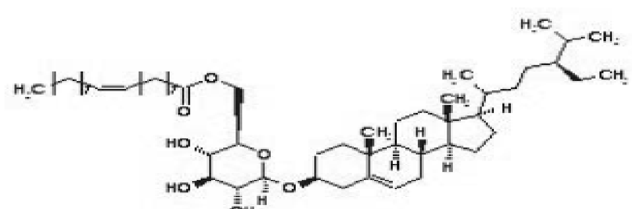
L-tryptophan



5-Hydroxytryptamine



7, 8-dihydroxy-3-methyl isochroman-4-one



Sitoindoside-II

2.8 Yam Peel

Nigeria is by far the world's largest producer of yams, accounting for over 70-76 percent of the world production. According to the food and agricultural organization report, in 1985 nigeria produced 18.3 million tones of yam from 1.5 million hectares, representing 73.8 percent of total yam production in Africa. According to 2008 figures, yam production in Nigeria has nearly doubled since 1985. With Nigeria producing 35.02 million metric tones with value equivalent of US$5.654 billion in perspective, the world's second and third producer of yams, Cote d'ivoire and Ghana, only produced 6.9 and 4.8 million tones of yams in 2008 respectively.

According to the International Institute Of Tropical Agriculture, Nigeria amounted for about 17 million tonnes from land area 2,837,000 hectares under yam cultivation. Yam a tropical crop in the genus *Dioscorea*, has many as 600 specie out of which six are economically important staple species. These are *Dioscorea rotundata* (white guinea yam), *Dioscorea alata* (yellow yam), *Dioscorea bulbifera* (aerial yam), *Dioscorea esculentum* (Chinese yam) *Dioscorea dumetorum* (trifoliate yam). *Dioscorea rotundata* (white yam) and *Dioscorea alata* (water yam) are the common species grown in Nigeria.

2.8.1 Taxonomy of Yam.

The table below shows the binomial nomenclature system of classification

Table 2.2 Taxonomical Classification

Classification	Name
Kingdom	**Plantea**
Phylum	**Magnoliophyta**
Class	**Liliopsida**
Order	**Dioscoreales**
Family	**Dioscoreaceae**
Genius	***Dioscorea***
Specie	***rotundata***

Source: www.wikipedea.com

The tuber has a rough skin usually dark to light brown in colour. This rough skin can be peeled with minimal degree of difficulty. The yam becomes edible only if it is well washed and properly cooked. These steps are necessary in order to reduce the anti-nutritional components of yam before consumption (Dumnnt and Vernier, 1997). Planting of yam tuber starts from March and harvesting is between September and October and late harvesting is between November and December for those not living in coastal region. The Igbos of south eastern Nigeria call it 'Jiaga', the Yorubas in the western part of the country refer to it as 'Isu Ewura' while in the northern part of the country, it is popularly known as 'Doya'. Yam in not only a preferred high energy food, but a king crop tied up with the socio-cultural life of the people in West Africa especially Nigeria.

Yam peels are basic wastes or by- products when yam is peeled during processing for cooking and other purposes. They are largely sourced from yam processing centres, commercial eateries, markets and are fed to animals such as goats and sheep. They are used as feed for snails, Broiler Chicks and Weaner Rabbits. Yam peels also possess biosorptive capacity for the removal of dye from aqueous solutions. The peels constitute about 10% of the yam and have been reported to contain 2 to 6% of crude protein depending on the varieties, the crude fibre ranges between 9 to 15% However, their utilization is sometimes limited as a result of poor understanding of their nutritional, antinutritional and economic values as well as proper use in livestock diets. They constitute environmental hazard where it is not properly utilized. Therefore, the objective of this study was to investigate the proximate, mineral, anti-nutritional and phytochemical composition of yam peel as it is been used as a preservative in local drinks.

2.8.2 Cultivation in Nigeria.

Yam is widely cultivated in the middle belt region of Nigeria which includes largely Benue, Platue, Kogi, Niger, F.C.T, Tarabar and southern part of Adamawa states. Yam is also produced in other parts of Nigeria but in trace amount. Yam is grown on free draining, sandy and fertile soil, after clearing the first fallow. Land is prepared in the form of mould or ridge or heap of 1 metre (3 ft 3 in) height.the yam recommended for such soil is white yam. Planting is done by seed yam or cut setts from ware tubers. One day before planting the tubers have to be subjected to treatment with wood ash or a fungicide to prevent damage to the soil. The setts are planted at an interval of 15-20 centimeters with the cut face facing up. It is about 1.6 m in height and weighs about 2-5 kg depending on size.

2.8.3 Phytochemicals Present In Yam Peels

Labouratory analysis carried out on previous research work using standard procedure and method have revealed the presence of certain phytochemicals in yam peel, they include; tannin, flavonoid, alkaloids, saponin glycocide and steroids**.** Anthraquinones, terpenes and phlobatanins were absent lawal *et al* (2014). Quantification of the phytochemicals and antinutritional content (in g/100g) showed yam peel contain alkaloids concentration of 0.03+0.01, tannin concentration of 8.19+0.01,Oxalate concentration of 0.028+0.01, Phytate concentration; 0.36+0.00, and cyanide concentration of 1.06+0.01,

Analysis of mineral composition (in mg/100g) showed that the yam peel contained 99.5+0.14 Na, 137.0+0.88 K, 68.5+0.70 Fe, and 45.5+0.23 Ca. Proximate analysis revealed that fiber, carbohydrate, ash and moisture content occurred in appreciable amounts while lipid and protein contents of the yam peel sample were low. High fiber content was detected in yam peel (41.0+0.9%) while carbohydrate content was recorded low (32.49+0.5%). The moisture content recorded was (11.75+0.03).

2.9 Preservatives That Cause Chemical Reactions.

Sulfites are common preservatives used in various foods, and are well known to cause a variety of symptoms. Nitrates and Nitrites: These additives are used as curing agents in meat products. Few reports of reactions to nitrates and nitrites exist, and include urticaria, itching and anaphylaxis. Benzoates are used in foods as antimicrobial preservatives, and have been responsible for worsening asthma, allergic rhinitis, chronic urticaria, and flushing in some people. Sorbates/sorbic acid are added to foods as antimicrobial preservatives. Reactions to sorbates are rare, but have included reports of urticaria and contact dermatitis.

