



Nutritional Health Benefits and Bioactive Compounds of *Mangifera indica* L (Mango) Leaves Methanolic Extracts

**Bashir Alabi Ali¹, Abdullahi Attah Alfa^{2*}, Kokori Bajeh Tijani³,
Egbeja Tsobaza Idris⁴, Umar Sabdat Unoyiza⁴ and Yahaya Junaidu⁵**

¹Department of Plant Science and Biotechnology, Faculty Natural Sciences,
Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria.

²Department of Human Anatomy, Faculty of Basic Medical Sciences,
Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria.

³Department of Pharmacology and Therapeutics, Faculty of Basic Clinical Sciences,
Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria.

⁴Department of Animal and Environmental Biology, Faculty Natural Sciences,
Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria.

⁵Department of Human Physiology, Faculty of Basic Medical Sciences,
Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors BAA and AAA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors KBT and ETI managed the analyses of the study. Authors USU and YJ managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2020/v6i230126

Editor(s):

(1) Dr. Msafiri Yusuph Mkonda, Sokoine University of Agriculture, Tanzania.

Reviewers:

(1) Shweta Govind Patil, University of Health sciences, India.

(2) H G S P Hewageegana, University of Colombo, Sri Lanka.

(3) Hossny Awad El Banna, Cairo University, Egypt.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/60211>

Original Research Article

Received 02 July 2020
Accepted 09 September 2020
Published 25 September 2020

ABSTRACT

Mango leaves (*Mangifera indica*) contain a lot of beneficial phytopharmacological compounds to remedy various diseases through its nutritional bioactives. *Mangifera indica* leaves were successfully collected from healthy mango tree. The qualitative phytochemical analysis of obtained,

indicated the presence of many medicinally important secondary metabolite present which are alkaloids, tannins, saponins, flavonoids, and total phenol with no trace of cardiac glycosides. This indicates that the (*Mangifera indica*) possess high profile values and can be used to treat various kinds of diseases. The quantitative phytochemical analysis of mango leave extract obtained revealed that, the content of total phenol was high ($1.342 \pm 0.001\text{mg/g}$) and the least concentration was observed in cardiac glycosides ($0.136 \pm 0.001\text{mg/g}$). It also contain $1.054 \pm 0.001\text{mg/g}$ of flavonoid. The extract was found to contain $0.977 \pm 0.001\text{mg/g}$ of tannins. The concentration of alkaloid observed was $0.300 \pm 0.141\text{mg/g}$. Saponins was $0.244 \pm 0.001\text{mg/g}$ concentration. The proximate composition of a nutritional benefits of mango leaves. It has crude protein value of 18.59%, for the carbohydrates is higher in it has a value of 30.60%. The percentage ash content which is an indicator of the quality of mineral nutrients present has a value of 11.49%. Crude fibre content has a value of 13.99%. Estimation of vitamins in the leaves of Mango, where vitamin A, B, C, E (121, 189, 30, 10). The mineral compositions in the leaves of Mango are Na, K, Ca, Mg, Fe, Zn, P, N, Mn (28, 589, 368, 98, 343, 14, 480, 2, 3). The metalocompounds play a vital roles in human health physiology. This research classified a large number of nutritional benefits available from various sources and used in the treatment of various diseases such as Cardiovascular, anemia, Obesity, Diabetes, Cancer, Alzheimer, Parkinson, Inflammation, and Allergy. These are cured by herbal nutrition or food herb dietary condiment for phytotherapeutic purposes. The presence of various phytochemicals in the tested plant reveals that this plant may be a good source for production of new drugs for various ailments.

Keywords: *Mango leaf; health benefits; bioactive compounds; methanolic extract; treating diseases.*

1. INTRODUCTION

In traditional medicine the different parts of the mango tree (fruit pulp, extracts of fruit kernel, leaves, and stem bark) are used for their health properties. Decoction of mango kernal was reported to be used in the treatment of diarrhea, haemorrhages, and bleeding haemorrhoids for its vermifuge and astringent properties, extracts of unripe fruit, bark and leaves are used for their antibiotic activity, while an aqueous stem bark extract from *Mangifera indica* is used in Cuba as a remedy for diarrhoea, fever, gastritis, and ulcers [1].

Mango (*Mangifera indica* L.) is a juicy stone fruit belonging to the family of *Anacardiaceae* in the order of Sapindales and is grown in many parts of the world, particularly in tropical countries; Mango is now commercially grown in more than 87 countries [2]. Mango fruit conquers the 2nd position as a tropical crop, behind only bananas in terms of production and acreage used [2]. It has been well documented that mango fruits are an important source of micronutrients, vitamins and other phytochemicals. Moreover mango fruits provide energy, dietary fiber, carbohydrates, proteins, fats and phenolic compounds, which are vital to normal human growth, development and health [3].

