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Extractive Value, Phytochemical Screening and Antioxidant Properties of Plantain (*Musa Paradisiaca*) Flower Extracts

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ABSTRACT

All parts of plantain plant *(Musa paradisiaca)* claims to have a lot of economic value such as medicinal and nutritional values. The aim of this research work is to establish the extractive value of solvents for bioactive ingredients and investigate the phytochemical constituents and antioxidant properties of plantain flower and its solvent extracts. The plantain flower was obtained washed, rinsed, air-dried, ground, sieved and extracted using six solvents and the extractive values of each solvent were calculated. The highest extractive value (16.026±0.007%) was obtained in water extract, followed by ethyl acetate extract with 13.850±0.005% while the least extractive values (1.347±0.000%) was obtained in chloroform extract. Alkaloid and terpenoid were present in all the solvent extracts. Cardiac glycoside, tannin, phenol and phlobotannin were not present in all the solvent extracts. Flavonoid was found in methanol extract while reducing sugar was detected in acetone, chloroform and water extracts. Quinone and volatile oil were found in ethyl acetate and acetone extract respectively. Steroid was present in acetone, ethanol and ethyl acetate extracts. The total flavonoids (mg/100g) in raw sample, ethyl acetate and water extracts of plantain flower were 0.045±0.001, 0.034±0.000 and 0.047±0.002 respectively. The total phenol (mg/100g) in raw sample, ethyl acetate and water extracts of plantain flower were 0.097±0.002, 0.065±0.001 and 0.043±0.001 accordingly. The DPPH (%) were 88.35±0.21, 86.71±0.30 and 65.81±0.17 in raw sample, ethyl acetate and water extracts of plantain flower. The iron chelating (%) were 24.75±0.12, 22.55±0.09, 22.56±0.07 in raw sample, ethyl acetate and water extracts of plantain flower. The ferric reducing antioxidant power (FRAP) (Garlic Acid Equivalent) in raw sample, ethyl acetate and water extracts of plantain flower were 0.29±0.01, 0.47±0.00 and 0.22±0.02. The plant raw sample and its extracts possess reasonable results that can make it serve as a source of natural antioxidants that have great potential in health-related area by preventing or treating diseases caused by the oxidative stress and might be extensively used for the treatment of degenerative diseases.

KEYWORDS: Extractive value, phytochemical, antioxidant properties, plantain flower.

1. Introduction

Plantain tree is a very useful tree for mankind starting from the fruit, leaf, stem, flower, everything is beneficial. Among all, plantain flower gains more importance. Plantain flower has exclusive health-enhancing characteristics. Plantain flower is rich in anti-oxidants, helps to get rid of infections. They are neutral anti-depressant. It prevents cancer and heart disease. It is also beneficial to diabetes patient. *Musa* species is one of the well-known plants of the *musaeae* family that have been used in traditional medicine since hundred years to alleviate various diseases and health problems (Adeleke, 2021). Active constituent presence in the plant materials might be responsible for its use in human health. The most important of these bioactive compounds of plants are alkaloids, flavonoids, tannins and phenolic compounds (Altemimi *et al*., 2017, Teiten et al., 2013; Edeoga *et al.*, 2005). It is estimated that more than 8,000 phenolics, 25,000 terpenoids and 12,000 alkaloids have been identified in plants (Saeed *et al.*, 2005), but most of them still remain unknown and need to be qualified for health benefits (Liu, 2003). These compounds were known to possess various bioactivities such as antioxidant, antimicrobial, antivirus and anticancer. Due to their potential to overcome health problems, plant based products have been produced in industries as botanical drugs, dietary supplements and functional foods.

