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The mineral, proximate and phytochemical components of ten Nigerian medicinal plants used in the management of arthritis

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Ethnobotanical investigation revealed the use of ten medicinal plants in the management of arthritis in Ibadan, Nigeria. This study screened the plants for mineral, proximate and phytochemical components that could be responsible for their therapeutic value in arthritis. The powdered plant samples were analysed for nutritional constituents and phytochemical compounds using standard laboratory protocols. The use value of plant-parts was 50% leaves and 50% roots. Three out of the 10 plants had high calcium content: *Oncoba spinosa* (180.0 mg/100 g), *Nymphaea lotus* (160.0 mg/100 g) and *Solenostemon monostachyus* (125.0 mg/100 g). *N. lotus* had the highest iron content (8.0 mg/100 g). Phosphorus content was highest in *O. spinosa* (150.0 mg/100 g). Magnesium was highest in *Phyllanthus amarus* (14.0 mg/100 g). Crude fibre was highest in *Solanum aethiopicum* (15.90%) and the least in *O. spinosa* (14.00%). *S. aethiopicum* had the highest protein content (18.50%) and *O. spinosa* the least (14.75%). All the medicinal plants tested positive to alkaloids, carotenoids and flavonoids. The plants contained minerals and secondary metabolites that are implicated in arthritis viz. calcium, zinc, carotenoids and flavonoids. The presence of these compounds in the test plants might alleviate pains associated with arthritis. *O. spinosa* had high potential in the management of arthritis due to its high calcium and phosphorus components.

Key words: Arthritis, medicinal plants, mineral analysis, proximate analysis, Nigeria.

INTRODUCTION

Lecaniodiscus cupanioides Planch ex Benth., *Carpolobia lutea* G.Don, *Microdesmis puberula* Hook.f. ex Planch., *Oncoba spinosa* Forssk., *Calliandra portoricensis* (Jacq.) Benth., *Phyllanthus amarus* Schumach. & Thonn., *Solenostemon monostachyus* (P.Beauv.) Briq., *Tetracera alnifolia* Willd., *Solanum aethiopicum* L. and *Nymphaea lotus* L. are used for the management of arthritis in Ibadan, Nigeria. Although the plants are of therapeutic importance in managing arthritis, they are used for other health problems in folk medicine. The aqueous root

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extract of *L. cupanioides* is used as a galactogen and as a laxative (Adeyemi et al., 2005). *C. lutea* is used in folk medicine to facilitate delivery and treat male sexual disorders (Mitaine-Offer et al., 2002). *M. puberula* is used traditionally for the treat-ment of infectious diseases, genital problems, menstrual complaints, sterility, miscarriage and loss of virility. The roots of *O. spinosa* are used in the treatment of dysentery and bladder complaints (Burkill, 1994). *C. portoricensis* is mixed with ginger and water for use as an enema for lumbago pain and constipation, and when mixed with pepper; it is used for gonorrhoea (Burkill, 1985). The root has very strong anticandidal property (Gbadamosi, 2008). The leaves of *S. monostachyus* are eaten as a potherb; leaves are also used to treat dysmenorrhoea, haematuria, female sterility, rheumatism, foot infections and snakebites (Burkill, 1995). The roots of *T. alnifolia* are used for the treatment of venereal diseases, arthritis and rheumatism. The stem bark of the plant forms part of a recipe used as anti-anaemic (Gbadamosi et al., 2012). Medicinal applications of *S. aethiopicum* include the use of roots and fruits as a carminative and sedative, and to treat colic and high blood pressure. The leaf juice is used as a sedative to treat uterine complaints (Burkill, 2000). *N. lotus* finds application in the management of circulatory system disorders, digestive system disorders, infections and inflammation (Burkill, 1997).

Arthritis is the inflammation of one or more joints. Most forms of arthritis affect the joints, tendons, ligaments, muscles, and cartilage. Some types, in the advanced stages, can affect the body's organs. Although there is no cure for arthritis, pain relievers, certain natural substances including vitamins and minerals, exercise and other lifestyle remedies can help manage the disease. The symptoms of arthritis will depend on the cause and the type. If the cause of arthritis is an autoimmune condition, then the symptoms may occur suddenly and aggressively. Many people with autoimmune forms of arthritis will experience alternating periods of flare-ups and remission. If the cause of arthritis is related to aging, then the symptoms will occur gradually - sometimes over a period of years. No matter the type of arthritis, the symptoms will vary based on other factors, including overall health of the sufferer. Regardless of the type of arthritis, common symptoms include pain, swelling in the tissue and joints, stiffness, deformity and diminished flexibility. People with arthritis tend to experience an aching sensation that may improve or worsen as a result of factors that include weather, time of day, movement and physical activity (www.symptomfind.com).

