Original Research Article

Review of Ethnopharmacology and phytochemistry of *Acacia ataxacantha*

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Sent for review: 22 February 2018 Revised accepted: 17 October 2018

**Abstract**

**Purpose:** To provide ethnopharmacological and phytochemical properties of *Acacia ataxacantha* as initial steps of assessing medicinal value and importance of the species in tropical Africa.

**Methods:** Information on the medicinal uses, phytochemistry and pharmacological activities of *A. ataxacantha* was collected from several sources including books, theses, scientific reports and journal articles obtained from internet sources such as SciFinder, Web of Science, Pubmed, BMC, Elsevier, Science Direct, Scielo and Scopus.

**Results:** *Acacia ataxacantha* is an important herbal medicine in tropical Africa used against abscesses, backache, cough, dental caries and toothache, headache, malaria, pneumonia, sores and wounds, and stomach problems. The chemical constituents of *A. ataxacantha* include alkaloids, anthracene derivatives, carbohydrates, coumarins, flavonoids, lignan, naphtoquinone, polyphenols, reducing sugars, saponins, steroids, tannins, terpenoids and triterpenoids. The biological activities demonstrated include antibacterial, antifungal, anti-diabetic, anti-inflammatory, antioxidant, laxative and ulcero-protective.

**Conclusion:** The phytochemical properties and pharmacological activities of *A. ataxacantha* lend some support for the traditional medicinal applications of the species against several diseases.

**Keywords:** *Acacia ataxacantha*, Ethnopharmacology, Herbal medicine, Indigenous medicinal knowledge, Primary health, Tropical Africa

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Tropical Journal of Pharmaceutical Research is indexed by Science Citation Index (SciSearch), Scopus, International Pharmaceutical Abstract, Chemical Abstracts, Embase, Index Copernicus, EBSCO, African Index Medicus, JournalSeek, Journal Citation Reports/Science Edition, Directory of Open Access Journals (DOAJ), African Journal Online, Bioline International, Open-J-Gate and Pharmacy Abstracts

INTRODUCTION

*Acacia ataxacantha* DC. is a member of the family Fabaceae and belongs to the subfamily Mimosoideae. Following recommendations from phylogenetic analysis, *A. ataxacantha* was renamed *Senegalia ataxacantha* (DC.) Kyalangaliwa & Boatwr. [1]. But international centres of botanical and taxonomical research such as Missouri Botanical Garden, St. Louis, Missouri, USA and the Royal Botanic Gardens, Kew, UK regard *S. ataxacantha* as an unresolved name and recognize *A. ataxacantha* instead. The specific name “*ataxacantha*” is made up of two Greek words “*taxis*” and “*akantha*” which mean “arrangement” and “thorns”, respectively in reference to the many scattered thorns on the stems and shoots of the
Acacia ataxacantha is a scrambling woody, many-stemmed shrub or small tree growing up to 10 m in height. The species has been recorded in Benin, Angola, Botswana, Cameroon, Burkina Faso, Central African Republic, Guinea, Chad, Ivory Coast, Liberia, Kenya, Mali, Namibia, Mozambique, Nigeria, Niger, Senegal, South Africa, Sierra Leone, Swaziland, Togo, Tanzania, Zimbabwe and Zambia. The species has been recorded on forest margins, bushveld, along streams and occasionally forming impenetrable thickets in disturbed areas.

Acacia ataxacantha is recognized as an important medicinal plant species throughout its distributional range in tropical Africa. Acacia ataxacantha is regarded as one of the most important herbal medicines in Kenya and its pods and seeds are sold in informal markets in Nigeria as herbal medicines. In South Africa in the Limpopo province, A. ataxacantha is a major constituent of traditional herbal mixture or concoction known as “dzovheyo” [4]. In Namibia, A. ataxacantha is popular as traditional medicine against acquired immunodeficiency syndrome (AIDS) and human immunodeficiency virus (HIV) opportunistic infections [5]. It is against this background that ethnomedicinal and phytochemical review of the species was carried out aimed at understanding its medicinal value and importance in tropical Africa.

METHODS

Information on the medicinal uses, phytochemistry and pharmacological activities of A. ataxacantha was collected from several sources including books, book chapters, theses, scientific reports and journal articles obtained from internet sources such as SciFinder, Web of Science, Pubmed, BMC, Elsevier, Science Direct, Scielo and Scopus. The search for this information was carried out between February to December 2017. The keywords used in the search included “ethnobotany”, “ethnomedicinal uses”, “medicinal uses”, “phytochemistry”, “biological activities”, “pharmacological properties”, “Acacia ataxacantha”, “Senegalia ataxacantha”, the synonym of the species “Acacia eriadenia” Benth.” and “Acacia lugardiae N. E. Br”, and the English common names “flame acacia” and “flame thorn”. The internet search generated 674 articles in total. After duplicate articles and those with limited raw data were excluded, 33 articles were included in this study.