Various parts of the plant are used as a dentifrice, antiseptic, astringent, diaphoretic, stomachic,

vermifuge, tonic, laxative and diuretic and to treat diarrhea, dysentery, anaemia, asthma, bronchitis, cough, hypertension, insomnia, rheumatism, toothache, leucorrhoea, haemorrhage and piles [4]. All parts are used to treat abscesses, broken horn, rabid dog or jackal bite, tumour, snakebite, stings, datura poisoning, heat stroke, miscarriage, anthrax, blisters, wounds in the mouth, tympanitis, colic, diarrhea, glossitis, indigestion, bacillosis, bloody dysentery, liver disorders, excessive urination, tetanus and asthma [4].

1.1 Nutritional Benefit of Mango Leaves

In Mango fruit, pre-biotic dietary fiber, vitamins, minerals and poly-phenolic flavonoid compounds are found. Mango is a very good source of Vitamin-A and flavonoids (beta-carotene, alpha-carotene, and beta-cryptoxanthin). 765 mg of recommended daily levels of vitamin A is present in 100 gm of mango fresh fruit. Together; these compounds are known to have antioxidant properties and are essential for vision [5]. Maintaining healthy mucus membranes and skin vitamin A is required. Consumption of natural fruits rich in carotenes is known to protect body from lung and oral cavity cancers [5]. Fresh mango is a very rich source of potassium. Potassium is an important component of cell and body fluids that helps in controlling heart rate and blood pressure. It is also a very good source of vitamin-B6 (pyridoxine), vitamin-C and vitamin-E. Consumption of foods rich in vitamin C helps the

body to develop resistance against infectious agents and scavenge harmful oxygen free radicals [5]. Vitamin B-6 or pyridoxine is required for GABA (neurotransmitters) production in the brain. It also controls homocystiene levels in the blood, which may otherwise be harmful to blood vessels resulting in stroke. Copper is a co-factor for many vital enzymes, including cytochrome c-oxidase and superoxide dismutase (other minerals function as co-factors for this enzyme are manganese and zinc). Copper is also required for the production of red blood cells. Mango peels are also rich in phytonutrients, such as the pigment antioxidants like carotenoids and polyphenol [5].

1.2 Medicinal Importance of Mango Leaf

Mango leaves contain a lot of beneficial chemical compounds to remedy various diseases, most importantly as diabetes medication, blood tonic, hepatitis and wound healing. Flavonoid as an antioxidant, steroid as hormone supply, gallic acid as antifungal and antiviral properties, and tannin as diarrhea remedy are some of the compounds that can be benefited from mango [4].

1.2.1 Anti-oxidant as free radical scavenging properties

Reactive oxygen species (ROS) possess a strong oxidizing effect and induce damage to biological molecules, including proteins, lipids and DNA, with concomitant changes in their structure and function. The major nutritional antioxidants, vitamin E, vitamin C and β -carotene, may be beneficial to prevent several chronic disorders. Considerable interest has arisen in the possible reinforcement of antioxidant defenses, both for chemoprevention and treatment purposes. The extract showed a powerful scavenging activity of hydroxyl radicals and acted as a chelator of iron [6]. It also showed a significant inhibitory effect on the peroxidation of rat brain phospholipid and prevented DNA damage caused by bleomycin or copper-phenanthroline systems [6]. The protective abilities of mango stem bark extract (Vimang) 50-250 mg kg⁻¹, mangiferin 50 mgkg⁻¹ and selected antioxidants (vitamin C 100mg/kg(1), vitamin E 100 mg kg⁻¹) and beta carotene 50 mgkg⁻¹) against the 12-O-tetradecanoylphorbol-13-acetate (TPA)-induced oxidative damage in serum, liver, brain as well as in the hyper-production of reactive oxygen species (ROS) by peritoneal macrophages was compared [6].

1.2.2 Antiviral activity

The *in-vitro* effect of mangiferin has been studied against Herpes simplex virus type 2; [6]. It was reported by Jain et al., [6] that In-vitro mangiferin was also able to inhibit HSV-1 virus replication within cells and to antagonize the cytopathic effects of HIV.

1.2.3 Anthelmintic and anti-allergenic activity

Anthelmintic and anti-allergic activities of stem bark components Vimang and mangiferin were investigated in mice [6] with experimentally infected with nematodes, *Trichinella spiralis*. It was discovered that mangiferin, the major compound of Vimang, contributes to the anti-allergic effects of the extract [6].

1.2.4 Anti-inflammatory

An ethanolic (95%) extract of the seed kernel show a significant antiinflammatory activity in acute, subacute and chronic cases of inflammation [6]. The leaf extract exhibited antibacterial activity against *Bacillus subtilis*, *Staphylococcus Albus* and *Vibrio Cholera* [6]. Analgesic and anti-inflammatory effects also has been studied [6].

1.2.5 Diabetes medication properties

Mango leaves have been reported to be very useful for managing diabetes. The tender leaves of the mango tree contain tannins called anthocyanidins that may help in treating early diabetes. The leaves can be dried and powdered, or used as an infusion to treat the same. It also helps to treat diabetic angiopathy and diabetic retinopathy. The leaves should be soaked in a cup of water overnight, strained and to be administered as a drink to help relieve the symptoms of diabetes. It also helps in treating hyperglycemia [6].