Phytochemicals are the chemicals that are produced by plants which are produced by the plants' primary and secondary metabolism. They help the plant by protecting them from disease and damage caused by environmental hazards like pollution, UV, stress and draught. They are also used as traditional medicine and as poisons from ancient days. Phytochemicals are not the essential nutrients because there is no proof established that they cause any possible health effects in humans and they are known to have roles in the protection of human health. More than 4,000 phytochemicals have been catalogued and are classified by protective function, physical characteristics and chemical characteristics (Balamurugan *et al*., 2019). Phytochemicals have biological activity in plant host and play a role in plant growth or defense against pathogens, competitors or predators. Phytochemicals stimulate the immune system, slow the growth rate of cancer cells, and prevent DNA damage that can lead to cancer and other diseases. Many phytochemicals are antioxidants protecting the cell of the body from oxidative damage from water, food, and the air (Ashley *et al*., 2016).

Antioxidants are molecules that fight free radicals in human body. Free radicals are compounds that can cause harm if their levels become too high in human body (Wikipedia, 2021). These free radicals are the causative agent of some illnesses such as diabetes, heart disease and cancer. Human body has its own antioxidant defense mechanism to keep free radicals in check. Antioxidants are substances that protect our body cells against the effects of free radicals. Free radicals are among the molecules produced when human body system breaks down food and they are released by environmental exposures like tobacco smoke and radiation. Environmental agents initiate free radical generation, which leads to different complications in the body (Abd-Allah *et al*., 2018). The toxicity of lead, pesticides, cadmium, ionizing radiation, alcohol, cigarette smoke, UV light and pollution may all be due to their free radical initiating capability. Free radicals can damage cells, and may play a role in heart disease, cancer and other diseases (Stanner and Weichselbaum, 2013). Oxidative damage can lead to a break down or even hardening of lipids, which is the major composition of all cell wall. In addition, other biological molecules including ribose nucleic acid (RNA), deoxyribosenucleic acid (DNA) and protein enzymes are also susceptible to oxidative damage (Draghici *et al*., 2018). It is now established that some phytochemicals have antioxidant properties (Thangapazham, 2016; El Zawawy, 2015). The nature of solvents used for extraction is an important parameter to be considered as this affect the extractable bioactive ingredient. Therefore the aim of this research work is to investigate the

phytochemical constituents and antioxidant properties of plantain flower and its solvent extracts while the objectives of this research work are to: obtain extracts from plantain flower using six solvents (methanol, ethanol. acetone, chloroform, ethyl acetate and water); determine the percentage yield of extract in each of the solvents; investigate the qualitative phytochemical screening of the extracts; investigate the antioxidant properties of the extracts and the raw samples as well as compare the antioxidant properties of the extract with that of the raw sample.

2. Materials and Methods

2.1 Sources of Materials

Plantain flowers were collected from a compound of a building at Ajagbale Street, Oka, Ondo City, Ondo State, Nigeria. All chemicals used for the experiment were of analytical grade gotten from Mackintech Enterprises at Akure, Ondo State.

2.2 Preparation and Extraction of Plantain Flower.

The plantain flower was plucked by hand, rinsed in water then cut into smaller pieces and air-dried. The dried sample was ground into powdery form using electric blending machine and sieved. The powdery sample was packed into a plastic container which was properly labeled and kept prior to extraction.

20 g of dried powdery sample was weighed into six (6) cleaned and dried reagent bottles; and 200 mL of each solvent (methanol, acetone, water, chloroform, ethyl acetate, ethanol) was separately added to each bottle and was left for 72 hours during which was intermittedly shaken. The mixture was filtered. The extracts were evaporated to dryness by pouring the extract into weighed petridish and kept in a desiccator. Weight of extract obtained was used to calculate the percentage yield of extract in each solvent (Arawande and Aderibigbe, 2020).

2.3 Phytochemical Screening of plantain flower and its extracts

The phytochemicals were qualitatively determined using standard methods described by Trease and Evans, 1989; Evans, 2002 and Sofowora, 2008.

2.3.1 Test for Tannins

About 0.2 g of the extract was taken and 2 mL of 10 % ferric chloride was added. Color changes into blue black which indicates the presence of tannin.

