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Medicinal Utilization and Phytochemical Composition of Brimstone (*Morinda lucida. Benth)* Tree: A Case Study of Igabi Local Government in Northern Guinea Savanna Area of Kaduna State, Nigeria

A. I. Sodimu[1]*, M. M. Olorukooba[2], G. O. Baba[3], A. A. Ademuwagun[4], R. K. Olaifa[5], M. F. Rasheed[4], L. O. Salau[1], K. Musa[1], M. I. Bello[6]

[1]Department of Forest Ecology and Environmental Management, Savannah Forestry Research Station, Forestry Research Institute of Nigeria, P.M.B 1039, Samaru-Zaria, Nigeria, [2]Department of Crop Protection Technology, Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria, PMB2273, Afaka-Kaduna, Nigeria, [3]Department of Forest Protection and Entomology, Savannah Forestry Research Station, Forestry Research Institute of Nigeria, P.M.B 1039, Samaru-Zaria, Nigeria, [4]Department of Basic Science and General Studies, Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria, PMB2273, Afaka-Kaduna, Nigeria, [5]Department of Forest Economics, Extension and Management, Savannah Forestry Research Station, Forestry Research Institute of Nigeria, P.M.B 1039, Samaru-Zaria, Nigeria, [6]Department of Forest Protection, Shelterbelt Research Station, Forestry Research Institute of Nigeria, Kano, Nigeria

ABSTRACT

Morinda lucida. Benth is known for its essential constituents required for good health of humans and arrays of indigenous uses, pharmacological and arrays of indigenous uses, pharmacological, and phyto-pharmacologicals for the treatments and prevention of several ailments and medical conditions. Hence, the study is aimed at documenting and unraveling the Medicinal utilization and phytochemical composition of Brimstone (*M. lucida. Benth*.) plant in Igabi Northern Guinea Savanna area of Kaduna State was studied. One hundred questionnaires were randomly administered to the respondents (Traditional healers; Herb traders, Civil servants and farmers) and a total of 90 were retrieved. The results revealed that the plant parts (leaves; bark; and the roots) can be used in the treatment and prevention of various diseases such as yellow fever; abdomen or chest pain; infertility; cancer; gonorrhea; leprosy; kidney and liver dysfunction, hernia; sexual problems; rheumatism; and so on. Infusion is the major (43.33%) method of herbal preparation. Parts of the plants species used in preparing the herbs include: The leaves; bark; and the root. Majority of the herbal are consumed in a fresh form. Demographic characteristic of the respondents was also examined. The percentage of Male was (43.34%) while that of their female counter part was (56.66%). Majority (43.33%) of the respondents were between 31 and 40 years' age bracket and majority (44.44%) are married with majority (37.78%) having 1–5 house hold size. 45.56% of the respondents had secondary education while 2.22% had no formal education and majority (51.11%) are traditional healers. Quantitative phytochemical analysis revealed the presence of tannins; alkaloids flavonoids; terpenoids; saponins; phenolic acid; and glycoside in various concentrations as there were significant differences ($P < 0.05$) between these phytochemicals and their plants parts. The presence of varied active ingredients in the different parts of these plants explains their diverse use in the treatment of different disease conditions. However, it is recommended that due to the increased interest in brimstone (especially on its medical utilization) and slow growth of the tree research should be directed on how to develop a new cultivar with short maturation period. Furthermore, the local population particularly the youth should be educated and also encouraged to learn more about the tradition medicine knowledge to preserve it from being lost with the old generation.

Keywords: Phytochemicals, Utilization, Medicinal, Active, Conservation, Maturation, Youth

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INTRODUCTION

Medicinal plants have been playing very important role in human healthcare since time immemorial. This practice of healthcare based on belief and experience of ethic people, which is part of their tradition and culture.[1,2] Traditional medicine refers to the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultural uses in the

Address for correspondence: A. I. Sodimu, Savannah Forestry Research Station, Forestry Research Institute of Nigeria, P.M.B 1039, Samaru-Zaria, Nigeria. Phone: +2348038026117. E-mail: akintundesodimu@yahoo.com

maintenance of health and in prevention, diagnosis improvement, and treatment of physical mental illness.[3] Traditional medicine covers a wide variety of therapies and practices which varies from country to country and region in some countries, it is referred to as alternative or complementary medicine they are influenced by factors such as culture, history, personal attitude, and philosophy.[4] Traditional medicine has been used for thousands of years with a great contribution made by practitioners to human health particularly as primary health-care providers at the community level. Medicinal plant has maintained its popularity worldwide since 1990s, its use surged in many developing countries and interest has increased by researchers on the use of plant medicinally both for traditional uses and as potential new source of drugs and treatment.[5] Although, the use of these plants has contributed enormously to the traditional health sector but unfortunately, the demand for herbs, particularly in parts of Africa, has brought some plant near extinction as the traditional healers have yet to considered the regeneration of these important medicinal plants used by them.[2,6] In the quest for conservation of the lower scale of production of medicine and other important products, attention is being on indigenous flora species from graduation opinion; drugs are not readily available and affordable especially within the rural places.

