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Review Article
Leptadenia hastata Pers. (Decne) a Promising Source for Natural Compounds in Biomedical Applications

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Abstract

Leptadenia hastata (Pers) Decne. of Apocynaceae family is an African plant which is used as nutriment as well as for medical purposes due to its health promoting properties. Traditional healers use *L. hastata* to treat many diseases as hypertension, sexual impotence, trypanosomosis, acute rhinopharyngitis. In quantitative and qualitative terms, the leaves of *L. hastata* contain significant quantities of secondary metabolites, as triterpenes, total flavonoids, tanins, which can be important in biomedical research. *In vivo* studies showed the antifertility effect of *L. hastata* leaves extracts which can be useful for hormonal therapy replacement. Herein, the ecology, traditional medicinal uses, phytochemistry, toxicity and pharmacology of *L. hastata* in consideration of its antifertility activity is reviewed. In view of its constituents such as steroidal glycosides, triterpenes and polyoxypregnane derivatives, further investigation on the effect of *L. hastata* on other hormonal endpoints like hormone dependent cancers appears promising.

Key words: Ethnomedicine, asclepiadaceae, leptadenia hastata, ecology, toxicology, natural compounds, biomedical research

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The interest of Africans in plants as source of potential remedies exists for thousands of years. Until now, more than 80% of the African population use single or combined plant extracts for their everyday health care needs. This is not only due to African poverty but also because of the richness of African plant species that have healing properties, known throughout the ages[1].

Leptadenia hastata (Pers.) Decne. (*L. hastata*) is a perennial liana species of the Apocynaceae family that includes the subfamily Asclepediaceae[2-4]. Asclepiadaceae plants are widely used in traditional medicine and have been reported to be rich in steroidal glycosides, cardenolides, flavonoids, triterpenes and polyoxypregnane derivatives[5-9].

Leptadenia hastata is an important emergent local food of Africa with the ability to grow under harsh environmental conditions[10]. Many studies have revealed the potential of *L. hastata* for different uses[11-13]. It is worth to be noticed that hormone-like activities of *L. hastata* have been reported in response to the administration of its extracts with regard to the weight of reproductive organs, spermatogenesis and testosterone levels[14,15]. However, despite its widespread distribution, traditional medicinal applications and rich chemical content, data on its phytochemistry and pharmacology have been only partially summarized so far[16,17]. Considering the wealth of *L. hastata* regarding steroidal compounds, the aim of this review is to assess phytochemical and pharmacological data available on *L. hastata* towards additional hormone-related conditions like hormone-dependent cancers and hormone deficiency syndromes.

NATURAL COMPOUNDS IN BIOMEDICAL APPLICATION

Botanical aspects: The genus *Leptadenia* R. Brown comprises 4 species: *L. arborea* (Forssk.) Schweinf., *L. madagascariensis* Decne., *L. hastata* (Pers.) Decne. and *L. pyrotechnica* (Forssk.) Decne. *L. arborea* is a slender liana of scrub vegetation, distributed from West Africa to Arabia in Sahelian areas[18]. It provides excellent forage for all livestock and is recognized to have medicinal properties[18,19]. *L. pyrotechnica* is an erect leafless shrub which grows on sand dunes and is widespread from Senegal to India. The latex and seeds of this shrub are of medicinal value and young shoots are used as vegetable[20]. *L. madagascariensis* is an endemic liana from Madagascar dry forests, where its mature leaves serve as fodder for lemurs and also used for medicine purposes[21,22].

Leptadenia hastata is a latex-containing herb at young stage and becomes woody liana when getting old, thereby developing a strongly branched climbing stem (Fig. 1a, b).

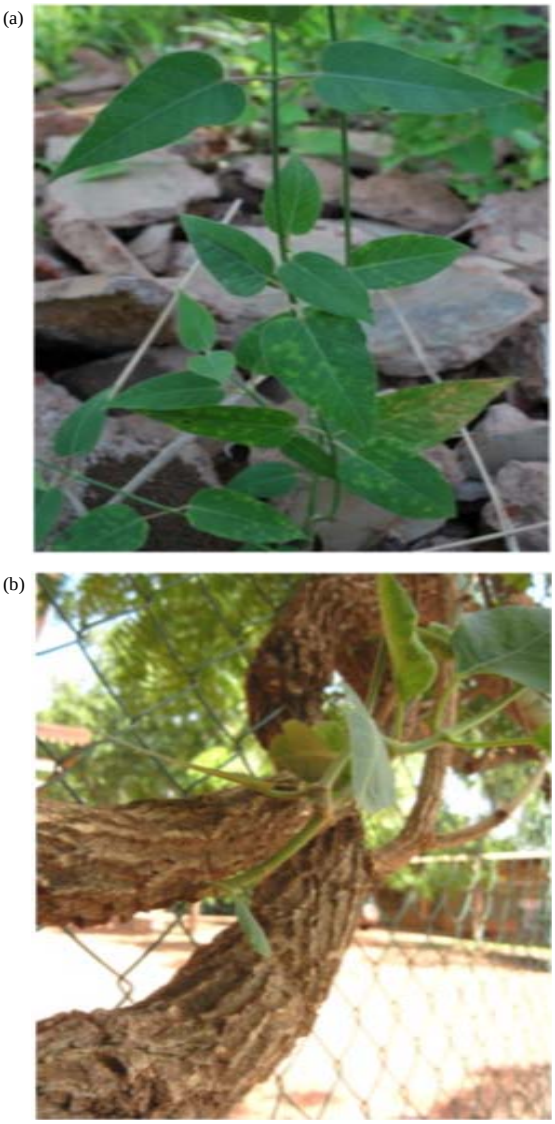


Fig. 1(a-b): *Leptadenia hastata* (a) Young stage and (b) Woody corky stems at adult stage (Photo BBale)

The finely pubescent branches get corky with age. The leaves of *L. hastata* are opposite and simple with petiole, variable limb shape, usually ovate, rounded or cordate at the base. The limb has an acuminate apex, an entire margin and both sides glabrous or finely pubescent. The inflorescences are umbellate with several flowers arranged on 1.5 cm long peduncle (Fig. 2). The Flowers are bisexual, regular 5-merous, yellowish and scented; corolla with 5 pubescent lobes. The fruit is a pair of follicles, each one is conical with a length up to 10 cm. The seeds carry a tuft of hairs at the apex[20].