2.3.2 Test for Alkaloids (Wagner's test)

About 0.2 g of the extract was hydrolyzed by 1% hydrochloric acid; six drops of Wagner's reagent were added. Color changes into brown red/orange precipitate which indicates the presence of alkaloids.

2.3.3 Test for Saponins

About 0.2 g of the extract was added with 5 mL of distilled water, it was shaken for 30 seconds and the presence of foam indicates presence of saponins.

2.3.4 Test for Terpenoids (Salkowski test)

About 3 mL of chloroform was added to about 0.2 g of the extract and then concentrated sulphuric acid was added from sides of the test tube. The presence of reddish brown color appears at the interface indicates the presence of terpenoids in extract.

2.3.5 Test for Cardiac Glycosides (Keller - Killiani test)

About 0.2 g of the extract was taken and then 1 mL of glacial acetic acid was added and 1 mL of 10% ferric chloride was added, then 1 mL concentrated sulphuric acid was added from the sides of test tube. Formation of green/blue precipitate indicates the presence of cardiac glycosides.

2.3.6 Test for Steroids (Lierbermann-Burchardt test)

In about 0.2 g of the extract, 1 mL chloroform was added, 3 mL acetic anhydride was added from sides of the test tube, and then two drops of concentrated sulphuric acid was added. The appearance of dark green color confirms the presence of steroids.

2.3.7 Test for Flavonoids

About 0.2 g of the extract was taken; dilute sodium hydroxide was added to create intense yellow color, which on addition of concentrated hydrochloric acid turns into colorless which indicates the presence of flavonoids.

2.3.8 Test for Reducing Sugars (Fehling's test)

About 0.2 g of the extract was shaken with distilled water and filtered. The filtrate was boiled with drops of Fehling solution A and B for few minutes.

An orange red precipitate indicates the presence of reducing sugar.

2.3.9 Test for Phlobatanins

About 0.2 g of the extract was added with distilled water then shaken and filtered, then 2 mL of 2% hydrochloric acid was added and boiled, Red colored developed which indicate the presence of phlobatannins.

2.3.10 Test for Phenol

2 mL of distill water followed by few drops of 10% ferric chloride was added to about 0.2 g of the extract. Formation of blue or green color occurred which indicates the presence of phenol.

2.3.11 Test for Volatile Oil

0.1 mL dilute sodium hydroxide and small quantity of dilute hydrochloric acid was added to about 0.5 g of the extract, the solution was shaken. White precipitate was formed which indicates the presence of volatile oil.

2.3.12 Test for Quinone

To about 0.2 g of the extract, 1 mL of concentrated sulphuric acid was added. Formation of red color indicates presence of quinone.

2.4 Determination of Antioxidant Property

2.4.1 Total Flavonoid

0.1 g of the extract was weighed into a sample bottle; 10 mL of 80% methanol was added and allowed to soak for 2 hours. 0.4 mL of the solution was measured into a 10 mL volumetric flask, 1.2 mL of 10% sodium hydroxide, 1.2 mL of 0.2 M concentrated sulphuric acid and 3 mL of 3 M sodium nitrate was added. 4.2 mL of distilled water was used to make it up. The absorbance was read using 6850 UV spectrophotometer at wavelength 325 nm. (Mahajan and Badujar 2008).

Total Flavonoid (mg/100g) =

$$\frac{\text{Concentration in (mg/l) x volume of sample x DF}}{\text{Sample weight}}$$

2.4.2 Ferric Reducing Antioxidant Power (FRAP)

0.1 g of the extract was weighed into a sample bottle; 10 mL of 80% ethanol was added. 2.5 mL sodium phosphate buffer (0.2 M Na_2PO_3, pH 6.6) and 2.5 mL 1% potassium ferricyanide was added and incubated at 50˚C for 20 minutes. 2.5 mL of TCA (trichloroacetic acid) was added to stop the reaction. 2.5 mL of the aliquot was taken and diluted with 2.5 mL distilled water and 0.5 mL 0.1 % ferric chloride was added and allowed to stand for 30 minutes in the dark for color development. The absorbance was read using 6850 UV/Visible spectrophotometer at wavelength 700 nm (Alachaher, *et al.* 2018).

