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THE EFFICACY OF EXTRACTS FROM MANGO (*Mangifera indica*) STEM IN THE TREATMENT OF TOOTHACHE

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ABSTRACT

The causative factors behind toothache include tooth decay or fracture, abscessed tooth, or infected gums. Over 750 species of bacteria inhabit the oral cavity and a number of these are implicated in oral diseases including toothaches.The efficacy of Mango stem extract can be used for the inhibition of pathogens causing human toothache was investigated. Ethanol was used as solvent for extraction. Two human pathogens; *Streptococcus mutans* which is a bacterial pathogen and *Aspergillus niger* which is a fungal pathogen were employed in this study. The inhibitory effects of the ethanol extract *Mangifera indica* on the test organisms were conducted using the agar well diffusion method of antimicrobial assay. Antibacteria (Amoxicillin) and Antifungal (Fluconazole) served as the control. A sub culture process was carried out to enable proper identification of the Minimum Inhibitory Concentration (M.I.C) of 3 different tooth samples (T_1,T_2,T_3). This process was carried out using the mango stem extract introduced in drops (0.5ml,0.10ml,0.15ml) in 9 petri dishes respectively for both fungi (Amoxicillin) and bacteria (Fluconazole) media. The result shows that the mean total zone of inhibition of T_2 (3.53) by mango extract is higher T_1(2.90) and T_3(3.10). When compared with the control, the mean total zone of inhibition becomes higher when the extract is being introduced in large amount (0.15>). So in a bacteria media the higher the mango extract is introduced the more the inhibition zone increases (Table 1). There are significant differences in the inhibition effects of the plant extracts and the susceptibility of the human pathogens ($P<0.05$). While in fungi media the mean total zone of inhibition of T_3 (3.36) by mango extract is higher T_1(2.83) and T_3(3.20). When compared with the control, the mean total zone of inhibition becomes lower when the extract is being introduced in large amount (0.5<). From the result it shows that the bark extract of mango is very active in treatment of toothache in the sense that the extract possess potential inhibitory activity against human pathogens *in vitro* to varying degrees.

Keywords: Toothache; mango (*Mangifera indica*) stem; efficacy; extracts.

1. INTRODUCTION

Toothache is a common issue that affects the entire human population. According to the WHO, it is considered a priority issue for the organization's global oral health promotion campaign. It is caused by various conditions such as dental caries, trauma, and abscess [1]

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The main causes of toothache are tooth decay, fracture, or abscessed tooth [2]. There are also a number of bacterial species that inhabit the oral cavity and are responsible for the development of dental caries [3].

According to the WHO, toothache is a common issue in low-income groups and those who are mainly untreated. It can affect a person's sleeping, eating, and productivity [4].

In children, the pain can affect their school attendance and speech development. In some parts of the world, the prevalence of dental caries has reached 90%. Studies also revealed that toothaches are common in school-aged children [5].

A study conducted in Finote Selam, Ethiopia, revealed that almost half of the students had dental caries. Another study conducted in 2016 in Debre Tabor, also revealed that dental caries is prevalent in the area [6]

Unfortunately, accessing healthcare for people with toothaches is limited in many developing countries, especially in Ethiopia. Many people in the region use plant species as toothpaste [7].

1.1 Mango Stem for Toothache Treatment

Mangifera indica, also known as mango, has been used as an herb for thousands of years in Indian medicine. It is a member of the Anacardiaceae family [8]

Ayurveda states that the various parts of mango tree, including the leaves and stem, have various medicinal properties. They have been used as medicine by different peoples all around the world [9].

A study conducted in 2022 revealed that shea butter is effective in treating coughs. The study also noted that the use of infusions and mixtures is very efficient when used for treating coughs. The medicinal properties of plants are based on the presence of various active principles [10]

The primary advantages of using plant-derived medicines over synthetic ones are that they are cheaper and provide better treatments. Also, the availability of these plant materials in rural areas has made traditional medicine relatively cheaper [11].

Various studies have been performed in an effort to identify the various antimicrobial and phytochemical properties of plants. They then could be used as an alternative to antibiotics for treating various infections [12].

Due to the properties of plants, many potent drugs have been successfully extracted from them and introduced to modern medicine [13].

One of the most popular tropical fruits is mango. It has powerful antioxidant properties and possesses various anti-diabetic and hypotensive activities [14].

The various parts of the mango plant are used as various medical treatments. Some of these include antiseptic, diaphoretic, stomachic, and laxative. They are also used to treat various conditions such as dysentery, asthma, and bronchitis [15].

Ripe mango fruit is known to freshen and reinvigorate the body. It is also used as a heat stroke tonic and as an astringent. The seeds are used as an ingredient for asthma [16].

The gum is used for treating wounds and scabies. It is also anti-syphilitic. The bark is also used for the purpose of dyeing [17]

For thousands of years, the mango plant has been used as a traditional medicine for treating various diseases. In developing countries, around 65% of the population uses mango plants as their primary medicine [18]

It's no wonder that the use of mango plants for the treatment of toothaches has been carried out globally. A study carried out in Tanzania revealed that traditional healers use mango stem extract to treat their patients [19].

