International Journal of Biochemistry Research & Review

Volume 33, Issue 6, Page 143-156, 2024; Article no.IJBCRR.119352
ISSN: 2231-086X, NLM ID: 101654445

A Review of Chronic and Infectious Diseases Potency of *Mangifera indica*

N. E. Ahajumobi [a*]

[a] Department of Public Health, College of Health Science, Walden University, Minneapolis, USA.

Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/ijbcrr/2024/v33i7897

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/119352

Systematic Review Article

Received: 19/06/2024
Accepted: 17/07/2024
Published: 30/07/2024

ABSTRACT

Background: It is an established fact that the persisting rising cost of healthcare across nations has prompted many nations to seek alternative safe and affordable solution for disease control. Many plant products including *Mangifera indica* have been implicated as alternative medicine. The focus is on *Mangifera indica* popularly known as Mango.
Objectives: It is to determine the composition of Mangifera indica and review its chronic and infectious disease potency owing to the composition. Some users lack the capacity to read and understand clinical evidence written with technical terms. Some believe its superstition and some who may dare to use, lack the capacity for appropriate use. This review breaks down the barriers to acceptance and right use. A need for more clinical trials on the pharmacological properties of mango is encouraged.
Place and Duration of Study: Walden University, College of Health Sciences, Minneapolis Minnesota, USA from May 2023- July 2024.
Methods: A systematic review and theoretical backgrounds were community approach to intervention services and native medicine theories. Google scholar was among the search engines used for data mining.

**Corresponding author: E-mail: eahajumobi@gmail.com;*

Cite as: *Ahajumobi, N. E. 2024. "A Review of Chronic and Infectious Diseases Potency of Mangifera Indica". International Journal of Biochemistry Research & Review 33 (6):143-156. https://doi.org/10.9734/ijbcrr/2024/v33i7897.*

Results: High levels of phytochemical compounds found. Results were presented in subheadings, which reflected on the type of diseases controlled, namely hepatoprotective and anti-carcinogenic properties, antimicrobial, anti-diabetes and antilipidemic capacities. The discussion was a synthesis of the results in relation to the literature on *Mangifera indica* disease control potency. Study will be beneficial to all users.
Conclusion: *Mangifera indica* is high in nutrients and phytochemical compounds with disease managing nutraceutical and pharmacological properties thus, justifying its use as native medicine.

Keywords: Magnifera indica; review; native medicine; Mangifera indica for disease control.

1. INTRODUCTION

It is no longer news that the ever rising cost of healthcare world wide has prompted many nations to seek alternative safe and affordable solutions for disease management. Many plant products including *Mangifera indica* have been implicated as alternative medicine. Greater population in developing countries pay for healthcare from personal pocket [1-5]. Many cannot afford modern treatment and in some cases, adverse effects of some treatments stand as barriers to a few who can afford modern treatment still [1-5]. In this study, the focus is on *Mangifera indica* popularly known as Mango, which belongs to a kingdom of plantar, class of *Mangoliopsida*, family of *Anacardiaceae*, genus of *Mangifera* and specie is indica. The use of *Mangifera indica* as native medicine is dated back many centuries ago. It is a flowering plant with about 30 different species spread across tropical countries [6]. The objectives of this study is to determine the composition of *Mangifera indica* and review its chronic and infectious disease potency. Though used as native medicine in Eastern Nigeria and West Africa; yet, some think it is superstitious to use it and some who dare to use are unsure of how to use it appropriately and safely. Clinical evidence have suggested its efficaciousness; however, some user lack the capacity to read and understand clinical evidence written with technical terms. A review such as this breaks down the language barrier of accessibility of knowledge, which yet stand in the way of right and accurate use. It provides an update on Mango and healing powers and consensus evidence to busy healthcare professionals. More clinical trials on the pharmacological properties of mango is encouraged. Methods of this study is a systematic review and theoretical backgrounds are community approach to intervention services and native medicine theories [7]. Google scholar was among the search engines used for data mining. The results were presented in subheadings, which were reflections of the type of diseases that the title on the subheadings control, namely hepatoprotective property, antimicrobial activity, anti diabetes capacity, anti carcinogenic property, antilipidemic capacity and others. The discussion of this study was a synthesis of the results in relation to the literature about *Mangifera indica*.

2. METHODOLOGY

This is a systematic review study and the theories behind this study are community approach to intervention services and traditional medicine [2,3,8]. Objective was to determine the composition and consensus evidence on the efficaciousness of *Mangifera indica* in disease management on account of the composition. To educate appropriate use based upon evidence and advocate for clinical and private use under the supervision of nutraceutical and herbal expert in nutritional and herbal clinics, traditional hospitals and clinics. Simplify scientific clinical terms with general level language to further reduce barriers to evidence accessibility and right use. And provide a quick access of consensus evidence to busy healthcare professionals. Google scholar was among search engines employed for data mining. Clinical, peer reviewed and systematic evidence were included in the data pool for study analysis and evidence not peer reviewed, not available online for free read were excluded. Results were presented in tables and subheadings with names, which reflected on the type of diseases that it controls, namely hepatoprotective, antimicrobial and anti diabetese properties. Others are anti-carcinogenic, anti-lipidemic, anti obesity/hypolipidemic and anti-diarrheal properties. Other subheading are nutritional and chemical composition, phytochemical composition, Anti-anemia, diabetes, cancer, obesity/lipid, antimicrobial clinical trials. The synthesis of the results and discussion involved the compositions and clinical findings. Order of result presentation is nutrients and phytochemical compositions and example of clinical trials on each disease studies.

3. RESULTS

Mangifera indica Seed, fruit, stem, heartwood, root and leaves possess healing powers on account of high level of phytochemical compound. Also, the nutrients and chemical presence *in Mangifera indica* are significant. The focus of the results is on composition and samples of clinical evidence. The composition are located on the tables and the synthesis presented with subheadings of diseases treatment and clinical trial as well as the outcome.

3.1 Nutrient Composition of *Mangifera indica* Leaves, Fruit and Seed

Mangifera indica is composed of carbohydrates, protein, lipids, fibre and ash (Table 1).

3.2 Nutrition and Chemical Composition of *Mangifera indica* Leaves, Fruits and Seeds

The highest composition of carbohydrates occurred in the seeds, 70.78% followed by the fruits, 17.00%, the least score, 3.30% occurred in the leaves. The highest amount of protein, 69.61% occurred in the leaves, next was seeds, 36.46% and low score of 5.0% occurred in the fruit. The level of fat in the seed ranked first, 11.00%, followed by the leaves, 8.65% and the lowest, 1.60% occurred in the fruit. Fibre was highest in the leaves, 8.24% and low levels occurred in the seed, 2.37% and 1.80% for the fruit. High amount of ash occurred in the plant, with the largest amount, 8.24% found in the leaves, next was the seed, 6.11% and the lowest score was located in the fruit (Table 2).