Ecology Aspects: *Leptadenia hastata* is a common species in the sahelo-sudanian semi-arid area of West Africa. It grows on

Fig. 2: Inflorescences and flowers of *Leptadenia hastata* (Photo. Bbalé)

all types of soils and is a pioneer species of bare soil restoration in the Sahel[23-25]. *Leptadenia hastata* reproduces by seeds that are widely dispersed by wind. Occasionally, it is intentionally sown near houses so that it is available for human consumption. *Leptadenia hastata* is frequently parasitized by the aphid *Aphis nerii*, which is predated by the coccinellid *Cydonia vicinia*. This latter species has been used to biologically control *Aphis craccivora*, *Aphis gossypii* and *Melanaphis sacchari* which are known to cause transmission of rosette disease of groundnut and to attack sorghum and cotton.

Traditional medicinal uses: Various parts or constituents of *L. hastata* have been described for the application in traditional medicinal applications (Table 1). The latex is applied on wounds and put in the nose against headache. Decoctions and macerations of roots and leaves are applied both, alone or in combination with other plants against abdominal complaints such as constipation, urethral discharge, gonorrhoea, stomachache and diarrhoea[12]. An extract of boiled leaves and stem is drunk regularly to treat dyspepsia and hemorrhoids. Ethnobotanical information from traditional medical practitioners in northern Nigeria revealed that *L. hastata* aqueous extracts are used for the treatment of diabetes mellitus[26].

The plant is used in herbal medicine against milk drying, sexual impotence, trypanosomosis and acute rhinopharyngitis[27]. The leaves are often chewed by shepherds against polydipsia and mouth dryness[28]. To treat nausea[28] three soup spoons full of a decoction are taken which is prepared from two handfuls of fresh leaves and boiling in about 500 mL of water until the fluid is reduced to half.

In Mali, traditional healers treat onchocerciasis with *L. hastata* leaves decoction and *Erythrina senegalensis* bark[29]. The roots are taken against scabies in Chad and, in Nigeria, local healers use the whole plant against hypertension and skin diseases[30].

In veterinary medicine, *L. hastata* is used to treat horse's colic. In addition, antibacterial and antimicrobial effects of *L. hastata* have been reported[31]. Safety studies revealed no acute toxicity from *L. hastata* water extract suggesting that use of the plant is relatively safe[24].

Chemical component of *L. hastata*: *L. hastata* is characterized by significant quantities of a variety of essential nutrients[11-14] (Table 2), justifying its important role as nutriment. Fatty acids, vitamin E, carotenoids, selected minerals and amino acids have been also determined in the leaves of *L. hastata,* particularly rich in lutein and beta-carotene[32]. So far, it is distinguished by the presence of terpenoids and saponins since the phytochemical data are rather limited. There is only a small number of studies related to the isolation and identification of secondary metabolites from *L. hastata*.

Specifically, the separation, purification and structural elucidation of six new polyoxypregnane esters and three new glycosides was accomplished together with five known esters from the $CHCl_3$ extract of the bark of *L. hastata*[33] (Fig. 3). The bark of *L. hastata* plant is used as an anti-inflammatory and antitumor drug in Senegalese folk medicine[34].

Further investigations of the most polar extracts ($CHCl_3$/MeOH 9:1 and MeOH) have led to the isolation of 34 new related esterified aglycones and glycosides (Fig. 4). The structures of these compounds are based on the known polyoxypregnane skeleton of sarcostin or deacetyl metaplexigenin as well as acetyl, benzoyl, cinnamoyl, nicotinoyl and m-hy-droxybenzoyl ester moieties linked at C-12 and/or at C-20 of the aglycones. In addition, the glycosides that possess an oligosaccharide portion linked at C-3 to the aglycones consist of three to five

Table 1: Overview of traditional medicinal uses of *Leptadenia hastata*

Part of *Leptadenia hastata*	Disease treated or disease related activity	Preparation	References
Whole plant	Trypanosomosis	Decoction	Kerharo and Adam[23]
	Horses colic		Aliero and Wara[31]
	Diabetes mellitus		Olivier-Bover[28]
	Antibacterial		
	Antimicrobial		
Latex	Acute rhinopharyngitis	-	Nikiema *et al.*[13]
	Wounds		Kerharo and Adam[23]
	Injuries		Olivier-Bover[28]
	Headache		
	Anti-inflammatory		
Leaves	Polydipsia	Decoction	Arbonnier[20]
	Mouth dryness	Maceration	Betti *et al.*[30]
	Stomach upset in children		Kerharo and Adam[23]
	Antioxidant		Aquino *et al.*[35]
	Haemorrhoïds		Olivier-Bover[28]
	Anti-tumor		
Roots and leaves	Abdominal complaints	Decoction	Kerharo and Adam[23]
	Constipation	Maceration	Neuwinger[27]
	Urethral discharge		Aliero *et al.*[12]
	Gonorrhea		Olivier-Bover[28]
	Sex impotence		
	Stomachache		
	Diarrhea		
Aerial part	Malaria	Decoction	Arbonnier[20]
	Cancer		Betti *et al.*[30]

Table 2: Nutrient composition of *Leptadenia hastata*[10-13]

