COMPARATIVE STUDIES OF NUTRITIONAL AND ANTI-NUTRITIONAL COMPOSITION OF BANANA (musa Sapiantum) AND PLANTAIN (musa paradislaca)

BY

HAFSAT ALIYU MUSA ANKA
1510302025

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PROJECT

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For the award of the Degree of

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PLANT SCIENCE AND BIOTECHNOLOGY

NOVEMBER, 2019

DECLARATION

I hereby declare that this project is written by me and it has not been presented before in any application for Bachelor Degree except for quotations and summaries which have been duly acknowledged.

Hafsat Aliyu Musa Anka

09/12/2019
Date

CERTIFICATION

This project entitled "Comparative Studies of Nutrition and Anti-nutrition Composition of Banana (*Musa Sapiantum*) and Plantain (*Musa Paradisiaca*)" meets the regulation governing the award of Bachelor of Science of the Federal University Gusau and is approved for its contribution to knowledge and literary presentation.

....	02/12/2019
Mal. Sufiyanu Saminu (Supervisor)	Date
....	04 12/19
f. Prof. S. J. Oniye (Head of Deparfment)	Date
....	02.12.19
Prof. K. Abdullahi (Dean of Science)	Date
....	2/12/2019
Prof. W. S. Japhet (External Examiner)	Date

DEDICATION

This work is dedicated to my familys for their unalloyed support and unquantifiable investment in my life may, May Almighty Allah reward you abundantly.

ACKNOWLEDGMENT

Praises and thanks to the Almighty Allah, the creator of the heavens and the earth, the Lord of mankind for his decree towards the success of this project.

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TABLE OF CONTENT

CHAPTER TWO

CHAPTER THREE

CHAPTER FOUR

CHAPTER FIVE

LIST OF TABLE

ABSTRACT

Banana and plantain plants are the world's biggest herbs, grown abundantly in many developing countries. Bananas and plantains are one of the most important sources of energy in the diet of people living in tropical humid regions. This research was conducted between July and October 2019 in Biochemistry Laboratory Federal University Gusau Zamfara State. The Banana and Plantain samples was collected in Gusau central market. The nutritional and anti-nutritional compositions of Banana and Plantain was evaluated using standard procedures. Results on nutritional compositions of Banana showed that, moisture content have the highest value (76.97 ± 2.03), followed by total carbohydrate with (6.88 ± 0.08), crude protein had (6.40 ± 0.46), Ash content (4.25 ± 0.15), Crude fiber (3.70 ± 0.24), the lowest value was obtained from Crude lipid (1.80 ± 0.16). Results on nutritional composition of plantain showed that, moisture content have the highest value (65.48 ± 0.72), followed by the total carbohydrate (16.7 ± 0.82), Crude protein (9.04 ± 0.35), Ash content (5.33 ± 0.45), Crude fiber (2.67 ± 0.24), the lowest value was obtained from Crude lipid (0.80 ± 0.16). Results on anti-nutritional composition of Banana showed that, Phytate have the highest value (81.53 ± 0.6067), followed by Nitrate (10.46 ± 0.00471), Cyanide (0.635 ± 0.0659), Oxalate (0.0783 ± 0.0846), the lowest value was obtained from Tannins (0.0147 ± 0.000471). Results on Anti-nutritional composition of Plantain showed that, Phytate have the highest value (93.347 ± 2.634), followed by Nitrate (2.633 ± 0.0047), Cyanide (0.538 ± 0.0078), Tannins (0.034 ±0.0334), the lowest value obtained from Oxalate (0.022 ± 0.000816). Therefore, it has been suggested that, Banana and plantain shall be consumed daily due to their higher nutritional and lower anti-nutritional compositions.

CHAPTER ONE

1.0 Introduction

1.1 Background of the Study

Banana and plantain plants are the world's biggest herbs, grown abundantly in many developing countries. Bananas and plantains are one of the most important sources of energy in the diet of people living in tropical humid regions. The plants are stenothermic, cultivated in hot and wet regions, and bear fruits all year round. There are approximately 1200 varieties of bananas all over the world (Kouassi, 2001). Banana is a general term embracing a number of species or hybrids in the genus Musa of the family Musaceae. Almost all of the known edible-fruit cultivars arose from two diploid species, *Musa acuminata* (AA) and *Musa balbisiana* (BB). Moreover, there are diploid, triploid and tetraploid hybrids made up of subspecies of *M. acuminata*, and subspecies between *M. acuminate* and *M. balbisiana* (Stover and Simmonds, 1987;m Robinso, 1996). Dessert bananas for world food trade are almost entirely derived from genetic make ups of *Musa acuminata* of triploid character, indicated as AAA. Plantain (*Musa* AAB) and other bananas that can be used for cooking (cooking bananas, *Musa* ABB) are also triploid and derived from the AA.BB hybridization. Plantains and cooking bananas are very similar to unripe dessert bananas in outward appearance,M although often larger. The major differences are that their flesh is starchy rather than sweet, they are used unripe, and require cooking. Bananas and plantains constitute the principal food resources in the world. They occupy the Fourth place in the World's most significant foodstuffs after rice, corn and milk (FAO, 1999; INIBAP, 2002). Banana trees are produced in large quantities in tropical and subtropical areas. In Africa, the main producers are Uganda and Cameroon. In Cameroon, the production of bananas and plantains represents the second agricultural economic resource of the country after wood (FAO, 2001). These bananas and plantains are the third most consumed food (Dury *et al.*, 2002) and since 2007 the exportation of bananas and plantains has tripled in Cameroon (Lassoudière, 2007).

However, each time one banana stem is produced; Bananas (including plantains) are one of the most important and oldest food crops of humankind with evidence of cultivation dating to 4000 BCE in New Guinea (Denham et al. 2003, 2004). Bananas are broadly classified into dessert and cooking types. Dessert types are eaten raw when ripe, while cooking (starchy) bananas are boiled, fried, brewed, powdered, or roasted before consumption. Plantains are the best known among the cooking bananas and form about one-third of total banana production. There is no clear demarcation between the banana and plantain, either botanically or genetically, although plantains usually contain more dry matter than banana. Several of the plantain and banana cultivars are used in various countries for both dessert and/or cooking use. In this review, the term banana will include plantains unless otherwise stated. In 2004, world production of bananas was 106.34 million tonnes (Mt) from 9.52 million hectares. This was exceeded among fruit crops by only citrus (110.91 Mt). Bananas are grown through the tropics and, to a limited extent, in the subtropics, with 37% in south and southeast Asia and the Pacific, 30% in tropical Africa, 26% in Central and South America and the Caribbean, and about 7% elsewhere (FAOSTAT). Plantains constitute the primary or secondary staple food for millions of people in tropical Africa, Pacific Ocean islands, Latin America, and the Caribbean. Annual world consumption of banana was 5.2 kg/person in 2001 but was 5 times higher in 28 of 162 consumption-reporting countries. The top banana-consuming countries (kg/person per year) were Uganda (237), Burundi (215), Rwanda (180), Sao Tome and Principe (151), Gabon (139), Ecuador (112), Bermuda (107), Ghana (92), Cameroon (90), St. Lucia (83), and Samoa (82) (FAOSTAT). Banana provides 10 to 27% of the daily calorie intake of the population in several countries. It possesses a major advantage over all the other important food crops in that is comes to harvest throughout the year. Hence it can help provide year round food security. The top banana-producing countries of the world are India (15% of total production), China, Ecuador, Brazil, and Philippines (5–6% each). About 15 to 20% of the total banana production in the world is traded internationally with an annual value of about US $6 billion. The major exporting countries are Ecuador, Costa Rica, Philippines, Colombia, Panama, and Honduras. The major importing countries/regions are the Plantain is one of the most important crops of the tropical plants. It belongs to the family *Musaceae* and the genus *Musa*. *Musa paradisiaca*, also known as plantain(English), '*Ogede agbagba*' (Yoruba), '*Ayaba*' (Hausa)and '*Ogadejioke*' (Igbo), is a tropical plant that is native to India. (2)The plant consists of long, overlapping leaf stalk sand bears a stem which is 1.22 to 6.10 m high (Oladiji *etal.*, 2010), with a life span of about 15 years (Philips,1982). The fruits grow in clusters, each separate plantain of the cluster being about 1 inch in diameter and somewhat longer than a banana fruit. Plantain fruit requires about two and a half to four months after shooting before the fruit becomes ready for harvesting ora total of about eight to twelve months after planting(Swennen, 1990a).Plantain contains a high fibre content, and thus is capable of lowering cholesterol and helps to relieve constipation and hence prevention of colon cancer .Besides this, its high potassium content is found to be useful in the prevention of raising blood pressure and muscle cramp (Ng and Fong, 2000). Various parts of the plant such as the leaves, root, fruit stalk, bract and fruit have been used for medicinal and domestic purposes. The fruit is consumed as food, the leaf juice is used in the treatment of fresh wounds, cuts and insect bites while the leaves act as an arbortifacient. Its sap is used as a remedy for diarrhoea, dysentery, hysteria and epilepsy. A cold infusion of the root is used to treat venereal diseases and anaemia. In addition, the fruit has been reportedly used as anti scorbutic, aphrodisiac and diuretic (Gill, 54 Afr. J. Food Sci. Technol 1992). Adeniji, *et al*., (2006) reported 100g edible portion of plantain to contain 67.30 g moisture, 0.4 g crude fat, 31.15 g carbohydrate, 0.95 mg potassium, 35.1 mg sodium, 71.5 mg calcium, 28 mg phosphorus, 2.4 mg iron, and yielded 116 kcal of energy. Plantain peels are by-products of the plantain processing industry, which are normally dumped in landfills, rivers or unregulated grounds (Osma *et al*., 2007). The peel of the fruit is discarded as waste after the inner fleshy portion has been eaten, thereby constituting a menace to the environment, especially where its consumption is common. Omole *et al* (2008) reported that the peel has the potentials of replacing corn starch in the diet of snail, while the bracts, fruit stalk and leaf at times are left in the farm as wastes. Leaves, pseudostems, fruit stalks and peels, after chopping, fermentation, and drying, yield a meal somewhat more nutritious than alfalfa press-cake. These waste materials have been considered for use as organic fertilizer in Somalia. In Malaya, pigs fed with pseudostems are less prone to liver and kidney parasites than those on other diets. In view of the need for waste management and upsurge in the prizes of livestock feeds coupled with their increasing demand, this study was conducted to determine the proximate and mineral composition of *Musa paradisiaca* wastes (bracts, fruit stalk, leaf and peel) flour for possible utilization as livestock feeds.