1.2.6 Improves digestions

Rich in prebiotic fiber which helps in growth of beneficial bacteria in the gut, this helps to reduce or lower acidity problem, prevent constipation and prevent a number of disease associated with gastrointestinal track like inflammation bowel disease, irritable bowel syndrome, and antibiotics related disorders [6].

1.2.7 Boost memory and amnesia properties

Mango is rich in glutamine which helps to boost memory, also rich in vitamin B6 which is

essential for gamma aminobutyric acid (GABA) production, an essential neurotransmitter [7].

1.2.8 Cures respiratory complicated diseases

Mango leaves are good for all kinds of respiratory problems. It is especially useful for people suffering from cold, bronchitis and asthma. Drinking a decoction made by boiling mango leaves in water with a little honey helps to cure cough effectively. It also helps in curing voice loss [8].

1.2.9 Lowers blood pressure as hypotensive agent

Hypertension or high blood pressure is one of the diseases that come secretly. It is difficult to know someone has hypertension without measuring his blood pressure. One way to lower high blood pressure is to consume mango leaf tea. Some of the compounds in mango leaves are proven to lower high blood pressure through angiotensin inhibitor in the kidney, where blood pressure upshot start before reaching the heart. However, drinking the boiled water of mango leaves will gradually lower the blood pressure [6].

1.2.10 Healing Wounds/burns

Burns are skin conditions that are injured by the contact with hot objects, such as hot water, hot oil, exhaust, ironing and more. In general, the burned skin will bubble, blister and watery. Many ways can be done to overcome or eliminate the burns; there is a simple way to overcome burns as first aid that is using mango leaves. Take the dried mango leaves and burn them into ash, just sprinkle the ash over the wound [6].

1.2.11 Treating kidney disease

Kidney works for disposing of metabolism waste such as calcium oxalate and calcium citrinate that occurs in the human body (Kidney stone). Kidney will systematically throw the excess fluid out of the body as much as 750 ml 1500 ml per day. If the kidney doesn't work properly, or in the medical world is well known as kidney failure, the rest of body metabolism will not be released, it will be toxic instead. One of the health benefits of mango leaves is treating kidney disease, this is done by consuming water of mango leaves, it will prevent the occurrence of infection in the kidney and also destroy kidney stones that inhibit urination [8].

1.2.12 Healing gut

Gut disease is a condition that can cause unbearable pain such as bowel irritation, swelling, and hot feeling in the joints. Although all joints in the body can be attacked by gut, the most frequent are fingers, knees, ankles, and toes. Mango leaves is capable of healing gut [8].

1.2.13 Keeps cholesterol in check

Mango has high level of vitamin C, pectin and fibres that help to lower serum cholesterol levels. Fresh mango is a rich source of potassium, which is an important component of cell and body fluids that helps to control heart rate and blood pressure [8].

1.2.14 Fights cancerous cells

Antioxidants like quercetin, isoquercitrin, astragalin, fisetin, gallic acid and methylgallat present in mango protect the body against colon and breast cancer [8].

1.2.15 Aphrodisiac properties

Mango has aphrodisiac properties and is also called the 'love fruit'. Mangoes increase the virility in men. Vitamin E, which is abundantly present in mangoes, helps to regulate sex hormones and boosts sex drive [8].

1.3 Ethnomedicinal Uses

Various parts of *mangifera indica* (bark, leaves, roots, fruits, and flowers) have been used in traditional medicine for more than thousands of years for the treatment of various diseases and conditions. Ethnomedicinal uses of various parts of *mangifera indica* in different countries in the world are summarized below.

Root and bark: Used as astringent, acrid, refrigerant, styptic, anti-syphilitic, vulnerary, anti-emetic, anti-inflammatory and constipating. They are useful in vitiated conditions of pitta, metrorrhagia, calorrhagia, pneumorrhagia, leucorrhoea, syphilis, uteritis, wounds, ulcers and vomiting. The juice of fresh bark has a marked action on mucous membranes, in menorrhoea, leucorrhoea, bleeding piles and diarrhoea [9].

Leaves: Used as astringent, refrigerant styptic, vulnerary and constipating. They are also useful in vitiated conditions of cough, hiccup,

hyperdipsia, burning sensation, hemorrhages, haemoptysis, haemorrhoids, wounds, ulcers, diarrhoea, dysentery, pharyngopathy, scorpion sting and stomachopathy. The ash of burnt leaves is useful in burns and scalds. The smoke from burning leaves is inhaled for relief of throat diseases [9].

Fruits: the unripe fruits are acidic, acrid, antiscorbutic, refrigerant, digestive and carminative. They are useful in dysentery ophthalmia, eruptions, urethrorrhoea and vaginopathy. The ripe fruits are refrigerant, sweet, emollient, laxative, cardiotoxic, haemostatic, aphrodisiac, and tonic. They are also used in vitiated conditions vata and pitta, anorexia, dyspepsia, cardiopathy, haemoptysis, haemorrhages from uterus, lungs and intestine, emaciation, and anemia [9].