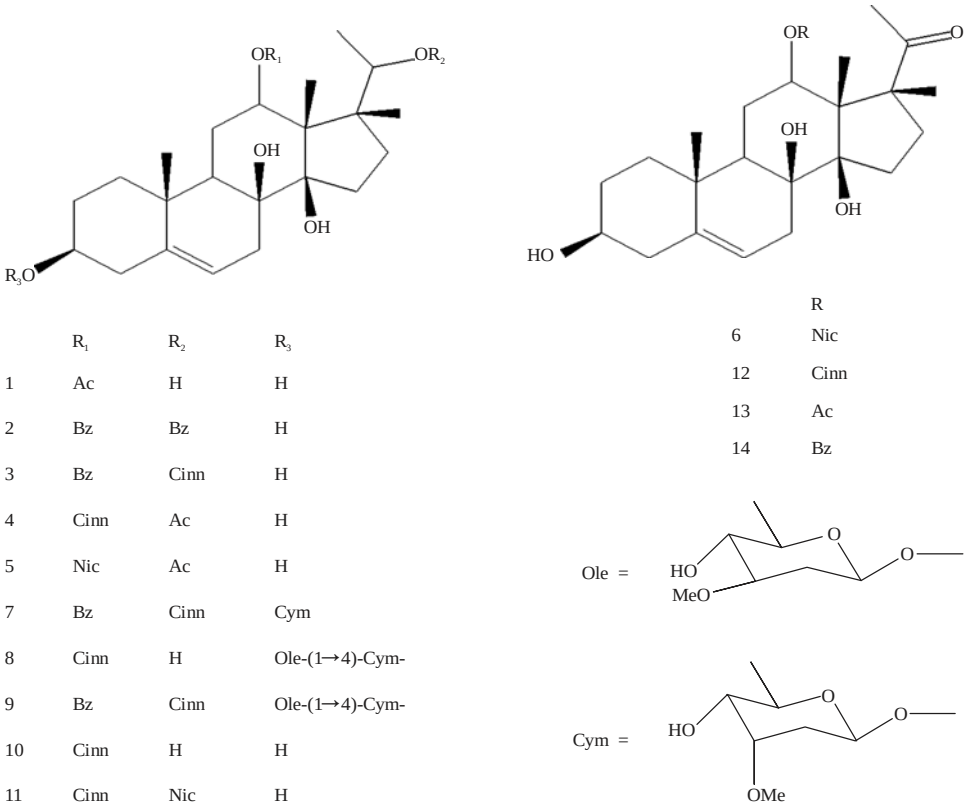
Mineral (μg g^{-1} dry weight)		Amino acid (mg g^{-1} dry weight)		Fatty acid (mg g^{-1} dry weight)		Carotenoid content (μg g^{-1} dry weight)	
Ca	21.4	Aspartate	8.41	C8:0	ND	Lutein	53.8
Cr	< 5.4	Glutamide	17.5	C10:0	ND	α-carotene	ND
Cu	9.50	Serine	5.64	C12:0	0.04	β-carotene	50.8
Fe	211	Glycine	6.58	C14:0	0.50	-	-
K	19.80	Histidine	3.18	C16:0	5.90	-	-
Mg	5660	Arginine	13.7	C16:1	0.31	-	-
Mn	81.9	Threonine	5.60	C18:0	0.30	-	-
Mo	7.10	Alanine	7.66	C18:1	0.70	-	-
Na	1100	Proline	9.21	C18:2	3.2	-	-
Ni	5.20	Tyrosine	6.59	C18:3	12.1	-	-
P	2.30	Valine	9.17	C20:0	0.11	-	-
Se	31.8	Methionine	1.98	C20:1	ND	-	-
Zn	<5.0	Isoleucine	6.69	Total fatty acid content (m g^{-1} dry weight)	23.2	-	-
-	-	Leucine	11.8	Total lipid content (mg g^{-1} dry weight)	138	-	-
-	-	Phenylalanine	7.81	-	-	-	-
-	-	Lysine	7.19	-	-	-	-
-	-	Cystéine	4.63	-	-	-	-
-	-	Tryptophan	6.24	-	-	-	-
-	-	Total protein	14.0	-	-	-	-

Ca: Calcium, Cr: Chromium, Cu: Copper, Fe: Iron, K: Potassium, Mg: Magnesium, Mn: Manganese, Mo: Molibdène, Na: Sodium, Ni: Nickel, P: Phosphor, Se: Selenium, Zn: Zinc

deoxyhexopyranoses and hexopyranoses, sugars well known to occur in Asclepiadaceae plants[35].

L. hastata is well known to be a good source of triterpenes. Triterpenes are a huge class of chemical compounds produced by arrangement of squalene epoxide in a chair-chair-chair-boat arrangement followed by condensation. As cholesterol does in animal cell membranes, free triterpenes can stabilize phospholipid bilayers in plant cell membranes. One triterpene which has gained wide attention of medical professionals, pharmaceutical marketers and researchers all around the world, is Lupeol (Fig. 5). Lupeol was isolated from the latex of *L. hastata* for tests on anti-inflammatory activities[13].

The evaluation of the phenolic compounds of *L. hastata* leaves indicated the presence phenolic glycosides, tannins, flavonoids, proanthocyanidins, alkaloids and saponins.