2.10 Effects of Food Preservatives.

Many foods available in the market contain different types of preservatives. These chemicals can give rise to certain health problems. Additives consistently maintain the high quality of foods. Food preservatives are the additives that are used to inhibit the growth of bacteria, molds and yeasts in the food. Some of the additives are manufactured from the natural sources such as corn, beet and soybean, while some are artificial, man-made additives.

Many people are allergic to certain food additives or colors. When someone has a reaction after eating certain foods, such an allergy is suspected. Unfortunately, some people do not have a reaction until a day or two later, so it is difficult to know what is causing the problem. When a certain food additive is believed to cause an allergic reaction, the blood is mixed with materials known to trigger allergies. The test measures the level of allergy antibodies in the blood that are present with an allergic reaction. Such test for synthetic additives is not reliable. Thus, people have to go on an elimination diet. They stop eating all foods that might be problematic and introduce one at a time to see if a reaction occurs. It is best to eat a preservative-free diet if at all possible. The reaction from these additives can be very mild to life-threatening. They can be immediate or build up in the body over time. Only in recent years have researchers seriously considered the physical impact of these additives over the long term.

2.11 Food Additives.

In its broadest sense, a food additive is any substance added to food. Legally, the term refers to any substance the intended use which results or may reasonably be expected to result-directly or indirectly-in its becoming a component or otherwise affecting the characteristics of any food. This definition includes any substance used in the production, processing, treatment, packaging, transportation or storage of food. Food additives are also substances added to food to preserve flavor or enhance its taste and appearance. Some additives have been used for centuries; for example, preserving food by pickling (with vinegar), salting, as with bacon, preserving sweets or using sulfur dioxide as in some wines. With the advent of processed foods in the second half of the 20th century, many more additives have been introduced, of both natural and artificial origin.

Food Additives are defined by the United States Food and Drug Administration (FDA) as “any substance, the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food”. In other words, an additive is any substance that is added to food. Direct additives are those that are intentionally added to foods for a specific purpose while indirect additives are those to which the food is exposed during processing, packaging, or storing. If a substance is added to a food for a specific purpose, it is referred to as a direct additive. For example, the low-calorie sweetener aspartame, which is used in beverages, puddings, yoghurt, chewing gum and other foods, is considered a direct additive. Many direct additives are identified on the ingredient label of foods. Indirect food additives are those that become part of the food in trace amounts due to its packaging, storage or other handling. For instance, minute amounts of packaging substances may find their way into foods during storage.

Food additives may be classified as:

2.11.1 Antimicrobial agents.

Which prevent spoilage of food by mold or micro-organisms; These include not only vinegar and salt, but also compounds such as calcium propionate and sorbic acid, which are used in products such as baked goods, salad dressings, cheeses, margarines, and pickled foods.

2.11.2 Antioxidants.

This class of food additive is used to delay the onset of or slow the pace at which lipid oxidation reactions in food processing proceed. Most of the synthetic antioxidants contain a phenolic functionality with various ring substitutions (monohydroxyl or polyhydroxyphenolic compounds) such as butylated hydroxytoluene (BHT), BHA, t-BHQ, PG, gossypol and tocopherol. From the viewpoint of chemistry, free radicals refer to any molecule with an odd unpaired electron in its outer electronic shell, a configuration responsible for the highly reactive nature of such species. The presence of such highly reactive free radicals in biological systems is directly linked to the oxidative damage that results in severe physiological problems. The free radical species that are of concern in living systems include the reactive oxygen species (ROS), super oxide radicals (SOR), hydroxyl radicals and there active nitrogen species (RNS). The oxygen-containing reactive species are the most commonly occurring free radicals in living medium and are therefore of greatest concern.

The oxidative damage caused by these free radicals can be prevented by using antioxidants which include enzymatic antioxidant systems such as catalase, glutathione peroxidase and superoxide dismutase (SOD) as well as non-enzymatic antioxidants. It should be noted that, in nature, the generation of free radicals which cause oxidative stress and that of antioxidants or radical scavengers is carefully controlled such that there is always a balance between the two (Vouldoukis *et al.* 2004). Examples of non-enzymatic antioxidants include vitamin C (ascorbic acid) which is a sugar acid, vitamin E (alpha-tocopherol) and betacarotene, bilirubin, propyl gallate. Condensation ester product of gallic acid and propanol), uric acid, tertiary butyl hydroquinone (t-BHQ), butylated hydroxyanisole (BHA), ubiquinone and macromolecules which include ceruloplasmin, albumin and ferritin.

Generally, mixtures of different antioxidants provide better protection against attack by free radicals rather than individual antioxidants. Due to the importance of antioxidant systems, there are a number of quality assessment criteria for the antioxidant performance of these systems. Various assays have been developed to assess the antioxidant capacities, including the oxygen radical absorbance capacity (ORAC) assay, ferric reducing ability of plasma (FRAP), Trolox equivalent antioxidant capacity (TEAC) assay, etc. Antioxidants prevent rancidity in foods containing fats and damage to foods caused by oxygen.

2.11.3 Colorants and flavor enhancers.

In simple terms, flavouring agents are extracts or concentrates. They are metabolites found in living media (tissues and cells) and their formation is complex, governed by genetic factors and well as being influenced by environmental factors. As the name suggests, a flavouring agent or system refers to a substance that gives or modifies the characteristic and natural taste of a certain food or drink, causing it to become more appealing, sweet or sour as determined by the sensory mechanism of either the tongue (taste buds), smell or touch (Auvray and Spence 2008). And in accordance with the chemistry of sweeteners, the word 'taste' was used frequently to differentiate this from the word 'flavour', which is used very often interchangeably. There is a need to define these two terms such that the difference is made clear. Taste comprises the rudimentary sensations of sweet, sour, bitter and salty, whereas flavour is the combined sensation of taste and the olfactory perception of food.