These articles included 27 journal articles, books (two), one book chapter, scientific report, thesis and website (one each).

RESULTS AND DISCUSSION

Medicinal uses of A. ataxacantha

A total of 33 medicinal reports of A. ataxacantha have been reported in literature with a high degree of consensus for abscesses, backache, cough, dental caries and toothache, headache, malaria, pneumonia, sores and wounds, and stomach problems (Table 1). Acacia ataxacantha is reported to be herbal medicine for these diseases in at least two countries (Table 1). In Benin and Swaziland, leaves and bark of A. ataxacantha is used against abscesses [6,7] while roots and young leaves are used for backache in Kenya and Nigeria [2,8]. In Chad, Kenya and Nigeria, bark, leaves and roots of A. ataxacantha are used as cough remedies [9-11] while bark, flowers, leaves and roots are used for dental caries, dentition and tooth decay in Chad, Benin and Nigeria [1-12].

In Namibia and Nigeria, bark, leaves and roots of A. ataxacantha are used as headache remedies [10,13] while flowers, leaves and roots are used against malaria in Benin and Burkina Faso [12,14]. Bark, leaves and roots of A. ataxacantha are used as remedies for pneumonia in Kenya and Namibia [2,5,9,13] while flowers, leaves, roots, pods and seeds are used against stomach problems in Benin and Nigeria [3,12]. Bark, leaves and roots of A. ataxacantha are used for burns, sores and wounds in Chad and Nigeria [10,11]. Information on other ethnomedicinal applications of A. ataxacantha is provided in Table 1.

Phytochemical constituents and nutritional composition of Acacia ataxacantha

Phytochemical screening of bark and root chloroform, dichloromethane, ethanol, ethyl acetate, glycosides, hexane, hydroalcoholic, petroleum ether and methanol extracts of A. ataxacantha showed the presence of anthracene derivatives, alkaloid, carbohydrates, coumarins, flavonoids, lignan, naphthoquinone, polyphenols, reducing sugars, saponins, steroids, tannins, terpenoids and triterpenoids [23-28].

Amoussa et al [24,29] isolated betulinic acid-3-trans-caffeate 1, betulinic acid 2 and lupeol 3, while Amoussa et al [30] isolated 7-hydroxy-2-methyl-6-[β-galactopyranosyl-propyl]-4H-chromen-4-one 4 from the stem bark extract of A. ataxacantha. Aba et al [26] isolated 3-amyrenol
(3β)-Urs-12-en-3-ol 5 from root bark extracts of *A. ataxacantha*. The compounds 1,2,3 and 4 demonstrated antioxidant properties [29,30] while compounds 3,4 and 5 demonstrated antibacterial and antifungal properties [26,29,30].

The nutritional composition of *A. ataxacantha* leaves is shown in Table 2. Results from literature search focusing on the FAO or WHO dietary reference intake (DRI), recommended dietary allowance (RDA) and tolerable upper levels (UL) of the chemical elements identified from *A. ataxacantha* leaves is shown in Table 2. Some major elements such as Ca, Fe, K, Mg, Mn, P, Na and Zn as determined by Daden *et al* [31] are within the permissible values defined by the FAO/WHO dietary limits.