Morinda lucida Benth. (Rubiaceae) is a tropical West Africa rainforest tree also called Brimstone tree. In Cote d'Ivoire, it is locally called Sangogo or Bondoukou alongua while in Ghana, it is known as Twi, Kòn kròmà or Ewe amake. Among the Togolese, the plant is popularly known as Ewe amake or Atak ake while among the Yoruba natives (South-West Nigeria), it is called Òruwó.[7] Different parts of the plant are attributed with diverse therapeutic benefits. For example, in Southern Cameroon, cold decoction of the plant leaves is used for the treatment of fever.[7] However, in most parts of West Africa, the bitter water decoction of the plant bark, root, and leaf is used as bitter tonic and as astringent for dysentery, abdominal colic and intestinal worm infestation.[7] The Europeans sometimes use the decoction of the plant root or stem to make "bitters."[7]

It is rich source of two powerful antioxidants, Vitamins A and E which could be effective in combating degenerative diseases such as atherosclerosis; Vitamin K, different secondary metabolites responsible for the ethnomedicinal properties of the plant – alkaloids, tannins, saponins, flavonoids, and phenols. Nutrient component which showed moderate qualities of proximate compounds – carbohydrates, protein, fat, fiber, ash, and high moisture content; bioactive phytochemical which act as antibiotic, antiviral, anti-plasmodia, and anti-parasitic. The plant is an excellent source of phytochemical constituent and nutritive components and the leaves contain high level of Vitamin K which helps in building of strong bone with various extracts of the plant dried leaves documented to possess trypanocidal.[8] Brimstone tree is locally used in the treatment of irregular menstruation, insomnia, and jaundice, also in the treatment of wound infections, abscesses, and chancre. The decoction is also reported as antidiarrheal if taken thrice daily. Decoction and infusions of plasters of root bark and leaves are recognized remedies against different types of fever, including yellow fever, and malaria.[9,10] It is reported to possess strong trypanocidal and aortic vasorelaxant activities. The leaf and stem bark is reported to possess anticancer, hepatoprotective, cytotoxic, and genotoxic, anti-spermatogenic, hypoglycemic, and anti-diabetic activities. The leaves effectively treat and improve all forms of infertility in women trypanosomiasis, and feverish condition during childbirth. The plants in some cases are employed in treating diabetes, hypertension, cerebral congestion, dysentery, stomach ache, ulcers, leprosy, and gonorrhea. *M. lucida* is reported to contain steroid which makes them useful against cerebral malaria and also confirming its effectiveness as anti-plasmodia agents. *M. lucida* is extra pancreatic in nature with the exception of the possibility for stimulating the liberation of insulin already produced by beta-cells. *M. lucida* was observed to lower blood sugar of one diabetic patient.[11] Among the Yoruba herbalists (South-West Nigeria), fresh leaves of the plant are often macerated in palm-wine and its bitter decoction is used in the oral treatment of suspected diabetic patients usually for a few days.[12]

M. lucida is a nutrient factory and is readily available throughout the year in southwestern Nigeria. The toxicity of *M. lucida* is largely unknown. However, one study report that large doses of extract can be administered without danger.[12] This research focused on phytochemical analysis and medicinal utilization of the plant. The medicinal values of plant and their components photochemical such as alkaloids, tannin, flavonoids, phenolic, and other compounds have been found to produce a definite physiological action on human body[13] *M. lucida. Benth* is one of the indigenous flora species in which its medicinal values cannot be over emphasized. Here, in Kaduna Northern Guinea Savanna, little of its medicinal utilization has been documented. Although, a lot of researches has been conducted on medicinal plants conservation elsewhere in Nigeria.[3,14-16] The people (herbalist, herb sellers, and tradomedical centers) who have the insight of these medicinal utilization of the tree learnt it by heart now that systematic search for useful bioactivities from medicinal plants is now considered to be a rational approach in pharmaceutical and drug research and also, considering the report of Monier and Abd El-Ghani[16] on rapid loss of the natural habitat for some of these medicinal plant due to anthropogenic activity. Thus, it is impetus to documents some of its medicinal utilizations for future generations. Therefore, this research aims at documenting the medicinal utilization of the part of the plant (leaves, roots, and the bark) in Igabi Local Government in Northern Guinea Savanna Area of Kaduna State.