There are more than one hundred identifiable types of arthritis. Some common types of arthritis are osteo-arthritis, rheumatoid arthritis, gout, ankylosing spondylitis, psoriatic arthritis and juvenile arthritis. Osteoarthritis occurs when the joints break down from wear and tear as a result of old age or injury. Rheumatoid arthritis is an autoimmune disease that occurs when the immune system attacks its own cartilage and tendons between the joints. Gout is caused by excess uric acid in the blood; it is a sudden and severe attack that causes pain and swelling in the joints especially in the joint of the big toe. Ankylosing spondylitis causes swelling, pain, stiffness and other complications in the spine. Psoriatic arthritis is similar to rheumatoid arthritis and tends to affect the fingers. Juvenile arthritis affects children. Most children who have juvenile arthritis will develop symptoms of a sudden fever and swelling knuckles. Juvenile arthritis patients may also develop a rash. Many children who develop this form of rheumatoid arthritis will recover completely, while others face a lifelong chronic condition (www.symptomfind.com).

Some medicinal plants have been reported to be useful in the management of rheumatoid arthritis. *Linum usitatissimum* (flaxseed) oil can be an effective part of a rheumatoid arthritis treatment regimen. It is rich in Omega-3 fatty acids like alpha-lipoic acid, which have anti-inflammatory properties. Also useful is *Tripterygium wilfordii* (thunder god vine) which has unique immune suppressant and anti-inflammatory properties. *Curcuma longa* (turmeric) is a potent herbal remedy for rheumatoid arthritis symptoms. It contains curcumin, which gives it both its characteristic yellow color and anti-inflammatory properties (Neidzooicha, 2013). Other plants with anti-inflammatory properties are *Ageratum conyzoides*, *Artemisia copa*, *Bauhinia tarapotensis*, *Croton pullei* and *Maytenus ilicifolia* (Lima et al., 2011). There is a lot of information in literature on plants with anti-inflammatory properties worldwide (Rathore et al., 2007; Adams et al., 2009; Vikrant and Arya, 2011; Vishwabhan et al., 2011; Mahesh et al., 2011; Apu et al., 2012). Medicinal plants with analgesic properties also play significant role in alleviating pains commonly associated with arthritis. Many plant analgesics have been reported (Santos et al., 1994; Mathangi et al., 2012).

This study analysed ten medicinal plants for their nutritional and phytochemical components with the aim of ascertaining their justification for ethnomedicinal uses in the management of arthritis. Furthermore, this study presents the test plants for future pharmacological and toxicological studies in related research fields.

MATERIALS AND METHODS

Ethnobotanical study

Twenty herb-sellers were interviewed on the traditional method of management of arthritis (Sofowora, 1993). They were interviewed in Yoruba language at a local herbal market (Bode) in Ibadan. The study revealed the use of *L. cupanioides* (roots), *C. lutea* (roots), *M. puberula* (roots), *O. spinosa* (roots), *C. portoricensis* (roots), *P. amarus* (leaves), *S. monostachyus* (leaves), *T. alnifolia* (leaves), *S. aethiopicum* (leaves) and *N. lotus* (leaves) for the management of arthritis in Ibadan, Oyo state, Nigeria.

Collection and Identification of botanicals

The test plants were identified at species level in the University of Ibadan Herbarium (UIH). Fresh and healthy plant parts of the test plants were either bought from the herbal market (Bode) or collected from University of Ibadan campus.

Preparation of powdered plant materials for experiment

The test plants were washed, cut into small pieces and air dried at room temperature (27 to 30°C) for two weeks until completely dried. The dry plant materials were ground into powder and stored in air-tight glass bottles at room temperature prior to experiments.

Mineral analysis of powdered plant samples

The mineral analysis of samples was done using standard protocol (Walsh, 1971). After wet digestion, samples were analysed for Calcium (Ca), Iron (Fe), Manganese (Mn), Magnesium (Mg), and Zinc (Zn) using atomic absorption spectrophotometer (FC 210/211 VGP Bausch scientific AAS). Phosphorus (P) was determined using Vanadomolybdate (Yellow method). Percentage transmittance was determined at 400 nm using Spectronic 20 (Bausch and Lomb) Colorimeter.