**Table 1:** Ethnomedicinal uses of *Acacia ataxacantha*

| Use                      | Plant parts used | Country practised | References |
|--------------------------|------------------|-------------------|------------|
| Abdominal pain           | Roots            | Zimbabwe          | [15]       |
| Abscesses                | Bark, leaves     | Benin, Swaziland  | [6,7]      |
| Aphrodisiac              | Root bark        | South Africa      | [4]        |
| Backache, back pain      | Roots, young leaves | Kenya, Nigeria  | [2,8]      |
| Bleeding                 | Leaves           | Namibia           | [13]       |
| Breathing problems       | Leaves           | Chad              | [11]       |
| Chest pains              | Roots            | Namibia           | [16]       |
| Chicken pox              | Stem bark sap    | Nigeria           | [17]       |
| Constipation             | Roots            | Zimbabwe          | [18]       |
| Convolutions             | Leaves           | Benin             | [6]        |
| Cough                    | Bark, leaves, roots | Chad, Kenya, Nigeria | [9-11]  |
| Dental caries, dentition, tooth decay | Bark, flowers, leaves, roots | Benin, Chad, Nigeria | [10-12] |
| Dysentery                | Pods, seeds, young leaves | Nigeria | [3,8] |
| Epilepsy                 | Bark, roots      | Burkina Faso      | [18]       |
| Eye problems             | Leaves           | Nigeria           | [19]       |
| Gastric ulcer            | Leaves           | Senegal           | [20]       |
| Gonorrhoea               | Roots            | Kenya             | [2]        |
| Gout                     | Roots            | Kenya             | [2]        |
| Headache                 | Bark, leaves, roots | Namibia, Nigeria | [10,13]    |
| Joint-ache               | Roots            | Kenya             | [2]        |
| Intestinal worms         | Roots            | Chad              | [11]       |
| Malaria                  | Flowers, leaves, roots | Benin, Burkina Faso | [12,14]   |
| Pneumonia                | Bark, leaves, roots | Kenya, Namibia   | [2,5,9,13] |
| Sickle cell disorder     | Leaves, roots    | Nigeria           | [21]       |
| Stomachache, stomach problems | Flowers, leaves, pods, roots, seeds | Benin, Nigeria | [3,12] |
| Burns, sores, wounds     | Bark, leaves, roots | Chad, Nigeria     | [10,11]    |
| Yellow fever             | Leaves           | Nigeria           | [10]       |
| Ethnoveterinary medicine | Leaves           | Nigeria           | [22]       |

**Table 2:** Nutritional composition of *A. ataxacantha* leaves [31]

| Caloric and nutritional composition | Value | Dietary reference intake (DRI) (mg/day) |
|-------------------------------------|-------|----------------------------------------|
|                                     |       | Recommended dietary allowance (RDA)  | Tolerable upper intake level (UL) |
|                                     |       |                              |                                  |
| Ash                                 | 4.0 % ± 0.16 |                                  |                                  |
| Calcium                             | 0.03 mg/100 g | 1000 – 1300                  | 2500                            |
| Crude fat                           | 13.2 % ± 0.8  | 300                         |                                  |
| Crude fiber                         | 39.8 % ± 0.8  | 25 - 38                     |                                  |
| Crude protein                       | 6.6 % ± 0.5   | 0.7                         | 2.0                             |
| Iron                                | 0.02 mg/100 g | 8.0 – 15.0                 | 45.0                            |
| Lignin                              | 1.0 % ± 0.1   |                            |                                  |
| Magnesium                           | 0.3 mg/100 g  | 310 – 320                   | 350                             |
| Manganese                           | 0.03 mg/100 g | 1.6 – 3.0                  | 9.0                             |
| Moisture                            | 6.57 % ± 0.02 | 0.7                        |                                  |
| Nitrogen                            | 1.1 % ± 0.1   |                            |                                  |
| Phosphorus                          | 2.9 mg/100 g  | 1250                       | 4000                            |
| Potassium                           | 0.02 mg/100 g | 4700                      |                                  |
| Sodium                              | 0.01 mg/100 g | 2300                    | 2300                            |
| Total carbohydrate                 | 51.8 % ± 0.4  | 130                        |                                  |
| Zinc                                | 0.03 mg/100 g | 8.0 – 11.0                | 34.0                            |
Pharmacological activities

A wide range of pharmacological activities of A. ataxacantha bark, leaf and root extracts have been reported including antibacterial [24,26,29,30], antifungal [24,26,29,30], anti-diabetic [23,28], anti-inflammatory [27], antioxidant [25,29,30], laxative [32] and ulcero-protective [20] activities.

Antibacterial activities

Amoussa et al [24] evaluated antibacterial activities of dichloromethane, ethyl acetate, hexane, hydroalcoholic and methanol bark extracts of A. ataxacantha against Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus epidermidis and Staphylococcus aureus using the broth microdilution method. The extracts exhibited some activities against these pathogens with minimum inhibitory concentrations (MIC) values ranging from 0.3 mg/ml to 5 mg/ml [24].

Similarly, Aba et al [26] evaluated antibacterial activities of chloroform, ethyl acetate, methanol, petroleum ether root bark extracts of A. ataxacantha and α-amyrenol (3β)-Urs-12-en-3-ol 5 isolated from the species against Bacillus subtilis, Corynebacterium ulcerans, Escherichia coli, Proteus mirabilis, Klebsiella pneumoniae, Salmonella enteritidis, Salmonella typhi, Staphylococcus aureus, Streptococcus faecalis, Streptococcus pneumonia, Pseudomonas aeruginosa and Streptococcus pyogenes using well diffusion method with sparafloxacin as positive control.