METHODOLOGY

Study Area

The study was conducted in Igabi Local Government, in Northern Guinea Savanna Area of Kaduna State. It is located

on latitude 10^0 37^1N and longitude 7^0 17^1E [Figure 1]. The major crops grown in the area include maize, cassava, millet, sorghum, guinea-corn, water melon, and so on. The area consists of different tribes such as Yoruba's, Hausas, Igbos Fulani's, and Gbagyi's living together in peace and harmony. The area as population of about 570,000 people with annual rainfall of 1000 mm–1500 mm.[17]

Data Collection and Source

Primary data were used for the study. The primary data were collected using structured questionnaire. The questionnaire was designed to collect the following types of information.

i. Demographic characteristics of the sample respondents such as sex; age; marital status; and so on
ii. Different diseases/ailment the species can cure; part used; mode of preparation; and administration
iii. Constraints confronting the traditional healers/practitioners and so on.

Sampling Techniques

Simple random sampling technique was used in selection of the respondents. One hundred questionnaires were randomly administered to the respondents (Traditional healers; Herb traders, Civil servants, and farmers) and a total of ninety were retrieved. The questionnaire was designed in English language and administered by group of interviewers who could speak and write in local dialects. Face-to-face method of interviews was adopted.

Processing of Plant Materials for Phytochemical Analysis

M. lucida Benth leaves, stem, and root were collected from Federal University of Agriculture Abeokuta and her environs. They were identified at the herbarium Department of Forestry Technology, Federal College of Forestry Mechanization, Afaka-Kaduna State. The different parts of the selected plant materials were air dried in the College laboratory. The dried sample was chopped into pieces and ground separately to powdered form using blender. The powdered samples were stored in small plastic air-tight containers which were taken for analysis at National Research Institute of Chemical Technology (NRICT) Zaria, Nigeria.

Phytochemical Screening

The extract was examined for the presence of the following phytochemicals: Alkanoids, saponins, cardiac glycosides, and flavonoids. The method described by Harbon[19] was used to ascertain the presence of alkanoids and glycoside. The presence of saponins was detected using the method adopted from,[20] while flavonoids and terpenoids were screened using the method of Trease and Evans.[21]