1.2 Justification

Banana and plantain are among the most important food crops in plant. Banana and plantain area healthy source of fiber, potassium and Vitamin B6, Vitamin C and varian anti oxidant. There have been many reports on Nutritional and Anti Nutritional contents of Banana and Plantain but none has been done in the study. This research will be provide information on Nutritional and Anti Nutritional contents in the study area.

1.3 Statement of the Problems

Despite the numerous health benefits of Banana and Plantain there are also certain side effects. Anti- nutrients are chemicals which have been Evolved by plant for their own defense, among other biological function and reduce the maximum utilization of nutrients especially protein , vitamin, and minerals, thus preventing optimal exploitation of nutrient present in food and decreasing the nutritive value.

1.4 Aim and Objectives

Aim of this research is to evaluate the nutritional and anti -nutritional composition of Banana and Plantain.*(Musa Sapientum and Musa Paradisiaca)*

Objectives

The Objectives Of This Research Are To:

1. Evaluate the nutritional composition of Banana and Plantain
2. Evaluate the anti-nutritional composition of banana and plantain
3. Compare the nutritional and anti-nutritional values of banana and plantain.

CHAPTER TWO

2.0 Literature Review

2.1 Banana Plant (*Musa Sapiantum*)

Banana plants are the world's foremost herbs and it's grown in several countries. However, Bananas and plantains are the world 4th prominent agricultural crop after rice, wheat, and maize. (Ganapathi *et al.*, 1999) and considered to be one of the most important sources of energy and starchy staple food for the people of tropical humid regions (Onwuka and Onwuka, 2005) . Furthermore, bananas and plantains are rich in nutrients, starch, sugar and vitamins A and C, potassium, calcium, sodium and magnesium, Doymaz (2010). Plantains are nutritionally low protein food material but relatively high in carbohydrates, vitamins and minerals (Offem and Njoku, 1993).

Moreover, latest studies on bananas grown in Africa and South America have shown that relationship between yellow-to-orange flesh coloration and higher carotenoid content (Amorim *et al.*, 2009 Newilah *et al.*, 2008) . Carotenoids-rich banana cultivars have been identified by several studies (Englberger *et al.*, 2003, 2006, 2010 Fungo *et al.*, 2007, 2010; Fungo and Pillay, 2011) . However, there is few published information on the variability in bananas and plantains micronutrient concentrations Wall, (2006) and Fungo *et al.* (2007). This is important to initiate activities to identify the banana and plantain cultivars with high level of provitamin A and micronutrients will be encourage the growth and consumption of such acceptable cultivars in the region of vitamin A and micronutrient deficiency. Based on the above mentioned comments, it is not surprising that the nutritional benefits of *Musa* species have been attracting great interest. Therefore, the present review has been detailed updates of the *Musa* species nutritional quality and its health benefits.

2.2 Origin and Distribution Of Banana

Seems likely, as we have seen above, that the bananas were distributed through Malaysia to the western fringes of the Pacific at a very early stage in the development. Their movement across the Pasific itself, however, presumably took place much latter. It seems to be generally accepted that the Polynesian trans-Pacific movement did not take place until the latter half of the first millennium A.D. and were familiar in their earlier home, somewhere Malaysia. It has been pointed out that Polynesian edible bananas have not yet been identified in Malaysia and that there is some reason to think that they might have come from the Philippine area. Whatever be the route taken by the Polynesians it seems fairly certain that their colonization of the Pacific is of quite recent date. In the Mediterranean in classical times the banana was known only by repute, having been seen in India in 327 B.C. by Alexander the Great and described by Magesthenes, Theophrastus and Pliny. All authors seem to agree, that the plant itself did not reach the Mediterranean until the Mohammedan .conquest of 650 A.D. The time and mode of introduction of banana to Africa is still quite uncertain and widely varying views have been expressed on this subject (Scot *et al.*, 2006).

2.3 Botanical Description Of Banana

A banana is an edible fruit – botanically a berry produced by several kinds of large herbaceous flowering plants in the genus Musa. In some countries, bananas used for cooking may be called "plantains", distinguishing them from dessert bananas. The fruit is variable in size, color, and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with a rind, which may be green, yellow, red, purple, or brown when ripe. The fruits grow in clusters hanging from the top of the plant. Almost all modern edible seedless (parthenocarp) bananas come from two wild species – Musa acuminata and Musa balbisiana. The scientific names of most cultivated bananas are Musa acuminata, Musa balbisiana, and Musa × paradisiaca for the hybrid Musa acuminata × M. balbisiana, depending on their genomic constitution. The old scientific name for this hybrid, Musa sapientum, is no longer used (Scot *et al.*, 2006). Worldwide, there is no sharp distinction between "bananas" and "plantains". Especially in the Americas and Europe, "banana" usually refers to soft, sweet, dessert bananas, particularly those of the Cavendish group, which are the main exports from banana-growing countries. By contrast, Musa cultivars with firmer, starchier fruit are called "plantains". In other regions, such as Southeast Asia, many more kinds of banana are grown and eaten, so the binary distinction is not useful and is not made in local languages (Scot *et al.*, 2006). The term "banana" is also used as the common name for the plants that produce the fruit. This can extend to other members of the genus Musa, such as the scarlet banana (Musa coccinea), the pink banana (Musa velutina), and the Fe'i bananas. It can also refer to members of the genus Ensete, such as the snow banana (Enseteglaucum) and the economically important false banana (Enseteventricosum). Both genera Description of the banana plant. (Scot *et al.*, 2006).

2.3.1 Size

Banana is a large, perennial, monocotyledonous herb 2–9 m(6.6–30 ft) in height that arises from large, subterranean rhizomes (usually called "corms") (Scot *et al.*, 2006).

2.3.2 Flowers

Upon flowering, the true stem or growing point emerges from the center of the tightly rolled Bunch of leaves. This odd-looking "flower cluster" is actually an elongated, plump, purple to green "bud" (sometimes called the "bell"or "heart"), which at first displays large female flowers(whose ovaries ripen into fruit). As the "bud" elongates, it exposes semicircular layers of female flowers, then neutral flowers, and finally small, generally non-functional (with no viable pollen) male flowers. Each group of flowers is arranged radially on the stem in nodal clusters. Each flower Cluster is borne on a prominence on the stem bearing the fruit (peduncle) and covered by a bract. About 12–20flowers are produced per cluster. Collectively, the flowering parts and fruit are referred to as the bunch. Individual clusters of fruits are known as hands, and individual fruitsare known as fingers (Scot *et al.*, 2006).