The extracts showed no activity against Corynebacterium ulcerans, Proteus mirabilis and Streptococcus faecalis but extracts and compound 5 showed some activity against the other pathogens with the zone of inhibition ranging from 17 mm to 30 mm for crude extracts, 25 mm to 31 mm for α-amyrenol (3β)-Urs-12-en-3-ol 5, which compared favourably with 35 to 42 mm exhibited by sparafloxacin, the positive control. The MIC values ranged from 2.5 to 10 mg/mL, minimum bactericidal concentration (MBC) values ranged from 2 to 20 mg/mL, while MIC and MBC values of α-amyrenol (3β)-Urs-12-en-3-ol 5 were 12.5 to 25 mg/mL and 25 to 50 mg/mL, respectively [26].

Amoussa et al [29] evaluated antibacterial activities of betulinic acid-3-trans-caffeate 1 isolated from the bark extracts of A. ataxacantha against Pseudomonas aeruginosa, Enterococcus faecalis, Staphylococcus aureus and Staphylococcus epidermidis using the microdilution method and disc diffusion assay with dimethyl sulfoxide (DMSO) and gentamicin as negative and positive controls, respectively. The compound 1 exhibited some activities with MIC values ranging from 12.5 µg/mL to 50 µg/mL compared to 0.4 to 0.8 µg/mL exhibited against the control. The MBC values ranged from 25 to 50 µg/mL compared to 0.8 to 1.6 µg/mL exhibited against the control [29]. Amoussa et al [30] evaluated antibacterial activities of 7-hydroxy-2-methyl-6-[β-galactopyranosyl-propyl]-4H-chromen-4-one 4 isolated from the ethyl acetate bark extract of A. ataxacantha against Enterococcus faecalis, Pseudomonas aeruginosa, Staphylococcus aureus and Staphylococcus epidermidis with DMSO and gentamicin as negative and positive controls, respectively. The compound 5 exhibited some activities with MIC values ranging from 25 to 50 µg/mL compared to 0.4 to 0.8 µg/mL exhibited against the control.

The MBC values ranged from 25 to 50 µg/mL compared to 0.8 to 1.6 µg/mL exhibited against the control [30]. These results support the traditional medicinal uses of the species against infectious diseases such as dental caries, dentition and tooth decay in Benin, Chad and Nigeria [10-12], dysentery in Nigeria [3,8], gonorrhoea in Kenya [2], stomach ache and stomach problems in Benin and Nigeria [3,12], burns, sores and wounds in Chad and Nigeria [10,11].

Antifungal activities

Aba et al [26] evaluated antifungal activities of chloroform, methanol, ethyl acetate and petroleum ether root bark extracts of A. ataxacantha and α-amyrenol (3β)-Urs-12-en-3-ol 5 isolated from the species against Candida albicans, Candida tropicalis and Candida krusei using well diffusion method with cefuroxime as the positive control. The extracts showed no activity against Candida tropicalis but exhibited activities against other pathogens with the zone of inhibition ranging from 18 mm to 23 mm for crude extracts, 24 mm to 31 mm for α-amyrenol (3β)-Urs-12-en-3-ol 5 and 32 mm to 37 mm for cefuroxime, the positive control. The MIC values ranged from 5 to 10 mg/mL, minimum fungal concentration (MFC) values ranged from 10 to 20 mg/mL, while MIC and MFC values of α-amyrenol (3β)-Urs-12-en-3-ol 5 were 25 and 50 mg/mL, respectively [26].

Similarly, Amoussa et al [30] evaluated antifungal activities of dichloromethane, ethyl acetate, hexane, methanol, and mixture of water and ethanol bark extracts of A. ataxacantha against...
Aspergillus clavatus, Aspergillus fumigatus, Aspergillus flavus, Aspergillus nidulans, Aspergillus parasiticus and Aspergillus ochraceus using agar diffusion method and counting the number of fungal spores. The extracts inhibited sporulation of fungi and mycelial growth with percentages of inhibition ranging from 33.8 to 99.7 % and 5.4 to 53.0 %, respectively [30].