Table 1. Nutritional and chemical composition of *Mangifera indica*, leaves, fruits and seeds

Macro Nutrients	Leaves (%)	Fruits (%)	Seeds
Moisture	20.10	86.51	8.01
Carbohydrates	3.30	17.00	70.78
Protein	69.61	5.00	36.46
Lipids	8.65	1.60	11.00
Fibre	10.60	1.80	2.37
Ash	8.24	1.95	6.11
Energy Kcal	5.92	126.05	108.49

**+ve: Present*
NR: Not reported
[6, 9-23, 1, 2, 3, 4, 5, 7]

Table 2. Mineral composition of *Mangifera indica*, leaves, fruits, seeds and bark

Micro Nutrients minerals	Leaves (mg/100 g)	Fruits	Seeds	Bark
Calcium (Ca)	3.83	10.00	49.00	523.40
Potassium (K)	0.83	204.30	365.00	189.30
Sodium (Na)	0.38	41.20	78.80	0
Magnesium (Mg)	0.91	11.20	0.50	23.30
Phosphorus (P)	0.78	15.60	140.00	0
Iron (fe)	0.002	5.63	10.10	3.50
Manganese (Mn)	0.003	0.16	100.00	+ve
Zinc (Zn)	7.88	0.13	5.80	0.40
Copper (Cr)	8.88	0.85	NR	0.10
Chromium (Cr)	NR	0.02	0.80	NR
Cadmium (Cd)	1.50	NR	NR	NR
Boron (B)	0.002	NF	NR	NR
Selenium (Se)	NR	NR	NR	1.30
Sulphur (S)	0.37	+ve	NR	NR
Lead (Pb)	NR	0.36	NR	0.20
Nitrogen	2.60	NR	NR	NR

**+ve: Present; NR: Not reported*

3.3 Mineral Composition of *Mangifera indica* Leaves, Fruits, Seeds and Bark

Macro Minerals: A disproportionate amount, 532.40 mg/100 g of calcium was located in the bark and high amount, 49.00 mg.100 g found in the seed. The concentration in the fruit was moderate, 10.00 mg/100 g and the least amount, 3.83 mg/100 g in the leaves. Except the leaves with low level, 0.83 mg/100 g of potassium, potassium occurred in very high concentrations, with the highest score, 365.00 mg/100 g located in the seed, 204 mg/100 g in the fruit and 189.00 mg/100 g in the bark. Organic sodium was very high, 78.80 mg/100 g in the seed, moderate amount, 41.20 mg/100 g in the fruit, the leaves with very low level, 0.38 mg/100 g and zero amount reported for the bark. Magnesium occurred moderately in the bark and fruit with 23.30 mg/100 g and 11.20 mg/100 g respectively. Low concentrations were located in the the leaves and seeds scoring 0.91 mg/100 g and 0.50 mg/100 g in that other. High level of phosphorus, 140.00 was located in the bark, moderate amount, 15.60 mg/100 g in the fruit, least amount, 0.78 mg/100 g in the leaves and zero concentration in the bark.

Micro Minerals: Amount of zinc was generally not high but ranges from moderate to low. Moderate level occurred in the leaves and the seed with 7.88 mg/100 g and 5.80 mg/100 g and very low levels occurred in the bark and fruit, 0.40 mg/100 g and 0.13 mg/100 g in that order. Iron was very high, 10.10 mg/100 g in the seeds, but occurred moderately in the fruit, 5.63 mg/100 g and bark, 3.50 mg/100 g and trace level, 0.002 mg/100 g was found in the leaves. High amount of manganese, 100.00 mg/100 g was located in the seed, low levels found in the fruit, 0.16 mg/100 g and 0.003 mg/100 g in the leaves. Non-specified quantity occurred in the bark. The quantity of copper in the leaves was highest, 8.88 mg/100 g, low levels of 0.85 mg/100 g and 0.10 mg/100 g occurred in fruit and the bark respectively. Amount in the seed was not reported. Low levels of chromium occurred in the seeds 0.80 mg/100 g and 0.02 mg/100 g in the fruit and nothing was reported for the bark and the leaves [6,9-23,1,2,3,4,5,7] (Table 3).

3.4 Vitamin Composition of *Mangifera indica* Leaves, Fruits, Seeds and Bark

Vitamin C occurred in large quantity in the fruits and leaves with 53.00 mg/100 g and 33.10 mg/100 g in that order. Low amount was located in the seed. 0.56 mg/100 g. High levels of folate was located in the fruit and leaves, scoring 44.50 mg/.100 g and 14.00 mg/100 g respectively and nothing reported for the seed. Vitamin A was found in high concentration in the leaves, fruit and seed, with a disproportionate amount in the leaves, 765.00 ug/100 g, high level in the fruit, 54.00 ug and moderate amount of 15.27 IU/100 g. Interestingly, vitamin E (tocopherol) occurred in the seed, 1.30 mg/100 g, leaves, 1.12 mg/.100 g and fruit, 0.91 mg/100 g. B-group vitamins namely, B1, B2, B3, B5, B6, were present at low quantities. A good amount of vitamin K was located in the leaves and fruits, 4.20 ug/100 g, each.

Table 3. Vitamins composition of *Mangifera indica*, leaves, fruits and seeds

Micro Nutrients Vitamins	Leaves (mg/100 g)	Fruits Mg/100 g	Seeds
Water Soluble vitamins			
Ascorbic acid (Vitamin C)	33.10	53.00	0.56
Thiamine (Vitamin B1)	0.0.48	0.03	0.08
Riboflavin (Vitamin B2)	0.21	0.05	0.03
Niacin (Vitamin B3)	1.29	0.76	NR
Pantothenic acid (Vitamin B5)	+ve	0.20	NR
Pyridoxine (Vitamin B6)	+ve	0.11	0.19
Folate (vitamin B9) µg	14.00	44.50	NR
Cyanocobalamin (B12) µg	NR	NR	0.12
Fat-Soluble vitamins			
Retinol (Vitamin A)	765.00 ug	54.00 ug	15.27 IU
Tocopherol (Vitamin E)	1.12	0.91	1.30
Vitamin K µg	4.20	4.20	NR
Iodine	NR	NR	5.58

**+ve: Present; NR: Not reported*

[6, 9-23, 1, 12, 3, 4, 5, 7]

3.5 Phytochemical Compounds Present in the Leaf, Fruit, Seed and Bark

Evidence suggested that there is a high concentration of phynrochemical compounds in the seeds studied and the quantity, varies in each seed.