2.3.3 Leaves

The entire above-ground portion of the plant is not a true woody trunk, as in other trees, but a "false trunk" or "falsestem" that consists of leaves and their fused petiole bases, referred to as a pseudostem. The pseudostem supports acanopy consisting of 6–20 (or more) leaves.(Scot *et al.*, 2006).

2.3.4 Fruit

Musa fruits are variable in size, shape, and color. They are generally elongate-cylindrical, straight to strongly curved,3–40 cm (1.2–16 in) long, and 2–8 cm (0.8–3 in) in diameter. The fruit apex is important in variety identification; it maybe tapered, rounded, or blunt. The skin is thin and tender to thick and leathery, and silver, yellow, green, or red in color. Inside the ripe fruit, the flesh ranges from starchy to sweet, and in color from white, cream, yellow, or yellow-orange too range. Bananas also vary in peel thickness. Some varieties have a thin peel and are more susceptible to damage intransport, whereas others have a comparably thicker peel(the Fe'i variety 'Karat' and others,(Scot *et al*., 2006).

2.3.5 Seeds

Cultivated varieties are typically seedless. When seeds arepresent, they vary among species in shape and morphology.Seeds of *Musa balbisiana*, parent of many commercial edible banana varieties, are dark brown, ovoid, about4 mm (0.2 in) long, with a conspicuous white, powdery endosperm (Scot *et al*., 2006).

2.3.6 Rooting habit

Plants have numerous (200–500) fibrous roots. In well drained, deep, and fertile soils, roots may extend 1.5 m (5ft) deep and 4.9 m (16 ft) laterally. In dry, shallow, or rocky soils, roots of *Musa* may not compete well; otherwise, *Musa*is an average to good competitor (Scot *et al*., 2006).

2.4 Botanical classification of Banana:

Belong to the Kingdom *Plantae*, Subkingdom : *Tracheobionta* ,

Superdivision:*Spermatophyta*,

Division *Magnoliophyta*, Class: *Monocots* Subclass: *Zingiberidae* Order: *Zingiberales*, Family : *Musaceae* Genus :*Musa*, Species: *musasapientum*

2.5 Banana Cultivation

2.5.1 Cultural practice

There are a number of cultural practices believed necessary to ensure a good crop. Among those recommended practices, thinning is used to keep each production unit to three plants – the mother, daughter, and granddaughter. The thinning is done periodically, by removing the excess sprouts using a tool in the form of a pipe with a sharp edge. The peeling of the banana plant, which consists of removing the old, dried, and sick leaves, should also be a periodic practice. This routine is designed to increase sunlight and aeration of the banana plant thereby reducing the incidence of pest and disease. In regions with more intensive production, as is the case of Costa Rica, there is also a shoring up of banana trees protecting against their tipping over with the weight of the bunches. In shoring, the bananas are tied to each other using nylon cords. It is also a common practice to use bamboo struts to support the plants in production.(Andre and Jim 2014)

2.5.2 Fertilizer Application for Banana

- A balanced use of both organic and inorganic fertilizers will give you the best guarantee for sustainable crop and soil management.
- Apply fertilizer in a ring 30 to 60 cm from stem or spread evenly.
- On slopes, fertilizer must be dug lightly into the soil surface on the Uphill side of plant.
- Always make sure that the soil is adequately moist during fertilization.
- Irrigate the field through sprinkler irrigation after fertilization.

2.5.3 Recommended Fertilization Program For Banana

- Apply 0.25 kg urea + 0.25 kg muriate of potash per mat every 3 months
- Nitrogen fertilizer may be applied after heavy leaching rain in the form of 90 g urea or 125 g ammonium nitrate
- Apply 4 treatments at 6-week intervals of 0.7 kg of mixture N:P:K 10:16:16 per mat (equivalent to 0.25 kg N, 0.04 kg P and 0.41 kg K).If pH is below 5.0, lime should be spread at 2.5 t/ha (250 g/).For quick response to magnesium deficiency, a combined foliar application of 0.5% Zinc sulfate ($ZnSO_4$), 0.2% ferrus sulfate ($FeSO_4$), 0.2% copper sulfate ($CuSO_4$) and 0.1% ( ) must be applied

2.5.4 Mulch.

The mulch should be kept at least 50 cm from the base of the plant as it generates heat when decomposing. This practice is known to reduce fungal diseases while improving soil texture and adding nutrients to the soil. Generally, mulch is only required to be applied once as mature plantation is self mulching i.e. dead Banana leafs and trunks are removed and left behind as naturally mulch (Andre and jim 2014).

2.5.5 Weeding

Keep the plantation weed free. Banana plants grow notably slower with the presence of weeds because partial of the water and nutrients are absorbed by the weeds. Five (5) or six (6) manual weedings should suffice after which the growth of weeds is rather impossible when Banana plants reached mature size. Alternatively, mulching is advisable to reduce the growth of weed. (Andre and jim 2014)

2.5.6 Harvesting

The banana is harvested all year round with no intervals between harvests. In the region of Torres, crop harvesting is carried out usually with a frequency ranging somewhere between every fifteen or thirty days. In colder times, when temperatures reach only an average of 10 °C, the interval period between harvesting may be higher, sometimes reaching up to 45 days. Also, during warmer periods, such as those occurring in the summer months, the interval may decrease to every 21 days. The selection of bunches to be cut is made by virtue of visual assessment when those with the fullest fruit (the more rounded) are taken. Another way to select bunches is to harvest a banana, cut it open, and assess its coloring. A more yellowish internal appearance indicates that the fruit is at the ideal moment to be harvested. Harvesting is typically carried out by only one person, partly by cutting the pseudostem with a machete, and lowering the bunches down slowly. Once harvested, the fruit is manually transported to a location where it is collected by truck. At the time of its sale, which usually occurs on the same day of its harvest, the bananas are dehanded (cut to transporting size) and arranged in boxes having a standard weight of 21.0 kg. Some farmers may dehandthe bunches into a vat containing cold water or a 0.5% solution of water with some disinfecting product with sanitizing action. One such commonly used disinfecting and sanitizing product is *Bacterol*(its commercial name). (Andre and Jim 2014)

2.6 Nutritional Information Of Banana

Nutrition Facts

The nutrition facts for 1 medium-sized banana (100 grams) are (1Trusted Source):

Calories: 89

Water: 75%

Protein: 1.1 grams

Carbs: 22.8 grams

Sugar: 12.2 grams

Fiber: 2.6 grams

Fat: 0.3 grams

Bananas are a rich source of carbs, which occur mainly as starch in unripe bananas and sugars in ripe bananas. The carb composition of bananas changes drastically during ripening. The main component of unripe bananas is starch. Green bananas contain up to 80% starch measured in dry weight. During ripening, the starch is converted into sugars and ends up being less than 1% when the banana is fully ripe. The most common types of sugar in ripe bananas are sucrose, fructose, and glucose. In ripe bananas, the total sugar content can reach more than 16% of the fresh weight.

Bananas have a relatively low glycemic index (GI) of 42–58, depending on their ripeness. The GI is a measure of how quickly carbs in food enter your bloodstream and raise blood sugar. Bananas' high content of resistant starch and fiber explains their low G1. A high proportion of the starch in unripe bananas is resistant starch, which passes through your gut undigested. In your large intestine, this starch is fermented by bacteria to form butyrate, a short-chain fatty acid that appears to have beneficial effects on gut health (4Trusted Source). Bananas are also a good source of other types of fiber, such as pectin. Some of the pectin in bananas is water-soluble. When bananas ripen, the proportion of water-soluble pectin increases, which is one of the main reasons why bananas turn soft as they age. Both pectin and resistant starch moderate the rise in blood sugar after a meal.