In Cameroon, 32 different medicinal plants are used to treat toothaches. In neighboring Burkina Faso, there are about 62 plants that are used to treat oral diseases [20].

In Madagascar, some of the local communities have been using 63 plant species to treat dental cavities and other periodontal diseases. A study conducted in 2014 revealed that the same plants were used by local residents in Iran and Kenya to treat toothaches [21].

Various studies have shown that the use of herbal extract in dentistry can reduce inflammation and inhibit the growth of oral pathogens. It can also prevent the release of histamine [22].

A study conducted in 2013 revealed that the ethanol and methanol extract of the Datura stramonium exhibited anti-bacterial properties. Also, a study conducted in 2013 revealed that the use of Salvadora persica, a tree used for oral hygiene, can inhibit the growth of certain bacteria [23]

The researchers analyzed the various active compounds extracted from the plant species to determine their antimicrobial properties. They also found that alcoholic and ethanol-based solvent products exhibited more antimicrobial properties than the plant's aqueous extract [24].

Various active compounds, such as tropane alkaloids, artocarpin, and scopolamine, were isolated from D. stramonium and from Artocarpus heterophyllus [25]

The goal of the study was to determine the antimicrobial properties of the mango stem extract and the effectiveness of this treatment against pathogens causing toothache [26].

2. LITERATURE REVIEW

The botany of *Mangifera indica* stem

2.1 Botanical Description

This large evergreen tree has a dome-shaped base with dense foliage. It has spirally arranged branches with elliptical leaves that are pointed at both ends. The plant produces an aromatic odour when crushed [27].

It has a panicle-like structure with about 3,000 tiny greenish or yellowish – red flowers. The fruit is a yellow pulp with a thick yellow skin [28].

According to the 2007 classification, this plant belongs to the Anarcardiaceae family [29].

It is native to the Indian subcontinent and is naturalized in other tropical countries.

Madhuula is from the Indian subcontinent. It has been translated into various languages. Some of its common names are: Ambrah, Madhuula, Mandabha, Manja, Tamil, Amram, and Marvo [30]

The various chemical constituents of this plant are known to be of interest. Among these are flavonoids, mangiferin, tannins, and gallic acid derivatives. The plant's bark is known to contain catechin, mangiferin, and various other bio-active constituents [31].

The various derivatives and chemicals found in the plant include manghopanal, mangopanal, and friedelin. They are isolated from the stem bark and are linked to common flavonoids [32]

The flowers of this plant produce various alkyl gallates, such as gallic acid, methyl gallate, n-propyl gallate, and 4-phenyl gallate. The root of mango also has the chromones [33].

The flowers and leaf of this plant are known to contain various essential oils. The fruit pulp is also rich in vitamin A and C, xanthophylls, and phenolic antioxidants. It has been isolated from the stem bark [15].

Although a lot of research has been conducted on the various components of this plant, further studies are still needed to confirm its potential [34]

Due to its strong oxidizing effect, reactive oxygen species are known to cause structural and functional changes in biological molecules. This has led to the potential use of these compounds in the treatment of various conditions [35]

A study conducted on the plant's extract revealed that it can reduce the damage caused by iron-induced oxidative damage. It also prevented the peroxidation of a rat brain phospholipid. The interaction between the extract and Fe has been studied to see if it can protect the body from the damage caused by iron [36].

The extract of this plant is known to have a hypoglycemic effect. It was tested in animal models that were infected with streptozotocin-induced diabetes and normal blood glucose levels. The effects of the extract on blood glucose were also assessed [37].

The results of the study indicated that the extract of the plant exhibited hypoglycaemic effects. It was also found to have a reduction in the absorption of glucose [38].

The extract of the mango plant has also exhibited hypoglycaemic activity. A study revealed that the use of mango flour could help control blood glucose levels in subjects with diabetes [39].

The various chemical compounds found in this plant, such as the phenolic acids, flavonoids, and mangiferin, are known to have antiinflammatory and analgesic effects. The results of this study support the potential use of this plant extract for the management of various inflammatory conditions [20].

In vitro studies have shown that mangiferin can inhibit the development of the herpes simplex virus-2 (HSV-2) by preventing the late onset of the virus' replication. It can also help in the treatment of HIV [40].

An immunological study conducted on the anti-allergic properties of mangiferin and vimang was performed on mice infected with Trichinella spiralis.

The results of the study revealed that both compounds exhibited anti-allergic properties. The study suggests that their use could be used in the treatment of allergic conditions [41].

The extract of the mango plant was also studied for its antiproliferative properties against the Plasmodium yoelii nigeri. It exhibited a reduced yeast-induced hyperpyrexia response [42].

The extract's in vitro antimalarial activity was evaluated against the parasites caused by P. falciparum [15]. It exhibited a growth inhibition of 50.4%.

The effects of the extract on the liver of mice were studied. It was found to be effective in suppressing the effects of anthracene-induced liver injury [43].

Mangiferin is a novel agent that was studied to protect the stomach from the effects of indomethacin and ethanol. The effects of this plant extract on the stomach were assessed. It was found that mangiferin can provide gastroprotection against the damage caused by these drugs [42]

A study conducted in 2007 revealed that the extract of the plant can reduce the frequency of toothaches [44].