3.6 Phytochemical Composition of *Mangifera indica* Leaves, Fruits, Seeds and Bark

High amounts of alkaloids 8.80 mg/100 g and 7.10 mg/100 g were located in the bark and leaves respectively, trace amount, 0.01 mg/100 g was found in the seed and nothing reported for the fruit. A good amount of flavonoids, 16.90, 6.50 and 3.30 mg/100 g occurred in the leaves, bark and the seed in that order. The amount present in the fruit was not specified. The quantities of saponins found in the bark and leaves were high, 7.80 mg/100 g each, low level was located in the seed and nothing was reported about the fruit. A very high amount, 11.30 mg/100 g of tannins were located in the leaves, low amounts found in the bark and seeds, scoring 1.20 mg/100 g and 1.03 mg/100 g, in that order. No mention was made about the amount in the fruit. Terpenoids were present in all but the fruit. Moderate quantity, 4.60 mg/100 g occurred in the leaves and low level was found in the bark, amount in the seed was not specified. Interestingly, steroids was located in all but the fruit. Highest quantity, 5.92 mg/100 g was found in the seed, next, was the leaves with a score of 3.10 mg/100 g and low quantity of 0.68 mg/100 g in the bark. Phenols were present in all, amounts in the fruit and seed were not specified, largest concentration, 34.00 mg/100 g occurred in the bark, next was the leaves following very closely, with a score of 33.75 mg/.100 g. Antioxidant was present in all but quantities were not specified. Reducing sugar and Anthraquinone were present in all but the bark. Glycoside was present in the leaves and seed but not mentioned in the fruit and the bark.

3.7 Anemia Treatment

In a clinical trial, 25 mg/kg body weight of *Mangiferin indica* stem bark water extract successfully and significantly treated anemia and iron deficiency in experimental rats and reversed weakness of sugar and lactose enzymes sucrase and lactase respectively and made each regain active function after treatment with the extract; on account of its high level of iron, saponins, and cardiac glycosides [21].

Stem back extract inhibited the growth of pathogenic microbes, while water extract showed higher inhibition for moulds than ethanol extract, on the other hand, ethanol extract showed higher bacteria inhibition than water extract and the rate of inhibition exhibited by both was as effective as standard antibiotics and effect from other parts of plant with similar phytochemical compounds [22,23].

Contrary to the finding of [23], which suggested that water and ethanol extracts of *Mangifera indica* stem bark were as effective as extract from other parts of the plant; Authors for 16 and 17 stated otherwise and suggested that the potency and strength of inhibition of microbial growth by the seed extract was much stronger than the strength of the leaves and stem bark extracts [1].

Table 4. Phytochemical composition of *Mangifera indica* leaves, fruits, seeds and bark

Macro Nutrients	Leaves (%)	Fruits	Seeds	Bark
Alkaloids	7.10	0	0.01	8.80
Flavonoids	16.90	+ve	3.30	6.50
Saponins	7.80	0	0.04	7.80
Tannins	11.30	0	1.03	1.20
Terpenoids	4.60	0	+ve	0.70
Steroids	3.10	0	5.92	0.68
Phenols	33.75	+ve	+ve	34.00
Reducing Sugar	+ve	+ve	0.55	NR
Athraquinone	+ve	+ve	+ve	NR
Glycosides	+ve	NR	+ve	NR
Anthioxidant	+ve	+ve	+ve	+ve

[6,9-23, 1,2, 3, 4, 5, 7]

Table 5. *Mangifera indica* fresh fruit

Micro nutrients vitamins	Fruits mg/100 g
Macronutrients	
Carbohydrates	17.00
Protein	5.00
Lipids (fat)	0.27
Cholesterol	0.00
Dietary fibre	1.80
Water Soluble vitamins	
Ascorbic acid (Vitamin C)	27.70
Thiamine (Vitamin B1)	0.03
Riboflavin (Vitamin B2)	0.05
Niacin (Vitamin B3)	0.76
Pantothenic acid (Vitamin B5)	0.20
Pyridoxine (Vitamin B6)	0.11
Folate	14.00 ug
Cyanocobalamin (B12) µg	NR
Fat-Soluble vitamins	
Retinol (Vitamin A)	765.00 IU
Tocopherol (Vitamin E)	1.12
Vitamin K	4.2 ug
Iodine	NR
Electrolyte	158 mg
Minerals	
Magnesium	9.00
Calcium	10.00

[6,9-23, 1, 2, 3, 4, 5, 7]

3.8 Antidiabetes

When the body experiences hyperglycaemia for a long time often caused by diabetes mellitus, it causes production of an end - product called glycosylate, which triggers a harmful reaction of reactive oxygen specie (ROS). ROS do oxidative harm to the kidney and heart. Extracts of *Mangifera indica* bark offers hope for diabetes types I and II treatment. Type I usually caused by absence or destruction of B-cells of the pancreas and type II, a complex situation caused by a range of factors namely, B-cell dysfunction, low level of insulin or sugar-resistant insulin [1,2].

At dozes 10 and 20 mg/kg, Mangiferin inhibited diabetes, lipidemia, atherogenesis, cell oxidation without necessarily causing hypoglycaemia [1,2,3].

Also, at doze 90 mg/kg after seven hours of oral administration to experimental rat with diabetes type II lowered baseline glucose concentration by 56%. Additionally, when only 30 mg/kg body weight was administered once a day, followed by 120 minutes of exercise for 2 weeks, the effects were, 40% reduction of cholesterol, 70% reduction of triglycerides. It is worthy of note that administering Mangiferin alone without exercise showed no reduction of the cholesterol but a significant drop in triglycerides. The same applied to doing exercise alone without administering Mangiferin. A combination of the two formed a synergy that yielded more effective result [1,2,3].

In an *in vitro* study, stem bark extract lowered glucose absorption in rat with type II diabetes. A study with glucose-induced rat showed that Mangiferin at doses of 10 mg/kg and 20 mg/kg caused a significant improvement in the ability of the rat to tolerate oral sugar and still maintains normal basal concentration of sugar. Mangiferin has the potency to control diabetes, lipids, atherogenesis and cell oxidation [6,9, 10,11,12,14,18].

3.9 Anti-lipidemic and Anti-hyperglycemic Properties

Inhibitory effect of Mangiferin at lethal dose IC50 value, doses of 41.88 ug/ml and 74.35 ug/ml, Mangiferin inhibited activities of an enzyme called alpha glucosidase, whereas, standard medicine achieved similar inhibition at and 83.33 ug/ml. Also, it achieved reduction of fasting blood

sugar (FBS), total cholesterol, (TC) triglycerides (TC), low density lipoprotein (LDL), and increased high density lipoprotein in study of mice with type II diabetes [3].