2.7 Economic Importance of Banana

- Important food crop of the world especially in the tropics.
- It is cheapest and most nourishing of all fruits.
- It contains all essential nutrients including mineral and vitamins.
- Banana fruit is reserve of energy, contains more of carbohydrate, phosphorus, calcium and iron.
- Used as dessert fruit and for culinary purpose.
- The leaves are used as biological plates.
- The various products like banana puree, powder, flour, chips, vinegar, jam, jelly and wine can be prepared.
- Banana is called as "Apple of paradise".
- It referred as " Kalpatharu" (plant of virtues) because of multifaceted uses

2.8 Plantain Plant (*Musa paradisiacal*)

Plantain is one of the most important crops of the tropicalplants. It belongs to the family *Musaceae* and the genus*Musa*. *Musa paradisiaca*, also known as plantain(English), '*Ogede agbagba*' (Yoruba), '*Ayaba*' (Hausa)and '*Ogadejioke*' (Igbo), is a tropical plant that is native to India. The plant consists of long, overlapping leaf stalksand bears a stem which is 1.22 to 6.10 m high (Oladiji *etal.*, 2010), with a life span of about 15 years (Philips,1982). The fruits grow in clusters, each separate plantain of the cluster being about 1 inch in diameter and somewhat longer than a banana fruit. Plantain fruit requires about two and a half to four months after shooting before the fruit becomes ready for harvesting ora total of about eight to twelve months after planting(Swennen, 1990a). Plantain is one of the most important crops of the tropicalplants. It belongs to the family *Musaceae* and the genus *Musa*. *Musa paradisiaca*, also known as plantain (English), '*Ogede agbagba*' (Yoruba), '*Ayaba*' (Hausa) and '*Ogadejioke*' (Igbo), is a tropical plant that is native to India. The plant consists of long, overlapping leafstalks and bears a stem which is 1.22 to 6.10 m high (Oladiji *et al.*, 2010), with a life span of about 15 years (Philips,1982). The fruits grow in clusters, each separate plantain of the cluster being about 1 inch in diameter and somewhat longer than a banana fruit. Plantain fruit requires about two and a half to four months after shooting before the fruit becomes ready for harvesting or a total of about eight to twelve months after planting (Swennen, 1990a). Plantain contains a high fibre content, and thus is capable of lowering cholesterol and helps to relieve constipation and hence prevention of colon cancer. Besides this, its high potassium content is found to be useful in the prevention of raising blood pressure and muscle cramp (Ng and Fong, 2000). Various parts of the plant such as the leaves, root, fruit stalk, bract and fruit have been used for medicinal and domestic purposes. The fruit is consumed as food, the leaf juice is used in the treatment of fresh wounds, cuts and insect bites while the leaves act as an *arbortifacient*. Its sap is used as a remedy for *diarrhoea*, dysentery, hysteria and epilepsy. A cold infusion of the root is used to treat venereal diseases and *anaemia*. In addition, the fruit has been reportedly used as *antiscorbutic*, aphrodisiac and diuretic (Gill, 54 Afr. J. Food Sci. Technol 1992). Adeniji, *et al*., (2006) reported 100g edible portion of plantain to contain 67.30 g moisture, 0.4 g crude fat, 31.15 g carbohydrate, 0.95 mg potassium, 35.1 mg sodium, 71.5 mg calcium, 28 mg phosphorus, 2.4 mg iron, and yielded 116 kcal of energy.

2.8.1 Origin and Distribution of Plantain

Plantains originated from South- East Asia where it remains fairly important. It has become an important staple in many African countries. In Central and South America, it is produced both for consumption and export. Plantains are a major sub group of the cultivated banana (*Musa* spp). It is a cross between *Musa acuminate*and *Musa balbisiana*. This cross produced three different types:-

Type A: Contains a low starch and high sugar content when ripe. This is known as banana.

Type B: Is the true plantain which is starchy even when ripe and is only eaten when cooked. It differs in shape from banana in that it carries a pointed tip where as that of banana is blunt.

Type C: Is a starchy banana used for cooking. It is known as cooking bananas.

2.8.2 Botanical Description of Plantain

(*Musa paradisiaca*), plant of the banana (q.v.) family (Musaceae) closely related to the common banana (M. sapientum). The plantain is a tall plant (3–10 metres [10–33

2.8.4.3 Mulching

This should be done, because it helps control weed, protect the topsoil from harsh weather conditions such as heavy rainfall, intense sunshine etc. and it will help the soil to retain its organic matter which is essential for plantain cultivation.

2.8.4.4 Propping This is the process of supporting the Plantain plant using a bamboo stick, or any other form of support called prop, it is done when it starts fruiting. It is used for tall varieties and also used in areas where there is a strong wind.

2.8.4.5 Trimming

Old dry leaves that hang down should be removed, because they can harbor insect and pest. The green leaves should not be touched, and weeds, dead leaves, and other plant debris piling up at the base of the Plantain plants should be removed in order to reduce root weevil and other insects that might harm the plant.

2.8.4.6 Fertilizer Application

Fertilizer should be applied a month after planting, or with the first rain, the fertilizer should be applied in a ring form at the base of the plant, and shouldn't be dug or worked into the soil. Fertilizer shouldn't be applied in dry season.

As a general rule, before applying fertilizers, the soil should be analyzed to determine the types and amounts to be used. If a soil analysis (soil test) was not done, the following are there commended rates can be applies to each plant:

Urea – 450 gm (1 lb)

Triple Super Phosphate (TSP) – 225 gm (1/2 lb)

Muriate of Potash (Mop) – 225 gm (1/2 lb)

With a spacing of 2.4 m x 2.4 m (8' x 8') one hectare will accommodate 1,700 plants/ ha feet]) with a conical false "trunk" formed by the leaf sheaths of its spirally arranged leaves, which are 1.5 to 3 m long and about 0.5 m wide. The fruit, which is green, is typically larger than the common banana. The botanical classification of plantains and bananas is so complicated that plantain is variously viewed as a subspecies of the banana, and the banana as a subspecies of plantain. The edible fruit of the plantain has more starch than the banana and is not eaten raw. Because plantain has a maximum of starch before it ripens, it is usually cooked green, either boiled or fried, often with coconut juice or sugar as a flavouring. It may also be dried for later use in cooking or ground for use as a meal. The plantain meal can be further refined to a flour. (Kepler A.K, and Rust F.G 2005).

2.8.3 Botanical Classification of Plantain: Belong to the Kingdom Plantae, Subkingdom Tracheobionta ,Superdivision Spermatophyta, Division Magnoliophyta, Class Liliopsida, Subclass Zingiberidae, Order Zingiberales, Family Musaceae , Genus *Musa Pradisiaca*

2.8.4 Plantain Cultivation

2.8.4.1 Post-Planting Operation

2.8.4.2 Weeding The weeds on the plantation can be controlled mechanically that is using a hoe, machete or machinery and also by using post-emergent herbicides (herbicides should never touch the plantain plants), and it should be done regularly for the first six months.

(approximately 680 plants/ ac). Hence for one hectare the following amount of fertilizers will be

required:

Urea – 300 kg (680 lb)

TSP – 150 kg (340 lb)

Muriate of Potash – 150 kg (340 ib)

With a spacing of 2.4 m x 2.4 m (8' x 8') one hectare will accommodate 1,700 plants/ haTSP – 150 kg (340 lb)Muriate of Potash – 150 kg (340 lb) leaf cluster and turns downwards forming the bunch3 All the TSP and one half of the Urea and Muriate of Potash should be appliedin the hole planting. At flowering, apply the remainder of the Urea and Muriate of Potash

2.8.4.7 Harvesting

Harvesting of the crop is done manually, by cutting the bunch of plantains when 1 or 2 fingertips start yellowing. The postharvest period of plantain should be well managed unless it can easily be affected by disease. Harvesting The usual method of harvesting plantains is to partly cut through the pseudostem approximately 2 m from the ground or at upper thirds with a machete. This allows the plant to bend over under the weight of the bunch. The bunch is then cut off and taken away while the pseudostem is left in the plot. The pseudostem is then cut into pieces to reconstitute the organic matter. The stages involved in harvesting a bunch of plantain This mode of harvesting exposes the fruits to mechanical damage, especially when no precautions are taken to prevent the bunch from falling on the ground . In the case of dwarf types, bunches can directly be cut off and removed from the pseudostem without cutting it into sections

2.8.4.8 Storage

They should be stored at room temperature in a well-ventilated area, in order for them not to rot. The plantains that are still green will ripen slowly after several days.

2.9 Nutritional Information of Plantain

One cup of cooked plantains (without added salt or fat) or one medium sized raw plantain contains: ~180-200 calories, 0.5 g total fat, 47-50 g carbohydrates, 3.5 g dietary fiber, 22 g sugar and 2 g protein Because of it's high carbohydrate content, you need to monitor your portion, otherwise your blood sugars will spike. If you are not really familiar with carbohydrates and carbohydrate counting, think of it this way — one cup of plantains is like eating 2.5 slices of bread. Two servings of plantains is the equivalent of eating more than 5 slices of bread. If you are eating plantains with other starches like rice or beans, you should try to limit your portion of all carbohydrates to no more than 1/4 of your plate. If, however, you use all your carbohydrates on plantains,

2.10 Nutritional Analysis

Nutrition or proximate analysis: proximate analysis also known as weende analysis is chemical method of assessing and expressing the nutritional value of feed, reports the moisture, ash (minerals).crude fiber, crude fat and crude protein (total nitrogen) present in fuel weight. Carbohydrate (nitrogen free extract) is determine by defference (AOAC 1990). The proximate analysis gives the overall nutritional composition of food substance.