Proximate analysis of powdered plant samples

The proximate analysis of powdered plant materials was carried out using the AOAC methods (2005) in the Laboratory of the Department of Animal Science, Faculty of Agriculture and Forestry, University of Ibadan. The plant samples were analysed for proximate compositions: moisture content, crude protein, crude fat, ash, crude fibre and carbohydrate.

Phytochemical screening of powdered plant samples

Phytochemical screening of samples was done using the methods of Sofowora (1993) and Evans (2002) as follows.

Alkaloids

The powdered plant sample (500 mg) was weighed and extracted with 10 ml of 2% hydrochloric acid (HCl). The HCl extract was then filtered with Whatman filter paper (No.1) so as to have a clear solution and also to prevent false results. The filtrate of about 2.5 ml was treated with few drops of Dragendorff's reagent. A precipitate indicated the presence of alkaloids.

Anthraquinones

The powdered plant sample (500 mg) was shaken with 10 ml of benzene. The solution was filtered and 5 ml of 10% ammonium hydroxide (NH_4OH) solution was added to the filtrate. A violet colour was observed in the lower phase. It indicated presence of anthraquinones.

Carotenoids

The extract (10 ml) was added to a test tube and evaporated to dryness on a water bath. 2 to 3 drops of saturated antimony (III) chloride ($SbCl_3$) in Chloroform ($CHCl_3$) was added to the residue. A blue-green colour eventually changing to red indicates the presence of carotenoids.

Flavonoids

A few drops of concentrated hydrochloric acid (HCl) were added to a small amount of an extract (0.5 g) of the plant material. Immediate development of a red colour was taken as an indication of the presence of flavonoids.

Saponins

The sample (200 mg) was shaken with 5 ml of distilled water and then heated to boil. Persistent frothing showed the presence of saponins.

Steroids

The extract (0.5 g) was dissolved in 2 ml of chloroform. Sulphuric acid was carefully added to form a lower layer. A reddish-brown colour at the interphase indicated the deoxysugar characteristic of cardenolides. A violet ring formed just above the layer and gradually spread throughout the layer (sulphuric acid) indicated presence of steroids.

Tannins

The sample (500 mg) was mixed with 10 ml of distilled water and heated on a water bath. The mixture was filtered and ferric chloride ($FeCl_3$) was added to the filtrate. Appearance of blue black colouration showed the presence of tannins.

Statistical analysis of data

All data were statistically analysed using one-way analysis of variance (ANOVA) and expressed as mean ± SD. The Duncan multiple range test (DMRT) was used to test means for significance ($P < 0.05$).

RESULTS

Table 1 shows the profile of the medicinal plants used in this study. Herbs (40%) are mostly used, followed by shrubs (30%) and trees (30%). The plants contained minerals in varied quantities (Table 2). The ten plants are rich in proteins and fibres (Table 3). Most of the medicinal plants tested positive to alkaloids, anthraquinones, carotenoids, flavonoids, saponins, steroids and tannins (Table 4).

DISCUSSION

The ten plants belong to 10 different families (Table 1). The use value of plant-parts was 50% leaves and 50% roots commonly used for the management of arthritis. Some traditional recipes used for the management of

Table 1. Profile of ten medicinal plants used in the management of arthritis.

Plant species	Family	Local names	Habit	Part used
Lecaniodiscus cupanioides	Sapindaceae	Aaka	Tree	Roots
Carpolobia lutea	Polygalaceae	Osunsun	Shrub	Roots
Microdesmis puberula	Pandaceae	Apata	Shrub	Roots
Oncoba spinosa	Flacourtiaceae	Gbonsere	Tree	Roots
Calliandra portoricensis	Fabaceae	Tude	Shrub	Roots
Phyllanthus amarus	Euphorbiaceae	Eyin olobe	Herb	Leaves
Solenostemon monostachyus	Lamiaceae	Olojogbodu	Herb	Leaves
Tetracera alnifonia	Dilleniaceae	Opon	Tree	Leaves
Solanum aethiopicum	Solanaceae	Igbagba/Osun	Herb	Leaves
Nymphaea lotus	Nymphaceae	Osibata	Herb	Leaves

Table 2. Mineral constituents of ten medicinal plants used in the management of arthritis.