A study conducted in 2004 revealed that the extract of the plant can help decrease the bacterial count and plaque index in patients suffering from toothaches [45].

This review focused on the traditional uses of plants for treating toothaches in Nigeria. It also highlighted the various studies that have been conducted to confirm the use of these plants against the growth of harmful pathogens [46].

The literature on the subject was collected from various sources, such as scientific journals, books, and various online databases. The terms used for the search terms were Indigenous people, medicinal plants, and traditional medicines [47]

After conducting a literature review, the researchers focused on reports that investigated the use of plants for treating various conditions, such as tooth decay and tooth pain [48].

Although many of the studies focused on the use of plants for the treatment of toothaches, some of the reports also included studies that focused on the plant species used as a toothbrush [49].

A separate literature review was also conducted to document the pharmacological and biological activities of various plant species for the treatment of toothaches [44].

3. MATERIALS AND METHODS

3.1 Collection of Plant Material

The plant material required for this research was; Bark of *Manigfera indica*. This plant material was randomly gotten from Nnamdi Azikiwe UniversityAwka,Anambra State, Nigeria and the botanical identity was authenticated by a plant taxonomist called Mr. Chisom .

3.2 Experimental Site

The Research work was carried out in the Botany Lab of Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

3.3 Source of Test Organism

The Test Organism used for this experiment is the affected tooth of three different individuals with toothache. The Stock Culture of these tooth were obtained from The General Teaching Hospital, Ward of the Dental Care, Onitsha, Anambra State, Nigeria. These cultures were preserved using Saline Solution and Hypochloride Solution. Saline Solution makes the tooth sample fresh while the Hypochloride reduces the odour and prevent cross infection.

Preparation of Medium

3.4 Materials and Equipments Used

Petri dishes, Weighing balance, Foil paper, Spatula, Beaker, Conical Flask, Ethanol, Sabouraud Dextrose Agar, Autoclave, Amoxicillin, Fluconazole.

3.5 Procedures for Preparation of Agar (Fungi Using Amoxicillin)

i. I Sterilised the work Area and the Equipment to prevent Contamination.
ii. I Measured 5g of Sabouraud Dextrose Agar in a Weighing Balance
iii. I Poured the Measured Sabouraud Dextrose Agar into the Conical Flask
iv. I then Diluted the measured Sabouraud Dextrose Agar with 100ml of Distilled Water
v. Then I added 250mg of Amoxicillin into the Solution and Stir
vi. Cover the Conical Flask and put in the Autoclave to avoid spillage during sterilization
vii. Allow the Solution in the Autoclave to boil at 120^0C

viii. After I brought out the Sabouraud Dextrose Agar, I Allowed it to cool for about 30 minutes
ix. I lighted a candle for sterilizing the Conical Flask and then I shared the Sabouraud Dextrose Agar equally in 6 Petri Dishes
x. After about 5minutes the Sabauraud Dextrose Agar were allowed to cool and gel in the inoculation room.
xi. After sterilizing the loop, I collected sample of the affected tooth and smear on the gelled agar in the Petri dish.
xii. Then I sealed the petri dishes with paper, then turned upside down and placed into the incubator for growth.

3.6 Procedures for Preparation of Agar (Bacteria Using Fluconazole)

i. I Sterilised the work Area and the Equipment to prevent Contamination.
ii. I Measured 5g of Sabouraud Dextrose Agar in a Weighing Balance
iii. I Poured the Measured Sabouraud Dextrose Agar into the Conical Flask
iv. I then Diluted the measured Sabouraud Dextrose Agar with 100ml of Distilled Water
v. Then I added 100mg of Fluconazole into the Solution and Stir
vi. Cover the Conical Flask and put in the Autoclave to avoid spillage during sterilization
vii. Allow the Solution in the Autoclave to boil at 120^0C
viii. After I brought out the Sabouraud Dextrose Agar, I Allowed it to cool for about 30 minutes
ix. I lighted a candle for sterilizing the Conical Flask and then I shared the Sabouraud Dextrose Agar equally in 6 Petri Dishes
x. After about 5minutes the Sabouraud Dextrose Agar were allowed to cool and gel in the inoculation room.
xi. After sterilizing the loop, I collected sample of the affected tooth and smear on the gelled agar in the Petri dish.
xii. Then I sealed the petri dishes with paper, then turned upside down and placed into the incubator for growth.

3.7 Sample Preparation and Extraction

The fresh bark of mango was washed and dried using oven at a temperature of 70^0C for 2 hours before grinding using a Mechanical grinder into a powder form.

About 19.7g of the ground sample was soaked in 150ml ethanol in other to obtain ethanol extract at room temperature for 24 hours.

Muslin cloth (40 by 20In) was used to filter the plant residues and the filtrates thus obtained were further purified by filtration through Whatman No 1 filter paper used under aseptic condition.

3.8 Pure Culture

To obtain a pure Culture of the pathogenic fungi and bacteria, developing fungal and bacteria culture were aseptically cultured repeatedly.

3.9 Sub Culturing (Agar Well Diffusion Methods)

When Growth was established, subcultures of both fungi and bacteria were prepared using innocula from the tooth of three individuals with toothache in the mixed culture obtained in the pure culture.