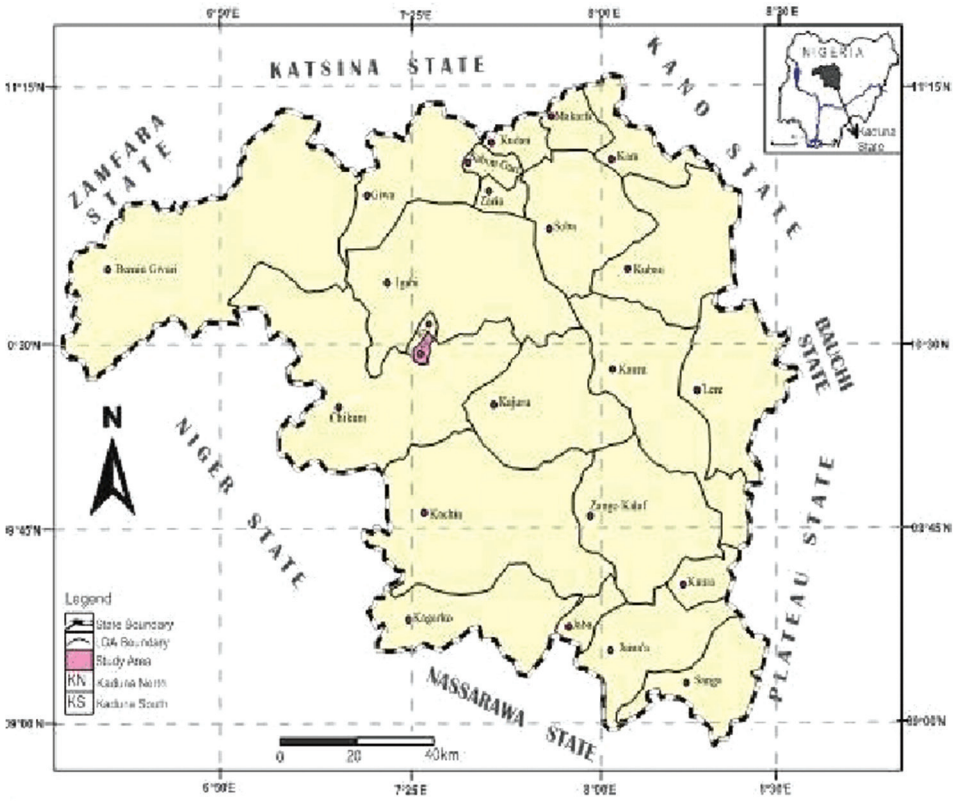

Figure 1: Map of Kaduna State Showing the Study Local Govt. Area. Source[18]

Analytical Techniques

Simple descriptive statistics

Simple descriptive statistics such as percentage, frequency distribution tables, and mean, was used.

Analysis of Variance (ANOVA)

Two-ways Analysis of variance (ANOVA) using GLM procedure (Prec. GLM) of SAS (Statistical Analysis System) was used to show the comparison between the phytochemical composition of the leaf, stem and root of the plant. The data were expressed as means 1 Standard deviation (Means of 3 determinations) and differences were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Some demographic characteristics are known to influence the medicinal utilization and phytochemical composition of brimstone (*M. lucida, Benth*) in Igabi Local Government Areas of Kaduna State. The variable employed in this study includes: age, sex, marital status, house hold sizes, and level of education.

Table 1 revealed that 43.33% of the sampled respondents were between the age brackets of 31 and 40 years. This implies that they were at middle and economically active age which could have positive effect on their standard of living. About 44.44% of the respondents are married, 41.11% are single, and 4.45% are divorced while 10.00% are widower. This is an indication that married people know the value and economic importance of the medicinal utilization of Brimstone tree for curing and prevention of diseases. Gender distribution further revealed that women are the majority (56.66%) in the medicinal utilization of brimstone tree against their men counter parts (43.34%). About 45.56% of the sampled respondents had secondary education and 28.89% had tertiary education, 13.33% had primary education, and 7.78% had Arabic education, 2.22% had adult education. Njoku[22] observed that formal education has positive influence on one's life. Furthermore, 37.78% of the respondents were between the household size of 1–5 while 18.89% of the respondents were in the household above 15.

Methods of Herbal Preparation of Brimstone Tree *(M. lucida. Benth)*: (Leaf, Bark, Stem, and Roots)

Over the decades, various methodologies have been adopted by the traditional healers, herbs trader, people knowledgeable about the medicinal of brimstone tree, etc., in herbal preparation of the part of the tree (roots, barks, fruit, seed, leaf, stem, etc.) for prevention and curing of various diseases in Igabi Local Government Area of Northern Guinea Savanna of Kaduna State. However, the most common adopted method in the study area is shown below.

Table 2 revealed that majority (43.33%) of the respondents adopted infusion methods of preparation. This implies that either or any of the parts of the tree are boiled or soaked in

Table 1: Demographic characteristics of respondents

Variable	Respondents	Percentage
Age in years		
10–20	19	21.11
21–30	16	17.78
31–40	39	43.33
41–50	13	14.45
Above 51	03	3.33
Marital status		
Married	40	44.44
Single	37	41.11
Divorce	04	4.45
Widower	09	10.00
Gender		
Female	51	56.66
Male	39	43.34
Educational Level		
Tertiary	26	28.89
Secondary School	41	45.56
Primary School	12	13.33
Arabic School	07	7.78
Adult School	02	2.22
Non Formal Education	02	2.22
Occupation		
Traditional Healer	16	51.11
Herbs Trader	30	33.33
Civil Servant	10	11.11
Famer	04	4.45
House hold size		
1–5	34	37.78
6–10	29	32.22
11–15	10	11.11
Above 15	17	18.89
Total	90	100.00

Table 2: Responses to methods of herbal preparation of brimstone tree (leaf, bark, and root)

Methods	Frequency	Percentage
Infusion	39	43.33
Maceration	17	18.89
Crushing	04	4.45
Grinding	30	33.33
Total	90	100

hot water before used. About 33.33% used grinding method while 4.45% used crushing. However, majority of advocate of alternative medicine hold that various alternative methods are effective in treating a wide range of major and minor medical condition. This results are in accordance with that of Gonsalkore *et al*.,[23] Berga *et al*.,[24] Michalsen *et al*.[25] whose research proves the effectives of specific alternative treatments.