Seed kernel: The seed kernel is rich source of protein (8.5%) and gallic acid. It is sweet, acrid, astringent, refrigerant, anthelmintic, constipating, haemostatic, vulnerary and uterine tonic. It is useful in vitiated conditions of pitta and cough, helminthiasis, chronic diarrhea, dysentery, haemorrhages, haemoptysis, haemorrhoids, ulcers, bruises, leucorrhoea, menorrhagia, diabetes, heat burn and vomiting [9].

2. MATERIALS AND METHODS

2.1 Collection and Preparation of Plant Materials

Mangifera Indica leaf were harvested at Baba Wali Street, NTA Community behind Prince Abubakar Audu University, Anyigba, Kogi State, Nigeria in March 2020. The plant's identification was authenticated by Mr. Ayegba Ojochele Sule at the Herbarium Unit of the Department of Biological Sciences, Faculty of Sciences, Prince Abubakar Audu University, Anyigba, and voucher specimen number of KSU/BS/066 was deposited for future reference. The leaves were washed with cleaned water. It was then air dried for three weeks in a shaded area (Botany Laboratory) and the dried leaves were pulverized using blender, and then further sieved to obtain a coarse powder.

2.2 Extraction Methods

Extraction was carried out using the method adopted by Abu and Uchendu, [10], in this method, 140 grams of powdered sample of *Mangifera indica* leaves were macerated with

600ml of methanol and it was kept in fume cupboard for 24 hours. It was then filtered with the use of vacuum machine. The extract was evaporated to dryness using water bath 45°C for 48 hours. 5g of the extract was dissolved in 25ml of methanol and it was filtered, the filtrate was used for the analysis.

2.3 Qualitative Phytochemical Screening of Methanolic Extract of *Mangifera Indica* Leaves

The methanolic extract of *mangifera indica* was subjected to phytochemical screening in order to identify the active constituent of the plant using the standard phytochemical reagents and procedures as described by Kokori et al., [11] and Abdullahi et al., [12]. The tannin, flavonoids, saponin, cardiac glycoside, alkaloids, phenolic were determined.

2.4 Quantitative Phytochemical Screening of Methanolic Extract of *Mangifera indica* Leaves

The phytochemicals determined are: tannins, saponins, alkaloids, flavonoids, phenols, cardiac glycosides.

2.4.1 Determination of tannins

The tannins were determined by Follin-ciocalteu method, [13]. About 0.1ml of the sample extract was added to a volumetric flask containing 7.5ml of distilled water and 0.5ml of Follin- ciocalteu phenol reagent. The Sample was shaken well and kept at room temperature for 30 minutes. A set of reference standard solution of Gallic acid 20, 40, 60, 80 and 100 g/ml were prepared in the same manner, absorbance for the test and standard solution were measured at 725 nm with an UV/visible spectrophotometer.

2.4.2 Determination of saponins

Total saponin content was determined by the method described by AOAC, [14], based on Vanillin sulphuric acid colorimeter reaction with some modifications. About 50ml of sample extract was added with 250ml of distilled water, to this about 250ml of Vanillin reagent (80 mg of vanillin in 10ml 99.5% ethanol) and 2.5ml of 72% sulphuric acid were added and was mixed well. This solution was kept in a water bath at 60°C for 10 minutes. It was cooled in an ice cold water and the absorbance was read at 544nm.

2.4.3 Alkaloid determination

About 5 g of the sample (*Mangifera Indica* leaf methanolic extract) was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol were added and covered and allowed to stand for 4hours. This was filtered and the extract is concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation is completed. The whole solution was allowed to settle and the precipitates were collected and wash with dilute ammonium hydroxide and then filtered. The residue is the alkaloid, which was dried and weighed. The percentage of total Alkaloids was calculated as:

$$\% \text{ weight Alkaloids} = \frac{\text{residual}}{\text{weight of sample}} \times 100 \text{ [14].}$$

2.4.4 Determination of phenol

Total phenolic content was determined by the Follin-ciocalteu method, a 10ml aliquote of extract solution was mixed with 1.16 ml of distilled water and 100ml of Follin-ciocalteu reagent followed by the addition of Na_2CO_3 solution (20%). Subsequently, the mixture was incubated in a shaking incubator at 40^o C for 30 minutes and it's absorbance at 760 nm was measured [14].

2.4.5 Flavonoid determination

About 10g of the plant sample was extracted repeatedly with 100 ml of 80% aqueous methanol at room temperature. The whole solution was filtered through Whatman filter upper No. 42 (125 mm). The filtrate was later be transferred into a crucible and evaporated into dryness over a water bath and weighed to a constant weight [14].