Flavour enhancers, on the other hand, are substances that are commonly added to food products for the purpose of imparting more taste (savoury) as well as adding nutritive value and appeal, especially to food items that are either tasteless or have an unsatisfactory taste (Barceloux2009; Jinap and Hajeb2010). Food additives classified either as fragrances, flavouring agents or flavour enhancers have been used extensively over theyears. In simple terms, colorants are added to make food more appealing and to provide certain foods with a colour that humans associate with a particular flavor (e.g. red for cherry, green for lime).

2.11.4 Thickening and stabilizing agents:

Which function to alter the texture of food, examples include the emulsifier lecithin, which, keeps oil and vinegar blended in salad dressings, and carrageen, which is used as a thickener in ice creams and low-calorie jellies.

Recently, most people tend to eat the ready-made food available in the market, rather than preparing it at home. Such foods contain some kind of additives and preservatives, so that their quality and flavor is maintained and they are not spoiled by bacteria and yeasts. More than 3000 additives and preservatives are available in the market, which are used as antioxidants and antimicrobial agents. Salt and sugar are the most commonly used additives. Some of the commonly used food additives and preservatives include; aluminum silicate, amino acid compounds, ammonium carbonates, sodium nitrate, propyl gallate, butylated hydrozyl toluene (BHT), butylated hydroxyanisole (BHA), monosodium glutamate, white sugar, potassium bromate, potassium sorbate, sodium benzoate, etc. Some artificial colors are also added to the foods to give them an appealing look. These coloring substances are erythrosine (red), cantaxanthin (orange), amaranth (Azoic red), tartrazine (Azoic yellow) and annatto bixine (yellow orange).

When the food is to be stored for a prolonged period, use of additives and preservatives is essential in order to maintain its quality and flavor. The excess water in the foods can cause the growth of bacteria, fungi and yeasts. Use of additives and preservatives prevents spoiling of the foods due to the growth of bacteria and fungi. Additives and preservatives maintain the quality and consistency of the foods. They also maintain palatability and wholesomeness of the food, improve or maintain its nutritional value, control appropriate pH, provide leavening and color, and enhance its flavor.

2.12 Nutrient additives:

Like all other organisms, humans possess genetical variations which mean differences between individuals in terms of response to diets as well as susceptibility to some genetical diseases and disorders such as obesity, cancer and diabetes as well as cardio vascular diseases. These variations in genetical make-up create sharp differences not only phenotypically but also with regard to the performance of food metabolism. The interaction and association of genes, food and the biological outcomes which are manifest health wise and the ability of individual's body to withstand or overcome diseases also vary from one individual to another.

This reasoning led to nutritional genomics, or nutrigenomics and nutrigenetics, which investigates how food affects or influences the regulation of genetic coding as well as the way an individual's genetic coding influences the metabolism of diets (Stover 2004, 2006; Stover and Caudill 2008). In simple terms, both diet and genes play important roles in determining the health of an individual and the ability of the body to withstand or fight a certain disease. The important part of nutrigenetic studies is to identify sets of genes that could be regulated by certain diets or nutrition and which are responsible for genetic diseases. This could result in a breakthrough in the process of design and development of diagnostic tools as well as curative mechanisms for problematic genetic diseases including vitamins and minerals are added to foods during enrichment or fortification. For example, milk is fortified with vitamin D, and rice is enriched with thiamin, riboflavin, and niacin.

2.13 Chemistry of Additives

When we need to store any food for a longer time, it should be properly processed. During this processing, some substances and chemicals, known as additives, are added to the food. In addition, we also need to add some preservatives in order to prevent the food from spoiling. Direct additives are intentionally added to foods for a particular purpose. Indirect additives are added to the food during its processing, packaging and storage. Food additives require the appropriate machinery; dispensing and storing equipment, whether one produce the chemical food additives, or rely on food preservative suppliers to deliver additives and preservatives for baked goods or beverages.

In the food preservatives industry, the industry considers supplies that align with the need for using food additives in food products. In other words, supplies and other equipment for food additives must be beneficial in maintaining freshness, consistency, texture, taste, color and nutrient levels that help sell food products. Supplies for food additives include liquid and solid separation equipment, food preservation presses, industrial mixers, homogenizers, pasteurizers and dispensers. Conveyors, storage and processing tanks and vacuum tumblers that marinate or cure meats are also common equipment used for preservatives in food. Chemical food additives such as corn starch, potassium sorbate and sodium nitrate are usually available as syrup, crystals or powders that must be ordered from food preservative suppliers.

2.14 Effects of Food Additives.

Some modern synthetic preservatives have become controversial because they have been shown to cause respiratory or other health problems. Some studies point to synthetic preservatives and artificial coloring agents aggravating ADD & ADHD symptoms in those affected. Older studies were inconclusive, quite possibly due to inadequate clinical methods of measuring offending behavior. Parental reports were more accurate indicators of the presence of additives than clinical tests several major studies show academic performance increased and disciplinary problems decreased in large non-ADD student populations when artificial ingredients, including preservatives were eliminated from school food programs.

Allergic preservatives in food or medicine can cause an aphylactic shock in susceptible individuals, a condition which is often fatal within minutes without emergency treatment. It is almost a certainty that few really know what it is, that is part of their foodstuffs, and yet may present threats and danger. Essentially, there are two main sources of dangerous or threatening additives. The first is those that are put in as part of the processing operation. These include the colorings, preservatives, flavors and flavor enhancers, sweeteners, texture agents and processing agents. Details of these must be included on the labelling and can be identified with a little knowledge and some attention to the information provided by the manufacturer. Ideally, food that has no additives at all is to be preferred and especially if it is to be used to feed children. Far too many of our young are sensitized through these additives and this can lead to allergies and such conditions as Attention Deficit Disorder and Hyperactivity.