FRAP (garlic acid equivalent)(GAE) =

$$\frac{\text{Absorbance} - \textit{Intercept} \text{ x volume of extract x } 100 \times \text{DF}}{\text{Slope of standard} \times \text{sample weight} \times 10\text{^}6}$$

DF: Dilution factor. If not diluted, then DF = 1

2.4.3 Total Phenol

0.1 g of the extract was weighed into a sample bottle; 10 mL of distilled water was added to dissolve. 1 mL of the solution was pipetted into a test tube and 0.5 mL 2 N Folin-Ciocalteu reagent and 1.5 mL of 20 % sodium carbonate solution was added. The solution was allowed to stand for 2 hours and the absorbance was read using a 6850 UV/Visible spectrophotometer at wavelength 765 nm. Garlic acid solution was used as standard viz 0.5 mg, 1 mg, 2 mg, 4 mg, 6 mg, 8 mg and 10 mg. (Hagerman, *et al.* 2000).

Phenol content mg/100g =

$$\frac{\text{Concentration in (mg/l)x volume of sample x DF}}{\text{Sample weight}}$$

DF: Dilution factor. If not diluted, then DF = 1

2.4.4 DPPH (2, 2-diphenyl-1-picrylhydrazyl) Scavenging

0.1 g of the extract was weighed into a sample bottle and 10 mL of ethanol was added, stirred for 15 minutes and allowed to stand for 2 hours. 1.5 mL of the extract was pipetted into a test tube and 1.5 mL of DPPH solution was added. The 6850 UV/Visible spectrophotometer was zeroed with ethanol as the blank solution. The absorbance/ optical density of the control (DPPH solution) was read. The absorbance of the test sample was read at 517 nm. (Teraos, *et al.* 1988)

DPPH Scavenged % =

$$\frac{\text{Absorbance of control} - \text{Absorbance of test sample}}{\text{Abs of control x sample weight}} \text{ x } 100$$

DF: Dilution factor. If not diluted, then DF = 1

2.4.5 Iron (Fe^{2+}) Chelation Assay

0.1 g of the extract was weighed into a sample bottle, 150 µL of 500 µM $FeSO_4$ was added. 168 µL of 0.1M Tris-HCl (pH 7.4) and 218 µL of saline

solution was added. 100 µL of the solution was taken and incubated for 5 minutes, before addition of 13 µL of 0.25% 1, 10-phenanthroline. The absorbance was read using 6850 UV/Visible spectrophotometer at wavelength 510 nm (Oboh and Omoregie, 2011).

$$\% \text{ inhibition} = \frac{\text{Absorbance of control} - \text{Absorbance of exract}}{\text{Absorbance of exract}} \times 100$$

4. Results and Discussions

4.1 Results

1. Solvent extractive value of plantain flower

The extractive values (% yield) of plantain flower using acetone, chloroform, ethanol, ethyl acetate, methanol and water are contained in Table 1. The percentage yield of plantain flower extract was 16.026±0.007 in water, 13.850±0.005 in ethyl acetate, 6.216±0.002 in ethanol, 3.825±0.004 in methanol, 1.690±0.001 in acetone and 1.347±0.000 in chloroform.