	R_1	R_2	R_3
1	Ac	H	H
2	Bz	Bz	H
3	Bz	Cinn	H
4	Cinn	Ac	H
5	Nic	Ac	H
7	Bz	Cinn	Cym
8	Cinn	H	Ole-(1→4)-Cym-
9	Bz	Cinn	Ole-(1→4)-Cym-
10	Cinn	H	H
11	Cinn	Nic	H

	R
6	Nic
12	Cinn
13	Ac
14	Bz

Fig. 3: Polyoxpregnane esters and new glycosides isolated from the bark of *L. hastata*

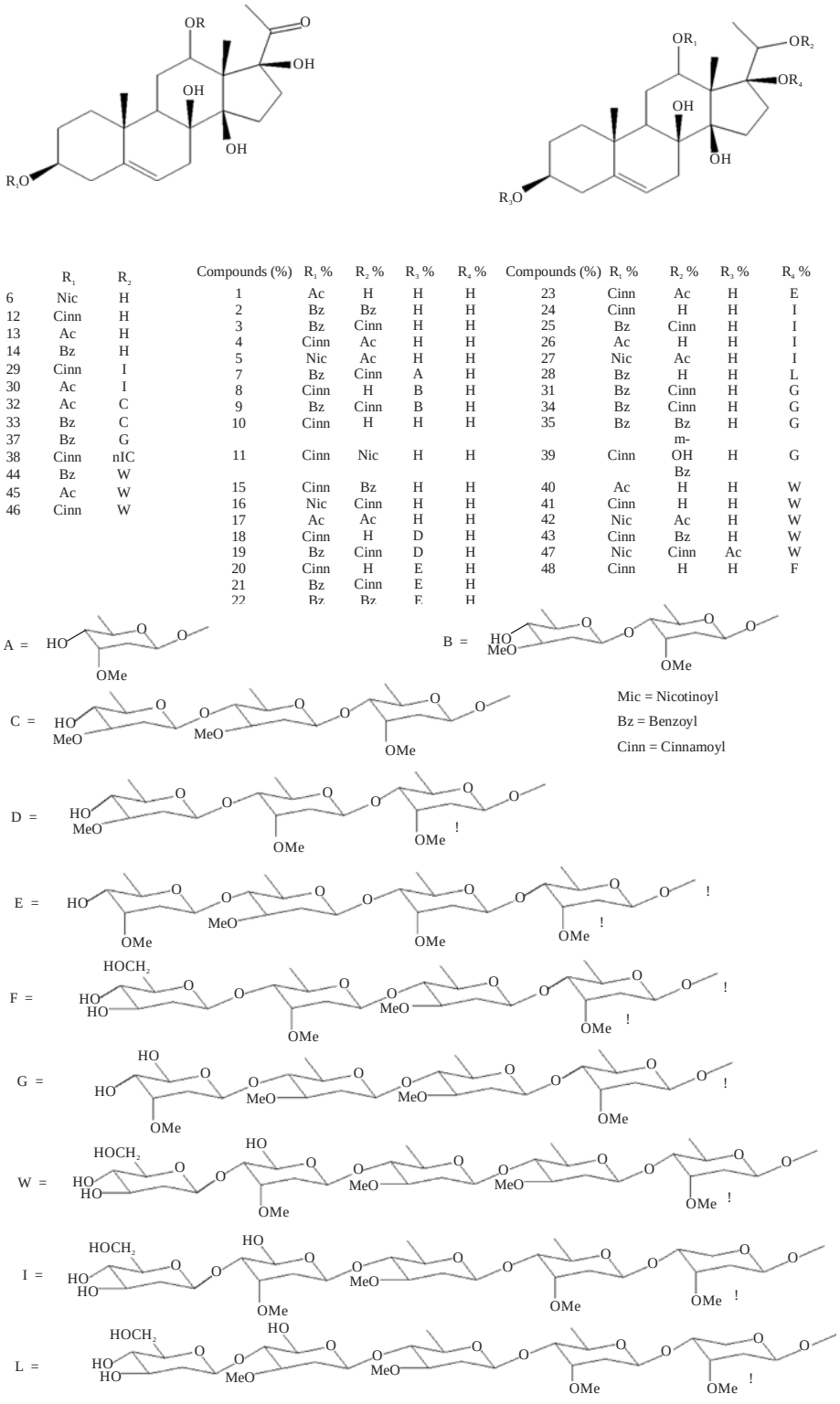
According to the extraction solvent, the amount of phenolics was more important and ranged in 17-38 mg g^{-1} compare to the amount of total flavonoids and proanthocyanidins which was in the ranges of 10-16 and 4-10 mg g^{-1} respectively[26].

Toxicology of *Leptadenia hastata*: Although, *L. hastata* is used as food, the acute toxicity of the aerial parts has been evaluated in male albino mice[24]. The orientation test showed that LD_{50} values varied between 1000 and 2000 mg kg^{-1}. The trial conducted on 6 groups of 6 mice each showed a LD_{50} value of 1512.879 mg kg^{-1} for *L. hastata* aqueous extract. Signs of intoxication observed were polypnea and asthenia. The ratios of LD_5/LD_{50} and LD_{50}/LD_{95} are similar and confirmed the validity of LD_{50} test values. The value 0.78 for the quotient LD_5/LD_{95} proves that *L. hastata* is very safe for use.

L. hastata leaves were shown to contain a trypsin inhibitor which is an anti-nutrient element. Before boiling the leaves, their content was 0.25 µg mg^{-1} and after boiling the leaves contained 0.18 µg mg^{-1} of the trypsin inhibitor. This trypsin inhibitor was 72% resistant to boiling. This caveat is based on the possible co-presence of protease inhibitors in the ingested *L. hastata* leaves, inhibitors that might reach the small intestine and block the activity of proteases, such as trypsin, that normally catalyze the hydrolysis of dietary proteins, an obligatory step in the process of protein digestion and absorption[36].

Pharmacological studies: Several studies were conducted to elucidate the biological activities of *L. hastata* extracts. Most of them were focused on anti-inflammatory and anti-bacterial effects of the extracts.

The acetone, methanol and aqueous extracts of *L. hastata* leaves were investigated against five selected bacterial species and two fungal species[31]. The aqueous extract markedly inhibited the growth of *Salmonella paratyphi* and *Escherichia coli* at 30 mg mL^{-1} and *Pseudomonas aeruginosa* at 60 mg mL^{-1}. The activity of the methanolic extract was generally low and the acetone extract did not show any activity against the investigated organisms. The results of anti-mycotic assay showed that the methanol extract suppressed the growth of *Fusarium oxysporum* and *Aspergillus niger* at 80 mg mL^{-1} with inhibition percentages ranging from 59-73%. The activity of the acetone extract was low with 40 and 50% inhibition on the growth of *A. niger* and *F. oxysporum*, respectively.



