Tropical Journal of Pharmaceutical Research November 2018; 17 (11): 2301-2308
ISSN: 1596-5996 (print); 1596-9827 (electronic)
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Available online at http://www.tjpr.org
http://dx.doi.org/10.4314/tjpr.v17i11.28

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

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plant. The common English name is "flame thorn", in reference to the deep red to purple-red pods which are held in conspicuous bunches on the shoots of the plant.

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 Zimbabwe. 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 [2] and its pods and seeds are sold in informal markets in Nigeria as herbal medicines [3]. 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 ethnopharmacological 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, naphtoquinone, 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 α-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	[15]
Convulsions	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	-	-
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 sparfloxacin 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 sparfloxacin, 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-galactopyranosyl-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 carragenaan 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 carragenaan 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 (IC_{50}) 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 IC_{50} value of 16.8 µg/mL while betulinic acid **2** had weak DPPH scavenging activity with an IC_{50} 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 IC_{50} value of 3.6 ± 0.1 µg/mL compared to quercetin with IC_{50} 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 histopatological 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.

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