2. Qualitative phytochemical screening of solvent extracts of plantain flower

Qualitative phytochemical screening of solvent extracts of plantain flower is shown in Table 2. The solvents used for extraction were acetone, chloroform, ethanol, ethyl acetate, methanol and water. While the phytochemicals screened in the plantain flower were alkaloid, flavonoid, saponin, cardiac glycoside, reducing sugar, tannin, quinone, volatile oil, phenol, terpenoid, phlobatannin and steroid. In all the solvents used for extraction of plantain flower, alkaloid and terpenoid were present in all the solvent extracts while cardiac glycoside, tannin, phenol, phlobatannin were absent in all the solvent extracts. Only methanol extract contained flavonoid. Saponin and volatile oil were only present in acetone extract. Reducing sugar was present in acetone, chloroform and water extracts. Quinone was present only in ethyl acetate extract. Steroid was detected in ethanol and ethyl acetate extracts. Amidst all the twelve phytochemicals considered for plantain flower extract, six were detected in acetone extract; four were found in ethyl acetate extract while three phytochemicals were present in each of chloroform, ethanol, methanol and water extracts. Acetone and ethyl acetate were able to extract 50% and 33% respectively of the phytochemicals screened while other solvents were able to extract 25% of the phytochemicals considered.

3. Antioxidant properties of plantain flower.

The antioxidant properties of raw sample, ethyl acetate extract and water extract of plantain flower is presented in Table 3.

The amount of total flavonoid content obtained in the raw samples and different solvent extracts of plantain flower is contained in Table 3.The concentration of total flavonoid (mg/100g) ranged between 0.034±0.000 and 0.047±0.002 in the plantain flower. The powdered raw sample had total flavonoid of 0.045±0.002 mg/100g and that of water extract was 0.047±0.002 mg/100g while the ethyl acetate extract had the least concentration of 0.034±0.000mg/100g. The total phenol content (mg/100g) of plantain flower was between 0.043±0.001 and 0.097±0.002. The highest value was for raw sample while the lowest value was for water extract and that of the ethyl acetate was 0.065±0.001. The radical scavenging activity of plantain flower was measured using the DPPH radical assay. 2, 2-diphenyl-1-picrylhydrazyl (DPPH) scavenging (%) of plantain flower ranged between 65.81±0.17 and 88.35±0.21. The DPPH value was highest in raw sample and least in water extract while it was 86.71±0.30% in ethyl acetate. The iron chelating power (%) ranged between 22.55±0.09 and 24.75±0.12 with higher value in raw sample and the least value in ethyl acetate;and it was 22.56±0.07 in water extract as shown in Table 3. The ferric reducing antioxidant power (FRAP) (Garlic Acid Equivalent (GAE)) of plantain flower had the highest (0.47±0.00) in ethyl acetate extract and lowest value (0.22±0.02) in water extract while it was 0.29±0.01 in raw sample. The reducing capacity of a compound may serve as an important

indicator of its potential antioxidant activity (Ho *et al*., 2012).

Table 1: Solvent extractive value of solvent extracts of plantain flower

Solvent	*Extractive Value (%)
Acetone	1.690±0.001
Chloroform	1.347±0.000
Ethanol	6.216±0.002
Ethyl acetate	13.850±0.005
Methanol	3.285±0.004
Water	16.026±0.007

Note: * = Result values are expressed as mean value of triplicate determinations ± standard mean deviation

Table 2: Qualitative phytochemical screening of solvent extract of plantain flower

Parameter	Solvent extract					
	Acetone	Chloroform	Ethanol	Ethyl acetate	Methanol	Water
Alkaloid	+	+	+	+	+	+
Flavonoid	-	-	-	-	+	-
Saponin	+	-	-	-	-	-
Cardiac Glycoside	-	-	-	-	-	-
Reducing Sugar	+	+	-	-	-	+
Tannin	-	-	-	-	-	-
Quinone	-	-	-	+	-	-
Volatile oil	+	-	-	-	-	-
Phenol	-	-	-	-	-	-
Terpenoid	+	+	+	+	+	+
Phlobatannin	-	-	-	-	-	-
Steroid	+	-	+	+	-	-