3.10 Antitumor Function

Small amount of Vimang and Mangiferin or any component of food eaten daily, which prevent carcinogenesis and revert tumour growth, is called chemopreventive agent. This is beneficial for cancer treatment [1,2,3]. When experimental rats were treated with 0.1% of Mangiferin in basal diet for 5 weeks at early and late stages of cancer, that was initiated and provoked by injection of - azoxymethane (AOM); alkylant at doze, 15 mg/kg body weight once a week for three weeks to generate early stage of colon cancer and five weeks for late stage. End of five weeks Mangiferin treatment prevented aberrant crept foci growth in AOM-treated experimental rats significantly for less than 40% [1,2,3]. Group that received Mangiferin treatment at early stage for longer period of time of 40 weeks showed over 40% reduction in colon neoplasms multiplication and 65-85% decrease in colon mucosa cell proliferation. Mechanism of chemopreventive action of Mangiferin in achieving the treatment is unclear. However, it is believed to be achieved by terminating azoxymethane (AOM) by xanthone, which is a cell proliferation inhibitory function of lymphocytes activated or prompted by Mangiferin through proapoptotic cytokines (death of cancer cells) [1,2,3].

In an I*n vitro* study, dose and time dependent use of Mangiferin prevented proliferation of leukaemia cells (K562) and prompted leukaemia cancer cells K563 apoptosis. Action believed to be achieved through reduction of bcr/abl gene expression. Results suggested that Mangiferin is chemopreventive and it possess the capacity to control cancer disease, including renal cancer. *Mangiferia indica* leave extract with 90% ethanol prevented cancer cell proliferation at doses , 62.5-500 ug/ml, function which cause G2/M cell phase to accumulate [1,2,3].

Studies have suggested that mango stem bark extract has cytotoxic effect against cancer (control cancer disease). It is effective against breast cancer, MCF7, MDA-N and MDA-MB-435, as well as colon cancers - SW-620) and renal cancer- 786-0 cells. Extracts obtained from the external parts of mongo plant at dose and time dependant rate of 250 mg/kg, achieved by intra-peritorial administration prevented leukaemia cell (K562) proliferation and its cell line death, suggesting that Mangiferin has capacity to protect the body against harmful effect of chemotherapy. Lupeol and mango pulp extract was tested to determine chemopreventive properties on 7, 12-dimethylbenz (a) anthracene (DMBA) of Swiss Albino mice. Result showed that both lupeol and mango pulp extract significantly lowered oxidative stress of mice life with cellular injury. This function was achieved by controlling of the mice cell-growth regulators [6, 9, 10, 11, 12, 18, 2, 3, 4, 5, 7].

3.11 Gastroprotective

An investigation of effect of natural glucosylxanthone from *Mangifera indica* plant called Mangiferin on experimental mice with gastric injury or gastric mucosal damage or ulcer caused by indomethacin and ethanol. In a research performed on glucosylxanthone and Mangiferin effect on mice with gastric injury caused by indomethacin and ethanol to determine change and level of change. Result of the mean gastric lesion or ulcer sore in the mice and amount of gastric secretion and total acidity in 4-pylorus-ligated mice revealed a significant reduction of the ulcer sore volume. It was concluded that Mangiferin has gastric protection properties, which is capable of controlling gastric ulcers caused by indomethacin and ethanol in experimental mice. Function was achieved through anti oxidation mechanism and prevention of secretion of gastric juice [1, 2, 3, 7].

3.12 Antioxidant Capacity

Mango pulp is high in vitamin C, E, Beta-carotene and these vitamins are antagonist to reactive oxygen species (ROS), which oxidize and do harm to body cells including DNA. The vitamins protects the body from harmful effect of chemotherapy. Stem bark extract is also rich in Vimang, which is specifically powerful in neutralizing iron-induced oxidative stress. Quantity required is 50-250 mg/kg, and for vitamin E and C, 100 mg/kg each and 50 mg/kg of beta-carotene to neutralize oxidative damage to the brain, liver and blood. Mangiferin is not toxic. It is not toxic to the embryo and gene. Non-mutagenic lethal dose (LD50) for mice is 400 mg/kg and rat is 365 mg/kg [6,9,10]. When Mangiferin is consumed up to 2000 mg/kg, human suffers transient dyspnoea (breathing difficulty or shortness of breath). Mangiferin has anti-atherosclerotic potency and it enhances

brain and cardiovascular functions [6,9, 10, 11, 12, 14, 18].

3.13 Radioprotective Effect

Mangiferin has a capacity to protect the body against radioactive effects of exposure to radiation or radiology by preventing the formation of micronuclei on cultured human peripheral blood lymphocytes and DBAzC57BL (black inbred strain of laboratory mouse).

3.14 Immunomodulatory Effect

Clinical trial of *Mangifera indica* stem bark alcohol extract was found to have immuno-stimulant properties, which was effective in modulating the immune-related disorders. It controlled nuclear factor (NF-xB) and suppressed NF-xB factor caused by inflammation resulting from tumour nuclear factor (TNF). This resulted in rise in intracellular glutathione (GSH) concentration and generated chemotherapeutic properties, which cause cell death. The chemotherapeutic function is highly needed for cancer treatment and the power to treat cancer is ached by raising the concentration of intracellular glutathione (GSH) and termination of reactive oxygen specie (ROS). Rise in GSH concentration prompts the activation of NF-xB levels to prevent trigger of tumour nuclear factor [1,2,3]. It quenches cell oxidation caused by reactive oxygen species (ROS) and increases the beneficial glutathione. This function has a clear benefit for cancer treatment. It has immunomodulatory effect, which protects the body from DNA damage [6, 9, 10, 11, 12, 14, 16, 2, 3, 4, 5, 7].

3.15 Anti-inflammation Property

In a clinical trial, extraction of *Mangifera indica* kernel with 95% ethanol showed a significant acute, subacute and chronic inflammation prevention and control. *In vivo* and *in vitro* investigations of the Vimang in mango extract showed that when it was applied topically, 0.5 - 2.0 mg on the ear of mice with edema caused by arachidonic acid and phorbol myristate acetate (PMA, ED 50 = 1.1 mg per ear) showed a significant reduction in the mice ear edema, which is anti-inflammation and anti-nociceptive effects [6, 9, 10, 11, 12]. Stem bark extract showed a significant antipyretic function [2, 3, 5, 7]. A study of analgesic and anti-inflammation potency of *Mangifera indica* was effective in controlling inflammation and the polyphenol content accounted for the inflammation control. An example of the polyphenol is VMANG. Treatment was administered topically to study the effect on mice with edema caused phorbol myristic acetate (PMA) and arachidonic acid (AA), ED50 = 1.1 mg per edema ear and 0.5 - 2.0 mg per edema ear respectively. The result showed a significant reduction in edema and nociceptive activity. Extract was applied on the edema ears of the mice topically [6, 9, 10, 11, 12, 17,1, 2, 3, 4, 5, 7].