Plant species	Phosphorous (mg/100 g)	Calcium (mg/100 g)	Iron (mg/100 g)	Manganese (mg/100 g)	Magnesium (mg/100 g)	Zinc (mg/100 g)
Lecaniodiscus cupanioides	*125.00^{b} ± 4.24	85.00^{e} ± 1.41	7.50^{b} ± 0.14	0.00^{a} ± 0.00	2.50^{bdec} ± 0.14	0.10^{a} ± 0.06
Carpolobia lutea	60.00^{a} ± 2.83	75.00^{f} ± 1.41	6.35^{c} ± 0.21	0.02^{a} ± 0.01	4.50^{a} ± 0.14	0.05^{a} ± 0.01
Microdesmis puberula	70.00^{f} ± 1.14	50.00 ± 1.41	2.45^{g} ± 0.07	0.02^{a} ± 0.01	1.50^{ed} ± 0.14	0.02^{a} ± 0.01
Oncoba spinosa	150.00^{a} ± 1.141	180.00^{a} ± 1.41	5.50^{d} ± 0.14	0.02^{a} ± 0.01	3.00^{bdac} ± 1.41	0.05^{a} ± 0.06
Calliandra portoricensis	85.00^{e} ± 1.41	60.00^{h} ± 1.41	6.25^{c} ± 0.07	0.01^{a} ± 0.01	4.00^{ba} ± 1.41	0.10^{a} ± 0.01
Phyllanthus amarus	45.00^{h} ± 1.41	70.00^{g} ± 1.41	6.00^{e} ± 0.14	0.02^{a} ± 0.0	14.00^{ba} ± 1.41	0.10^{a} ± 0.01
Solenostemon monostachyus	90.00^{d} ± 1.41	125.00^{c} ± 1.41	4.50^{e} ± 0.14	0.01^{a} ± 0.01	3.00^{bdac} ± 1.41	0.02^{a} ± 0.01
Tetracera alnifonia	55.00^{g} ± 1.41	40.00^{j} ± 1.41	3.55^{f} ± 0.07	0.02^{a} ± 0.01	1.00^{e} ± 0.57	0.05^{a} ± 0.01
Solanum aethiopicum	60.00^{g} ± 2.83	95.00^{d} ± 1.41	6.00^{c} ± 0.14	0.08^{a} ± 0.10	3.50^{bac} ± 0.14	0.05^{a} ± 0.01
Nymphaea lotus	120.00^{c} ± 1.41	160.00^{b} ± 1.41	8.00^{a} ± 0.28	0.01^{a} ± 0.01	2.00^{dec} ± 0.28	0.01^{a} ± 0.06

*****Value = mean ± SD

arthritis are: (i) the leaves of *P. amarus* and *S. monostarchyus* (1:1) are squeezed together in water and the extract (150 ml) is taken daily after food. (ii) The root of *L. cupanioides* is dried and powdered; a teaspoonful of the powder is taken in hot water or pap daily after food. (iii) The root of *C. portoricensis* is dried and powdered; a teaspoonful of the powder is taken in hot water or pap daily after food.

Phosphorus content was highest in *O. spinosa* (150.0 mg/100 g) (Table 2), followed by *L. cupanoides* (120.0 mg/100 g). *L. cupanioides* (125.0mg/100g) and the least was for *P. amarus* (45.0 mg/100 g). Three out of the 10 plants had high calcium content: *O. spinosa* (180.0 mg/100 g), *N. lotus* (160.0 mg/100 g) and *S. monostachyus* (125.0 mg/100 g). Calcium builds and maintains strong bones and teeth. A daily intake of 1,500 mg is recommended for people with inflammatory conditions. Calcium needs to be combined with phosphorus and vitamin D to be more effective. People with rheumatoid arthritis who took 1,000 mg of calcium along with 500 IUs of vitamin D reversed steroid-induced bone loss and gained bone mass as well (Holt, 2011). *N. lotus* had the highest iron content (8.0 mg/100 g), followed by *L. cupanioides* (7.50 mg/100 g) and *M. puberula* the least at 2.45 mg/100 g. There is an earlier report on high iron content (7.78 mg/g) in *N. lotus* (Okayi and Abe, 2000). Magnesium was highest in *P. amarus* (14.0 mg/100 g), followed by *C. lutea* (4.5 mg/100 g) and the least was for *T. alnifolia* (1.0 mg/100 g). The antioxidant activity and ion profiles of *C. lutea* have been reported (Nwidu et al., 2012). The highest zinc value (0.1 mg/100 g) was observed for *L. cupanioides*, *C. portoricensis* and *P. amarus*. Zinc is often deficient in people with arthritis and a daily intake of 50 mg is recommended for arthritis sufferers (Holt, 2011). The findings of the present study on mineral components of the test plants conform to the reports of previous authors (Nwidu et al., 2012; Afolabi et al., 2012). Overall, *O. spinosa* is a valuable plant in the management of arthritis due to its high phosphorus and calcium content.