2.15 Significance of Food Preservatives And Additives.

The importance of preserving food is that, it lengthens the shelf life of a food and it slows down the spoilage of food which is caused by microorganisms present in the container or the hands that held it before putting it inside a container. The importance of food preservation is so that the food cannot be spoilt or can cause illness. Although preservatives are essential to maintain food safety, too much of a good thing is not healthy. Besides allergies, these foods may cause stomach pains, vomiting, breathing problems, hives and skin rashes.

Some of the worst additives include benzoates, which can cause skin rashes, asthma and perhaps brain damage. Bromates can cause nausea and diarrhea. Saccharin may lead to toxic reactions that impact the gastrointestinal tract and heart, as well as cause tumors and bladder cancer. Red Dye 40 may result in certain birth defects. Sodium chloride can lead to high blood pressure, kidney failure, stroke and heart attack. Such problems are why some doctors are now saying it is better to have a soda with sugar than a diet soda with additives.

2.16 Advantages of Food Preservatives

Food additives play a vital role in today's food supply. They allow our growing urban population to have a variety of foods year-round. And, they make possible an array of convenience foods without the inconvenience of daily shopping. Food additives perform a variety of useful functions in foods that are often taken for granted.

I. Since most people no longer live on farms, additives help keep food wholesome and appealing while en route to markets sometimes thousands of miles away from where it is grown or manufactured.

II. Additives also improve the nutritional value of certain foods and can make them more appealing by improving their taste, texture, consistency or colour.

Additives are used in foods for five main reasons:

I. To maintain product consistency. Emulsifiers give products a consistent texture and prevent them from separating. Stabilizers and thickeners give smooth uniform texture. Anti-caking agents help substances such as salt to flow freely.

II. To improve or maintain nutritional value. Vitamins and minerals are added to many common foods such as milk, flour, cereal and margarine to make up for those likely to be lacking in a person's diet or lost in processing. Such fortification and enrichment has helped reduce malnutrition among the U.S. population. All products containing added nutrients must be appropriately labeled.

III. To maintain palatability and wholesomeness. Preservatives retard product spoilage caused by mold, air, bacteria, fungi or yeast. Bacterial contamination can cause foodborne illness, including life-threatening botulism. Antioxidants are preservatives that prevent fats and oils in baked goods and other foods from becoming rancid or developing an off-flavor. They also prevent cut fresh fruits such as apples from turning brown when exposed to air.

IV. To provide leavening or control acidity/alkalinity. Leavening agents that release acids when heated can react with baking soda to help cakes, biscuits and other baked goods to rise during baking. Other additives help to modify the acidity and alkalinity of foods for proper flavor, taste and color.

V. To enhance flavor or impact desired color. Many spices, natural and synthetic flavors enhance the taste of foods. Colors, likewise, enhance the appearance of certain foods to meet consumer expectations.

Additives and preservatives are used to maintain product consistency and quality improve or maintain nutritional value, maintain palatability and wholesomeness provide leavening, control pH, enhance flavor, or provide color.

2.17 Disadvantages of Food Additives

Although additives and preservatives are essential for food storage, they can give rise to certain health problems. They can cause different allergies and conditions such as hyperactivity and Attention Deficit Disorder in some people who are sensitive to specific chemicals. The foods containing additives can cause asthma, hay fever and certain reactions such as rashes, vomiting, headache, tight chest, hives and worsening of eczema. Some of the known dangers of food additives and preservatives are as follows:

I. Benzoates can trigger the allergies such as skin rashes and asthma as well as believed to be causing brain damage.

II. Bromates destroy the nutrients in the foods. It can give rise to nausea and diarrhea.

III. Butylates are responsible for high blood cholesterol levels as well as impaired liver and kidney function.

IV. Caffeine is a colorant and flavoring agent that has diuretic, stimulant properties. It can cause nervousness, heart palpitations and occasionally heart defects.

V. Saccharin causes toxic reactions and allergic response, affecting skin, gastrointestinal tract and heart. It may also cause tumors and bladder cancer.

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CHAPTER THREE

MATERIALS AND METHODS

3.1 MATERIALS USED

3.1.2 Yam peel:

The yam peel used in this research work is of the specie *Discorea rotundata* (white yam) cultivated Yakoko in Zing local government area of Tarabar State, Nigeria.

3..1.3 Plantain peel:

The Plantain peel used in this research work was gotten from plantain bought at Jimeta Ultra Modern Market, Yola-North local Government Area of Adamawa State. The plantains were identified by the Crop production department in Modibbo Adama University of Technology, Yola. To obtain the ripe peel, the unripe plantains (green) were kept to ripen at room temperature for two days, and the ripe plaintain peel (yellow) was removed with a sharp clean knife and the pulp removed gently as described by (Ajila *et al.*, 2007).

3.2 Chemicals and media:

Methanols, ethanol, tetraoxosulphate (VI), sodium hydroxide solution, alcoholic ferric chloride, petroleum ether, acetic anhydride solution, hydrochloric acid, hydrogen tetraoxonitrate (VI), nutrient agar, nutrient broth, KBr pellet, distill water, tap water.

3.3 Instruments:

mortar and pestle, electronic weighing balance, pipette, test tubes, reagent bottle, oven, conical flasks, beakers, measuring cylinder, filter paper, water bath, swab sticks, universal (sterilized), wire loop, funnel, stirrer and FTIR spectroscope.

3.4 Preparation of plant material:

The Yam tubers and the plantain fruits were pealed manually with the aid of clean Knife. The peels were cleaned, rinsed with distil water to avoid contermination and then dried at room temperature to constant weight for five (5) days. The dried samples were pulverized using pestle and mortar; the samples were passed through a 100-mesh sieve producing a free flowing-powder and then stored in plastic containers prior to the analysis.

3.5 Methods:

3.5.1 Methanol extracts of the plant material:

Fifty (50) g of the powdered samples were macerated in 500 mililitres of methanol with the resultant solution filtered using whatman filter paper after 48 hours under room temperature (34^0C) to obtain the methanol extract.

The extracts obtained above were concentrated to one third of its original volume on a water bath. The concentrates are then used for the phytochemical screening. Afresh extractions were then carried out and the concentrates were then transferred into reagent bottles to be used for subsequent analysis.