2.4.6 Determination of cardiac glycosides

It was determined according to AOAC, [14], by some modifications 10% extract of the sample

was mixed with 10ml freshly prepared Baljectis reagent (95 ml of 1% picric acid and 5 ml of 10% NaoH). After an hour, the mixture was diluted with 20ml of distilled water and the absorbance was measured at 495 nm.

2.5 The Proximate Analysis

The proximate analysis of the samples was carried out according to AOAC, [15] for moisture content, ash, fat, crude protein, crude fibre after drying the samples of Mango leaf (*Mangifera Indica*) at room temperature.

2.6 Determination of Vitamins

Vitamins A, E, B and C were determined according to methods previously described AOAC, [14,16].

2.7 Determination of Mineral Elements

The mineral elements were determined by the dry ash extraction method of AOAC, [16] and Kokori et al., [17].

2.8 Statistical Analysis

Results obtained were recorded as mean \pm SEM and subjected to one way analysis of variance (ANOVA) and where significant differences exist, means were compared using Waller Duncan test was performed using Statistical Analysis System (SAS, software version 2002) at 0.05 significant level ($P < 0.05$).

3. RESULTS

The result obtained from this research contains both the qualitative and quantitative phytochemical analysis of *Mangifera indica* leaves collected.

Table 1 shows qualitative phytochemical screening which indicated that mango leave is rich with several chemical constituents, by using specific test method for each group of compound,

Table 1. Qualitative phytochemical constituent of methanolic extract of *Mangifera indica* leaf

Phytochemicals	Inference	Test methods
Alkaloids	+	Mayer's Test
Tannins	+++	FeCl_3
Flavonoids	++	NaOH- HCL
Saponins	++	Frothing Test
Total phenol	+++	Dennis Test
Cardiac glycosided	-	Fehling A and B Test

Key's: (-): Negative; (+): Weakly positive; (++) : Moderately positive; (+++): Strongly positive

mango leave contains alkaloids, tannins, flavonoids, saponins and total phenol with no trace of cardiac glycosides. Alkaloids shows weakly positive (+) result to Mayer's test, tannins shows strongly positive result (+++) to FeCl₃ test, flavonoids shows moderately positive result (++) to NaOH - HCL test, saponins shows moderately positive result (++) to frothing test, total phenol shows strongly positive result (+++) to Dennis test while cardiac glycosides shows negative result (-) to felhing A and B test methods respectively.

absorbance, the higher the concentration, therefore the phytochemical with highest concentration was recorded to be total phenol. Flavonoid, tannins, alkaloids and saponins has the concentration of 1.054 ± 0.001, 0.977 ± 0.001, 0.300 ± 0.141 and 0.244 ± 0.001 respectively. There was no significant difference (P< 0.05, Df =5) between the concentration of the phytochemicals.

Table 2 below shows the quantitative phytochemical content (absorbance) of methanolic extract of *Mangifera indica* leave which ranges from 1.342 ± 0.001- 0.136 ± 0.001. The highest concentration was recorded in total phenol while the lowest concentration was recorded in cardiac glycosides. According to Lambert (1962) principle the higher the

Table 2. Quantitative phytochemical constituent of methanolic extract of *Mangifera indica* leaf

Phytochemicals	Contents (%)
Total phenol	1.342 ± 0.001
Flavonoid	1.054 ± 0.001
Tannins	0.977 ± 0.001
Alkaloids	0.300 ± 0.141
Saponins	0.244 ± 0.001
Cardiac glycosides	0.136 ± 0.001