	R_1	R_2
6	Nic	H
12	Cinn	H
13	Ac	H
14	Bz	H
29	Cinn	I
30	Ac	I
32	Ac	C
33	Bz	C
37	Bz	G
38	Cinn	nIC
44	Bz	W
45	Ac	W
46	Cinn	W

Compounds (%)	R_1 %	R_2 %	R_3 %	R_4 %
1	Ac	H	H	H
2	Bz	Bz	H	H
3	Bz	Cinn	H	H
4	Cinn	Ac	H	H
5	Nic	Ac	H	H
7	Bz	Cinn	A	H
8	Cinn	H	B	H
9	Bz	Cinn	B	H
10	Cinn	H	H	H
11	Cinn	Nic	H	H
15	Cinn	Bz	H	H
16	Nic	Cinn	H	H
17	Ac	Ac	H	H
18	Cinn	H	D	H
19	Bz	Cinn	D	H
20	Cinn	H	E	H
21	Bz	Cinn	E	H
22	Bz	Bz	F	H

Compounds (%)	R_1 %	R_2 %	R_3 %	R_4 %
23	Cinn	Ac	H	E
24	Cinn	H	H	I
25	Bz	Cinn	H	I
26	Ac	H	H	I
27	Nic	Ac	H	I
28	Bz	H	H	L
31	Bz	Cinn	H	G
34	Bz	Cinn	H	G
35	Bz	Bz	H	G
39	Cinn	m-OH Bz	H	G
40	Ac	H	H	W
41	Cinn	H	H	W
42	Nic	Ac	H	W
43	Cinn	Bz	H	W
47	Nic	Cinn	Ac	W
48	Cinn	H	H	F

Fig. 4: Esterified aglycones and glycosides from *L. hastata*

Very few studies showed anti-fertility activities of *L. hastata* although, in some parts of Africa, many breeders claim the loss of fertility of their animals after consumption of *L. hastata* leaves. Literature surveys and ethnobotanic

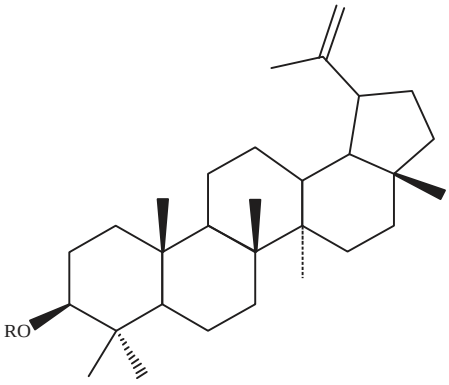


Fig. 5: Lupeol isolate from *L. hastata* latex

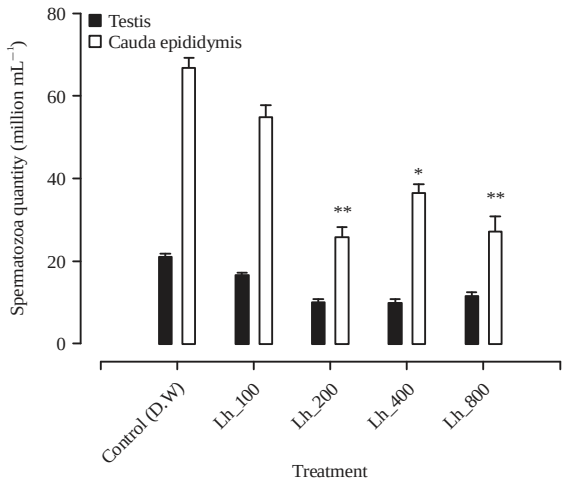


Fig. 6: Effect of *Leptadenia hastata* extracts on sperm number in testis and cauda epididymis
*p<0.05, **p<0.001)[48]

investigations with traditional healers revealed that the consumption of *L. hastata* leaves by donkeys, horses and dromedaries can compromise fertility.

In Linguere, Senegal, some abortions on horses and dromedaries are linked to *L. hastata* ingestion. To evaluate the abortifacient properties of *L. hastata* in mice, pregnant mice were fed a diet substituted with 25 and 50% of a powder of the aerial parts of *L. hastata*[37]. The results obtained showed that reproduction rates are significantly reduced in groups fed with 25 and 50% of *L. hastata* if compared to control groups. From those results, it was concluded that *L. hastata* causes partially abortion in mice, probably by a toxic effect leading to the death and the resorption of the embryo.

For the north regions of Burkina Faso, it was also reported that the consumption of *L. hastata* leaves had harmful effects on the fertility of sheep and goats[38,39].

If tested in male rats, *L. hastata* aqueous extracts reduced significantly the weight of androgen dependent accessory reproductive glands, the content of Prostatic acid Phosphatase (PAP) and fructose in seminal vesicles and prostate, as well as the serum testosterone level. When Testosterone Propionate (TP) was simultaneously administered with 100, 200 and 400 mg kg^{-1} of *L. hastata* aqueous extracts in a dose-dependent manner, a potentiation of TP action with the dose of 100 mg kg^{-1} of *L. hastata* was observed. This effect was detectable by a weight increase of androgen-dependent accessory reproductive glands, fructose and PAP levels in seminal vesicles and prostate and on the serum testosterone level. An anti-androgenic effect of *L. hastata* in a combinatorial experimental setting with TP appeared at doses of 200 and 400 mg kg^{-1} b.wt., which significantly reduced the experimental parameters specified above. Overall this can be interpreted as mixed agonistic/antagonistic properties of *L. hastata* extracts[40].