(+): positive = present (-): negative = absent

Table 3: Antioxidant properties of plantain flower

Antioxidant Properties	Plantain flower*		
	Raw Sample	Ethyl acetate extract	Water extract
Total flavonoid (mg/100g)	0.045±0.001	0.034±0.000	0.047±0.002
Total Phenol (mg/100g)	0.097±0.002	0.065±0.001	0.043±0.001
DPPH (%)	88.35±0.21	86.71±0.30	65.81±0.17
Iron (Fe^{2+}) chelation assay (%)	24.75±0.12	22.55±0.09	22.56±0.07
Ferric reducing antioxidant power (FRAP) (Garlic Acid Equivalent)	0.29±0.01	0.47±0.00	0.22±0.02

NOTE * = Result values are expressed as mean value of triplicate determinations ± standard mean deviation

4.2 Discussion

The extractive value of solvent is a measure of the capacity of the solvent to extract bioactive ingredients from a given organic material (Arawande et al., 2018). The solvent ability in obtaining extract from plantain flower decreases in order: water > ethyl acetate > ethanol > methanol > acetone > chloroform. The selection of solvent system for extraction largely depends on the specific nature of the bioactive compound being targeted. Also, different solvent systems are available to extract the bioactive compound from natural products. Extraction efficiency is affected by the chemical nature of phytochemicals, the extraction method used, sample particle size, the solvent used, as well as the presence of interfering substances. Under the same extraction time and temperature, solvent and composition of sample are known as the most important parameters (Alachaher, *et al.* 2018).

Plants rich in phytochemicals can serve as good supplement to the needs of human body by acting as natural antioxidants and the extracts of such plants can serve as additives and preservatives in foods especially lipid containing foods. Most of the phytochemicals are antioxidants in nature. Phytochemicals protect humans against diet related diseases (Usunobun *et al*., 2014).

The phytochemicals such flavonoids, saponins, alkaloids, reducing sugar, tannin, phenol etc. exhibit various pharmacological and biochemical actions when ingested by animals; and plants containing these bioactive compounds are used in treatment of diseases. These phytochemicals possess biological activities which are responsible for odour, smell, taste, pungencies and colour of plants. Some of the phytochemicals gives certain plants their culinary, medicinal or poisonous features. Phenolic compounds represent the largest category of phytochemicals and they are most widely distributed in the plant kingdom. Phenols are hydroxyl group (−OH) containing class of chemical compounds where the (−OH) group is bonded directly to an aromatic hydrocarbon group. Phenol (C_6H_5OH) is considered the simplest class of this group of natural compounds. Being a secondary metabolite, they have an important role as defense compounds and they exhibit several properties beneficial to humans and its antioxidant properties are important in determining their role as protecting agents against free radical-mediated disease processes (Walton *et al.*, 2003). Alkaloids are natural products that contain heterocyclic nitrogen atoms and are always basic in character. The name 'alkaloids' was derived from the 'alkaline' nature and it was used to describe any nitrogen-containing base compound (Muller-Harvey, 1999). Almost all the alkaloids have a bitter taste. For example, the alkaloid 'quinine' is one of the bitter tasting substances known and is significantly bitter ($1x10^{-5}$) at a molar concentration (Adeleke, 2021). Many saponins are known to be anti-microbial, to inhibit mould, and to protect plants from insect attack. Saponins may be considered a part of plants' defense systems, and as such have been included in a large group of protective molecules found in plants named phytoanticipins or phytoprotectants (Lacaille-Dubois and Wagner, 2000). Saponin mixtures present in plants and plant products possess diverse biological effects when present in the animal body. Terpenoid comprises of natural products that was derived from five-carbon isoprene units. Most of the terpenoids have multi cyclic structures that differ from one another by their functional groups and basic carbon skeletons. Many of these are commercially interesting because of

their use as flavours and fragrances in foods and cosmetics (Harborne and Tomas-Barberan, 1991). Flavonoids have been reported to exert multiple biological properties including anti-microbial, cytotoxic, anti-inflammatory and anti-tumor activities; but the best-described property of almost every group of flavonoids is the capacity to act as powerful antioxidants (Shirsat *et. al.*, 2012; Teiten *et. al.*, 2013) which can protect the human body from the dangerous free radicals and reactive oxygen species (ROS).