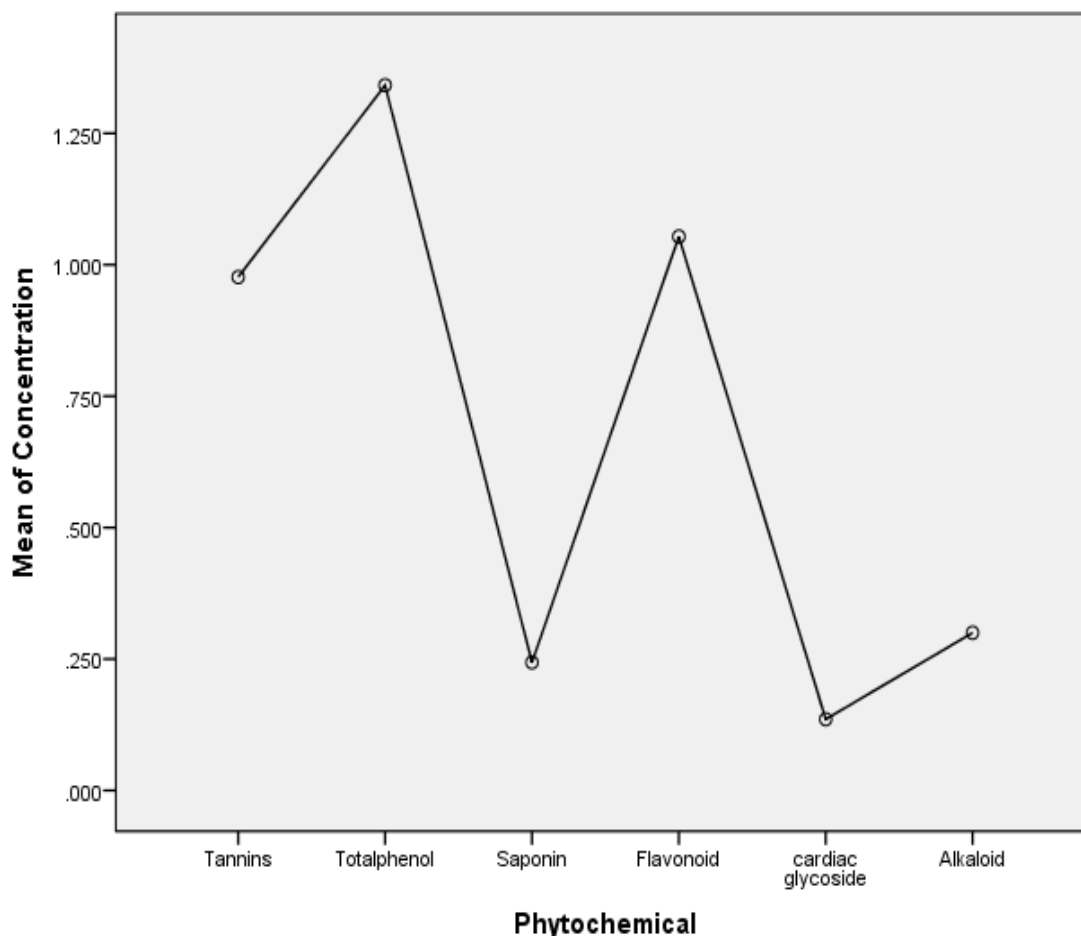


Fig. 1. A line graph of mean concentration of the phytochemical

Table 3. Analysis of variance of the concentrations of the phytochemicals present

Phytochemical	N	Subset for alpha = 0.05			
		1	2	3	4
Cardiac Glycoside	2	0.13550			
Saponin	2	0.24350	0.24350		
Alkaloid	2		0.30000	-	
Tannins	2			0.97650	
Flavonoid	2			1.05350	
Total phenol	2				1.34150
Sig.		0.111	0.366	0.231	1.000

3.1 Proximate Analysis

The result obtained showed that the proximate composition of a nutritional benefits of Mango leaves (*Mangifera indica*), (See Table 4).

Table 4. Shown summary of proximate composition of mango leaves (*Mangifera indica*)

Parameters	Sample Leaf
%Moisture Content	21.06
% Ash Content	11.49
% Crude Fibre	13.99
% Fat Content	4.31
% Crude Protein	18.59
% Carbohydrate	30.60

3.2 Determination of Vitamins

Table 5. Determination of vitamins of mango leaf (*Mangifera indica*)

Vitamins (mg/100 mL)	Sample Leaf
A	121
B	189
C	30
E	10

3.3 Determination of Mineral Elements

Table 6 shows determination of mineral elements present in Mango leaves (Na, K, Ca, Mg, Fe, Zn, P and Mn).

4. DISCUSSION

Phytochemical are substance produced mainly by plants, and these substances have both biological and inhibitory properties. In the pharmaceutical industry, plants represented the main source for obtaining various active ingredients.

Table 6. Mineral composition of seeds and leaves of mango leaves (*Mangifera indica*) (mg/100 g dry matter)

Minerals	Mango leaves (<i>Mangifera indica</i>) Leaf
Na	28
K	589
Ca	368
Mg	98
Fe	343
Zn	14
Cu	n
P	480
N	2
Mn	3

Key: n-non detected

Phytochemical analysis of the plant (*Mangifera indica*) revealed the presence of active constituent which were known to exhibit various medicinal uses as well as action on human body [18].

The qualitative phytochemical analysis of *Mangifera indica* obtained, indicated the presence of many medicinally important secondary metabolite present which are alkaloids, tannins, saponins, flavonoids, and total phenol with no trace of cardiac glycosides, and this indicates that the plant (*Mangifera indica*) possess high profile values and can be used to treat various kinds of diseases and for healing wounds, this due to the strongly positive inferences of tannins and Total phenols. Total phenol is a good antioxidant [19].

The quantitative phytochemical analysis of mango leave extract obtained revealed that, the content of total phenol in *Mangifera indica* leave was high (1.342 ± 0.001 mg/g) and the least concentration was observed in cardiac glycosides (0.136 ± 0.001 mg/g). Phenols protect plants from oxidative damage and perform the same functions for human [19]. The outstanding

phytonutrients features of phenol is their ability to block specific enzymes that causes inflammation, they also modify the prostaglandin pathway, thereby protecting platelet from clumping. Phenolic compound can also play an important role in preventing body cells from injuries by hydrogen peroxide, preventing cells and organs of human from physiological damage and absorbing and neutralizing free radical [20]. Free radicals scavenging and antioxidant activity of mango are responsible for therapeutic effect against cancer, diabetes and cardiovascular diseases [20].