3.6 Reagents Preparation

3.6.1 Ninety Percent Ethanol (90% C_2H_5OH):

90 ml of ethanol was measured into a volumetric flask and distil water was added to bring the level 100ml mark, i.e. about 10ml of distil water added.

3.6.2 Ten Percent Sodium Hydroxide (10% NaOH):

10 g sodium hydroxide pellets was weighed and dissolved into 100ml distilled water in a beaker. This was then transferred into a reagent bottle.

3.6.3 Dilute Sulphuric Acid (H_2SO_4):

10 g of concentrated sulphuric acid (H_2SO_4) was measured and slightly poured into a beaker containing distil water. This was transferred into a 100 ml volumetric flask and made up to the mark with the distil water added to make up 100ml mark.

3.6.4 Alcoholic Ferric Chloride:

1 g of $FeCl_3$ was weighed and dissolved into 100ml of ethanol and stored in a reagent bottle.

3.6.5 Five Percent Ferric Chloride (5% $FeCl_3$):

5% of $FeCl_3$ was weighed and dissolved into 100ml of distil water, which was transferred into a reagent.

3.6.6 Acetic Anhydride Solution:

2ml solution was prepared using the formular;

C x M_W x V/1000 x Sp x % purity

Where,

C = Concentration of the acetate,

V = Volume needed (100ml),

M_W = Molar weight,

% = Percentage purity,

Sp = specific gravity,

Substituting their respective values in the above formular thus the value of the acetic acid obtained above was measured and slightly poured into 100ml of distilled water, then stored in a reagent bottle.

3.6.7 One Percent of Hydrochloric Acid (1% HCl):

The formular shown below was used;

C x V/Sp

Where,

C = Concentration of the acid,

V = Volume needed (100ml),

Sp = Spacific gravity.

Substituting the values in the above formular;

Thus, the value gotten for the acid was measured and slightly poured into 100ml of distilled water, then stored in a reagent bottle.

3.7 Qualitative phytochemical analysis.

3.7.1 Glycoside

A 0.5 g portion of each of the sample was mixed with 2ml of glacial acetate and 1 drop of ferric chloride solution, after which 1ml of concentrated sulphuric acid were added. The reaction was observed for a brown ring formation

3.7.2 Steroids

A 0.5 g portion of the ethanolic extract fraction of each plant was mixed with 2ml of acetic anhydride followed by 2ml of sulphuric acid. The colour changed from violet to blue or green in some samples indicated the presence of steroids (Sofowora, 1993).

3.7.3 Flavonoids

A portion of powdered plant in each case was heated with 10ml of ethyl acetate in a test tube over a steam bath for 3 minutes. The mixture was filtered and 4ml of the filtrate was shaken with 1ml of dilute ammonia solution. Yellow coloration was observed that indicated the presence of Flavonoids (Harborne, 1973; Sofowora, 1993).

3.7.4 Tannins

A 0.5 g portion of the dried powdered sample was boiled in 20ml of distilled water in a test tube and filtered. 0.1% ferric chloride ($FeCl_3$) solution was added to the filtrate. The appearance of brownish green or a blue-black colouration indicates the presence of tannins in the test samples

3.7.5 Saponins

A 2.0 g portion of the powdered sample was boiled in 20ml of distilled water in a test tube in boiling water bath and filtered. 10ml of the filtrate was mixed with 5ml of distilled water and shaken vigorously to form a stable persistent froth. The frothing was mixed with 3 drops of olive oil and shaken vigorously for the formation of emulsion characteristic of saponins (Obadoni and Ochuko, 2001).

3.7.6 Anthraquinones

A 0.5 g portion of the plant extract was shaken with 5 ml of chloroform. The chloroform layer was filtered and 5.0 cm^3 of 10 % ammonia solution was added to the filtrate. The mixture was shaken thoroughly and the formation of a pink/violet or red, yellow colour in the ammoniacal phase indicates the presence of Anthraquinones (Harborne, 1973).

3.7.7 Alkaloids

A 0.5 g portion of the extract was stirred with $5cm^3$ of 1% aqueous HCl on a steam bath. Few drops of picric acid solution were added to $2cm^3$ of the extract. The formation of a reddish brown precipitate was taken as preliminary evidence for the presence of alkaloids (Harborne, 1973: Trease and Evans 1989).

3.7.8 Phlobatannins

A 2.0 g portion of the powdered sample was boiled with 1% aqueous hydrochloric acid; the formation of red precipitate thus indicated the presence of phlobatanins (Harborne, 1973; Sofowara, 1993).

3.8 Fourier Transform Infrared Spectrophotometer (FTIR)

Fourier Transform Infrared Spectrophotometer (FTIR) perhaps is the most powerful tool for identifying the type of chemical bonds/functional groups present in the phytochemicsls. The wavelength of light absorbed is salient feature of the chemical bond as can be seen in the annotated spectrum. By increasing the infrared absorption spectrum, the chemical bond in a compound can be determined.

Dried powders of the extracts were used for FTIR analysis. Meanwhile about 1g of the powder was placed on the pallet wiv few drops of mehtylene chloride added in order to prepare translucent sample before its been loaded on the FTIR spectroscope with scan range from 400 to 4000 cm^{-1} with a resolution of 4 $cm^{-1.}$

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Results

Phytochemical constituents present in the plant extract included saponins, alkaloids, flavonoids, terpenes, glycosides and antraquinones. The results for phytochemical screening of both plantain and yam peel are shown in Tables 1 and 2 respectively**.**

4.2 The preliminary phytochemical analysis of the methanolic peel extract of *M. paradisica.* Was carried out and the results is as shown in Table 1

Table 1: Phytochemical components of *M. paradisica* methanolic peel extrct.