2.10.1 Moisture Content:

The moisture content is determined as the loss in weight that result from drying a known weight of food to constant weight at 100°c. This method is satisfactory for most food, but with few, such as silage, significance losses of volatile material may take place the moisture content is used to determine the shelf life of food substance (AOAC 1990).

2.10.2 Ash Content

The ash content is determine by ignition of a known weight of the food at 550°c until all carbon has been removed. The residue is the ash and is taken to present the inorganic constituents of the food. The ahs may, however, contain material of organic origin such as sulphur ans hosphorus from protein, and some loss of volatile material in the form of sodium, chloride, potassium, phosphorus, and sulphur will take place during ignition. The ash content is thus not truly representative of the inorganic material in the food either qualitatively or quantitatively(AOAC1990)

2.10.3 Crude Protein

The crude protein (CP) content is calculated from the nitrogen content of the food, determine by modification of a technique originally devised by Kjeldahl over 100 years ago. In this method the food is digested with sulphuric acid, which converts to ammonia all nitrogen present except that in the form of nitrate. This ammonia is librated by adding sodium hydroxide to digest, distilled off and collected in standard acid, The quantity so collected being determined by titration or by an automated colorimetric method. It is assumed that the nitrogen is derived protein containing 16 percent nitrogen, and by multiplying the nitrogen figure by 6.25 (i.e. 100/16) an approximate protein value is obtained. This is not true protein since the method determined nitrogen from source other than protein, such as free amino acid, amines and nucleic acid, and the fraction is therefore designated crude protein (AOAC 1990).

2.10. 4 Crude Lipid:

The ether extract (EE) fraction is determined by subjecting the food to a continuos extraction with petroleum ether for a defined period. The residue, after evaporation of the solvent, is the extract. As well as lipid it contains organic acid, alcohol and pigments. In the current official method, the extraction with ether is preceded by hydrolysis of the sample with sulphuric acid and the resultant residue is the acid ether extract (AOAC 1990).

2.10. 5 Total Carbohydrate:

The extract (EE) fraction is determined by subjecting the food to a continuous extraction with petroleum ether for a defined period. The residue, after evaporation of the solvent, is the extract. As well as lipid it contain organic acid, alcohol and pigment. In the current official method, the extraction with ether is preceded by hydrolysis 0f the sample with sulphurir acid and the resultant residue is the ether extract (AOAC 1990).

2.11 Anti-nutrition Analysis

Anti-nutritional factors are a chemical compounds matrent mechanisms (for example inactivation of some nutrients, diminution of the digestive process or metabolic utilization of food/feed) which exerts effect contrary to optimum nutrition. Such chemical compounds, are frequently, but not exclusively associated with foods and feeding stuffs of plant origin. These anti-nutritional factors are also known as 'secondary metabolites' in plants and they have been shown to be highly biologically active. These secondary metabolites are secondary compound produced as side products of processes leading to the synthesis of primary metabolites. One major factor limiting the wider food utilization of many tropical plants is the ubiquitous occurrence in them of a diverse range of natural compounds capable of precipitating deleterious effects in man, and animals compound which act to reduce nutrient utilization and/or food intake are often referred to as anti-nutritional factors. Antinutrients are chemicals which have been evolved by plants for their own defense, among other biological functions and reduce the maximum utilization of nutrients especially proteins, vitamins, and minerals, thus preventing optimal exploitation of the nutrients present in a food and decreasing the nutritive value. Some of these plant chemicals have been shown to be deleterious to health or evidently advantageous to human and animal health if consumed at appropriate amounts. There have been several reviews in recent years about the antinutritional factors found in foods. Most of them, however, deal with specific properties or 285 Habtamu Fekadu *et al.*,(2016). However, this review was aimed to assess updated scientific information of the potential health benefits and adverse effects of major antinutritional factors in plant foods (Habtamu *et al* 2014).

2.11.1 Tannins Content

The word tannin is very old and reflects a traditional technology. Tanning was the word used in the scientific literature to describe the process of transforming raw animal hides or skins into durable, nonputrescible leathers by using plant extracts from different plant parts. Tannin is an astringent, bitter plant polyphenolic compound that either binds or precipitates proteins and various other organic compounds including amino acids and alkaloids. The term tannin refers to the use of tannins in tanning animal hides into leather; however, the term is widely applied to any large polyphenolic compound containing sufficient hydroxyls and other suitable groups to form strong complexes with proteins and other macromolecules. Tannins have molecular weights ranging from 500 to over 3000. Tannins are heat stable and they decreased protein digestibility in animals and humans, probably by either making protein partially unavailable or inhibiting digestive enzymes and increasing fecal nitrogen. Tannins are known to be present in food products and to inhibit the activities of trypsin, chemotrypsin, amylase and lipase, decrease the protein quality of foods and interfere with dietary iron absorption. Tannins are known to be responsible for decreased feed intake, growth rate, feed efficiency and protein digestibility in experimental animals. If tannin concentration in the diet becomes too high, microbial enzyme activities including cellulose and intestinal digestion may be depressed . Tannins also form insoluble complexes with proteins and the tannin-protein complexes may be responsible for theantinutritional effects of tannin containing foods.(Habtamu fekadu *et al.*,2014)

2.11.2 Phytate Content

Phytate (is also known as Inositol hexakisphosphate (InsP6)) is the salt form of phytic acid, are found in plants, animals and soil. It is primarily present as a salt of the mono- and divalent cations K+, Mg2+, and Ca2+ and accumulates in the seeds during the ripening period. Phytate is regarded as the primary storage form of both phosphate and inositol in plant seeds and grains. In addition, phytate has been suggested to serve as a store of cations, of high energy phosphoryl groups, and, by chelating free iron, as a potent natural anti-oxidant. Phytate is ubiquitous among plant seeds and grains, comprising 0.5 to 5 percent (w/w). The phosphorus bound to phytate is not typically bio-available to any animal that is non-ruminant. Ruminant animals, such as cows and sheep, chew, swallow, and then regurgitate their food. This regurgitated food is known as cud and is chewed a second time. Due to an enzyme located in their first stomach chamber, the rumen, these animals are able to separate, and process the phosphorus in phytates. Humans and other non-ruminant animals are unable to do so. Phytate works in a broad pH-region as a highly negatively charged ion, and therefore its presence in the diet has a negative impact on the bioavailability of divalent, and trivalent mineral ions such as Zn2+, Fe2+/3+, Ca2+, Mg2+, Mn2+, and Cu2+. Whether or not high levels of consumption of phytate-containing foods will result in mineral deficiency will depend on what else is being consumed. In areas of the world where cereal proteins are a major and predominant dietary factor, the associated phytate intake is a cause for concern (Habtamu Fekadu *et al.*, 2014)

2.11.3 Oxalate Content

A salt formed from oxalic acid is known as an Oxalate: for example, Calcium oxalate, which has been found to be widely distributed in plants. Strong bonds are formed between oxalic acid, and various other minerals, such as Calcium, Magnesium, Sodium, and Potassium. This chemical combination results in the formation of oxalate salts. Some oxalate salts, such as sodium and potassium, are soluble, whereas calcium oxalate salts are basically insoluble. The insoluble calcium oxalate has the tendency to precipitate (or solidify) in the Kidneys or in the Urinary tract, thus forming sharp-edged calcium oxalate crystals when the levels are high enough. These crystals play a role to the formation of kidney stones formation in the urinary tract when the acid is excreted in the urine . Oxalate is an anti-nutrient which under normal conditions is confined to separate compartments. However, when it is processed and/or digested, it comes into contact with the nutrients in the gastrointestinal tract . When released, oxalic acid binds with nutrients, rendering them inaccessible to the body. If food with excessive amounts of oxalic acid is consumed regularly, nutritional deficiencies are likely to occur, as well as severe irritation to the lining of the gut. In ruminants oxalic acid is of only minor significance as an anti-nutritive factor since ruminal microflora can readily metabolize soluble oxalates, and to a lesser extent even insoluble Ca oxalate. While the importance of the anti-nutritive activity of oxalic acid has been recognized for over fifty years it may be a subject of interest to nutritionists in the future . Oxalic acid forms water soluble salts with Na+, K+, and NH4+ ions, it also binds with Ca2+, Fe2+, and Mg2+ rendering these minerals unavailable to animals. However Zn2+ appears to be relatively unaffected. In plants with a cell sap of approximately pH 2, such as some species of Oxalis and rumex oxalate exists as the acid oxalate (HC2O4), primarily as acid potassium oxalate. In plants with a cell sap of approximately pH 6, such as some plants International Journal of Nutrition and Food Sciences 2014; : 284-289 286 of goosefoot family it exists as oxalate (C2O4)2- ion usually as soluble sodium oxalate and insoluble calcium and magnesium oxalates. Calcium oxalate is insoluble at a neutral or alkaline pH, but freely dissolves in acid. (Habtamu Fekadu *et al.*, 2014)