Mangifera indica leave extract in this research was found to contain 1.054 ± 0.001 mg/g of flavonoid, plant flavonoid has antioxidant activity has been reported to protect the cells against oxidative damage. The biological functions of flavonoid include protection against allergies, inflammations, free radical scavenging, platelets aggregation, microbes, ulcers, hepatoxins, viruses and tumor's, the flavonoid are responsible for the antioxidant effect of the leaves [21].

Mangifera indica leave extract was found to contain 0.977 ± 0.001 mg/g of tannins. Tannins have the ability to form complexes with several bimolecules and might be efficacious in precipitating poisonous materials in burned tissue. Tannins lead to improve wound healing and reduce scar formation tissue by inhibition of the formation and removal of reactive oxygen substance. Plant tannins also help to relief pain, limitations of secondary infection, prevention of loss of plasma and promotion of prolifc epitheliasation, tannins have astringent activities which help to quicken wound healings and treat inflammations [21].

The concentration of alkaloid observed was 0.300 ± 0.141 mg/g. The presence of alkaloids in mango leave supported the use of this plant part in the treatment of malaria and fever in Nigeria [22]. Plant alkaloids are used as a basic medicinal agent for their analgesic, antispasmodic and bactericidal effect, it also protects against chronic diseases [22].

Mangifera indica leave extract was found to contain 0.244 ± 0.001 mg/g concentration of saponins. Saponins has natural tendency to remove microbes makes them good for treating fungal and yeast infections. These compounds serve as natural antibiotics, helping the body to fight infections and microbial invasion. These

compounds also appear to greatly enhance certain vaccines. Plant saponins help humans to fight fungal infections, combat microbes and viruses, boost the effectiveness of certain vaccine and knock out some kinds of tumor cells particularly lung and blood cancers. They also lower blood cholesterol thereby reducing heart disease. The most outstanding and exciting prospects for saponins are how they inhibit or kill cancer cells. They may also be able to do it without killing normal cells in the process [23]. Cancer cells have more cholesterol type compounds on their membranes than normal cells, Saponins bind cholesterol and thus, interfere with cell proliferation [23].

The beneficial medical uses of cardiac glycosides are as treatment for congestive heart failure, cardiac arrhythmias and cancer treatment. Glycoside of plants can be used as cardiac stimulant [24].

The plant (mango leave) thus find their medicinal values due to the presence of respective phytochemical constituents. The presence of various phytochemicals in the tested plant reveals that this plant may be a good source for production of new drugs for various ailments.

These findings were in accordance with the findings of Buniyamin et al., [25], who found that mango leave extract shows the presence of tannins, saponins, flavonoids and total phenol with no trace of cardiac glycoside.

The Table 4 shows the proximate composition of a nutritional benefit of mango leaves. It has crude protein value of 18.59%, for the carbohydrates is higher in it has a value of 30.60%. The percentage ash content which is an indicator of the quality of mineral nutrients present has a value of 11.49%. Crude fibre content has a value of 13.99%. Table 5: shows estimation of vitamins in the leaves of Mango (*Mangifera indica*) where vitamin A, B, C, E (121, 189, 30, 10). Table 6: shows mineral compositions in the leaves of Mango (*Mangifera indica*) where mineral present are Na, K, Ca, Mg, Fe, Zn, P, N, Mn (28, 589, 368, 98, 343, 14, 480, 2, 3) [17].

5. CONCLUSION

The medicinal plants (mango leave) are the source of the secondary metabolites such as alkaloids, flavonoids, tannins, saponins, total phenol and cardiac glycosides. Medicinal plants play a vital role in preventing various diseases.

Mangifera indica leave extract contain more of tannins and total phenol, this plant (mango leaves) can be used for treating various diseases because total phenol is a good antioxidant [19]. It also contained vital mineral elements and vitamins that assist in building damage cells.

