

**Medicinal Forage Present in the Natural Pasture in Benin:
Review Article**

Awohouedji D. Y. G., Lesse P., Houinato M. And Hounzangbe-Adote S.

J Anim Prod Adv 2013, 3(11): 301-310



Online version is available on: www.grjournals.com

Medicinal Forage Present in the Natural Pasture in Benin: a Review

^{1*}Awohouedji D. Y. G., ²Lesse P., ³Houinato M. And ⁴Hounzangbe-Adote S.

¹Université d'Abomey-Calavi, Faculté des Sciences Agronomiques, Laboratoire d'Ethnopharmacologie et de Santé Animale, Benin

²Université d'Abomey-Calavi, Faculté des Sciences Agronomiques, Laboratoire d'Ecologie Appliquée, Benin.

³Université d'Abomey-Calavi, Faculté des Sciences Agronomiques, Laboratoire d'Ecologie Appliquée, Benin.

⁴Université d'Abomey-Calavi, Faculté des Sciences Agronomiques, Laboratoire d'Ethnopharmacologie et de Santé Animale, Benin.

Abstract

There's a great opportunity of studying some underutilized forage in the natural pasture which had therapeutic properties. When comparing the pasture's species list with African medicinal plants list, we had five forage, which have strong therapeutic properties. The leafy stems and leaves of *Boerhavia diffusa* are cut as a fodder for sheep and also used as medicinal plant in Asia and in Africa. *Bridelia ferruginea* is well known for its pharmacological properties. It's also used as forage for sheep. In many parts of Africa and Asia the medicinal properties of *Chamaecrista absus* are used. In the Sahel and in Nigeria it is well liked by livestock, used to make silage and favor growth. In veterinary medicine *Detarium microcarpum*'s leaves and roots are used to treat diarrhea in cattle in southern Mali, and in Benin to treat constipation and fever in Niger. *Khaya senegalensis* is used in veterinary medicine. Its leaves were also used as fodder with low nutritional value. This article have choose to present those five forages, their use and their properties in the goal to offer a strategy to completely solve the problem of poor feeding and health management of ruminant livestock.

Keywords: Therapeutics plants, animal nutrition, ruminants, Benin.

* Corresponding author: Université d'Abomey-Calavi, Faculté des Sciences Agronomiques, Laboratoire d'Ethnopharmacologie et de Santé Animale, Benin.

Received on: 10 Oct 2013.

Revised on: 07 Nov 2013.

Accepted on: 17 Nov 2013.

Online Published on: 30 Nov 2013.

Introduction

Improving livestock production needs valorization of natural grazing species by identification of their properties in the goal to optimize their use. Indeed farming is an economic activity practiced in all agro-ecological zones of the world. The importance of livestock production is also reflected by their contribution to the maintaining of rural areas' activity, their involvement in environment's quality and poverty alleviation (Gbangboché *et al.*, 2005). In addition, the Republic of Benin holds a large herd of ruminants consisting of 900,000 head of cattle, 1,439,600 head of goats and 811,200 head of sheep (MAEP, 2011). Despite these benefits, ruminants' productivity is low. Low productivity is related to the type of farming on the one hand and especially the lack of quality food which is mainly based on natural pasture and the prevalence of diseases such as gastric parasitosis of other. In worldwide, the strongyles are recognized as one of the first cause of production losses (Gbangboché *et al.*, 2005).

The treatment of these parasites and other diseases is done using synthetic molecules. While the exclusive use of synthetic drugs in health prophylaxis is currently limited by many obstacles. First, some parasites have developed resistance to anthelmintics such as benzimidazoles, Levamisole, and even now with Ivermectin because of too frequent use (Brunet, 2008). And routine deworming regress youngs' immunity development (Brunet, 2008). Finally, the label of anthelmintic treatments are often based more expensive and in some cases, more harmful to the environment and animal products (Hoste *et al.*, 2005b). Because parasitic diseases cause loss of appetite, disturbance of the physiology of the digestive tract and a reorientation of the host metabolism (Hoste *et al.*, 2005), it is logical that the quality or quantity of ration offered to the animal must cover its needs are considered major factors affecting its capacity to respond to outbreaks. Given all these facts, it is essential to explore and scientifically validate the locally available natural resources (especially inexpensive and accessible to all farmers) can allow farmers to effectively fight against the disease in general and gastric parasitosis especially the one hand and ensure good nutrition for animals other hand so that they can fully show their genetic potential.