2.11.4 Saponins Content

Saponins are secondary compounds that are generally known as non-volatile, surface active compounds which are widely distributed in nature, occurring primarily in the plant kingdom. The name 'saponin' is derived from the Latin word sapo which means 'soap', because saponin molecules form soap-like foams when shaken with water. They are structurally diverse molecules that are chemically referred to as triterpene and steroid glycosides. They consist of nonpolar aglycones coupled with one or more monosaccharide moieties. This combination of polar and non-polar structural elements in their molecules explains their soap-like behaviour in aqueous solutions. The structural complexity of saponins results in a number of physical, chemical, and biological properties, which include sweetness and bitterness, foaming and emulsifying properties, pharmacological and medicinal properties, haemolytic properties, as well as antimicrobial, insecticidal, and molluscicidal activities. Saponins have found wide applications in beverages and confectionery, as well as in cosmetics and pharmaceutical products. Due to the presence of a lipid-soluble aglycone and water soluble sugar chain in their structure (amphiphilic nature), saponins are surface active compounds with detergent, wetting, emulsifying, and foaming properties. Saponins were treated as toxic because they seemed to be extremely toxic to fish and cold-blooded animals and many of them possessed strong hemolytic activity. Saponins, in high concentrations, impart a bitter taste and astringency in dietary plants. The bitter taste of saponin is the major factor that limits its use. In the past, saponins were recognized as antinutrient constituents, due to their adverse effects such as for growth impairment and reduce their food intake due to the bitterness and throat-irritating activity of saponins. In addition, saponins were found to reduce the bioavailability of nutrients and decrease enzyme activity and it affects protein digestibility by inhibit various digestive enzymes such as trypsin and chymotrypsin . Saponins are attracting considerable interest as a result of their beneficial effects in humans. Recent evidence suggests that saponins possess hypocholesterolemic, immunostimulatory, and anticarcinogenic properties. In addition, they reduce the risk of heart diseases in humans consuming a diet rich in food legumes containing saponins. Saponin-rich foods are important in human diets to control plasma cholesterol, preventing peptic ulcer, osteoporosismand to reduce the risk of heart disease. Saponins are used as adjuvants in viral (e.g., Quillaja saponaria-21) and bacterial vaccine (e.g., Quillaja saponins) applications . A high saponin diet can be used in the inhibition of dental caries and platelet aggregation, in the treatment of hypercalciuria in humans, and as an antidote against acute lead poisoning. In epidemiological studies, saponins have been shown tohave an inverse relationship with the incidence of renalstones.(Habtamu fekadu *et al.*,2016)

2.11.5 Lectins Content

Lectin comes from the Latin word "legere", whichmeans "to select". Lectins have the ability to bindcarbohydrates. Nowadays, proteins that can agglutinate red blood cells with known sugar specificity are referred to as "lectins" (Fereidoon S., 2014). The name "hemagglutinins" is used when the sugar specificity is unknown. Lectins and hemagglutinins are proteins/glycoproteins, which have at least one non-catalytic domain that exhibits reversible binding to specific monosaccharides or oligosaccharides. They can bind to the carbohydrate moieties on the surface of erythrocytes and agglutinate the erythrocytes, without altering the properties of the carbohydrates (. Lectins are glycoproteins widely distributed in legumes and some certain oil seeds (including soybean) which possess an affinity for specific sugar molecules and are characterized by their ability to combine with carbohydrate membrane receptors. Lectins have the capability to directly bind to the intestinal muscosa, interacting with the enterocytes and interfering with the absorption and transportation of 0.01% free gossypol within some lowgossypol cotton nutrients (particularly carbohydrates) during digestion and causing epithelial lesions within the intestine. Although lectins are usually reported as being labile, their stability varies between plant species, many lectins being resistant to inactivation by dry heat and requiring the presence of moisture for more complete destruction . Lectins have become the focus of intense interest for biologists and in particular for the research and applications in agriculture and medicine. These proteins with unique characteristics have found use in diverse fields of biology and as more lectins are being isolated and their role in nature elucidated, they continue to occupy an important place in agricultural and therapeutic areas of research . Lectins are carbohydrate binding proteins present in most plants, especially seeds like cereals, beans, etc., in tubers like potatoes and also in animals. Lectins selectively bind carbohydrates and importantly, the carbohydrate moieties of the glycoproteins that decorate the surface of most animal cells. Dietary lectins act as protein antigens which bind to surface glycoproteins (or glycolipids) on erythrocytes or lymphocytes . They function as both allergens and hemagglutinins and are present in small amounts in 30% of foods, more so in a whole-grain diet. Lectins have potent *in vivo* effects. When consumed in excess by sensitive individuals, they can cause 3 primary physiological reactions: they can cause severe intestinal damage disrupting digestion and causing nutrient deficiencies; they can provoke IgG and IgM antibodies causing food allergies and other immune responses (Habtamu Fekadu *et* al.,2014). and they can bind to erythrocytes, simultaneously with immune factors, causing hemagglutination and anemia. Of the 119 known dietary lectins, about half are panhemagglutinins, clumping all blood types. The remainder are blood-type specific. In general, lectins alter host resistance to infection, cause failure to thrive and can even lead to death in experimental animals (Vasconcelos and Oliveira, 2004). Lectin comes from the Latin word "legere", which means "to select". Lectins have the ability to bind carbohydrates. Nowadays, proteins that can agglutinate red blood cells with known sugar specificity are referred to as "lectins" (Fereidoon S., 2014). The name "hemagglutinins" is used when the sugar specificity is unknown. Lectins and hemagglutinins are proteins/glycoproteins, which have at least one non-catalytic domain that exhibits reversible binding to specific monosaccharides or oligosaccharides. They can bind to the carbohydrate moieties on the surface of erythrocytes and agglutinate the erythrocytes, without altering the properties of the carbohydrates . Lectins have become the focus of intense interest for biologists and in particular for the research and applications in agriculture and medicine. These proteins with unique characteristics have found use in diverse fields of biology and as more lectins are being isolated and their role in nature elucidated, they continue to occupy an important place in agricultural and therapeutic areas of research.

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CHAPTER THREE

3.0 Material and Method

3.1 Study Area

This research was conducted in Biochemistry laboratory Federal University Gusau Zamfara State between July and September 2019.

3.2 Sample Collection and Preparation

The Banana and Plantain sample was collected at Gusau Tudun wada Market. The sample was cut into pieces using knife the banana sample was oven dried at 105C temp 5hours . The dried sample of banana and plantain were grounded into powder using mortar and pestle.

3.3 Determination Of Anti-nutritional Factors

3.3.1 Determination of Nitrate

Nitrate was determined using method ILTA (1988)

Reagent

1. Salicylic acid in con, H_2SO_4

2. (Analytical reagent) 5% (W/V) Freshly prepared at least once aweek and stored in brown bottle.

3. NaOH 2N

4. Stsndard $NaNO_3$ solution 0.1g or (100mg) in 100ml of distilled water. DH_2O

5. Sodium nitrate standards -0 to 3 in 100ml

PROCEDURE: 0.1g of powder sample was added into 100ml conical flask, 10ml of distilled water added and boil for 30 minute, filter using filter paper.