Circulating levels of testosterone are required for the maintenance of accessory sex organ function but the threshold levels of required hormone might be different for different functions and may be species-specific. The *L. hastata* aqueous extracts can inhibit androgen function through multiple mechanisms[41,42], antagonism of androgen receptors[43] and inhibition of testosterone production by increasing testosterone turn-over and elimination through induction of metabolic enzymes. Also, it is conceivable that *L. hastata* extracts may contain phytoestrogen-like activities: The potential role of phytoestrogens on male fertility has been attributed to both estrogenic and anti-estrogenic properties[44]. These observations could explain the loss of fertility of animals consuming the leaf stems of *L. hastata* which might be induced by non-steroidal compounds with anti-androgenic properties. Anti-androgens may have many implications in the regulation of animal reproduction[45] and may be useful for the treatment or prevention of prostate cancer. All currently applied anti-androgen therapies of prostate cancer are based on the reduction of the accessibility of the receptor by the ligand, either by a competitive antagonism on the level of the receptor or indirectly by inhibition of androgen production. Limitations of these therapies are acquired resistance and serious side-effects[46,47].

Male rats exposed to *L. hastata* presented a decreased number of sperm (Fig. 6)[48]. It is well established that

androgens and gonadotropins are essential for the spermatogenesis and the function of male reproductive system[49]. The decrease of the number of sperm in rats treated with plant extracts may be derived from a hormonal imbalance including serum levels of testosterone, prolactin and LH. Low cauda epididymal and testis sperm count and a reduction in the epididymis and testis weight imply that effects following exposure to *L. hastata* aqueous extracts might be caused by several factors. One factor may be that *L. hastata* extract interferes with enzymatic reactions including the oxidative phosphorylation uncoupling[50,51].

It is a known and a widely accepted concept that Luteinizing Hormone (LH) is basically responsible for testosterone production in animals[52]. One plausible explanation may be the suppression of LH as the primary step in the mechanism of the effects of the *L. hastata* extract on testis. At the testicular level, the absence of stimulation by LH would secondarily cause Leydig cell dysfunction, which, as a consequence, results in the decline of testosterone secretion and this in turn is responsible for the impairment of spermatogenesis and hence reflected by the reduction in sperm counts[53-55]. In addition, the structure and the function of the epididymis are dependent on androgens[56]. The suppression of cauda epididymal sperm motility suggests an under-supplementation of the epididymis with testosterone and, therefore, leads to an impaired epididymal function. The impaired epididymal function may also be due to the reduction of the testicular activity which affects the normal passage of testicular fluid into the epididymis[48,49]. Finally, this phenotype is also in part consistent with an Estrogen Receptor-α (ERα) deficiency or with phenotypes observable following treatment of animals with a pure antiestrogen[57].

Normal and alloxan induced diabetic rat models were used to assess the hypoglycaemic and hypolipidaemic effects of *L. hastata* water and methanol extracts. The results are showed with oral administration, the decreased of blood glucose and the increase of liver and muscle glycogen levels at the dose of 300 mg kg^{-1}. There was also an increase in high density lipoprotein cholesterol levels and a reduction of serum triglyceride, very low-density lipoprotein cholesterol levels[27].

CONCLUSION

Leptadenia hastata plays a very important role as a medicinal plant. Its ecology shows that this plant is a non-cereal and non-cultivated plant in the Sahel regions. Toxicological and pharmacological studies showed negligible general toxicity and anti-inflammatory and anti-bacterial activities. The effect of the leaves extracts on rat and mice showed an anti-androgenic and abortifacient properties pointing to potential hazards regarding reproductive toxicology. All these activities are due to the rich diversity of the chemical constituents of *L. hastata*.

In view of the composition of *L. hastata* in steroidal glycosides, triterpenes and polyoxypregnanes, it will be promising to evaluate the plant towards additional hormone-related conditions like hormone-dependent cancers and hormone deficiency syndromes.

SIGNIFICANCE STATEMENT

This study shows the medicinal, phytochemical and biological potentialities of *L. hastata* which can be beneficial in hormonal replacement therapy. *L. Hastata* is a food plant immensely spread in western and center of Africa with an extremely weak toxicity. This study will help the researchers to take *L. hastata* as a biological material for the biomedical research for hormono-dependent cancers.

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REFERENCES

1. Gurib-Fakim, A., 2006. Medicinal plants: Traditions of yesterday and drugs of tomorrow. Mol. Aspects Med., 27: 1-93.
2. Meve, U. and S. Liede, 2004. Subtrial division of Ceropegieae (Apocynaceae-Asclepediaceae). Taxon, 53: 61-72.
3. Endress, M.E., S. Liede-Schumann and U. Meve, 2007. Advances in apocynaceae: The enlightenment, an introduction. Ann. Missouri Bot. Garden, 94: 259-267.
4. APG., 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Bot. J. Linn. Soc., 161: 105-121.
5. Bazzaz, B.S.F. and G. Haririzadeh, 2003. Screening of Iranian plants for antimicrobial activity. Pharmaceut. Biol., 41: 573-583.
6. Paulo, A. and P.J. Houghton, 2003. Chemotaxonomic analysis of the genus *Cryptolepis*. Biochem. Syst. Ecol., 31: 155-166.
7. Atta, A.H. and S.M. Mouneir, 2005. Evaluation of some medicinal plant extracts for antidiarrhoeal activity. Phytother. Res., 19: 481-485.
8. Cioffi, G., R. Sanogo, A. Vassallo, F. Dal Piaz, G. Autore, S. Marzocco and N. De Tommasi,. 2006. Pregnane Glycosides from *Leptadenia pyrotechnica*. J. Nat. Prod., 69: 625-635.
9. Khanna, V.G. and K. Kannabiran, 2007. Larvicidal effect of *Hemidesmus indicus*, *Gymnema sylvestre* and *Eclipta prostrata* against *Culex qinquifaciatus* mosquito larvae. African J. Biotechnol., 6: 307-311.