This article reviews the natural pasture's forage (Table I) which are in the medicinal plants list of Plant Resources of Tropical Africa (Schmelzer *et al.*, 2010). Note that in tropical countries ruminants are fed almost exclusively on natural pasture (Koné and Atidehou, 2006). These resources lose much of their nutritional value during the dry season through the process of lignification. During this period, their nutritional value is insufficient to support animals' growth of and fight against infestation. Their use requires proper supplementation (Fall *et al.*, 1999). However such supplementations are often not available in the breeding places and even when available, their cost limits their use by farmers. Fortunately, in this context of low quality food resources during wetting, there is some forage which have therapeutic properties.

Wanzala *et al.*, (2005), worked on the history of veterinary ethnomedicine. They found that the poor peoples of underdeveloped countries have implemented some prophylaxis that support primarily on natural resources. These people live in remote areas infected by parasites, vectors and endemic diseases. Because of the inaccessibility of modern veterinary medicine, these breeders have developed on the basis of ancestral knowledge of forage or we can care for and feed their animals. In fact, after work of Githiori *et al.*, (2006), of Athanasiadou *et al.*, (2007) and those of Rochfort *et al.*, (2008), there are many plants with anthelmintic properties which have been demonstrated by scientific tests or by feeding of the whole plant, or by administration of plant extracts for animal.

Stark *et al.*, (2013) have presented the importance of African medicine veterinary and their wish for its development like for China's by teaching and research. It is in this vein that this article will introduce the therapeutic properties of some plants in the natural pasture and were identified as medicinal. The therapeutic properties of these five (5) plants will be presented in this article. In a second step we will give our analysis on the issue. This would better contribute to the enhancement of our natural pasture plants.

Medicinal Plants Identified in the Floristic Inventories of Natural Pasture

The realization of this list (Table I) was based primarily on the study of floristic inventories of species belonging to the natural pasture (Lesse, 2009; Sinsin, 1992). Once the different species

identified, the list has been crossed with the list of medicinal plants established by Plant Resources of

Tropical Africa (Schmelzer *et al.*, 2010). The plants descriptions are in the table II.

Table 1: Forage plants in natural pastures and in the list of medicinal plants PROTA.

Plant	Family	Synonyms:	Vernacular names
<i>Boerhavia diffusa</i> Linn.	Nyctaginaceae	<i>Boerhavia africana</i> Lour. . (1790).	Spreading hogweed, (English); Punarnava and Shothaghni in India (Yelne <i>et al.</i> , 2000); 'pig's grass' and 'water food' (Okoli <i>et al.</i> , 2007) in Nigeria..
<i>Bridelia ferruginea</i> Benth.	<i>Phyllanthaceae</i> ,	<i>Cassia absus</i> L. (1753)	pig's senna (English). Casse absus (French) (Baerts and Lehmann, 2005)
<i>Chamaecrista absus</i> (L.) H.S.Irwin and Barneby	<i>Caesalpinaceae</i> (<i>Leguminosae</i>).		
<i>Detarium microcarpum</i> Guill. and Perr.	<i>Caesalpinaceae</i> (<i>Leguminosae</i>).	<i>Detarium senegalense</i> auct. non J.F.Gmel	Sweet dattock (English). Petit détar (French) (Adjonohoun <i>et al.</i> , 1989).
<i>Khaya senegalensis</i> (Desr.) A.Juss.	<i>Meliaceae</i> .		Senegal mahogany, Gambia mahogany (English). Acajou du Sénégal, acajou caïlcédrat (French).