Phytochemical	Observation
Tannin	+
Saponin	+
Flavonoid	+
Steroid	-
Alkaloid	+
Terpenes	+
Glycoside	+
Antraquinones	-

Key word: + = present - = absent

4.3 The preliminary phytochemical analysis of the methanolic peel extract of *D. rotundata*. Was carried out and the results is as shown in Table .2

Table 2. Phytochemical Analysis of *D. rotundata* methanolic peel extract

Phytochemical	Observation
Tannin	+
Saponin	+
Flavonoid	+
Steroid	-
Alkaloid	+
Terpenes	-
Glycoside	+
Antraquinones	-

Key word: + = present   - = absent

4.4 FTIR Result

Results of FTIR spectroscopic analysis of methanolic extract of plantain peel and plantain peel revealed the existence of various chemical constituents and they are presented in figures 1 and 2 respectively.

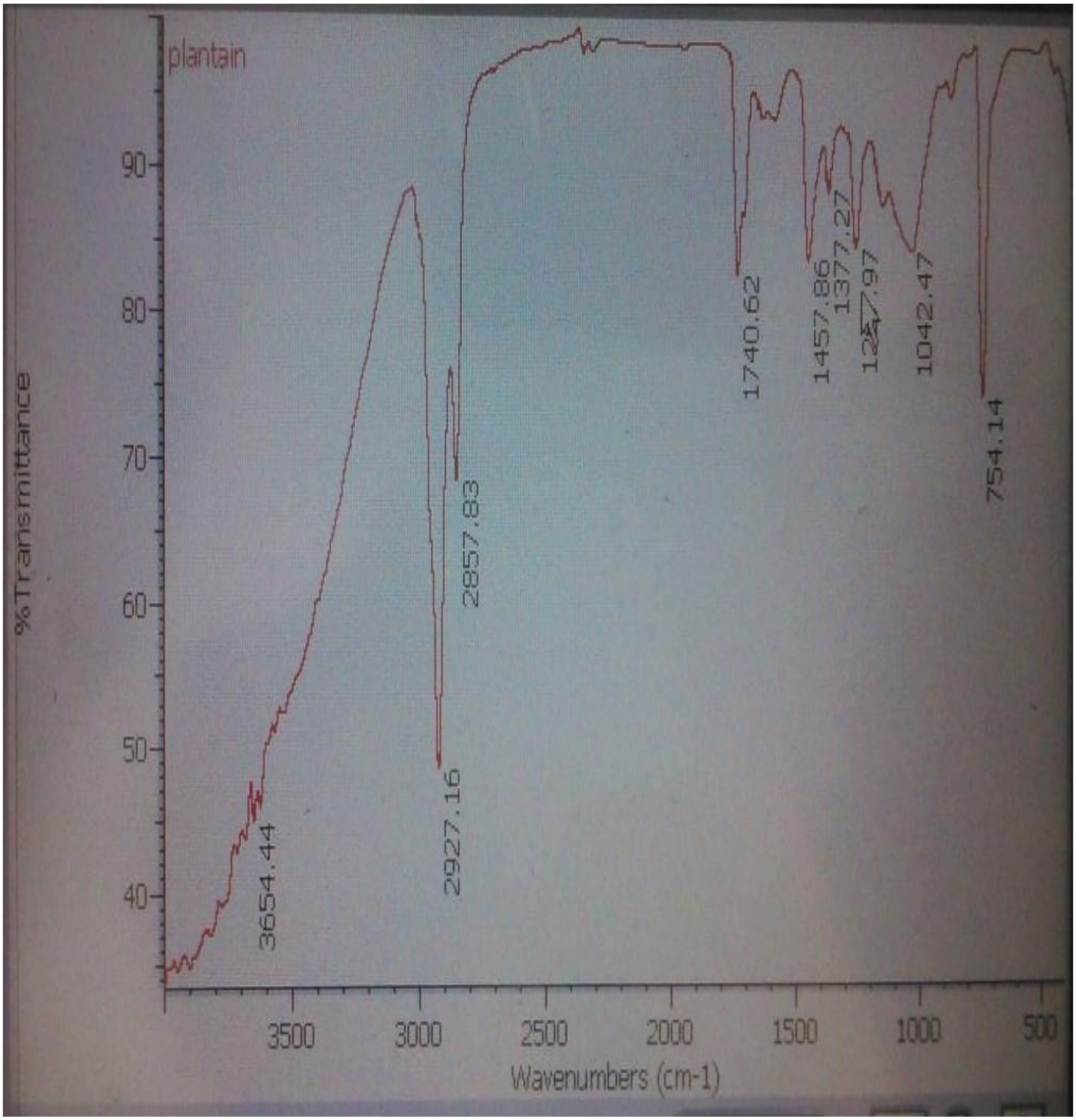

Figure 1: FTIR spectra of methanolic extract of plantain peel.