6. RECOMMENDATIONS

1. Tannins is strongly present in *Mangifera indica* leaf and this shows that, this plant can be used for healing diseases.
2. It is recommended that more research should be carried out on this plant, which is *Mangifera indica*, to find more about their pharmacological benefits and their potential against fighting various ailments and diseases.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Masibo M, He Q. Major Mango Polyphenols and Their Potential Significance to Human Health. *Comprehensive Review of Food Science*. 2009;7:309–319.
2. Muchiri DR, Mahungu SM, Gituanja SN. Studies on Mango (*Mangifera indica* L.) kernel fat of some Kenyan varieties in Meru. *Journal of the American Oil Chemist's Society*. 2012;89:1567-1575
3. Jahurul MHA, Zaidul ISM, Ghafoor K, Al-Juhaimi FA, Nyam KL, Norulaini NAN, Sahena F, Omar AKM. Mango (*Mangifera indica* L.) by-products and their valuable components. *A Review of Food Chemistry*. 2015;183:173-180.
4. Kalita P. An Overview on *Mangifera indica*: Importance and Its Various Pharmacological Action. *Pharma Tutor*. 2014;2(12):72-76.
5. Sompong S, Pirote S. Nutritive value and nutrient digestibility of ensiled mango byproducts, *Maejo International Journal of Science Technology*. 2009;3(3):371-378.
6. Jain AP, Tandon M, Rathore SP, Kori ML. Pharmacological properties of *Mangifera indica*, RKDF (Research and knowledge developmental fund) College of Pharmacy, Bhopal. *Journal of Novel Research in Pharmacy and Technology*. 2018;317-320.
7. Ahmed M. *Medicinal Modernist Journal* publisher, Chennai; 2010.
8. Sánchez G, Ruiz-Montañez JA, Ragazzo M, Calderón-Santoyo G, Velázquez-De La Cruz JA, Ramírez De León, Navarro-Ocaña A. Evaluation of extraction methods for preparative scale obtention of mangiferin and lupeol from mango peels (*Mangifera indica* L.), *Food Chemistry*. 2014;159:267–272.
9. Masud Parvez GM. Pharmacological Activities of Mango (*Mangifera indica*) Review. *Journal of Pharmacognosy, Phytochemistry*. 2016;5:1–7.
10. Abu AH, Uchendu CN. Architectural Application of Science Research. 2010;5: 56-68.
11. Kokori BT, Abdullahi AA, Abdullahi AS. Studies on phytochemical, nutraceutical profiles and potential medicinal values of *Allium sativum* Linn (Liliaceae) on Bacterial Meningitis. *International Neuropsychiatric Disease Journal*. 2019;13(2):1-15, Article no.INDJ.51609. ISSN: 2321-7235, NLM ID: 101632319
12. Abdullahi Attah Alfa, Orukotan Abimbola Ayodeji, Goji Anthony Donatus Teru, Kokori Bajeh Tijani. Studies on the phytochemical compounds in the Ethanolic leaf extract (ELE), ethanolic bark extract (EBE) and ethanolic root extract (ERE) of *Bridelia ferruginea* Benth (euphorbiaceae). *Asian Journal of Biochemistry, Genetics and Molecular Biology*. 2019;2(4):1-8.
13. Abdelnaser Abdelghany Elzaawely and Shinkichi Tawata. Preliminary phytochemical investigation on Mango (*Mangifera indica* L.) leaves. *World Journal of Agricultural Sciences*. 2010;6:735-739.
14. AOAC. Association of official analytical chemists, Official methods of Analysis, 11th edition, Washington DC USA. 2015; 70-84.
15. AOAC. Official Methods of Analysis - 17th edition. Association of Official Analytical Chemist, Maryland; 2018.
16. AOAC. Official methods of analysis, 21st Edition. Association of Official Analytical Chemist, Washington, D.C. 2019;40-57.
17. Kokori Bajeh Tijani, Danjuma Nuhu Muhammed, Janet I. Ejiofor, Busayo Olayinka and Abdullahi Attah Alfa. Herbominerals and antibacterial activities of *Allium sativum* I extracts on pathogenic bacteria causing meningitis in Sub-Saharan Africa, Zaria, Kaduna State, Nigeria. *Asian Journal of Research in*

- Infectious Diseases. 2020;3(1):1-15. Article no.AJRID.53275. ISSN: 2582-3221
18. Yadav R, Agarwala M. Phytochemical analysis of some medicinal plants. Journal of Phytochemistry. 2011;3(12):104.
 19. Okwu. Phytochemicals, Vitamin and mineral content of two Nigerian medicinal plants. International Journal of Molecular Medical Advanced Science. 2005;375–381.
 20. Sroka Z, Cisowski W. Hydrogen peroxide scavenging, antioxidant and antiradical activity of some phenolic acids. Food Chemistry Toxicol. 2003;44:753-758.
 21. Olusegun Dare Omotoso, Abdullahi Attah Alfa, Samson E. Olorunnado, Kokori Bajeh Tijani Histomorphological characterization of *Pneumococcal meningitis* in bone marrow of wistar rats treated with *Bridelia ferruginea* and Ciprofloxacin. International Journal of Medicine and Health Development. 2020;25(2).
 22. Adesegu SA, Coker HAB. Plants used in traditional medicine against malaria, Nigerian. Journal of Pharmacology. 2001; 32:50–62.
 23. Okwu DE, Emenike IN. Evaluation of the Phytonutrients and Vitamins Contents of *Citrus* Fruits. International Journal of Molecular Medical Advanced Science. 2006;2(1):1–6.
 24. Sofowora A. Medicinal plants and traditional medicine in African. Ibadan: Spectrum Book Ltd; 1993.
 25. Buniyamin AA, Eric KI, Fabian CA. Pharmacognosy and hypotensive evaluation of *Mangifera indica* and *Ficus exasperata vahl* (Moraceae) leaf. Acta; 2008.

© 2020 Ali et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/60211>