3.16 Hepatoprotection and Cardio Protection

In another *in vivo* and *in vitro* clinical trial, chemopreventive properties of mango pulp extract and lupeol was studied on the liver of Swiss albino mice using 7,12-dimethylbenz (a) anthracene (DMBA). Outcome caused alteration in liver of Swiss albino mice, a function achieved by controlling oxidative stress, which induced injury on the cell of the mice liver. It regulated liver cell-growth [1,2,7]. *In vitro* means study in the laboratory and *in vivo depicts* live study with human or study animal. *Mangifera indica* peel extract protected Swiss albino rat from myocardia injury, which received pre-treatment of peel extract and treatment of polyphenol extract. A function achieved by lowering the myocardial enzymes [1,2,7].

3.17 Anti-microbial And Anti-parasitic Properties

There was an *in vitro* trial study of agar diffusion technique on seven pathogenic bacteria namely, *Staphylococcus aureus, Escherichia coli, Salmonella agona, Klebsiella pneumoniae, Bacillus pumilus, Bacillus cereus* and *Staphylococcus aureus, four fungi - Trichoderma reesei, Aspergillus flavus, fumignatus, Aspergillus flavus*, *Thermoascus aurantiacus* and one yeast, *Sacccharomyces cerevisiae*. Methanolic extracts of *Pisium guajava* and *Mangifera indica* leaves extracts prevented the microbial growth at 20 mg/ml; however, the potency of Pisium guajava methanol extract was stronger than *Mangifera indica*'s. It inhibited microbial growth more than *Mangifera indica* [1,2,3,4,5,7]. The Vmang and Mangiferin components of stem bark significantly reduced the parasitic larvae or egg of *Trichinella Spirals* and nematode.

In an *in vitro* study, 1:1 methanol extract of mango leaf and stem back extract caused 50.4%

reduction in malaria parasite agent concentration at a dose of 20 ug/ml [6, 9, 10, 11, 12, 17, 1, 2,4,5].

3.18 Anti-HIV, Antispasmodic and Antypyretic

Stem bark extract of *Mangifera indica* prevented plasmodial function of plasmodium yoelii nigeriensis, pyretic activity of experimental mice, in early infection of schizonts as a depository. It also inhibited hyperpyrexia induced by yeast. Stem bark extract and Mangiferin controlled pyrexia in study mice. Mangiferin exhibited antagonism to cytotoxic HIV [1, 2, 7].

3.19 Antidiarrhoeal Property

Magnesium sulphate and castor oil induce diarrhoea or runny stomach. When water and methanol extract of *Mangifera indica* seed was evaluated in a clinical *in vitro* trial on an experimental rat with diarrhoea caused by ingestion of magnesium Sulphate and castor oil; it significantly inhibited diarrhoea achieved by the extract capacity to cause transit movement on the intestine. It was concluded that water and methanol extract of *Mangifera indica* seed extract have a capacity to stop or prevent diarrhoea [1, 2,3,4, 5].

3.20 Antihelminthic and Antiallergic Properties

Extract of stem bark rich in Mangiferin and Vimang was found to possess anti-allergic and anthelminthic properties. A study showed that 100 mg/kg of Mangiferin inhibited a parasitic function of *Cryptosporidium parvum* in a neonate and it was more effective than standard medicine. Mangiferin being a major component of Vimang showed powerful anti allergic potency and the extract killed parasite such as, trichinella spirals and nematode [6,9,10, 11, 12, 14, 15].

A 50 days oral consumption of Mangiferin and Vmang at doses of 50 and 500 mg/kg body weight per day showed inhibition of cell degranulation caused by cutaneous anaphylaxis. Cutaneous anaphylaxis cause high immunoglobulin E (IGE) titre in the serum of experimental mice and IGE cause allergic pathogenesis. IGE is an antibody or protein, which protects the body as part of immune system. Also when same doses were administered to experimental rat, it prevented the growth of helminths called nematode and *Trichinella Spiralis* [6, 9, 10, 11, 12, 14, 15, 7].

4. DISCUSSION

In this discussion, the focus was on some selected bioactive compounds found in *Mangiferia indica* and some selected diseases *Mangifera indica* extracts control. The bioactive compounds are, tannins, saponins, alkaloids, flavonoids, phenolic compounds and steroids. Some controlled diseases namely, diabetes, inflammation, arthritis, allergy, cell oxidation, microbial and parasitic potency.

4.1 Tannins

Tannins has other names such as tannoids and tannic acid. Tannins are water-soluble polyphenols that occurs in plants naturally. Tannins are naturally astringent, plant use it to protect from predators and it gives plants unpleasant and pungent tastes [3, 4, 5, 7]. Tannins can be used for healthy food preservation. Tannins are bioactive molecules, which usually bind to protein and cause protein precipitation. Tannins perform anti-cancer function, it retards cancer growth and mutagen, it protects cell from oxidation damage, inhibits lipid peroxidation and superoxide radical formation [3, 4, 5,7]. It is also important to mention that some authors suggested that oesophageal cancer was linked with the excessive consumption of plants rich in tannins; however, more authors suggested that evidence of oesophageal cancer linked with tannins was not necessarily caused by tannins but rather caused by compounds that composed of tannins. Tannins can be beneficial to food and pharmaceutical industries for healthy food and medicine, which are critical for metabolic syndrome disease management [3, 4, 5, 7].