In this process a Cork borer is used to make a hole at the middle of the gelled SDA of both the fungi and bacteria media, where the mango bark extract is being initiated in drops, that is in 0.5ml,0.10ml and 0.15ml respectively, this process is repeated in 3 Petri dishes of both fungi and bacteria growth media.

After the introduction of the mango bark extract, the innocula are placed a distance away from the middle of the Petri dish. This process is repeated 3 times using the innocula of 3 different tooth T_1, T_2, T_3, which are placed in both Fungal and Bacterial Media. After this process the Petri Dishes are covered with a masking tape to avoid contamination and placed in an incubator for 48hours.

After 48hours I checked and discovered that the bacteria and fungi had grown in each Petri dish, this process helped me to determine the Minimum Inhibition Concentration (M.I.C).

Plate 1. A picture showing the three infected teeth with toothache

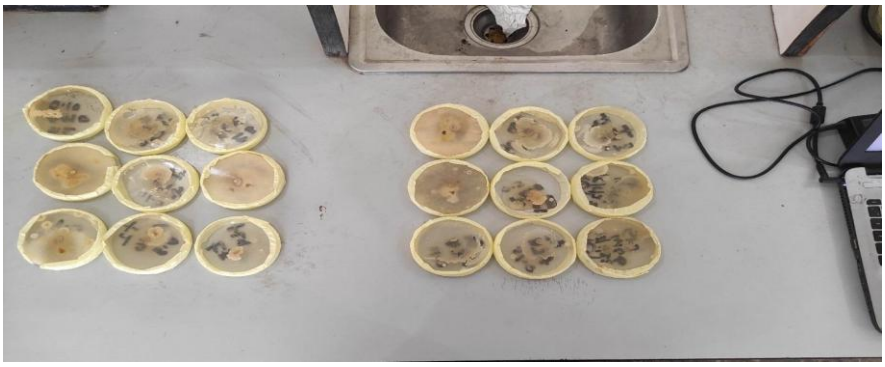

Plate 2. A picture showing the minimum inhibition concentration of the total petri dishes of both the bacteria and fungi media

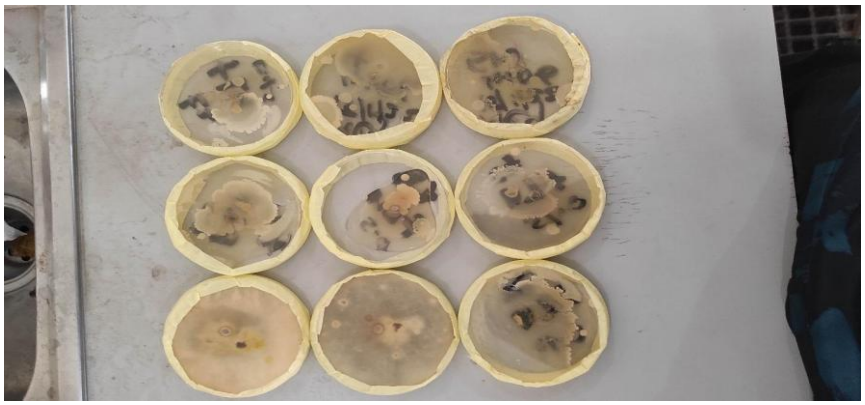

Plate 3. A picture showing the minimum inhibition concentration of *Streptococcus mutans*

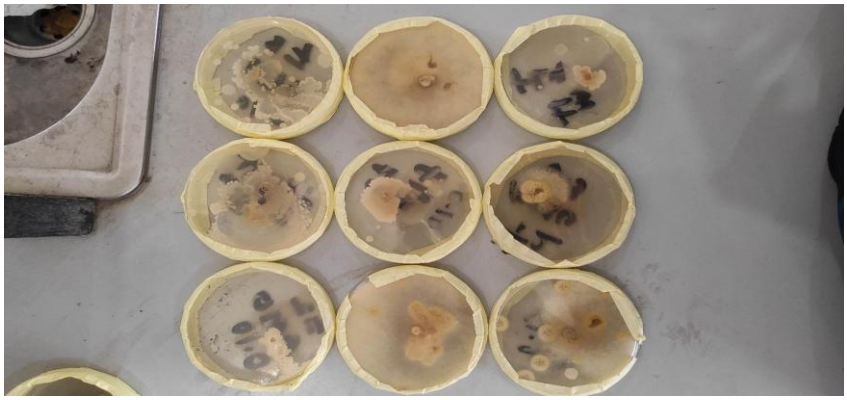

Plate 4. A picture showing the minimum inhibition concentration of *Aspergillus niger*

4. RESULTS

4.1 Minimum Inhibition Concentration (M. I.C)

To determine the minimum inhibition concentration you measure the distance between the point where you made the hole to the point where the growth extends to. The tables below show various Inhibition Concentration of the three tooth of the individual both in fungal and Bacterial media.

4.2 Statistical Analysis

The statistical analysis was based on the method of statistical analysis system (SAS). Data generated were subjected to two-way analysis of variance (ANOVA) using multiple least test and Fisher's least significant

difference (FLSD) at 5% probability to separate the treatment.