Moisture content was highest in *S. aethiopicum* (9.50%) and the least was for *O. spinosa* (8.45%) (Table 3).

Table 3. Proximate components of ten medicinal plants used in the management of arthritis.

Plant species	% Moisture Content	% Protein	% Crude fat	%Ash	% Crude fibre	% Carbohydrate
Lecaniodiscus cupanioides	*9.25^{bac} ± 0.07	17.55^{b} ± 0.07	2.20^{a} ± 0.14	9.80^{bc} ± 0.28	15.50^{ba} ± 0.14	45.70^{h} ± 0.14
Carpolobia lutea	8.90^{edc} ± 0.14	15.25^{e} ± 0.21	1.60^{bc} ± 0.28	7.95^{f} ± 0.07	14.25^{dc} ± 0.07	52.10^{a} ± 0.14
Microdesmis puberula	8.75^{ed} ± 0.07	16.85^{c} ± 1.41	1.40^{c} ± 0.14	8.65^{e} ± 0.07	15.50^{cd} ± 0.42	48.85^{e} ± 0.21
Oncoba spinosa	8.45^{ba} ± 0.07	14.75^{f} ± 0.07	2.05^{a} ± 0.07	8.50^{e} ± 0.14	14.00^{d} ± 0.14	51.25^{b} ± 0.21
Calliandra portoricensis	8.50^{e} ± 0.42	15.90^{d} ± 1.41	1.40^{c} ± 0.14	9.55^{c} ± 0.07	15.05^{b} ± 0.07	49.60^{d} ± 0.14
Phyllanthus amarus	8.70^{ed} ± 0.14	16.70^{c} ± 0.28	1.85^{ba} ± 0.28	10.02^{a} ± 0.14	14.60^{c} ± 0.28	48.05^{f} ± 0.07
Solenostemon monostachyus	8.95^{dc} ± 0.07	18.50 ± 0.28	2.05^{a} ± 0.07	9.85^{bc} ± 0.07	13.85^{d} ± 0.07	46.80^{g} ± 0.42
Tetracera alnifonia	9.05^{bdc} ± 0.21	15.85^{d} ± 0.07	1.90^{ba} ± 0.14	8.60^{e} ± 0.14	14.05^{d} ± 0.21	50.55^{c} ± 0.07
Solanum aethiopicum	9.50^{a} ± 0.14	17.90^{b} ± 0.14	1.85^{ba} ± 0.07	9.95^{ba} ± 0.21	15.90^{a} ± 0.14	44.85 ± 0.07
Nymphaea lotus	8.70^{ed} ± 0.14	15.60^{ed} ± 0.28	1.60^{bc} ± 0.28	9.20 ± 0.14	15.40^{b} ± 0.00	49.45 ± 0.07

*Value = mean ± SD.

Table 4. Phytochemical quality of ten medicinal plants used in the management of arthritis.

Plant species	Alkaloids	Anthraquinones	Carotenoids	Flavonoids	Saponins	Steroids	Tannins
Lecaniodiscus cupanioides	+	+	+	+	+	+	±
Carpolobia lutea	+	+	+	±	+	+	±
Microdesmis puberula	+	+	+	+	+	+	+
Oncoba spinosa	+	+	+	±	+	±	±
Calliandra portoricensis	+	+	+	±	+	+	+
Phyllanthus amarus	+	+	+	+	+	+	+
Solenostemon monostachyus	+	+	+	+	+	+	+
Tetracera alnifonia	+	+	+	+	+	+	+
Solanum aethiopicum	+	+	+	+	+	+	+
Nymphaea lotus	+	+	+	+	+	+	+

+ means presence; ± means inconclusive.