4.2 Saponins

The activities of Saponins' is similar to anti oxidation functions. It lowers the formation rate of harmful nitric oxide in the body. Some authors that reported that saponins cause inflammation and damage the intestine; however, this writer is yet to locate evidence to support these claims [3, 4, 5]. There are more evidence suggesting that saponins are body shepherds. It occurs naturally in plants and plant use saponins to protect self from infections and predators. Also, saponins protects the body from infections and diseases. Saponins can protect the body from infection and diseases by reducing blood sugar, blood

cholesterol and the risks of cancer and raising fibre levels of human diet. Saponins have strong anti-inflammatory capacity, especially gut inflammation [3, 4, 5]. Saponins cause autophagic death of cancer cells and weakens the cytoskeleton strength and disassembles it. Saponins cause cytotoxic action by causing cancer cell apoptosis and cell death, which did not occur as a result of apoptosis stimulation. Example of saponins that have anti-carcinogenic properties are, Polyphilin D, Tinosaponin, diosgenin, dioscin, gensenoside, Saikosaponin A and D, and oleandrin. It has Chem-protective effect on cancer cells and it has anti-inflammatory and anti-tumour properties. Inflammation is a way the body responds to harmful stimuli caused by autoimmune diseases, disease infections, cell irritations and cell damage [3,4,5]. Saponins are good for healthy teeth and bones, prevents platelet aggregation and lower cholesterol. It prevents dental caries, and prevent hypercalciuria - high calcium level in the urine. Saponins are found mostly in vegetables, edible legumes and generally in herbs (97). This author strongly believe that the exploration of potentials plant-based products such as *Mangifera indica* extracts will generate the most desired health benefits; as well as prompt other multiple effects on the economy amounting from increase in productivity, as a result of more healthier populations, diversification in farming, trade, investment, and rise in employment [3,4, 5].

4.3 Alkaloids

On account of the rising disease burden among nations of the world particularly metabolic syndrome diseases, both poor and rich countries are desperately searching for safe, affordable and safe leeways to treat diseases. Clinical evidence is showing that plant-based products are the much sought leeway [3,4,5,7]. Various parts of *Mangifera indica* parts extracts examined in this investigation namely, leaves, seed and bark showed a significant level of alkaloids. Alkaloids are phytochemical compounds, which are antagonist to the world most dreaded disease, cancer. *In vivo* and *in vitro* Clinical evidence revealed that alkaloids have a long-sought-for anti-cancer capability and anti cancer proliferation properties (19, 20, 21, 23). And as such, Alkaloids of plant origin offers high potentials for use in the manufacture of cancer drugs in the future. Alkaloids are highly antagonistic to cancer cells growth and proliferation. Alkaloids prompt cancer cells apoptosis. These alkaloids such as, Berberine, Tetrandrine, Martin, sanguinarine, piperine and evodiamine have potency against cancer [3,4,5,7].

4.4 Flavonoids

One of the major obstacle to cancer treatment is that cancer cells are not sensitive (resistant) to chemotherapy and radiotherapy treatments. Clinical evidence has revealed that flavonoids from plants have the capability to sensitize cancer cells to respond to chemotherapy and radiotherapy treatments to enhance cancer treatment. Examples of flavonoids are quercetin, isoquercitrin, Kaempherol, and myricetin [3, 4, 5, 7]. The parts of *Mangifera indica* investigated in these study possess rich amount of flavonoids. Flavonoids are also available in food example, rasp berries, black berries and blue berries. Also, flavonoids occur in high amounts in onions, spring onions, citrus and bananas. Fenugreek, leek, sea buckthorn and African spices are good food sources of flavonoids [3,4,5,7]. Additionally, flavonoids namely, isoflanones, sulforaphane, isoflavonoids, isothiocyanate and insoles are healthy food preservatives. Exploring the use of flavonoids in food processing and preservation can replace the use of harmful chemicals in food preservation and processing, which will have a direct major control in chronic diseases explosion, metabolic syndrome diseases caused mainly by unhealthy lifestyle and the consumption of food processed with harmful chemicals. The outcome of this study now calls for exploration of the potentials of *Mangifera indica* parts extracts in bringing a significant global social change through chronic diseases effective treatment and healthy food processing [3,4, 5,7].

4.5 Phenolic Compounds

Phenolic compounds occur in several forms namely, ellagic acids, sodium gallate, protacatechuric acid, methyl gallate, and phenolic acids. Phenolic acids can come in the form of, garlic acid, caffein acid and trans-ferulic acids [2,3,4,5]. Phenols and phenolic compounds are group of molecules with strong anti-carcinogenic properties. Phenolic compounds attacks cancer cells at different spots essentially, at spots most badly affected. Phenols disrupt the damaging process and prompt cancer cell apoptosis. Phenols cause interrupt cancer cell life cycle to cause cancer autophagy and starvation of cancer cell to death [2,3,4,5].

Phenols generally inhibits cancer cell initiation, progression and proliferation. Phenols particularly the quercetin and garlic acids can treat cancer diseases alone or in combination with other drugs [21, 22, 23, 1, 2, 3, 4, 5].

Polyphenolic composition of *Magnifiera indica* seeds include, tannins, garlic acids, xanthone, catechins, quercetin, kaempferol, caffeic acid, magniferin and mangoxanthonoid. These and other phytochemical properties listed above, Antioxidant vitamins A, C, and E, polyphenols and other photochemical compositions of *Mangifera indica* offer it the capacity to protect the body from inflammation, diabetes, tumour, cell oxidation and radiology damage, allergy, microbial and parasitic infections and bone resorption. It protects the body from lipids harmful effect and performs immunomodulatory functions [2, 3, 4, 5].

4.6 Steroids

Steroids are cholesterol or hormones that occur in nature. It is manufactured by adrenal gland for the purpose of performing specific body functions in the cells, tissues and organ. Steroids can also be produced artificially as drug known as cortisol for disease treatment. Steroids are also known as corticosteroids. Steroids are organic compound, which performs biological functions in human cells. Steroids are located at the membrane for altering the amount of fluid in the membrane and transmission of molecular signals. Steroids prevent inflammation and hinders the immune system from producing compounds that cause inflammation. Steroids is good for arthritis and asthma at optimum consumption level. Conversely, it also has many adverse effect when its concentration in the body is high. Some people use steroids for strength, pain, and performance-enhancement. Steroids are effective agents for treating rheumatoid arthritis, autoimmune disorders example, lupus, multiple sclerosis, asthma, eczema and rashes. Various parts of *Mangifera indica* contain steroids in different concentrations so, *Mangifera indica* extracts can be natural sources of steroids and can be beneficial to the pharmaceutical industry [2, 3, 5].

4.7 Anti Diabetic

Water extract of leaf also reduced sugar in animal with hyperglycaemic property and to animal that was glucose-induced, as well as streptozocin induced animal. Similarly, leaf extract has strong hyperglycaemic properties. 250 mg/kg of 50% ethanol extract was used to achieve a significant sugar level reduction in a normal and streptozotocin-induced diabetic animals [6, 9, 10, 11, 18]. Additionally, mango flour (from the seed) consumption was found to cause a significant drop in the the blood glucose; thus, it is suggested to be effective for diabetes treatment. While seed flour can be effective in lowering blood sugar level, stem bark extract is effective in reducing blood glucose as well as effective analgesic and strong inflammation control. Polyphenols, mangiferin, flavonoids, triterpenoids located in all parts of the plants possess strong potency against inflammation, diabetes, a powerful analgesia and the effect on inflammation and analgesic capacity made its use as native medicine to control arthritis, inflammation and pain justifiable [6, 9, 10, 11, 12, 14, 18, 7].