4.3 Bacteria Media (Fluconazole)

The Table Below shows the 3 different samples of tooth grown in a bacteria media (T_1, T_2, T_3) with the introduction of the mango bark extract in drops (0.5ml, 0.10ml, 0.15ml).

Table 1. Different samples of tooth grown in a bacteria media

Tooth	Ml	Cm
T_1	0.5	4.2
	0.10	3.0
	0.15	1.5
T_2	0.5	4.4
	0.10	3.4
	0.15	2.8
T_3	0.5	3.9
	0.10	3.1
	0.15	2.2

The Mango Bark demonstrated antibacterial activities against toothache (Table 1). Amongst the three tooth sample T_1 =Tooth 1, T_2=Tooth 2, T_3=Tooth 3

4.4 Fungi (Using Amoxicillin)

The Table Below shows the 3 different samples of tooth grown in a fungi media (T_1, T_2, T_3) with the introduction of the mango bark extract in drops (0.5ml, 0.10ml, 0.15ml).

Table 2. Different samples of tooth grown in a fungi media

Tooth	Ml	Cm
T_1	0.5	1.7
	0.10	3.0
	0.15	3.8
T_2	0.5	2.3
	0.10	3.4
	0.15	3.9
T_3	0.5	2.4
	0.10	2.7
	0.15	4.7

The Mango Bark demonstrated antifungal activities against toothache (Table 1). Amongst the three tooth sample T_1 =Tooth 1, T_2=Tooth 2, T_3=Tooth 3

The mean total zone of inhibition of T_2 (3.53) by mango extract is higher T_1 (2.90) and T_3 (3.10). When compared with the control, the mean total zone of inhibition becomes higher when the extract is being introduced in large amount (0.15>).

So in a bacteria media the higher the mango extract is introduced the more the inhibition zone increases (Table 1). There are significant differences in the inhibition effects of the plant extracts and the susceptibility of the human pathogens ($P<0.05$).

The Results of Growth Inhibition of T_1=Tooth 1, T_2=Tooth 2, T_3=Tooth 3 in Fungi growth Media: The mean total zone of inhibition of T_3 (3.36) by mango extract is higher T_1 (2.83) and T_3 (3.20). When compared with the control, the mean total zone of inhibition becomes lower when the extract is being introduced in large amounts (0.5<).

Table 3. Mean of minimum inhibition of concentration bacterium (*Streptococcus mutans*)

Infected Tooth	Mean± Standard Deviation
T_1	2.9 ±1.353
T_2	3.53±1.497
T_3	3.10±1.204
Total = Mean ± Standard Deviation	3.73±1.348

The Results of Growth Inhibition of T_1, T_2, T_3 in Bacteria growth Media

Table 4. Mean of minimum inhibition of concentration fungus (*Aspergillus niger*)

Infected Tooth	Mean± Standard Deviation
T_1	2.83±1.060
T_2	3.20+0.819
T_3	3.360+1.153
Total = Mean ± Standard Deviation	3.14±1.032

Table 5. Growth Inhibition of pathogens at 0.5ml

Pathogens	T_1	T_2	T_3	Mango Bark Extrat (Control)	Total (Mean +S.D)
Aspergillus	1.7±1.06	2.3±0.82	2.4±1.15	4.16±0.000	2.13±0.14
Streptococcus mutans	4.2±1.35	4.4±1.50	3.9±1.20	8.20±0.000	4.17±0.06
Total (Mean±S.D)	2.95±1.40	3.35±0.80	3.15±1.18	6.12±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				

Table 6. Growth inhibition of pathogens at 0.10ml

Pathogens	T_1	T_2	T_3	Mango Bark Extract (Control)	Total (Mean +S.D)
Aspergillus	3.00±1.06	3.4±0.82	2.7±1.15	5.2±0.000	1.97±0.14
Streptococcus mutans	3.12±1.35	3.4±1.50	3.1±1.20	8.20±0.000	3.90±0.06
Total (Mean±S.D)	3.05±1.40	3.23±0.80	3.20±1.18	6.12±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				

Table 7. Growth Inhibition of pathogens at 0.15ml

Pathogens	T_1	T_2	T_3	Mango Bark Extract (Control)	Total (Mean ±S.D)
Aspergillus	3.8±0.78	3.9±1.09	4.7±1.15	5.2±0.000	1.97±0.14
Streptococcus mutans	1.5±1.35	2.8±1.18	2.2±1.13	5.10±0.000	3.90±0.06
Total (Mean±S.D)	1.89±1.40	2.9±0.80	3.11±1.18	4.97±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				

5. DISCUSSION AND CONCLUSION

The efficacy of Mangifera indica bark extract for the prevention of human pathogens was studied. The use of ethanolic extract was suggested due to its antimicrobial properties

An analysis of the anti-toothache effects of M. indica revealed that its extract reverses the process by which S. mutans develop tooth decay. It also helps in reducing the bacterial count and plaque index.

Various herbal extract products are used in dentistry to treat various conditions such as inflammation, inhibit the growth of oral pathogens, and prevent the release of histamine [50]

An analysis of the effects of D. stramonium on various bacterial species revealed that its extract exhibited the highest bactericidal activity against gram-positive bacteria. A study conducted on the use of Salvadora persica showed that its extract can also inhibit oral bacteria.