S. aethiopicum had the highest protein content (18.50%) and *O. spinosa* the least (14.75%). The protein content of *S. aethiopicum* (2.24 ± 0.03 g/100 g protein) (17.90%) observed in this study is higher than the value reported for its fruit (Chinedu et al., 2011). The ash content for *P. amarus* (10.02%) was the highest and the least was recorded for *C. lutea* (7.95%). Crude fibre was highest in *S. aethiopicum* (15.90%) and the least in *O. spinosa* (14.00%). The carbohydrate content of *C. lutea* (52.10%) was the highest and *S. aethiopicum* (44.85%) was the least. Generally, *S.*

aethiopicum was highest in nutritional constituents (moisture, crude protein and crude fibre), a result that agrees with the findings of Chinedu et al. (2011).

The phytochemical components could be responsible for the analgesic, antioxidant and anti-inflammatory properties of the test plants and their effectiveness in the management of arthritis. The antioxidant properties of *P. amarus* (Joseph and Raj, 2011), *S. aethiopicum* (Okoko and Ere, 2012) and *C. portoricensis* (Moharram et al., 2006) have been reported. *C. lutea* (Jackson et al., 2011), *C. portoricensis* (Agunu et al., 2005) and *M. puberula* (Okany et al., 2012) have analgesic properties.

Conclusion

The test plants contained significant mineral, proximate and phytochemical components. The antioxidant, analgesic and anti-inflammatory properties of some of the plants have been reported, and these therapeutic properties are significantly relevant in the management of arthritis. The nutritional components of the test plant might complement the phytochemicals in alleviating pain and reducing inflammation in arthritis

REFERENCES

Adams M, Berset C, Kessler M, Hamburger M (2009). Medicinal herbs for the treatment of rheumatic disorders—A survey of European herbals from the 16th and 17th century. J. Ethnopharmacol. 121:343–359.

Adeyemi OO, Yemitan OK, Adeogun OO (2005). Analgesic activity of the aqueous root extract of *Lecaniodiscus cupanioides*. West Afr. J. Pharmacol. Drug Res. 20(1,2):10–14.

Afolabi IS, Akpokene ON, Fashola DV, Famakin TC (2012). Comparative evaluation of the nutritional benefits of some underutilized plants leaves. J. Nat. Prod. Plant Resour. 2(2):261-266.

Agunu A, Abdurahman EM, Shok M, Sadiq AY (2005). Analgesic activity of the roots and leaves of *Calliandra portoricensis*. Fitoterapia 76:442-445.

AOAC (2005). Official Methods of Analysis. 18th Edition. Association of Official Analytical Chemists, Washington, DC., USA.

Apu AS, Bhuyan SH, Prova SS, Muhit MA (2012). Anti-inflammatory activity of medicinal plants native to Bangladesh: A review. J. Appl. Pharm. Sci. 2 (2):7-10.

Burkill HM (1985). The useful plants of West Tropical Africa. Royal Botanic Gardens Kew, 2nd edition, 2:413–414.

Burkill HM (1994). The useful plants of West Tropical Africa. Royal Botanic Gardens Kew, 2nd edition, 2:160–162.

Burkill HM (1995). The useful plants of West Tropical Africa. Royal Botanic Gardens Kew, 2nd edition, 3:34–35.

Burkill HM (1997). The useful plants of West Tropical Africa. Royal Botanic Gardens Kew, 2nd edition, 4:264–267.

Burkill HM (2000). The useful plants of West Tropical Africa. Royal Botanic Gardens Kew, 2nd edition, 5:120–121.

Chinedu SW, Olasumbo AC, Eboji OK, Emiloju OC, Arinola OK, Dania DI (2011). Proximate and Phytochemical Analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. Fruits. Res. J. Chem. Sci. 1(3):63-71.

Evans WC (2002). Trease and Evans Pharmacognosy, 15th Edition. London: Bailliere Tindall, p. 585.

Gbadamosi IT (2008). Ethnobotany and micro-propagation of selected medicinal plants with in vitro anti-candidal activity in Ibadan, southwestern Nigeria. Ph.D dissertation, University of Ibadan, Nigeria.

Gbadamosi IT, Moody JO, Yekini AO (2012). Nutritional composition of ten ethnobotanicals used for treatment anaemia in southwestern Nigeria. Eur. J. Med. Plants 2(2):140-150.