10. Sena, L.P., D.J. Vanderjagt, C. Rivera, A.T. Tsin and I. Muhamadu *et al*., 1998. Analysis of nutritional components of eight famine foods of the republic of Niger. Plant Foods Hum. Nutr., 52: 17-30.
11. Freiberger, C.E., D.J. Vandergat, A. Pastuszyn, R.S. Glew, G. Mounkarla, M. Millson and R.H. Glew, 1998. Nutrient content of edible leaves of seven wild plants from Niger. Plant Foods Hum. Nutr., 53: 57-69.
12. Aliero, B.L., M.A. Umaru, H.A. Suberu and A. Abubakar, 2001. A Handbook of Common Plants in Northwestern Nigeria. Sokoto University Press, Sokoto, pp: 130.
13. Nikiema, J.B., R. Vanhaelen-Fastre, M. Vanhaelen, J. Fontaine, C.D. Graef and M. Heenen, 2001. Effects of antiinflammatory triterpenes isolated from *Leptadenia hastata* latex on Keratinocyte Proliferation. Phytother. Res., 15: 131-134.
14. Bayala, B., M.T. Rubio-Pellicer, M. Zongo, B. Malpaux and L. Sawadogo, 2011. Activite anti-androgenique de *Leptadenia hastata* (Pers.) Decne: Effet competitif des extraits aqueux de la plante et du propionate de testosterone sur des rats impuberes castres. Biotechnol. Agron. Soc. Environ., 15: 223-229.
15. Bayala, B., T.B.P. Savadogo, A. Savadogo, L. Sawadogo and B. Malpaux, 2012. Combined effects of *Testosterone propionate* and *Leptadenia hastata* Pers. (Decne) aqueous extracts on immature castrated male rats. J. Med. Plant Res., 6: 2925-2931.
16. Thomas, S.D., 2012. *Leptadenia hastate*: A review of its traditional uses and its pharmacological activity. Med. Chem., 2: 148-150.
17. Abubakar, S., A.B. Usman, I.Z. Ismaila, G. Aruwa, S.G. Azizat, G.H. Ogbadu and P.C. Onyenekwe, 2014. Nutritional and pharmacological potentials of *Leptadenia hastate* (Pers.) Decne. ethanolic leaves extract. J. Food Nutr. Res., 2: 51-55.
18. Sanogo, R., 2011. *Leptadenia pyrotechnica* (Forssk.) Decne. [Internet] Record from Prota 4U. In: Prota (Plant Resources of Tropical Africa), Schmelzer G.H. and A. Gurib-Fakim (Eds.)., Wageningen University, Netherlands.
19. El-Hassan, A., M. El-Sayed, A.I. Hamed, I.K. Rhee, A.A. Ahmed, K.P. Zeller and R. Verpoorte, 2003. Bioactive constituents of *Leptadenia arborea*. Fitoterapia, 74: 184-187.
20. Arbonnier, M., 2002. Arbres, Arbustes et Lianes des Zones Seches d'Afrique de l'Ouest. CIRAD., Paris, France, Page: 573.
21. Tarnaud, L., 2004. Ontogeny of feeding behavior of *Eulemur fulvus* in the dry forest of Mayotte. Int. J. Primatol., 25: 803-824.
22. Pan, E., L. Harinantenaina, P.J. Brodie, M. Callmander and S. Rakotonandrasana *et al*., 2011. Cardenolides of *Leptadenia madagascariensis* from the Madagascar dry forest. Bioorg. Med. Chem., 19: 422-428.
23. Kerharo, J. and J.G. Adam, 1974. La Pharmacopee Senegalaise Traditionnelle. Plantes Medicinales et Toxiques. Vigot Freres, Paris, France, Page: 1011.
24. Tamboura, H.H., B. Bayala, M. Lompo, I.P. Guissoe and L. Sawadogo, 2005. Ecological distribution, morphological characteristics and acute toxicity of aqueous extracts of *Holarrhena floribunda* (G. Don) durand and schinz, *Leptadenia hastata* (PERS.) decne and cassia sieberiana (DC) used by veterinary healers in Burkina Faso. Afr. J. Trad. Compl. Alternat. Med., 2: 13-24.
25. Ouedraogo, A., 2006. Diversite et dynamique de la vegetation ligneuse de la partie orientale du Burkina Faso. Ph.D. Thesis, University of Ouagadougou.
26. Bello, A., A.A. Aliero, Y. Saidu and S. Muhammad, 2011. Phytochemical screening, polyphenolic content and alpha-glucosidase inhibitory potential of *Leptadenia hastate* (Pers.) Decne. Niger. J. Basic Appl. Sci., 19: 181-186.
27. Neuwinger, H.D., 1996. African Ethno Botany: Poisons and Drugs. Chapman and Hall, London, Glasgow, Weinheim, New York, Tokyo, Melbourne, Madras, pp: 280-286.
28. Olivier-Bover, B.E.P., 1986. Medicinal Plants in Tropical West Africa. Cambridge University Press, Cambridge, UK., Page: 375.
29. Togola, A., I. Austarheim, A. Theis, D. Diallo and B.S. Paulsen, 2008. Ethnopharmacological uses of *Erythrina senegalensis*: A comparison of three areas in Mali and a link between traditional knowledge and modern biological science. J. Ethnobiol. Ethnomed., Vol. 4. 10.1186/1746-4269-4-6
30. Betti, J.L., S. Rost, A.A.S.R.M. Yemef and F.N. Tarla, 2011. Contribution to the knowledge of non wood forest products of the far north region of Cameroon: Medicinal plants sold in the Koussri market. J. Ecol. Natural Environ., 3: 241-254.
31. Aliero, A.A. and S.H. Wara, 2009. Validating the medicinal potential of *Leptadenia hastata*. Afr. J. pharmacy pharmacol., 3: 335-338.
32. Glew, R.S., D.J. Vanderjagt, L.T. Chuang, Y.S. Huang, M. Millson and R.H. Glew, 2005. Nutrient content of four edible wild plants from west Africa. Plant Foods Hum. Nutr., 60: 187-193.
33. Aquino, R., G. Peluso, N. De Tommasi, F. De Simone and C. Pizza, 1996. New polyoxypregnane ester derivatives from *Leptadenia hastate*. J. Nat. Prod., 59: 555-564.
34. Adjanohoun, E.J., 1989. Contribution aux Etudes Ethnobotaniques et Floristiques en Republique Populaire du Benin. Agence de Cooperation Culturelle et Technique, Paris, France,
35. Aquino, R., C. Pizza, N. De Tommasi and F. De Simone, 1995. New polyoxypregnane ester derivatives from *Leptadenia hastata*. J. Natural Prod., 58: 672-679.
36. Vanderjagt, D.J., C. Freiberger, H.T. Vu, G. Mounkaila, R.S. Glew and R.H. Glew, 2000. The trypsin inhibitor content of 61 wild edible plant foods of Niger. Plant Foods Hum. Nutr., 55: 335-346.
37. Lapo, R.A., M. Assane, L.J. Pangui and O.B. Gbati, 2003. Study of the abortifacient effects of *Leptadenia hastate* Pers.(Decne). Dakar Med., 48: 222-225.