In another experiment, Amoussa et al [29] evaluated antifungal activities of betulinic acid-3-trans-caffeate 1 isolated from the bark extracts of A. ataxacantha against Candida albicans using the microdilution method and disc diffusion assay with DMSO and fluconazole as negative and positive controls, respectively. The compound 3 exhibited some activities with MIC value of 12.5 µg/mL compared to 0.8 µg/mL exhibited against the control, and MFC value of 25 µg/mL compared to 1.6 µg/mL exhibited against the control [29]. Amoussa et al [30] evaluated antifungal activities of 7-hydroxy-2-methyl-6-[β-galactopranosyl-propyl]-4H-chromen-4-one 4 isolated from ethyl acetate extract of A. ataxacantha against Candida albicans with DMSO and fluconazole as negative and positive controls, respectively. The compound 4 exhibited some activities with MIC value of 25 µg/mL when compared to 0.8 µg/mL exhibited against the control and MFC value of 25 µg/mL compared to 1.6 µg/mL exhibited against the control [30]. These findings corroborate the traditional medicinal uses of the species against fungal infections such as dental caries, dentition and tooth decay in Benin, Chad and Nigeria [11,12,22], stomachache and stomach problems in Benin and Nigeria [3,12], burns, sores and wounds in Chad and Nigeria [10,11].

Anti-diabetic activities

Arise et al [23] evaluated anti-diabetic activities of ethanolic bark extract of A. ataxacantha in streptozotocin-induced diabetic Albino rats (Rattus norvegicus) with the standard anti-diabetic drug, metformin used as control. The extract, at 125 mg/kg body weight, exhibited promising anti-diabetic activities in streptozotocin-induced diabetic rats [23]. In another experiment, Arise et al [2016] evaluated anti-diabetic activities of ethanolic extract of A. ataxacantha roots in streptozotocin-induced diabetic rats. Blood glucose was significantly reduced after 7 days of oral administration of the plant extract at 125 mg/kg body weight with a value of 110.0 ± 9.6 mg/dl which was comparable to that of the control with value of 106.3 ± 4.13 mg/dl. There was an increase in the alanine aminotransferase and aspartate aminotransferase activities of the liver and serum of rats, triglyceride and the serum total cholesterol were decreased upon administration of the plant extract and metformin. These results revealed that the ethanolic extract of A. ataxacantha root reduced blood glucose in streptozotocin-induced hyperglycemic rats to levels comparable to the reference clinical drug metformin after 7 days [28]. Therefore, these findings imply that A. ataxacantha may be considered as an alternative source in the search for new leads of anti-diabetic agents.

Anti-inflammatory activities

Abbas et al [27] evaluated the anti-inflammatory activities of methanol leaf extracts of A. ataxacantha in rats using the carrageenan and albumin induced paw edema. The extract showed significant anti-inflammatory activity which was demonstrated by swelling of the hind-paw oedema which occurred progressively from time 0 - 2 h after carrageenan injection, but at the 3rd hour oedema reduction occurred in a dose dependent manner and was significant only in rats pre-treated with extract at doses 200 and 400 mg/kg body weight. However, at the 4th hour there was significant difference in the swelling of oedema at 100, 200 and 400 mg/kg when compared with the normal saline, the negative control [27]. Similarly, there was significant inhibition of inflammation at the 20th, 40th, 60th and 120th min post extract administration in albumin induced hind-paw inflammation [27].

These results apparently justify the traditional application of A. ataxacantha against inflammatory infections and damage such as abdominal pain in Zimbabwe [15], abscesses in Benin and Swaziland [6,7], backache in Kenya and Nigeria [2,8], chest pain in Namibia [16], dental caries, dentition and tooth decay in Benin, Chad and Nigeria [10-12], joint-ache in Kenya [2], burns, sores and wounds in Chad and Nigeria [10,11].

Antioxidant activities

Amoussa et al [25] evaluated antioxidant activities of dichloromethane, ethyl acetate, n-hexane, hydroalcoholic and methanol bark extracts of A. ataxacantha using the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging and ferric reducing antioxidant power (FRAP) assays. The DPPH radical scavenging activities of extracts exhibited antioxidant activities ranging from 0.7 to 92.6 % while the
FRAP of the extracts varied from 120.3 to 1273.6 μmol AAE g⁻¹.

The strongest ferric reducing ability was found in ethyl acetate extract with value of 1273.6 μmol AAE g⁻¹, followed by methanol (849.1 μmol AAE g⁻¹), hydroalcoholic (816.7 μmol AAE g⁻¹), dichloromethane (489.4 μmol AAE g⁻¹) and n-hexane (120.3 μmol AAE g⁻¹) [25]. Similarly, Amoussa et al [29] evaluated antioxidant activities of betulinic acid-3-trans-caffeate 1, betulinic acid 2 and lupeol 3 compounds isolated from the bark extracts of A. ataxacantha using DPPH assay with quercetin as the standard reference. The compound, betulinic acid-3-trans-caffeate 3 demonstrated significant antioxidant activities with half maximal inhibitory concentration (IC₅₀) of 3.6 μg/mL compared to value of 1.0 μg/mL exhibited against the control. The compound, lupeol 1 showed moderate activity with an IC₅₀ value of 16.8 μg/mL while betulinic acid 2 had weak DPPH scavenging activity with an IC₅₀ value of 25.2 μg/mL [29].