Table 1: Determination of Nitrate

Reagents	Test	Blank
Sample	0.2ml	-
Standard sodium Nitrate	-	-
DH2O	-	0.2ml
5% Salicylic acid	0.8ml	0.8ml
Mix and incubate for 20 minute		
2nNaOH	19ml	19ml
Mix and allow to cool and measure the absorbance at 410nm		

Calculation (%Nitrate mg%)

$$\frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times \text{Concentration of Standard.}$$

3.3.2Determination of Tannin

Tannins were determined by method of (Trease, and Evans1978)

Principle

The method is base on quantitative consumption of tannins and pseudo tannins to iodine in alkhaline medium, a character which is attributed to their phenolic nature. True tannins, in contrast to pseudotannins can be removed from the extract by precipitation with gelatin, this can permit the determination of each group of constituents alone. Excess iodine is determine by Titration, rendering acidic with sodium thiosulphate standard solution.

Reagents

1. Folin denis (Sodium tungstate, 10g phosphomolybdic acid, 25ml of outhorphosporic acid, was disolved in 200ml of distilled water.(DH_2O)
2. Tannic acid (0.1g of tannic acid was dissolved in 100ml of distelled water DH_2O)
3. 17%Sodium carbonate (17g was disolved in 100ml of distelled water, DH_2O).

Procedure

Powdered sample sample (100mg) was put into 100ml conical flask, 50ml of distilled water DH_2O) Were added and boiled for 30 minute, in boiling water and filter using filter paper.

Table 2 :Determination of Tannin

Reagents	Test	Blank
Sample	10ml	-
Standard tannic	-	-
acid	-	10ml
DH2O	10ml	10ml
17% Sodium	2.5ml	2.5ml
carbonate		
Folin denins		
reagent		

Mix and make the volume of 50ml of distelled water DH_2O and incubate for 20 minute at room temperature and measure the absorbance at 760nm.

Calculation (% of tannic acid mg%)

$$\frac{\text{Absorbance sample}}{\text{Absorbance of standard}} \times \text{Concentration of standard}$$

3.3.3 Determination of Cyanide

Cyanide was determine method as reported by (rails,1992).

Reagent

1.alkaline picrate

2.standard potassium cyanide

Procedure

0.5g of powder sample was measure into 100ml of conical flask and 50ml of distilled water DH_2O was added and boil for minute and filter using paper.

Table 3: Determination of Cyanide

Reagent	Test	Blank
Sample	1ml	-
Standard KCN	-	-
DH_2O	-	1ml
Alkakine picrate	4ml	4ml

Mix and boil at 90˚ for 5 minute. Cool and measure the absorbance at 490nm.

Calculation (%cyanide mg%)

$$\frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times \text{Concentration}$$

3.3.4 Determination of Oxalate

Principle

Oxalate is precipitate as calcium oxalate, the concentration is determined by titration with potassium permanganate which gives a faint pink end point.

Reagent

1.15% H_2SO_4

2.0.1NKMNO$_4$

Procedure

One gram (1g) of the sample was added to 75ml to 15% H_2SO_4 he solution was carefully stirred intermittently with magnetic stirred for 1 hours and filtered using whatman No. 1 filter paper, the filter (25ml) was then collected and titrated against 0.1KMNO$_4$ solution till a faint pink colour appeared that persisted for 30 second. 1cm3 of 0.1N KMNO$_4$ =0.0045g of oxalic acid.

Calculation (% Oxalate g %) = Titre value × 0.0045.

3.3.5 Determination of Phytate

The phytate of each sample was determined through phytic acid determination using the procedure described by Lucas and Marakaka (1975).

Reagent

1. 2%HCL

2. Ferric chloride (0.00195g/ml)

3. 0.3% ammonia thiocynate

Procedure

4g of sample was soaked in 100ml of 2% HCL for 3 hours, and filtered 25ml of the filtered, 5ml of 0.3% NH_4SCN, and 53ml of distilled water, DH_2O were mixed together and titrate against 0.01N standard ferric chloride fecl3 solution containing 0.0019g/ml until a brownish yellow colour persisted for 5 minute

Calculation

(% phytate mg%)

Titrate value× 1.19=phytin phosphorose

Phytate =phytin phosphorose × 3.55

3.4 Proximate Analysis

Proximate analysis involves an assay for all the constituents of a sample including; moisture, mineral, crude protein, crude lipid, crude fiber and carbohydrate by different.

3.4.1 Determination of % Ash and Moisture in Food Sampe

Materials

Crucible, muffle furnace, dessicator, weighing balance, morter and pestle, petridish.

Introduction

Ash is the inorganic residue remaining after the water and organic matter have been removed by heating, which provide a measure of total amount of mineral within a food.

Principle

When a food materials is ashed in muffle furnace at a high temperature of 550oc to 600 for five hours all the organic matter is burnt off leaving the inorganic substance in the form of ash.

Procedure

Ignite a clean crucible in a hot furnace for one minute. Remove the crucible and cool in s dessicator and weigh as W1.Weight 2g of grinded sample and put in the empty crucible and weigh as W2. Heat the crucible containing the sample in a muffle furnance at 550oc to 600oc for 5 hours to burn off all the organic matter, remove the crucible, cool in dessicator and weigh as W3.

Calculation

%Ash=weight of ash/weight of sample × 100

=W3-W1/W2-W1

% Organic matter =100-% Ash.

Introduction Moisture Content

Moisture content this measure the water content of the sample is one of the most commonly measured properties of food material. It is especially important in food preservation and processing.

Principle

This is based on heating the sample to eliminate all the water content in the sample. This is achieved by placing the sample in an oven at 105oc for 25 hours. High temperature is not needed to avoid decomposition of some organic compound.

Procedure

Clean and dry an empty dish in an oven at 80oc for about 30 minute and weigh as W1.Weigh 2g of the grinded sample and pour into the dish, then weigh as W2. Place the dish containing the sample in the hot air oven and dry at 105oc for 24 hours. Cool in a dessicator for 20 minute and weigh as W3. The

[illegible]

[illegible] of 2% boric acid into a250ml beaker and add in indicator. [illegible] digest in the distillation flask. Fix up the apparatus and add [illegible] NaOH to the 10ml of the digest slowl slowl from a syringe. [illegible] heating system and heat continuosly for 25 minute. Remove the [illegible] and titrate the distillate with 0.1 NHCL until the end point.

[illegible]

[illegible] value × dilution factor/ weight of the sample

[illegible] = % N × 6.25

[illegible] of 6.25 is used if the sample is egg, meat, beans; 6.38 for milk [illegible] 5.55 for gelatin factor.

[illegible] of Crude Lipid

[illegible] component of food sample are easily extracted into organic [illegible] usual procedure continuosly extracts the fat content using suitable

[illegible]

[illegible]

[illegible] soxhlet apparatus and weigh 2g of sample, place into a thimble [illegible] dried and weighed as W1. Wwigh the trimble containing the [illegible] sample as W2, cover the mouth of the porous thimble with cotton [illegible] to distributed the droping organic solvent. Place the timble into the [illegible] organic solvent. Finally weigh the extraction flask containing the

[illegible]

[illegible]

[illegible] W2-W1 × 100/2

procedure should be repeated, drying for about 3 hours for each subsequent drying until a constant value is obtain.

Calculation

=W2-W3/W2 –W1 × 100

3.4.2 Determination Of Crude Protein

Material

Kjeldals flask, retort stand, burette, pippet, conical flask, cupboard, condenser, distilled water, NaOH, H_2SO_4, Boric acid, HCL, indicator.

Principle

In this determination the total protein contents in a sample is quantified from it nitrogen content. First the sample will be digest in boiling H_2SO_4 containing selenium or copper catalyst. During this digestion the protein is oxidized and the ammonia formed remain in solution as ammonium sulphate. The concentration of ammonia librated by alkaline distillation with NaOH is determined by distilling into boric acid solution. Back titration is done on the solution using a standard acd(0.1MHCL)

Procedure

Digestion: weigh out 1g of the protein sample and introduce onto the bottom of a 500ml kjeldahl flask, add 20 ml of conc. H_2SO_4 and mix gentle by swirling under tap water. Mix together 10g of anhydrous Na2SO4 and 1g of $CUSO_4$ and introduce 3g of this info the mixture. The Na2SO_4 and $CUSO_4$ mixture is the Kjeldahl catalyst. Boil gentle the entire mixture in the Kjeldahl flask in a fme cupboard until charred particules diappear and a clear green solution is obtain, make, up digest mixture up to 100ml with distilled water.

Distillation

Measure out 40ml of 2% boric acid into a250ml beaker and add in indicator. Place 10ml of the digest in the distillation flask. Fix up the apparatus and add 30ml of 40% NaOH to the 10ml of the digest slowl slowl from a syringe. Switch on the heating system and heat continuosly for 25 minute. Remove the receiver breaker and titrate the distillate with 0.1 NHCL until the end point.