In order to extract the active compounds from the plant, the researchers used solvents such as alcohol and hexane. They found that alcoholic drinks have the most antimicrobial activity than the extract of Salvadora persica [40]

The use of the extract of the mango plant supports my research regarding the antimicrobial properties of this plant.

A follow-up analysis revealed that the amount of extract added to larger quanties decreases the bacterial activity.

The study also revealed that the bark extract can be more effective than the placebo at preventing tooth decay. It was found that the concentration of extract that was added to the fungi media decreased the effectiveness of the extract [50].

Although the extract can fight against both bacterial and fugal pathogens, it tends to be more active against fungi [51-54].

The literature on the use of the mango stem in treating toothache in Nigeria was collected from various sources. This data was extracted using various search terms such as traditional medicines and medicinal plants.

The researchers then searched for papers that contain references to the use of plants for treating various conditions such as tooth decay, toothache, and tooth infection [55,56].

The researchers also collected data such as the year of publication, the number of respondents, and the preparation methods used.

NOTE

The study highlights the efficacy of "traditional medicine" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

ETHICAL APPROVAL

Ethical Committee Approval was gotten from General Teaching Hospital Onitsha in Anambra State of Nigeria

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Carvalho AC, Guedes MM, De Souza AL, Trevisan MT, Lima AF, Santos FA. Gastroprotective effect of mangiferin: A xanthonoid from Mangifera indica, against gastric injury induced by ethanol and indomethacin in rodents. Plantarum Medicine. 2007;73: 1372.
2. Ethiopia Oral Health and Dental Management. 2016;15(1):36–41.
3. Hobdell M, Petersen PE, Clarkson J, Johnson, N. Global goals for oral health. International Dental Journal. 2003;53(5):285–288.
4. Sharma SR, Dwivedi SK, Swarup D. Hypoglycemic potential of Mangifera indica leaves in rats. International Journal of Pharmacology. 1997;35:130.
5. Ivancheva S, Nikolova M, Tsvetkova R. Pharmaco-logical activities and biologically active compounds of Bul-garian medicinal plants. In Phytochemistry: Advances in Research, F. Inperato, Ed. 2006;87–103.
6. Agbor MS, Naidoo S. Ethnomedicinal plants used by traditional healers to treat oral health problems in Came-roon," Evidence-Based Complementary and Alternative Medicine; 2015. Article ID 649832, 10 pages, 2015.
7. Pardo-Andreu GL, Sanchez-Baldoquín, C, Avila-González R, Yamamoto ET, Revilla A, Uyemura, SA, Interaction of Vimang (*Mangifera indica L.extract*) with Fe(III) improves its antioxidant and cytoprotecting activity. Pharmacology Resources. 2006;54: 389–95.
8. Aderibigbe AO, Emudianughe TS, Lawal BA. Evaluation of the antidiabetic action of Mangifera indica in mice. Phytother Resources. 2001;15:456–8.
9. Goes PS, Watt RG, Hardy R, Sheiham A. Impacts of dental pain on daily activities of adolescents aged14–15 years and their families. Acta Odontologica Scandi-navica. 2008;66(1) :7–12.
10. Kathmandu RY. E burden of restorative dental treat-ment for children in third world countries. International Dental Journal. 2002;52(1):1–9.
11. Ngari F, Wanjau R, Njagi E, Gikonyo N. Herbal materials used in management of oral conditions in Nairobi,Kenya,"Journal of Oral Health and Community Dentistry. 2014;8(1): 36–42.
12. Nunez Selles AJ, Vélez Castro HT, Agüero-Agüero J, Gonzalez-Gonzalez J, Naddeo F, De Simone F. Isolation and quantitative analysis of phenolic antioxidants, free sugars, and polyols from Mango (*Mangifera Indica L.)* stem bark aqueous decoction used in cuba as a nutritional supplement. Journal Agric Food Chemical. 2002;50:762–6.
13. Ranjarisoa LN, Razanamihaja N, Rafatro H. Use of plants in oral health care by the population of Mahajanga, Madagascar. Journal of Ethnopharmacology. 2016;193:179–194.
14. Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. Journal of Ethnopharmacology. 2000;71:23–43.
15. WHO, "e world traditional medicines situation," in Traditional Medicines: Global Situation, Issues and Chal-lenges, WHO, Geneva, Switzerland; 2011.
16. Amare T, Asmare Y, Muchye G. Prevalence of dental caries and associated factors among Finote Selam primary school students aged 12–20 years, Finote Selam town,
17. Birhan W, Giday M, Teklehaymanot T. 'e contri-bution of traditional healers' clinics to public health care system in Addis Ababa, Ethiopia: A cross-sectional study. Journal of Ethnobiology and Ethnomedicine. 2011;7(1): 39.