In another experiment, Amoussa et al [30] evaluated antioxidant activities of 7-hydroxy-2-methyl-6-[β-galactopyranosyl-propyl]-4H-chromen-4-one 4 isolated from the ethyl acetate bark extract of A. ataxacantha using DPPH radical assay with quercetin as the standard reference. The compound 4 demonstrated antioxidant activities with IC₅₀ value of 3.6 ± 0.1 μg/mL compared to quercetin with IC₅₀ value of 1.0 ± 0.01 μg/mL [30]. The documented antioxidant activities of the bark extracts of A. ataxacantha are as a result of flavonoids and phenolics which have been isolated from the species [23-28].

**Laxative activities**

Akapa et al [32] evaluated the laxative activities of aqueous extract of A. ataxacantha leaves against loperamide induced constipated rats. Constipated control rats received normal saline while the treatment constipated rats were given 100, 200 and 400 mg/kg body weight per day of the extract for ten days with senokot used as a standard reference drug. The feacal properties, water intake, feeding characteristics, laxative activity and gastrointestinal transit ratio were assessed. The extract produced significant laxative activities and reduced loperamide induced constipation in dose dependent manner as seen in the elevated feacal properties compared to the normal control rats. The 400 mg/kg body weight of the extract showed the best efficacy and the effect of the extract compared favourably with senokot, a standard laxative drug [32]. These findings corroborate the traditional use of A. ataxacantha leaves as traditional medicine for constipation in Zimbabwe [15].

**Ulcero-protective activities**

Akapa et al [20] evaluated the ulcero-protective activities of methanolic leaf extract of A. ataxacantha against indomethacin and stress induced gastric ulcer in experimental rats. The leaf extracts at the dose of 100 and 200 mg/kg body weights were administered to male albino rats 30 minutes before the administration of indomethacin and subjected to stress. Ranitidine was used as a standard antiulcer drug and rats were then sacrificed and various gastric parameters such as gastric pH levels, gastric ulcer indices and gastric ulcer percentage inhibition were assessed.

Animals pretreated with A. ataxacantha extracts (100 and 200 mg/kg body weight) showed significant reduction in ulcer index to indomethacin and stress induced ulcer models in a dose dependent manner when compared to the negative control group. Authors recorded significant decrease in the gastric pH levels of both ulcer models which were normalized by A. ataxacantha extracts and various percentages of gastric ulcers inhibition were statistically significant in groups pretreated with A. ataxacantha extracts and the overall effect of the extract was comparable to that of the standard drug, ranitidine used in this study [20]. Therefore, these findings corroborate the traditional uses of leaves of A. ataxacantha as herbal medicine against gastric ulcers in Senegal [20].

**Safety**

Preliminary safety evaluation of A. ataxacantha extracts seem to suggest the plant extracts to be atoxic. Amoussa et al [33] evaluated the oral acute toxicity of the crude hydroethanolic bark extract of A. ataxacantha on rats using a single dose of 2000 mg/kg given to three female rats with distilled water (10 ml/kg body weight) given to three female rats as a control. All tested animals were physically active and no deaths were reported. No significant changes were observed in haematological parameters, biochemical parameters and body weight of treated animals compared with the controls. The histopathological analysis of kidney and liver showed normal architecture suggesting no morphological disturbances [33]. Therefore, these results suggest that the hydroalcoholic bark extract of A. ataxacantha is non-toxic up to 2000 mg/kg body weight.
Abbas et al [27] evaluated acute toxicity of methanol leaf extract of A. ataxacantha in rats with extracts at doses of 10, 100, 1000, 1600, 2900 and 5000 mg/kg body weight and the rats were monitored for 24 h for signs of toxicity and mortality. The oral median lethal dose (LD_{50}) of the extract was found to be greater than 5000 mg/kg body weight [27], therefore, the extract is practically non-toxic when administered orally.