Herbal Forms and Method of Administration of the Plant

The respondents show and claim that all the parts of brimstone tree (leaf, bark, and root) can be used to prevent and cure various ailments, forms, and methods of preparing the parts varies depending on the ailments. However, advocate of alternative medicine hold that

Table 3: Ailments forms, preparation and method of administering brimstone *(Morinda lucida. benth)* plant parts (leaf, root, and bark) herbal

Diseases	Part used	Preparation	Status	Method of Use
Yellow fever and malaria	Leaves	Immerse in water and boiled for about 30-40 min	Fresh	1 Ghasi per day 2 tea spoon for children
Abdomen or chest for coughs. and enlarge spleen	Leaves	The leaves are heated and applied to the effected parts	Fresh and Dry	Applied the heated leaves to the abdomen or chest in the morning and night for 7 days
Infertility and Hypertension	Leaves	Squeeze or blend fresh leaves and bitter leaves in water, then filtered it	Fresh	2 times daily. Two table spoon to be taken in the morning and night
Cancer and Gonorrhea	Leaves combined with other plant; lemon grass and pods of sweet orange.	The leaves and other parts of the plants mentioned are being boil in water for 30–40 min	Fresh	Administration or application by taking one short glass three times daily for adult and half of the glass for children 2 times daily (Morning and Night)
Leprosy	Leaves	The leave is squeeze or extracted in water and maceration of fresh leaves is gotten	Fresh or Dry	1 ghasi (short glass cup) for adult 3 times daily
Jaundice	Bark	Weak decoction of the stem bark	Fresh	Decoction is administered for the treatment of severe jaundice often characterized by hemoglobinuria and hematuria. 1 tea spoons to be taken only in the Morning for children and 1 ghasi for adult only in the morning also
Stomach ache	Bark combined with lemon grass	The bark and lemon grass boiled together for 30–40 min allow to cool before use	Fresh or dry	½ Ghasi to be taken only in the Morning for children and 1 full ghasi for adult only in the morning also
Menstrual pains	Root	Boiled fresh root for 40–50 min. Allow to cool before use	Fresh and Dry	Dilute with water for bathing in the night. 2 table spoon is taken in the morning and Night
Kidney and Liver dysfunction	Root	Boiled fresh extracted root for 30–40 min	Fresh	½ Ghasi to be taken only in the Morning for children and 1 full ghasi for adult only in the morning also
Hernia	Leaves and root	Leaves and fresh root gently soaked in hot water for 40–50 min	Fresh	1 full ghasi to be taken 3 times daily for 5 days
Increase sexual capacity and improve weak impotence and deficiency of premature ejaculation.	Root	Soaked fresh extracted root with other plants part in Gin or 7-up for a day (24 h)	Fresh	½ Ghasi to be taken 3 times daily for 7–9 days
Chronic rheumatism	Leaves and root	Boiled dry leaves with fresh root for 35 – 45 min	Fresh and dry	Soak clean rag with the water and place it on the joint 3 times daily

various methods of administration are effective in treating a wide range of major and minor medical conditions.[26] The table below shows various ailments form of preparation and method of administering brimstone tree parts (herbs) in the study area.

Table 3 showed various diseases that *M. lucida* tree can be used to cure in Igabi Northern Guinea Savanna Area of Kaduna State. However, most of the practitioners learnt and inherited the practices from their forefathers. Thus, they were very reluctant in disclosing some of the preparation and administration. Similar observation was reported by Sodimu *et al*.[3] Dalhatu.[27] The diseases that can be cured by this species include yellow fever, malaria; abdomen or chest pain; Cancer; Gonorrhea; Hernia; Rheumatism; and so on. However, some of the parts of the tree were used in fresh while other are used in dry condition during the preparation of the herbal. The table further revealed that there is standardization of measurement in taking the herbal with the use of table spoon, tea spoon, and sometimes with the use of short glass cup called "ghasi" in Yoruba language.

Constraints Confronting Traditional Medicine Practitioners

Various constraints were identified from the respondent's confronting traditional medicine practitioners in the study area. Some of the constraints identified are shown in Table 4.