18. Cohen LA, Bonito AJ, Akin DR. Toothache pain: behavioral impact and self-care strategies. Special Care in Dentistry. 2009;29(2):85–95.
19. Khan MN, Nizami SS, Khan MA, Ahmed Z. New saponins from Mangifera Indica. J National Production. 1993;56:767–70.
20. Palombo EA. Traditional medicinal plant extracts and natural products with activity against oral bacteria: potential application in the prevention and treatment of oral diseases. Evidence Based Complement Alternative Medicine; 2011.
Article ID 680354, 15.
21. Guha S, Ghosal S, Chattopadyay U. Antitumor, immune modulatory and anti-HIV effect of mangiferin: A naturally occurring glucosylxanthone Chemotherapy. 1996;42: 443–51.
22. Knödler M, Berardini N, Kammerer DR, Carle R, Schieber A. Characterization of major and minor alk(en)ylresorcinols from mango (*Mangifera Indica L*.) peels by high-performance liquid chromatography/ atmospheric pressure chemical ionization mass spectrometry. Rapid Commun Mass Spectrom. 2007;21:945–51.
23. Bidla G, Titanji VP, Jako B, Bolad A, Berzins K. Antiplamodial activity of seven plants used in African folk medicine. Indian Journal of Pharmacology. 2004;36:245–6.
24. Awe SO, Olajide OA, Oladiran OO, Makinde JM. Antiplasmodial and antipyretic screening of Mangifera indica extract. Phytother Resources. 1998;12:437–8.
25. Pai MP, Acharya LD, Udupa N. Evaluation of antiplaque activity of Azadirachta indica leaf extract gel—a 6-week clinical study. Journal of Ethnopharmacology. 2004; 90(1):99–103, 2004.
26. Rolo AP, Palmeira CM. Diabetes and mitochondrial function: Role of hyperglycemia and oxidative stress. Toxicology Application in Pharmacology. 2006;212:167–78.
27. Afam-Ezeaku CE, Oledibe OJ, Mbaukwu O.A., Anyanele WC, Azubuike MU. Effect of Shea Butter (*Vitellaria paradoxa*) in the Treatment of Cough in some Communities Of Awka Town. Journal of Medicinal Plants Studies. 2022;(10)1:xx-xx
28. Balto H, Al-Howiriny T, Al-Somaily. Screening of the antimicrobial activity of Salvadora persicaextracts against Enterococcus faecalis and Candida albicans,"In-ternational Journal of Phytomedicine. 2013;5(4):486–492.
29. Bala WY, Pardo-Andreu GL, Sanchez-Baldoquín C, Avi99la-González R, Yamamoto ET, Revilla A, Uyemura SA. Interaction of Vimang (*Mangifera indica L.extract*) with Fe(III) improves its antioxidant and cytoprotecting activity. Pharmacology Resources. 2006;54:389–95.
30. Subha R, Pandey MM, Singh AK, A new, convenient method for determination of mangiferin: An anti-diabetic compound, in Mangifera indica L. Journal of Plant Chromatography. 2007;20:317–320.
31. Tapsoba H, Deschamps JP. Use of medicinal plants for the treatment of oral diseases in Burkina Faso. Journal of Ethnopharmacology. 2006;104(1-2):68–78,.
32. Rocha Ribeiro SM, Queiroz JH, Lopes Ribeiro ME, Campos FM, Pinheiro Santana HM. Antioxidant in mango (*Mangifera indica L*.) pulp. Plant Foods Human Nutrition. 2007;62:13–7.
33. Ross IA, New Jersey Totowa: Human Press. Medicinal plants of the world. 1999;1:199–200.
34. Shibahara A, Yamamoto K, Shinkai K, Nakayama T, Kajimoto G, Cis-9, cis-15-octadecadienoic acid:a novel fatty acid found in higher plants. Biochemical Biopsy Acta. 1993;1170:245–52.
35. Sato M, Fujiwara S, Tsuchiya H. Flavones with antibacterial activity against cariogenic bacteria. Journal of Ethno pharmacology. 1996;54(2-3):171–176.
36. Rivera DG, Balmaseda IH, Leon AA, Hernandez BC, Montiel LM, Garrido GG. Anti-allergic properties of Mangifera indica L.extract (*Vimang)* and contribution of its glucosylxanthone mangiferin. Journal of Pharmacoogy. 2006;58:385–92.
37. Desai PD, Ganguly AK, Govindachari TR, Joshi BS, Kamat VN, Manmade AH. Chemical investigation of some Indian plants: Part II. Indian Journal of Chemistry. 1966;4:457–549
38. Darout K, Albandar JM, Skaug N, Ali RW. Salivary microbiota levels in relation to periodontal status,experience of caries and miswak use in Sudanese adults. Journal of Clinical Periodontology. 2002;29(5):411–420.
39. Faisal MD, Sarker MH, Rahman A. *Murraya paniculata (L.)* jack: A potential plant for treatment of toothache. Journal of Dentistry, Oral Disorders and Therapy. 2014;2(3):1–3.
40. Perpétuo GF, Salgado JM. Effect of mango (*Mangifera indica, L*.) ingestion on blood glucose levels of normal and diabetic rats. Journal Plant Foods Human Nutrition. 2003;58:1–12.
41. Salman NB, Vahabi S, Rad MM. Use of herbs andmedicinal plants in dentistry: a review. Journal Dental School. 2017;35(2): 133–149.