Holt B (2011). Vitamins and minerals for arthritis. Available at: www.livestrong.com/article/467878-vitamins-minerals-for-arthritis/. Retrieved 26th March, 2013.

Jackson C, Mbagwu H, Jackson I, Ekpe G, Etienam F (2011). Analgesic activities of ethanolic extract of the root of *Carpolobia lutea*. Afr. J. Pharm. Pharmacol. 5(3):367-370.

Joseph B, Raj SJ (2011). An overview: Pharmacognostic properties of *Phyllantus amarus* Linn. Int. J. Pharmacol. 7(1):40-45.

Lima GRM, Montenegro CA, Almeida CLF, Athayde-Filho PF, Barbosa-Filho JM, Batista LM (2011). Database Survey of Anti-Inflammatory Plants in South America: A Review. Int. J. Mol. Sci. 12:2692-2749.

Mahesh G, Ramkanth S, Mohammed Saleem TS (2011). Anti-inflammatory drugs from medicinal plants a comprehensive review. Int. J. Rev. Life. Sci. 1(1):1-10.

Mathangi N, Elumalai E, Eswaraiah MC, Mamatha A, Swathi AS (2012). An updated analgesic review on medicinal plants - 2011. Int. J. Pharm. Res. Dev. 4(1):22-29.

Mitaine-Offer A, Miyamoto T, Khan IA, Delaude C, Dubois M (2002). Three new triterpenes saponins from two species of Carpolobia. J. Nat. Prod. 65:533-557.

Moharram FA, Marzouk MSA, Ibrahim MT, Marby TJ (2006). Antioxidant galloylated flavanol glycosides from *Calliandra haematocephala*, Nat. Prod. Res. 20:927-934.

Neidzooicha L (2013). Herbs to Get Rid of Rheumatoid Arthritis Pain in Knees. Available at: http://www.livestrong.com/article/303726-herbs-to-get-rid-of-rheumatoid-arthritis-pain-in-knees /. Retrieved 26th May, 2014.

Nwidu LL, Cilli EM, Vilegas W (2012). Amino acid, Antioxidant and Ion Profiles of *Carpolobia lutea* Leaf (Polygalaceae). Trop. J. Pharm. Res 11(5):807-813.

Okany CC, Ishola IO, Ashorobi RB (2012). Evaluation of analgesic and antistress potential of methanolic stem wood extract of *Microdesmis puberula* Hook.f. ex Planch (Pandaceae) in mice. Int. J. Appl. Res. Nat. Prod. 5(3):30-36.

Okayi RG, Abe OM (2000). Preliminary study of the aquatic macrophytes of selected fish ponds and reservoirs in Makurdi, Benue State, Nigeria. 165-168. Available at: www.aquaticcommons.org/3639/1/16P165.pdf Retrieved 26th March, 2013.

Okoko T, Ere D (2012). Antioxidant activities of *Solenostemon monostachyus* leaf extract using in vitro methods. Sci. Res. Essays 7(6):621-626.

Rathore B, Mahdi AA, Paul BN, Saxena PN, Das SK (2007). Indian Herbal Medicines: Possible Potent Therapeutic Agents for Rheumatoid Arthritis. J. Clin. Biochem. Nutr. 41(1):12–17.

Santos AR, Filho VC, Niero R, Viana AM, Moreno FN, Campos MM, Yunes RA, Calixto JB (1994). Analgesic effects of callus culture extracts from selected species of *Phyllanthus* in mice. J. Pharm. Pharmacol. 46(9):755-759.

Sofowora A (1993). Medicinal Plants and Traditional Medicine in Africa, 2nd Edition. Ibadan, Nigeria: Spectrum Books Ltd. P 289.

Vikrant A, Arya ML (2011). A Review on anti-Inflammatory plant barks. Int. J. Pharm. Tech. Res. 3:899-908.

Vishwabhan S, Harsh P, Vishal S, Kailash S (2011). Some traditionally used anti-arthritic herbs a review. Int. Res. J. Pharm. 2(11):43-45.

Walsh LM (1971). Instrumental methods for analysis of soils and plant tissue. Madison. Wis. USA: Soil Sci. Society Am. Inc., p. 222.

Symptomfind (2014). Arthritis. http://www.symptomfind.com/diseases-conditions/arthritis/. Retrieved 26th March, 2013.