CONCLUSION

A. ataxacantha is used as herbal medicine in at least two countries against abscesses, backache, cough, dental caries and toothache, headache, malaria, pneumonia, sores and wounds, and stomach problems. The observed high degree of consensus for these diseases calls for detailed in vitro and in vivo studies to corroborate traditional medicinal applications of A. ataxacantha against these diseases. Some of the ethnomedical uses of A. ataxacantha have been confirmed by the species’ pharmacological properties and these include antibacterial, antifungal, anti-diabetic, anti-inflammatory, antioxidant, laxative and ulcero-protective. Therefore, the pharmacological and phytochemical activities of A. ataxacantha provide credence to the traditional medicinal applications of the species against various diseases, and hence the need for detailed in vitro and in vivo studies.

DECLARATIONS

Acknowledgement

Financial support of this work by the National Research Foundation (NRF) and Govan Mbeki Research and Development Centre (GMRDC), University of Fort Hare is gratefully acknowledged.

Conflict of Interest

No conflict of interest is associated with this work.

Contribution of Authors

The author declares that this work was done by the author named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by him.

REFERENCES

1. Kyalangallwa B, Boatwright JS, Daru BH, Maurin O, van der M. Phylogenetic position and revised classification of Acacia s.l. (Fabaceae: Mimosoideae) in Africa, including new combinations in Vachellia and Senegalia. Bot J Lin Soc 2013; 172(4): 500-523.
2. Karuru PG, Kenji GM, Gachanja AN, Kerkio JM, Mungai G. Traditional medicines among the Embu and Mbeere peoples of Kenya. Afr J Trad Compl Altern Med 2007; 4(1): 75-86.
3. Idu M, Erhabor JO, Efijuemue HM. 2010. Documentation on medicinal plants sold in markets in Abeokuta, Nigeria. Trop J Pharm Res 2010; 9(2): 110-118.
4. Mabogo DEN. The ethnobotany of the Vhavenda. MSc dissertation, University of Pretoria, Pretoria; 1990; p 260.
5. Hedimi M, Chinsembu KC. Ethnomedicinal study of plants used to manage HIV/AIDS-related disease conditions in the Ongwena region, Namibia. Int J Med Pl Res 2012; 1(1): 4-11.
6. Adjanohoun EJ, Adjakidjé V, Ahyi MRA, Aké AL, Akoégninou A, d’Almeida J, Apovo F, Boukef F, Chadare M, Cusset G et al. Contribution aux études ethnobotaniques et floristiques en République Populaire du Bénin. Agence de Coopération Culturelle et Technique, Paris; 1989; p 852.
7. Long C. Swaziland’s flora: sSwati names and uses. Swaziland National Trust Commission, Mbambane; 2005. Available on: http://www.sntc.org.sz/index.asp, retrieved on 4 September 2017.
8. Olowokudejo JD, Kadiri AB, Travih VA. An ethnobotanical survey of herbal markets and medicinal plants in Lagos State of Nigeria. Ethnobot Leaflets 2008; 12: 851-65.
9. Kaigongi M, Musila F. Ethnobotanical study of medicinal plants used by Tharaka people of Kenya. Int J Ethnobiol Ethnomed 2015; 1(1): 1-8.
10. Singh D. Study on traditional medicinal flora of Argungu local government areas, Kebbi State, Nigeria, West Africa. Int J Modern Pl Animal Sci 2015; 5(1): 16-32.
11. Delphine DN, Marie MP, Mahamat A, Valerie NN. Ethnological studies on melliferous plants of the Soudano-Sahelian zone of Chad. J Med Pl Stud 2017; 5(3): 193-198.
12. Yaoitcha AS, Houehanou TD, Fandohan AB, Houinato MRB. Prioritization of useful medicinal tree species for conservation in Wari-Maro forest reserve in Benin: A multivariate analysis approach. For Pol Econ 2015; 61: 135-146.
13. Cheikhrouessef A, Shapi M, Matengu K, Ashkele HM. Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia. J Ethnobiol Ethnomed 2011; 7: 10.
14. Bonkian LN, Yerbanga RS, Coulibaly MT, Leferve T, Sangaré I, Ouédraogo T, Traoré O, Ouédraogo JB, Guiquemdé TR. Plants against malaria and mosquitoes in Sahel region of Burkina Faso: An ethnobotanical survey. Int J Herbal Med 2017; 5(3): 82-87.