4.8 Anti-Inflammation, Anti-arthritis, and Antipyretic Function

A 95% ethanol extract of mango seed showed a significant anti-inflammation capacities for chronic, subacute and acute inflammatory conditions [6, 9, 10, 11, 12, 17, 2, 3, 4, 5]. Generally, high sugar, trans fatty acids, omega 6 fatty acids, gluten, casein (solid) milk, alcohol and monosodium glutamate aggravate arthritis. However, healthy spices namely, ginger, garlic, chilli, Nigerian spices offer therapeutic effect to arthritis disease. Healthy nuts, which are beneficial to arthritis are, cashew nuts, walnuts, almonds, African walnut, coconut, pecan, mango and star apple seeds. Among beneficial cereals are, barley, sorghum, millet and corn. Fruits such as citrus, mango, berries, guava, grapes, watermelon, carrot, are beneficial. Vegetables such as potatoes, yam, cassava, celery, beet, and all kinds of green and coloured leafy vegetables are beneficial to inflammation, arthritis and pain [6, 9, 10, 11, 12, 13, 17, 2, 3, 4, 5, 7].

4.9 Antioxidant Vitamins

Mango pulp contain high level of antioxidant vitamins namely, vitamin A, C, E, Beta-carotene, which have strong capacities to inhibit reactive oxygen species (ROS). Reactive oxygen species perform harmful oxidation activity in the body, which cause damage to the DNA. Other beneficial effects of anti-oxidant vitamins is that it protects the body from harmful effect of chemotherapy.

Daily recommended dietary allowance for vitamin A is 765 mg and only 100 gm of fresh *Mangifera indica* fruit contains 765 mg of vitamin A. It is also rich in pre-biotic dietary fibre, flavonoids, polyphenols. *Mangifera indica* fruit consumption protects the body from oral cavity and lung cancer. It is rich in vitamin B6 (pyridoxin), which is essential for the formation of GABA hormone in the brain [3, 5, 7].

4.10 Anti-microbial and Anti-parasitic Capacities

Extracts were effective in treating seven pathogenic bacteria discussed above example, *Staphylococcus aureus, Escherichia coli, Salmonella agona, Klebsiella pneumoniae, Bacillus pumilus, Bacillus cereus* and *Staphylococcus citreus,* four fungi - *Trichoderma reesei, Aspergillus flavus, fumignatus, Aspergillus flavus and Thermoascus aurantiacus* and one yeast, *Saccharomyces cerevisiae* [1,2,3,4,5,7]. Also, the Vmang and Mangiferin components of stem bark significantly reduced the parasitic larvae or egg of *Trichinella Spirals* and nematode [7].

Mangifera indica seed, fruit, stem, heartwood, root and leaves possess healing powers because of high concentration of phytochemical compound. *Mangifera indica* is high in polyphenols, flavonoids, triterpenoids, Mangiferin, isomagniferin, tannins and gallic acid derivatives. Phytochemical compounds such as, Mangiferin, kinic acid, protocatechic acid, alanine, catechin, glycine, shikimic acid, tetracyclic triterpenoids cycloart-24-en-3B-26diol, y-aminobutyric acid are located at the bark [6, 9, 10, 11, 12, 14, 18, 5, 7].

Mangiferin is highest in the leave and stem extract. The leaf also contains homomangiferin (phenol). Mangiferin is an antioxidant that neutralizes and scavenges free radical from the body and it is a strong anti-inflammatory agent, it relieves pain and protects the body from nitric oxide peroxidation, cardiovascular diseases, tumour, hypercholesterolemia, allergy, diabetes, microbial attack. Mangiferin also kills cancer cells. Mangiferin is effective against different kinds of cancer namely, breast, colon, neurone and lung cancer. It is beneficial to cerebral infarction, cerebral oedema and neurological damage [6, 9, 10, 11, 12, 14, 18, 5, 7].

5. CONCLUSION

Evidence suggest that *Mangifera indica* stem bark, heartwood, leave extracts, peel and juice possess the capacities to clear digestive system and neutralize body acidity, as well as control various diseases. These parts of *Mangifera indica* contain phytochemical compounds in different concentrations namely, flavonoids, saponins, alkaloids, tannins, phenols, polyphenols, terpenoids, glycosides and antioxidants. Clinical evidence connects compounds with healing capacities for metabolic syndrome diseases namely, obesity, inflammation, high cholesterol, triglycerides, immunomodulation, cancer, tumour, diabetes, hypertension and cardiovascular diseases. Evidence also suggested that the phytochemical compounds are capable of treating communicable disease namely, microbial, viral, parasitic, fungal, allergic, diseases, while possessing antipyretic functions. More studies on *Mangifera indica* and pharmaceutical properties will be beneficial. The general public, researchers, public health, health practitioners, farmers, manufacturers, investors, pharmaceutical industry and policy decision makers are to profit from the results.

6. RECOMMENDATIONS

The world can no longer afford to continue to watch its citizens live in pain, disability, suffer and die prematurely on account of chronic diseases, which have held mankind to ransom for close to half a century. Thankfully, nutrition and plant products now offers hope, quick action is required from various governments of the world to take bold actions to create and integrate nutrition and herbal clinic into healthcare. Even the big Pharma can jump in and develop an innovative strategy on how to use Pharma might to leverage on that to save more lives. The life we save today could be ours tomorrow.

More clinical studies on the plant-based products, essentially *Mangifera indica* is necessary.

Inclusion of nutrition and herbal treatments in healthcare policy and in health insurance coverage is recommended.

Training of Nutrition and Herbal clinicians is encouraged, which will require government allocation, if policy is in favour of it.

A review and revise of government policies in these regard is highly encouraged. Our world is evolving and we need to use resources at our disposal to improve the quality of life of the local and global communities.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

This is a systematic review, written consent was not applicable.