38. Berhaut, J., 1979. Flore illustree du Senegal. Ministere du Developpement Rural, Direction des Eaux et Foret. Vol. 7. Gouvernement du Senegal.
39. Ake-Assi, Y.A., 1992. Contribution au recensement des especes vegetales utilisees traditionnellement sur le plan zootechnique et veterinaire en Afrique de l'Ouest. Master's Thesis, University of Claude Bernard, Lyon.
40. Bayala, B., M.T. Pellicer-Rubio, I.H.N. Bassole, R. Belemtougri, H.H. Tamboura and B. Malpaux, 2011. Effects of aqueous extracts of *Leptadenia hastate* (Pers.) Decne. (Asclepediaceae) on male reproductive functions using castrated immature rats. Res. J. Med. Plants, 5: 180-188.
41. Lambright, C., J. Ostby, K. Bobseine, V. Wilson, A.K. Hotchkiss, P.C. Mann and L.E. Gray, Jr., 2000. Cellular and molecular mechanisms of action of linuron: An antiandrogenic herbicide that produces reproductive malformations in male rats. Toxicol. Sci., 56: 389-399.
42. Wilson, V.S., C. Lambright, J. Furr, J. Ostby, C. Wood, G. Held and L.E. Gray, Jr., 2004. Phthalate ester-induced gubernacular lesions are associated with reduced insl3 gene expression in the fetal rat testis. Toxicol. Lett., 146: 207-2015.
43. Vinggaard, A.M., C. Nellemann, M. Dalgaard, E.B. Jorgensen and H.R. Andersen, 2002. Antiandrogenic effects *in vitro* and *in vivo* of the fungicide prochloraz. Toxicol. Sci., 69: 344-353.
44. Rochira, V., A. Balestrieri, B. Madeo, E. Baraldi, M. Faustini-Fustini, A.R. Granata and C. Carani, 2001. Congenital estrogen deficiency: In search of the estrogen role in human male reproduction. Mol. Cell. Endocrinol., 178: 107-115.
45. Navarro-Martin, L., M. Blazquez and F. Piferrer, 2009. Masculinization of the European sea bass (*Dicentrarchus labrax*) by treatment with an androgen or aromatase inhibitor involves different gene expression and has distinct lasting effects on maturation. General Comparat. Endocrinol., 160: 3-11.
46. Jones, J.O. and M.I. Diamond, 2008. A cellular conformation-based screen for androgen receptor inhibitors. ACS Chem. Biol., 3: 412-418.
47. Taplin, M.E., 2008. Androgen receptor: Role and novel therapeutic prospects in prostate cancer. Expert Rev. Anticancer Ther., 8: 1495-1508.
48. Bayala, B., P.B. Telefo, I.H.N. Bassole, H.H. Tamboura and R.G. Belemtougri *et al*., 2011. Anti-spermatogenic activity of *Leptadenia hastata* (Pers.) decne leaf stems aqueous extracts in male wistar rats. J. Pharmacol. Toxicol., 6: 391-399.
49. Leidl, W., U. Braun, J. Braun and G. Buck, 1982. The Testis. In: Handbook of Endocrinology, Gass, G.H. and H.M. Kaplan (Eds.). CRC Press, Boca Raton, pp: 145.
50. Abou-Donia, M.B. and J.W. Dieckert, 1974. Gossypol: Uncoupling of respiratory chain and oxidative phosphorylation. Life Sci., 14: 1955-1963.
51. Ke, Y.B. and W.W. Tso, 1982. Variations of gossypol susceptibility in rat spermatozoa during spermatogenesis. Int. J. Fertil., 27: 42-46.
52. Ewing, L.L., J.C. Davis and B.R. Zirkin, 1980. Regulation of testicular function: A spatial and temporal view. Int. Rev. Physiol., 22: 41-115.
53. Chase, D.J., J.A. Karle and R.E. Fogg, 1992. Maintenance or stimulation of steroidogenic enzymes and testosterone production in rat Leydig cells by continuous and pulsatile infusions of luteinizing hormone during passive immunization against gonadotrophin releasing hormone. J. Reprod. Fertil., 95: 657-667.
54. Shan, L.X. and M.P. Hardy, 1992. Developmental changes in levels of luteinizing hormone receptor and androgen receptor in rat Leydig cells. Endocrinology, 131: 1107-1114.
55. Verhoeven, G., 1992. Local control systems within the testis. Baillieres Clin. Endocrinol. Metab., 6: 313-333.
56. Cooper, T.G., 1992. The Epididymis as a Site of Contraceptive Attack. In: Spermatogenesis Fertilization, Contraception, Nieschlag, E. and U.F. Habenicbt (Eds.)., Springer, Berlin, pp: 419-460.
57. Hess, R.A., 2003. Estrogen in the adult male reproductive tract: A review. Reprod. Biol. Endocrinol., Vol. 1.