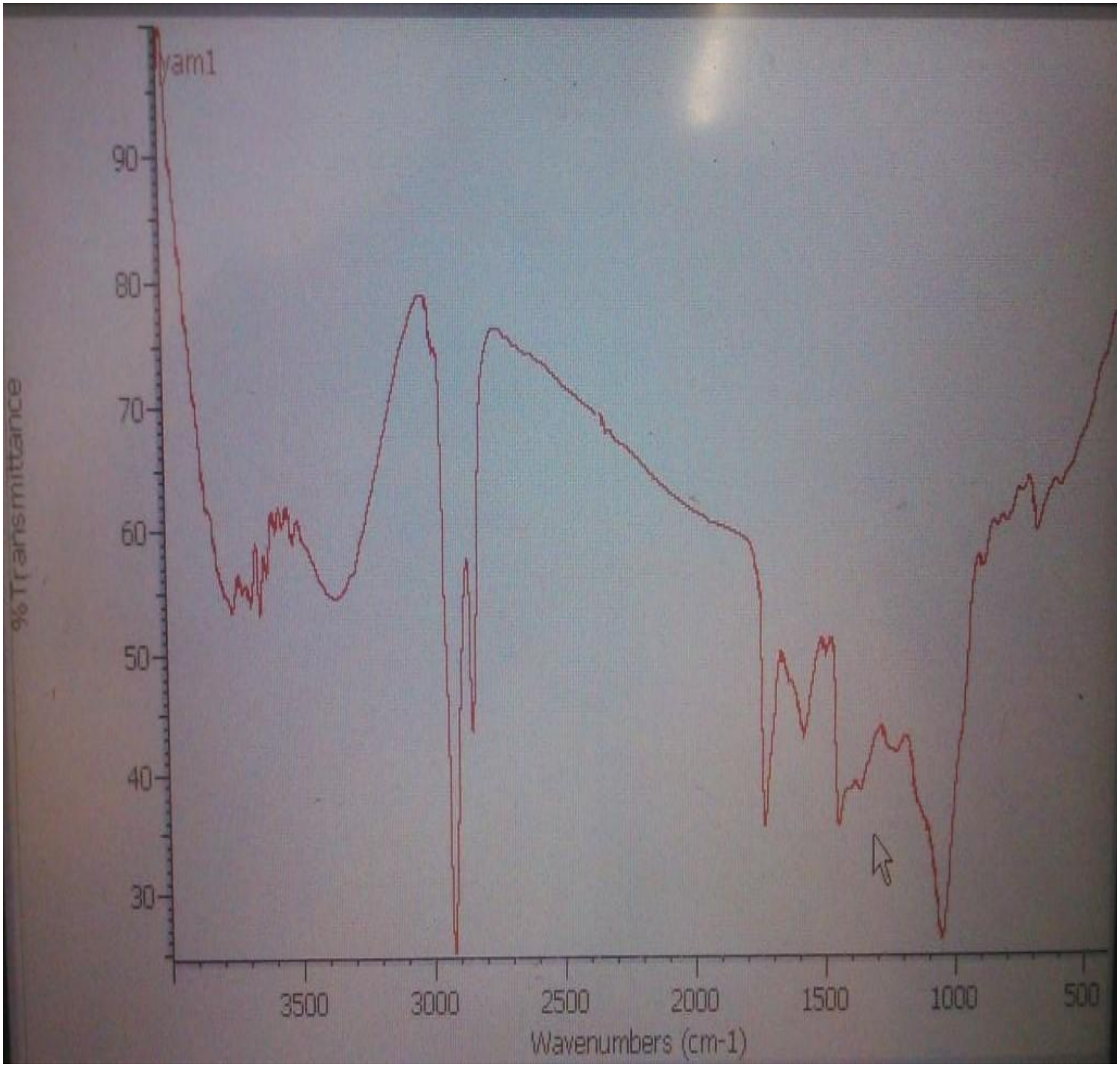

Figure 2: FTIR spectra of methanolic extract of yam peel.

4.5 FTIR analysis of *M. paradisiaca* peels has absorption bands and wave numbers (cm-1) of the potential peaks obtained were described in the Table 3. The peak at a frequency 1040 is strong while the rest varies from medium to weak.

Table 3: FTIR analysis of the methanolic extracts of *M. paradisiaca* peels.

Type	Absorption frequency (cm^{-1})	Intensity	Remark an assignment
OH group (alcohol)	3654.44	MN	OH free stretching
Methylene group (alkane)	2927.16	MN	Asymmetry stretching
Methylene group (alkane)	2857.83	MN	Symmetry stretching
Carbonyl group	1740.62	WN	C=O Stretching Aldehyde
Methylene group (alkane)	1457.86	WN	Bending alkane
OH group (phenol)	1377.27	WN	Bending phenol
Cyanide group	1240.97	WN	C-N Stretching amine
C-O group	1042.47	SN	Stretching primary alcohols
Alkenyl group (alkene)	754.14	WN	C=C bending

4.6 FTIR analysis of *D.rotundata* peels has absorption bands and wave numbers (cm-1) of the potential peaks obtained were described in the Table 4. The peaks at frequencies of 2910cm^{-1} 1050 cm^{-1} are strong while the rest varies from medium to weak

Table 4: FTIR analysis of the methanolic extracts of *D.rotundata* peels.

Type	Absorption frequency (cm^{-1})	Intensity	Remark an assignment
NH group (amine)	3400	MB	Primary amine stretching
Methylene group (alkane)	2910	SN	Asymmetry stretching
Methylene group (alkane)	2830	MN	C-H Stretching aldehyde
Carbonyl group	1750	MN	C-O Stretching aldehyde
Alkenyl (alkene)	1600	MN	Conjugated alkene stretching
Methylene group (alkane)	1450	MN	C-H bending
C-O group	1050	SN	Stretching primary alcohol
Alkenyl group (alkene)	850	WN	C=C bending

Key word: S=Strong N=Narrow B=Broad M=Medium W=Weak

4.7 Discussion.

The phytochemical analysis of the methanolic extract of the *M. paradisiaca* revealed the presence of, tannin, saponin, flavanoid, alkaloid, terpene, glycoside (Table1). The phytochemical analysis of the methanolic extract of *D. rotundata* revealed the presence of tannin saponin, flavanoid, alkaloid, terpene, glycoside (Table 2). This finding is in agreement with Eleazu et al. (2013), Akinsanmi et al. (2015), with slight contrast to Lawal et al. (2014) who stated the presence of steroid. The observed difference could be as a result of differences in weather conditions where these plants were grown and then collected. It could also be as a result of changes during extraction or storage.

Flavonoids have been reported to have antioxidants properties, anti inflammatory properties, anti cancer properties and as thus required in the treatments of coronary heart diseases and lots more. The antioxidant properties of the two samples were due to the presence of flavonoid hence substances used as preservatives have antioxidants properties. (Titus 2014). The presence of alkaloid in the crude methanolic extract of the two samples has contributed to its antimicrobial effect because alkaloids have been reported to have antimicrobial and antiparasitic properties (Usman *et al.,* 2013) the alkaloid berberine and palmatine were known to inhibit the multiplication of bacteria, fungi and viruses (Usman *et al.,* 2013).