42. Prasad S, Kalra N, Shukla Y. Hepatoprotective effects of lupeol and mango pulp extract of carcinogen induced alteration in Swiss albino mice. Molecular Nutrition Food Resources. 2007;51:352–9.
43. Shankarnarayanan D, Gopalakrishman C, Kameswaran L, Arumugum S. The effect of mangostin, mangostin-3, 6-di-O-glucoside and Mangiferin in carbon tetrachloride liver injury. Mediscope. 1979;22:65.
44. Zhu XM, Song JX, Huang ZZ, Whu YM, Yu MJ, Antiviral activity of mangiferin against herpes simplex virus type 2 in vitro. Zhongguo Yao Li Xue Bao. 1993;14:452–4.Gaire BP, Subedi L. A review on the pharmacological and toxicological aspects of Datura stramonium L. Journal of Integrative Medicine. 2013;11(2):73–79.
45. Ojewole JA. Antiinflammatory, analgesic and hypoglycemic effects of Mangifera indica Linn. (*Anacardiaceae)* stem-bark aqueous extract. Methods Find Experimental Clinical Pharmacology. 2005;27:547–54.
46. Okigbo RN, Ezeaku CE. Efficacy of Three Tropical Plants for Inhibition of Pathogen Causing Human Diarrhoea. CPQ Microbiology. 2018;1(4):01-26.
47. Pott I, Marx M, Neidhart S, Mühlbauer W, Carle R. Quantitative determination of beta-carotene stereoisomers in fresh, dried, and solar-dried mangoes (*Mangifera Indica L.*) Journal Agric Food Chemical. 2003;51:4527–31.
48. Garcia D, Escalante M, Delgado R, Ubeira FM, Leiro J. Anthelminthic and antiallergic activities of Mangifera indica L.stem bark components Vimang and mangiferin. Phytothermo Resources. 2003;17:1203–8.
49. Jenkinson HF, Lamont RJ. Oral microbial communities in sickness and in health," Trends in Microbiology. 2005;13(12):589–595.
50. Kumar G, Jalaluddin MD, Rout P, Mohanty R, Dileep CL. Emerging trends of herbal care in dentistry. Journal of Clinical and Diagnostic Research. 2013;7(8): 1827–1829.
51. Maxwell SR. Anti oxidant therapy: Does it have a role in the treatment of human disease? Expert Opinion Investigation Drug. 1997;6: 211–36.
52. Ngilisho LA, Mosha HJ, Poulsen S. e role oftraditional healers in the treatment of toothache in Tanga Region, Tanzania. Community Dental Health. 1994;11(4):240–242.
53. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. 'e global burden of oral diseases and risk to oral health,"Bulletin of the World Health Organization. 2005;83(9): 661–669.
54. Seifried HE, Anderson DE, Fisher EI, Milner JA. A review of the interaction among dietary antioxidants and reactive oxygen species. Journal Nutrition of Biochemistry. 2007;18:567–79.
55. Slade GD. Epidemiology of dental pain and dental caries among children and adolescents. Community Dental Health. 2001;18(4):219–227.
56. Tafere Y, Chanie S, Dessie T, Gedamu H. Assessment of prevalence of dental caries and the associated factors among patients attending dental clinic in Debre Tabor general hospital: A hospital-based cross-sectional study. BMC Oral Health. 2018;18(1): 119.

APPENDIX

Mean of Minimum Inhibition of Concentration Bacterium (*Streptococcus mutans*)

Infected Tooth	Mean± Standard Deviation
T_1	2.9 ±1.353
T_2	3.53±1.497
T_3	3.10±1.204
Total = Mean ± Standard Deviation	3.73±1.348

Mean of Minimum Inhibition of Concentration Fungus (*Aspergillus niger*)

Infected Tooth	Mean± Standard Deviation
T_1	2.83±1.060
T_2	3.20±0.819
T_3	3.360+1.153
Total = Mean ± Standard Deviation	3.14±1.032

Pathogens	T_1	T_2	T_3	Mango Bark Extract(Control)	Total (Mean +S.D)
Aspergillus	1.7±1.06	2.3±0.82	2.4±1.15	4.16±0.000	2.13±0.14
Streptococcus mutans	4.2±1.35	4.4±1.50	3.9±1.20	8.20±0.000	4.17±0.06
Total (Mean±S.D)	2.95±1.40	3.35±0.80	3.15±1.18	6.12±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				

Pathogens	T_1	T_2	T_3	Mango Bark Extract (Control)	Total (Mean +S.D)
Aspergillus	3.00±1.06	3.4±0.82	2.7±1.15	5.2±0.000	1.97±0.14
Streptococcus mutans	3.12±1.35	3.4±1.50	3.1±1.20	8.20±0.000	3.90±0.06
Total (Mean±S.D)	3.05±1.40	3.23±0.80	3.20±1.18	6.12±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				

Growth Inhibition of pathogens at 0.10ml

Pathogens	T_1	T_2	T_3	Mango Bark Extract (Control)	Total (Mean ±S.D)
Aspergillus	3.8±0.78	3.9±1.09	4.7±1.15	5.2±0.000	1.97±0.14
Streptococcusmutans	1.5±1.35	2.8±1.18	2.2±1.13	5.10±0.000	3.90±0.06
Total (Mean±S.D)	1.89±1.40	2.9±0.80	3.11±1.18	4.97±0.000	
P- value Plant Extract	0.000				
P-value Pathogens	0.000				