Table 4: Constraints of traditional medicine practitioners

Constraints	Frequency	Percentage
Deforestation	30	33.33
Insects/ Pest	10	11.11
Illiteracy	08	8.89
Transportation	05	5.56
Finance	02	2.22
Government Policy	35	38.89
Total	90	100.00

Table 4 revealed that government policy is the major (38.89%) constraint confronting traditional medicine practitioners in the study area, this is closely, followed by deforestation (33.33%), insect/pest (11.11%) while finance issues is the least with 2.22%. These observations were also reported in the work of[28] that government law and policies are the major challenges facing herbal practitioners.

Quantitative Phytochemical Composition of the Brimstone *(M. lucida. Benth)* Tree (Leaf, Root and Bark)

Phytochemical constituents of brimstone (*M. lucida. Benth*) tree show the presence of medicinally active compositions in various quantities in different plant part. However, the quantitative estimation of the crude constituents in the tree parts study is presented in Table 5:

- Figures are expressed as mean ±SD
- Figures bearing different alphabets differ significantly (P<0.05)
- Figures bearing the same alphabets are not significantly different (P<0.05).

Table 5 shows that significant differences ($P < 0.05$) exist between the plant parts. Leaves of *M. lucida* had the highest composition of flavonoids, steroids, tannins, phenols, and glycosides while the bark had the highest composition of terpenoids and alkanoids while the roots had the least composition of saponins, glycoside, flavonoids, steroids, and tannins. Suradkar *et al*.[29] reported the presence of terpenoids, saponins, alkanoids, and cardiac glycoside in the leaves and the bark of the extract of *M. lucida*. They thus, concluded that the presence of these chemical could possibly explain the scientific basis of the plants in the medicinal utilization by the traditional healers in treatment and prevention of various diseases across West African Countries. The results above are also in agreement with the work of Schneider and Wolfing,[30] Okwu and Omodamiro[,31] who documented that the presence of saponins, alkanoids and cardiac glycosides in *M. lucida* has contributed to the medicinal utilization of the plant in treatment of congestive heart failure, diabetes, allergies, and ulcers.

Table 5: Quantitative Phytochemical Composition of Brimstone *(Morinda lucida Benth)*

Parts	Tannins (Mg/100 g)	Terpenoids (Mg/100 g)	Alkanoids (Mg/100 g)	Flavonoids (Mg/100 g)	Steroids (Mg/100 g)	Saponins (Mg/100 g)	Phenol (Mg/100 g)	Glycosides (Mg/100 g)
Leaves	1.50a±0.003	2.40b±0.088	2.74b±0.009	0.30a±0.003	1.18a±0.005	0.08a±0.005	4.94a±0.004	0.53a±0.004
Barks	1.45b±0.002	3.98a±0.015	3.21a±0.006	0.09b±0.007	1.18a±0.005	0.08a±0.005	4.94a±0.004	0.53a±0.004
Root	0.51c±0.003	2.01c±0.004	0.29c±0.004	0.09c±0.003	0.55b±0.006	0.06b±0.007	1.06b±0.005	0.18b±0.005
LSD (P<0.05)	0.003	0.008	0.006	0.003	0.005	0.005	0.004	0.004

CONCLUSION AND RECOMMENDATIONS

Conclusion

In this study, medicinal utilization and phytochemical analysis of the iconic brimstone (*M. lucida. Benth*) tree revealed that the whole plant (root, leaves, and the bark) can be used in the treatment and prevention of arrays of chronic/acute ailments due to adequate presence of phytochemical compounds which serve as active ingredient in the utilization of the plant. Furthermore, the species addressed an important healthcare need. Thus, its integration with conventional medicine should be promulgated.

Recommendations

The Federal Ministry of Health should identify and encourage the traditional healers and herbs trader who are knowledgeable about the medicinal utilization of *M. lucida. Benth* at various local levels to develop their recipes and give incentives to motivate them. However, the local population particularly the youth should be educated and also encouraged to learn more about the traditional medicinal knowledge to preserve it from being lost with the old generation.

There is need to create awareness of environmental conservation and protection of medicinal plant species biodiversity. Government should stop individuals from indiscriminate destruction of forest and encourage cultivation of medicinal plants. Similarly, sustainability of biodiversity and biological resources should be ensured so that individual plants like *M. lucida. Benth* do not go into extinction.

Finally, the research institutes in collaboration with tree arms of government should carry out further research into traditional medicine and other multipurpose uses of the plant and due to the increased interest in medicinal utilization of sponge gourd plant, there is need to create awareness about its conservation. Furthermore, the local population particularly the youth should be educated and also encouraged to learn more about the traditional medicinal knowledge to preserve it from being lost with the old generation.

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