ETHICAL APPROVAL

This is a systematic review, ethical approval is not applicable. This study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Osei-Djarbeng SN, Kwarteng OR, Osei-Asante S, Owusu-Dapaah G. Comparative antimicrobial activities os ethanol extract of leaves, seed and stem bark of Mangifera indica (Mango). Journal of Pharmascognosy and Phytochemistry. 2022;9(1):1240-1243.
   Available:https://www.phytojournal.com/archives/2020/vol9issue1/PartU/9-1-204-528.pdf
2. Wauthoz N, Blade A, Blade E S, Damme MV, Duez P. Ethnopharmacology of Mangifera indica L. Bark and pharmacological studies of its main C-Glucosylxanthone, Mangiferin. International Journal of Biomedical and Pharmaceutical Sciences. 2007;1(2):112-119.
   Available:https://d1wqtxts1xzle7.cloudfront.net/33808419/IJBPS_1%282%29112-119-libre.pdf
3. Pallab Kalita. An overview on *Mangifera indica*: Importance and its various pharmacological action. Pharma Tutor. 2014;2(12):72-76.
4. Ahajumobi NE. A comparative analysis of phytochemical composition of eight leaves used as native medicine in Africa. International Journal of Recent Advances in Multidisciplinary Research. 2023;10(08): 8774-8782.
   Available:http://ijramr.com/sites/default/files/issues-pdf/4565.pdf
5. Ahajumobi NEA. Comparative analysis of phytochemical composition of seven seeds used to treat diseases in Eastern Nigeria. International Journal of Recent Advances in Multidisciplinary Research. 2023;10(08): 8783-8791.
   Available:https://www.ijramr.com/sites/default/files/issues-pdf/4566_0.pdf
6. Shah KA, Patel MB, Patel RJ, Parmar PK. *Mangifera indica* (Mango). Pharmacognosy Review. 2010;4(7):42- 48.
   DOI: 10.4103/0973-7847.65325
7. Pal AK, Singh SP, Sati K. Phytochemical in mango (*Mangifera indica*) parts and their bioactivities: A Review. Journal of Crop Research. 2022;57(1 & 2):79-95.
   DOI: 1031830/2454-1761.2022.012Accessed on July 11, 2024.
8. Pollock A, Berge E. How to do a systematic review. International Journal of Stroke. 2018;13(2):138-156.
   DOI: 10.1177/1747493017743796
9. Imran M, Arshad MS, Butt MS, Kwon JH, Arshad MU, Sultan MT. Mangiferin: A natural miracle bioactive compound against lifestyle related disorders. Lipids Health Dis. 2017;16(1):84.
   DOI: 10.1186/s12944-017-0449-y
   PMID: 28464819; PMCID: PMC5414237.
10. Vaibhav Walia, Sushil Kumar Chaudhary, Neeraj Kumar Sethiya. Therapeutic potential of mangiferin in the treatment of various neuropsychiatric and neurodegenerative disorders, Neurochemistry International. 2021; 143:104939. ISSN 0197-0186.
    DOI: 10.1016/j.neuint.2020.104939
11. Mieczyslaw Pokorski. A Nutraceutical with clinical implications. Journal of Vitamins & Minerals. 2013;3(1). ISSN-2376-1318.
12. K Rashid K, Sil PC. Chapter 3 - Identification and extraction of antidiabetic antioxidants from Natural Sources, Editor(s): Goutam Brahmachari, In Natural Product Drug Discovery, Discovery and Development of Antidiabetic Agents from Natural Products, Elsevier. 2017;63-111. ISBN 9780128094501.
    DOI: 10.1016/B978-0-12-809450-1.00003-X
13. Masud GM, Parvez, Khokon Miah Akanda. Chapter 1 - Foods and Arthritis: An overview, Editor(s): Ronald Ross Watson,

Victor R. Preedy, Bioactive food as dietary interventions for arthritis and related inflammatory diseases (Second Edition), Academic Press. 2019;3-22. ISBN9780128138205.
DOI: 10.1016/B978-0-12-813820-5.00001-5. S

14. Derese EM, Guantai Y, Souaibou V, Kuete. Chapter 21 - *Mangifera indica* L. (Anacardiaceae), Editor(s): Victor Kuete, medicinal spices and vegetables from Africa, Academic Press. 2017;451-483. ISBN 9780128092866.
DOI: 10.1016/B978-0-12-809286-6.00021-2
15. Gunter R Neeb, Chapter 7 - Blood stasis related medicinals, their application and combination, Editor(s): Gunter R. Neeb, Blood Stasis, Churchill Livingstone. 2007;53-95. ISBN 9780443101854.
DOI: 10.1016/B978-044310185-4.50015-1.
16. Satish K Garg, Amit Shukla, Soumen Choudhury. Chapter 42 - Green coffee beans, Editor(s): Ramesh C. Gupta, Rajiv Lall, Ajay Srivastava, Nutraceuticals (Second Edition), Academic Press. 2021; 725-748. ISBN 9780128210383.
DOI: 10.1016/B978-0-12-821038-3.00042-2.
17. Jiyoung Kim, Ki Won Lee, Hyong Joo Lee. Chapter 29 - Polyphenols suppress and modulate Inflammation: Possible roles in health and disease, Editor(s): Ronald Ross Watson, Victor R. Preedy, Sherma Zibadi, Polyphenols in Human Health and Disease, Academic Press. 2014;393- 408. ISBN 9780123984562.
DOI: 10.1016/B978-0-12-398456-2.00029-3
18. Alok Kumar Gupta, Pawan Singh Gurjar, Karma Beer, Alemwati Pongener, Ravi SC, Smita Singh, et al. A review on valorization of different byproducts of mango (*Mangifera indica* L.) for functional food and human health, Food Bioscience. 2022;48:101783. ISSN 2212-4292.
DOI: 10.1016/j.fbio.2022.101783
19. Kumar M, Saurabh V, Tomar M, Hasan M, Changan S, Sasi M, et al. Mango (*Mangifera indica* L.) Leaves: Nutritional composition, phytochemical profile, and health-promoting bioactivities. Antioxidants. 2021;10:299.
Available:https://doi.org/10.3390/antiox10020299
20. Ruchi Singh SK. Singh RS, Maharia AN. Garg. Journal of Pharmaceutical and Biomedical Analysis. 2015;105(i):150-155.
ISSN 0731-7085.
DOI: 10.1016/j.jpba.2014.12.010
21. Oluwasegun Modupe, Temidayo Adenike Oladiji. Optimizing dose of aqueous extract of Mangifera indica L stem bark for treating anaemia and its effect on some disaccharidases activity in iron deficient weanling rats. Journal of Nutrition & Intermediary Metabolism. 2016;3:18-22. ISSN 2352-3859.
DOI: 10.1016/j.jnim.2015.12.001
22. Udem G C, Dahiru D, Etteh C C. *In vitro* antioxidant activities of aqueous and ethanol extracts of *Mangifera indica* leaf, stem-bark and root-bark. Pharmacognosy Communications. 2018; 8(3):119-124.
23. Ogidi OI, Okore CC, Akpan UM, Ayebabogha MN and Onukwufo CJ: Evaluation of antimicrobial activity and bioactive phytochemical properties of mango (*Mangifera indica*) stem-bark extracts. Int J Pharmacognosy 2021;8(5): 189-95.
DOI: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.8(5).189-95

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/119352