15. Gefand M, Mavi S, Drummond RB, Ndemera B. The traditional medical practitioner in Zimbabwe: His principles of practice and pharmacopoeia. Mambo Press, Gweru; 1985; p 411.
16. von Koenen E. Medicinal, poisonous and edible plants in Namibia. Klaus Hess Publishers, Windhoek; 2001; p 335.
17. Oladumoye MK, Kehinde FY. Ethnobotanical survey of medicinal plants used in treating viral infections among Yoruba tribe of South Western Nigeria. Afr J Microbiol Res 2011; 5(19): 2991-3004.
18. Kinda PT, Zerbo P, Guenné S, Compaoré M, Ciobica A, Kiendrebeogo M. Medicinal plants used for neuropsychiatric disorders treatment in the Hauts Bassins region of Burkina Faso. Medicines 2017; 4, 32.
19. Erhenhi AH, Obadoni BO. Known medicinal and aphrodisiac plants of Urhonigbe forest reserve, Edo State, Nigeria. J Med Pl Stud 2015; 3(4): 101-106.
20. Akapa TC, Arise RO, Olajide OJ, Ikusemoro IT. Ulcer-protective potentials of methanolic extract of Acacia ataxacantha leaves in indomethacin and stress induced gastric ulcer models. Int J Biochem Res Rev 2014; 4(4): 312-321.
21. Amujoyegbe OO, Idu M, Agbedahunsi JM, Erhabor JO. Ethnomedicinal survey of medicinal plants used in the management of sickle cell disorder in southern Nigeria. J Ethnopharmacol 2016; 185: 347-360.
22. Salihu T, Ameen SA, Mbaogo CO, Anoruo-Dibia CA, Arowolo ROA. Management of bovine trypanosomiasis with medicinal plants in Taraba State, Nigeria. Int J Health Med Inf 2014; 3(1): 24-33.
23. Arise RO, Ganiyu AI, Oguntibeju OO. Lipid profile, antidiabetic and antioxidant activity of Acacia ataxacantha bark extract in streptozotocin-induced diabetic rats. In: OO Oguntibeju (Ed.), Antioxidant-antidiabetic agents and human health, InTech; 2014. Available on: https://www.intechopen.com/books/antioxidant-antidiabetic-agents-and-human-health/lipid-profile-antidiabetic-and-antioxidant-activity-of-acacia-ataxacantha-bark-extract-in-streptozotocin-retrieved-on-23 November 2017.
24. Amoussa AMO, Lagnika L, Sanni A. Acacia ataxacantha (bark): chemical composition and antibacterial activity of the extracts. Int J Pharm Pharm Sci 2014; 6(11): 138-141.
25. Amoussa AMO, Sanni A, Lagnika L. Antioxidant activity and total phenolic, flavonoid and flavonol contents of the bark extracts of Acacia ataxacantha. J Pharmaco Phytochem 2015; 4(2): 172-179.
26. Aba OY, Ezuruike JT, Ayo RG, Habila JD, Ndukwe GI. Isolation, antibacterial and antifungal evaluation of α-amyrinol from the root extract of Acacia ataxacantha DC. Sch Acad J Pharm 2015; 4(2): 124-131.
27. Abbas MY, Ejiofor JI, Yaro AH, Yakubu MI, Anuka JA. Anti-inflammatory and antipyretic activities of the methanol leaf extract of Acacia ataxacantha (Leguminosae) in mice and rats. Bayero J Pure Appl Sci 2017; 10(1): 1-5.
28. Arise RO, Akapa T, Adigun MA, Yekeen AA, Oguntibeju OO. Normoglycaemic, normolipidaemic and antioxidant effects of ethanolic extract of Acacia ataxacantha root in streptozotocin - induced diabetic rats. Not Sci Biol 2016; 8(2):144-150.
29. Amoussa AMO, Lagnika L, Bourjot M, Vontron-Sénécheau C, Sanni A. Triterpenoids from Acacia ataxacantha DC: antimicrobial and antioxidant activities. BMC Compl Altern Med 2016; 16: 284.
30. Amoussa AMO, Bourjot M, Lagnika L, Vontron-Sénécheau C, Sanni A. Acthaside: a new chromone derivative from Acacia ataxacantha and its biological activities. BMC Compl Altern Med 2016; 16: 506.
31. Daben JM, Dashak DA, Praise O, Ogbole E, Agba MA. Assessment of the proximate and mineral compositions of Acacia ataxacantha leaves. Int J Sci Res 2015; 6(5): 899-903.
32. Akapa TC, Obidola SM, Philip FO. Loperamide induced constipated wister rats: laxative role of aqueous extract of Acacia ataxacantha leaves. World J Pharm Pharmaceut Sci 2014; 3(12): 189-199.
33. Amoussa AMO, Lagnika L, Tchatchedre M, Laleyé A, Sanni A. Acute Toxicity and Antifungal Effects of Acacia ataxacantha (Bark). Int J Pharmaco Phytochem Res 2015; 7(4): 661-668.