Calculation

% N=1.4 × titrate value × dilution factor/ weight of the sample

%crude protein = % N × 6.25

NOT E: Factor of 6.25 is used if the sample is egg, meat, beans; 6.38 for milk and milk product; 5.55 for gelatin factor.

3.4.3 Determination of Crude Lipid

The non polar component of food sample are easily extracted into organic solvent. The usual procedure continuosly extracts the fat content using suitable solvent.

Procedure

Set up the soxhlet apparatus and weigh 2g of sample, place into a thimble which as been dried and weighed as W1. Wwigh the trimble containing the powdered sample as W2, cover the mouth of the porous thimble with cotton wool so as to distributed the droping organic solvent. Place the timble into the extraction organic solvent. Finally weigh the extraction flask containing the oil.

Calculation

% fat = W2-W1 × 100/2

3.4.4 Determination of Crude Fibre

Principle

The sequential hot digestion with acid and alkaline solution of the defatted sample is followed by thorough washing with boiling water finally dry off. This ensure the removal of all other materials.

Procdure

Weigh 2g of powdered sample and place in a conical flash, add 20ml of distilled water, 20ml of. 10%H_2SO_4 and then boil for 30 minute to maintain constant value. Filter with muslin cloth and rinse with warm water. Use a spatula to scrap the sample into flask, add 20ml of 10% NaOH, and then boil for 30 minute. Filter with muslin cloth, then use ethanol to rinse the sample one more, allow to dry and scrap the residue into a crucible Place the crucible in an oven to dry at 105oc for 1 hour and then weigh as W1. Again put the crucible in muffle furnace to ash for 2 hours at 550oc, cool in dessicator and weigh as W2.

Calculation

%crude fiber = W1-W2 × 100/Weight of

CHAPTER FOUR

4.0 Results

Result on nutritional compositions of Banana showed that, moisture content have the highest value (76.97 ± 2.03), followed by total carbohydrate with (6.88 ± 0.08), crude protein had (6.40 ± 0.46), Ash content (4.25 ± 0.15), Crude fiber (3.70 ± 0.24), the lowest value was obtained from Crude lipid (1.80 ± 0.16). Result on nutritional composition of plantain showed that, moisture content have the highest value (65.48 ± 0.72), followed by the total carbohydrate (16.7 ± 0.82), Crude protein (9.04 ± 0.35), Ash content (5.33 ± 0.45), Crude fiber (2.67 ± 0.24), the lowest value was obtained from Crude lipid (0.80 ± 0.16) (Table 4).

Result on anti-nutritional composition of Banana showed that, Phytate have the highest value (81.53 ± 0.6067), followed by Nitrate (10.46 ± 0.00471), Cyanide (0.635 ± 0.0659), Oxalate (0.0783 ± 0.0846), the lowest value was obtained from Tannins (0.0147 ± 0.000471). Result on Anti-nutritional composition of Plantain showed that, Phytate have the highest value (93.347 ± 2.634), followed by Nitrate (2.633 ± 0.0047), Cyanide (0.538 ± 0.0078), Tannins (0.034 ±0.0334), the lowest value obtained from Oxalate (0.022 ± 0.000816) (Table 5).

Table 4: Nutritional Composition of Banana and Plantain

Properties analyzed	Percentage composition of Banana (%)	Percentage composition of Plantain (%)
Ash content	4.25 ± 0.15	5.33 ± 0.45
Moisture content	76.97 ± 2.03	65.48 ± 0.72
Crude lipid	1.80 ± 0.16	0.80 ±0.16
Crude fiber	3.70 ± 0.24	2.67 ± 0.24
Crude protein	6.40 ±0.46	9.04 ± 0.35
Total carbohydrate	6.88 ±0.08	16.7 ± 0.82

Values are means of triplicate determinations ± standard deviation (SD).

Table5: Anti-nutritional Composition of Banana Plantain

Parameters Analyzed	Percentage composition of Banana (%)	Percentage composition of Plantain (%)
Nitrate	10.46 ± 0.00471	2.633 ± 0.0047
Tannins	0.0147 ± 0.000471	0.034 ± 0.0334
Cyanide	0.635 ± 0.0659	0.538 ± 0.0078
Oxalate	0.0783 ± 0.0846	0.022 ± 0.000816
Phytate	81.53 ± 0.6067	94.347 ± 2.634

Values are means of triplicate determinations ± standard deviation (SD).

CHAPTER FIVE

5.0 Discussion, Summary, Conclusion and Recommendation

5.1 Discussion

According to this research, both species were observed to contain all the nutrients being analyzed. The carbohydrate, fat, protein and moisture contents were present in Banana and Plantain. Carbohydrate content and moisture content was higher in plantain when compared to that of banana, this might be as a result of varietal differences. This signifies that, plantain may be richer sources of these energy than Banana. Crude lipid was low in both the species, Lower levels of fat in Banana and plantain probably give a higher probability of a longer shelf life interms of the onset of rancidity (Chukwu, *et al*., 1998). This present finding was agreed by findings of Auta and Kumurya, 2015 who worked on comparative proximate, mineral elements and antinutrient compositions between Banana and plantain pulp flour.

Furthermore, results on anti-nutritional compositions of Banana and Plantain showed the highest concentration of phytate, while the other anti-nutrients cyanite, nitrate and tannins were lower. Cyanide is poisonous because it binds with cytochrome oxidase and stops its action in respiration in the body. Oxalate can binds to calcium and other metals unavailable for normal physiological and biochemical roles. In this present study, the values obtained on anti-nutritional analysis are low, this signifies that the Banana and Plantain evaluated has higher nutritional and lower antinutritional compositions. These are in agreement with findings of Adeniji *et al*. (2007) who carried out research on nutritional and anti-nutritional compositions of flour made from plantain and banana hybrid pulp and peel mixture.

5.2 Summary

Banana and plantain plants are the world's biggest herbs, grown abundantly in many developing countries. Bananas and plantains are one of the most important sources of energy in the diet of people living in tropical humid regions. Nutrition or proximate analysis: proximate analysis also known as weende analysis is chemical method of assessing and expressing the nutritional value of feed, reports the moisture content, ash content, crude fiber, crude lipid , crude protein and Total carbohydrate is determine by defference (AOAC 1990). The proximate analysis gives then overall nutritional composition of food substance. Anti-nutritional factors are compounds which reduce the nutrient utilization and/or food intake of plants or plant products used as human foods and they play a vital role in determining the use of plants for humansThis research was conducted between July and October 2019 in Biochemistry Laboratory Federal University Gusau Zamfara State. The Banana and Plantain samples was collected in Gusau central market. The nutritional and anti-nutritional compositions of Banana and Plantain was evaluated using standard procedures. Results on nutritional compositions of Banana showed that, moisture content have the highest value (76.97 ± 2.03), followed by total carbohydrate with (6.88 ± 0.08), crude protein had (6.40 ± 0.46), Ash content (4.25 ± 0.15), Crude fiber (3.70 ± 0.24), the lowest value was obtained from Crude lipid (1.80 ± 0.16). Results on nutritional composition of plantain showed that, moisture content have the highest value

(65.48 ± 0.72), followed by the total carbohydrate (16.7 ± 0.82), Crude protein (9.04 ± 0.35), Ash content (5.33 ± 0.45), Crude fiber (2.67 ± 0.24), the lowest value was obtained from Crude lipid (0.80 ± 0.16). Results on anti-nutritional composition of Banana showed that, Phytate have the highest value (81.53 ± 0.6067), followed by Nitrate (10.46 ± 0.00471), Cyanide (0.635 ± 0.0659), Oxalate (0.0783 ± 0.0846), the lowest value was obtained from Tannins (0.0147 ± 0.000471). Results on Anti-nutritional composition of Plantain showed that, Phytate have the highest value (93.347 ± 2.634), followed by Nitrate (2.633 ± 0.0047), Cyanide (0.538 ± 0.0078), Tannins (0.034 ±0.0334), the lowest value obtained from Oxalate (0.022 ± 0.000816). Banana and plantain shall be consumed daily due to their higher nutritional and lower anti-nutritional compositions.

5.3 Conclusion

The result obtained from banana and plantain contain very higher nutritional and low level of anti-nutrients.

5.4 Recommendation

This research has the following recommendations:

1. Banana and plantain should be consumed daily due to their higher nutritional and lower anti-nutritional composition.
2. Banana and plantain forming should be encourage in order to boost its production

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