From the result in Fig.1 above, the methanolic extract of *M. paradisiaca* peel has absorption bands, the wave number (cm^{-1}) of the prominent peaks obtained absorption spectra were described in Table 3. The IR spectra of different extracts reveal structural information about major and minor constituents. The peak at 3654 cm^{-1} assigned to the OH stretching viberation. In addition, the peak at 1740 cm^{-1} assigned to C=O stretching aldehyde vibrations means that some carbonyl compounds exist in the peels of *M. paradisiacal.* So depending on the fingerprint characters of the peak positions, shapes and intensities,the fundamental components may be identified. (Chen et al. 2001). The peaks at 2927 cm^{-1} narow medium belongs to CH_2 (methylene) assymetic alkane.and likewise peak at 2857 cm^{-1} which is narrow weak assigned to CH_2 (methylene) symmetry alkane; meanwhile the peak intensity at 1377 cm^{-1} is narrow weak and assigned OH bending phenol, intensity at 1240 cm^{-1} which is narrow weak is assigned C-N stretching amine. The remaining peaks at 1042 cm^{-1} which is narrow strong was assigned C-O group stretching primary alcohol and 754 cm^{-1} narrow weak belongs tp C=C bending alkene. The presence of C=O, C-H, C=C, C-N, C-O, OH are responsible for the formation of alkyl groups, methyl groups, alcohols, cyanides, esters, ethers, carboxylic acids, anhydrides and deoxyribose (Dukor, 2001; Sohrabi et al., 2005).

From the result in Fig. 2 above, the methanolic *D. rotundata* peel extract has absorption band as were described in Table 4. The medium broad peak at 3400 cm^{-1} assigned to NH group primary amine stretching. Meanwhile the peak at 2910 cm^{-1} strong and narrow assigned to methylene (CH_2) group asymmetric stretching. The peak at 2830 cm^{-1} medium and narrow is assigned methylene C-H stretching aldehyde and so is the peak at 1750 cm^{-1} medium narrow is assigned C-O stretching aldehyde. Peak at 1600 cm^{-1} medium and narrow is assigned alkynyl conjugated alkene stretching. A characteristic peak at intensity of 1050 cm^{-1} strong and narrow is assigned C-O stretching primary alcohol and lastly the only weak and narrow peak observes in yam peel was found at 850 cm^{-1} and was assigned alkenyl C=C bending.

The plantain peel extracts suggest the presence of alcohol, aromatic benzene, carbonyl, cyanide, amine and aldehyde which is characteristic of methylene group both symmetry and asymmetry stretching. On the other hand, the yam peel methanolic extract also suggest the presence of primary amine, primary alcohol, conjugated alkene, alkane and aldehyde which is an indicative of methylene group asymmetric, symmetric with accompanying carbonyl group. Many workers revealed the FTIR spectrum as an effective tool for differentiating, classifying and discriminating closely related plants and other organisms.

The presence of alcohol and aldehyde in the both *M. paradisiaca* and *D. rotundata* peel extracts proved that both plantain peel and yam peel can be used in the preservation of local drinks. Hence alcohol and aldehyde (formaldehyde) are the two major components of preservation. While alcohol is consumable, formaldehyde when consumed in large quantity could lead to strange behaviors e.g loss of sanity and in extreme cases leads to mental disorder. Considering the fact that the peels are consumed by animals, it can resolved that formaldehyde occurring in yhe peels are in trace quantity and as such the main preservative property is largely due to the presence of alcohol.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMENDATIONS

5.1 Summary.

The bioactive compounds contained in plants were majorly responsible for their medicinal properties (Ighodaro *et al*, 2009). Flavonoids, tannins, alkaloids, glycosides and terpenoids were found to be present in peels of *M. paradisiaca* with the exception of terpenes in *D.rotundata.* These phytochemicals have been reported to exert multiple biological and pharmacological effects (antibacterial, antihypertensive, antidiabetic and anti-inflammatory activities (Middleton and Kandaswami, 1996). The presence of these bioactive substances in these plants extracts therefore suggests that the peels possess valuable medicinal potential yet to be explored.

This study was aimed at determining the preservative potential of *M. paradisiaca* and *D.rotundata.* the results from phytochemical screening of the two samples revealed the presence of Flavonoids, tannins, alkaloids, glycosides and others. The FTIR revealed relevant information about the presence of certain chemical constituents. The peaks were found to contain alcohol. Aldyhyde (formaldehyde), alkane among others. Alcohol and formaldehyde been the major component responsible for preservation. Finally it can be concluded that *M. paradisiaca* and *D.rotundata* have the potentials to be used as natural preservatives in the preservation of locally made drinks.

5.2 Conclusion.

At the end of this research work, it can be concluded that the presence of flavonoid and alkaloid in the methanolic extract of the two samples contributed to its antimicrobial effect. Flavonoid are known to exhibit antioxidant properties while alkaloids have been reported to have antimicrobial and antiparasitic properties. Hence certain alkaloids are known to inhibit the multiplication of bacteria, fungi and viruses. The presence of alcohol group from the results of FTIR conducted on *M. paradisiaca* and *D.rotundata* is a major component required for preservation of food materials.

5.3 Recommendations.

The following are recommendation drawn during the course of this research work:

I. Other spectroscopic analysis such as NMR, Ultra-Violet and mass should be done to confirm the presence of alcohol and formaldehyde.
II. Further studies such as quantitative analysis of the phytochemicals should be carried out to determine the quantity of flavonoids and alkaloids present.
III. Preservative study should be carried out on other parts of these plants e.g leaves, fruits ripe or unripe, room-dried or oven-dried.
IV. Other extraction methods should be employed
V. Antimicrobial analysis should be conducted to check there respective antimicrobial properties.
VI. Further studies should be conducted to provide means of detecting more preservatives.

Contribution to Knowledge

At the end of this project work, the following are the contributions that can be said to have been added to the general body of knowledge:

I. This study has provided an alternative means for obtaining alcohol from natural products.
II. This study has resulted in the use of natural product as preservatives instead of the usual sodium benzoates commonly used. Benzoates can trigger the allergies such as skin rashes and asthma as well as believed to be causing brain damage.
III. This study has promoted innovative chemical technology that reduces the use of preservatives used in the preservation of local drinks. Hence most of the preservatives used are not recommended by food scientist.

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