Antioxidant activities were carried out on the plant raw sample and the first two solvent extracts with the highest percent yield. The antioxidant properties of water extract, ethyl acetate extract and raw sample of plantain flower were examined. The antioxidant properties considered for water extract, ethyl acetate extract and raw sample of plantain flower are total flavonoid, total phenol, 2,2-diphenyl-1-picrylhydrazyl **(**DPPH**)** radical scavenging, iron (Fe^{2+}) chelation assay and ferric reducing antioxidant power (FRAP). The biological functions of flavonoid include protection against allergies, inflammation, free radicals, ulcers and tumors (Tabiri *et al*., 2016). Flavonoids represent the most common and widely distributed groups of plant phenolic. They are potent water-soluble antioxidants and free radical scavengers which prevent oxidative cell damage, have strong anti-cancer activity and protects against all stages of carcinogenesis (Sagar, *et al*., 2018). Phenolic compounds have been reported to protect the human body from free radicals, whose formation is associated with the normal natural metabolism of aerobic cells. The antiradical activity of total phenols and flavonoids is principally based on the structural relationship between different parts of their chemical structure (Sola, *et al.* 2015). It was noticed that the solvent extracts possess less phenolic content than the raw sample. The extracts with high phenol content are said to possess compound that can protect the body from free radicals (Mehra *et al*., 2015). The percent DPPH is an expression of antioxidant activity of a given plant material (Tabiri et al., 2016) and the lower the value the higher is the antioxidant activity (Fidrianny *et al*., 2018). The raw samples and extract that has high antioxidant activity may contain many phenolic compounds that contributed to their antioxidant activity. The antioxidant activity of DPPH from plant sample extracts depends on the solvent used in the extraction. The different compounds can be extracted with different solvent due to different solubility (Boakye et al., 2015). The reducing power of plantain flower and its water and ethyl acetate extracts were assessed based on their ability to reduce Fe^{3+} to Fe^{2+}. The reducing power which is a novel antioxidant defense mechanism was determined by measuring the percentage iron chelating of the raw samples and solvent extracts of plantain flower. The high content of reducing power explains the medicinal importance and usefulness of plant samples. This assay just indicates how easily a given antioxidant donates electrons to reactive free radicals species, thus promoting the termination of free radical chain reactions. The ability of the antioxidant to reduce Fe^{3+} to its more active Fe^{2+} form might also be an indicator of its ability to act as a pro-oxidant in the system (Zhan-Wu *et al.* 2011). The reducing properties are generally associated with the presence of reductones that is reducing agent (Krishnamoorthy *et al*., 2011). Antioxidant action of reductones is based on the breaking of the free radical chain by donating a hydrogen atom (Oseni and Okoye, 2013). The antioxidant activity of these plant samples may be due to the presence of polyphenols which may act as reductones (reducing agent) to convert free radicals into more stable products and terminate free radical chain reaction. Similar trend of observation on polyphenolic constituents' dose dependent reducing power activity has been reported for several other plant extracts (Amarowicz *et al*., 2004; Zhu *et al*., 2002).

5. Conclusion

The extractive value, phytochemical and antioxidant properties of plantain flower reported makes it needed part of plantain tree that can be utilized as an additive in food and feeds of animals thereby turning this agricultural waste to wealth. Plantain flower possess some potential can be used

in pharmaceutical, cosmetic, and food products. However, anti-microbial and anti-fungal properties of plantain flower extracts can be further investigated to ascertain their potency against microbes and fungus.

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