Table 2: Description of plants.

Plant	Description	Properties	Use	Management and Genetic resources
<i>B. diffusa</i>	Annual to perennial herb up to 1 m tall, sometimes with thick taproot; stem branching mainly from the base, prostrate when young, ascending to erect when flowering, fleshy, green, often flushed with red, glabrescent to short or long hairy with multicellular hairs, often glandular, especially around the swollen nodes. Seed obovoid and pale brown. Seedling with epigeal germination; hypocotyls well developed; cotyledons rounded, with distinct midvein; first leaves alternate, shortly hairy, purplish beneath (Gilbert, 2000; Dhar <i>et al.</i> , 2011).	Presence of sugars, sterols, β -sitosterol and alkaloids known as punarnavine and punarnavoside; hentriacontane, β -sitosterol and ursolic acid along with glucose, fructose and sucrose from the roots (Misra and Tiwari, 1971); a new dihydroisofuranoxanthone from the benzene extract of the roots Kadota <i>et al.</i> , (1989); rotenoids (therapeutic most interesting metabolites) known as boeravinones from the roots (Kadota <i>et al.</i> , 1989; Jain <i>et al.</i> , 2004); two lignans, liriiodendrin and syringaresinol mono-beta-D-glucoside from the methanol extract of the roots and the former compound was found to exhibit a significant calcium (Ca^{2+}) channel antagonistic effect in frog heart single cells (Jain <i>et al.</i> , 2004); four new compounds from the root namely boerhavisterol, boerhadiffusene, diffusarotenoid, boerhavanastenyl benzoate and a rotenoid named boerhavinone (Gupta <i>et al.</i> , 2012)	Antioxidant, contraceptive (flowers and seeds), antibacterial, antihepatotoxic, antibacterial, antidiabetic (Dhar <i>et al.</i> , 2011), anti-inflammatory, (Bhalla <i>et al.</i> , 1971), diuretic and laxative (Chopra <i>et al.</i> , 1923;), anticonvulsant (Adesina, 1979), antinematodal, antifibrinolytic (Jain <i>et al.</i> , 2004), ,; anthelmintic, antileprotic, antiasthmatic, antiscabby and antistress activities (Rawat and Vashistha, 2011). Absence of teratogenic and mutagenic effects (N'guessan <i>et al.</i> , 2012) during toxicological studies. Use as forage for sheep and cattle (Alade <i>et al.</i> , 2010).	Industrial use only in India where especially the roots enter in popular medicinal formulations (Rawat and Vashistha, 2011). Traditional use in other countries. <i>Boerhavia diffusa</i> has a large area of distribution, often as a weed, and is not at risk of genetic erosion. There seems to be a geographical variation in the composition of pharmacological compounds (Edeoga and Ikem, 2002), and more research is needed in order to evaluate the most promising populations. There are no known breeding programmes of <i>Boerhavia diffusa</i> .
B. ferruginea Benth	Shrub commonly growing up to a height of 45 feet in the Savannah or in open spaces of coastal districts (Ngueyem <i>et al.</i> , 2009). The genus <i>Bridelia</i> includes approximately 60–70 species, from Africa to Asia. (Kathriarachchi <i>et al.</i> , 2005; Ngueyem <i>et al.</i> , 2009).	Presence of tannins, galloocatechin-(4'-O-7) epigallocatechin, flavonoids and biflavonoids (Ngueyem <i>et al.</i> , 2009)	Can contribute to treat rheumatism pains, intestine disorders, dysentery, diabetes, thrush, epilepsy, infectious diseases, including sexually transmitted diseases, skin diseases and eruption, skin cancer, cystitis, roundworm (anthelmintic) (Cimanga <i>et al.</i> , 2001). It's also antidote for arrow poison, (Ngueyem <i>et al.</i> , 2009) and use as inflammatory (Olajide <i>et al.</i> , 2003) and antitumor (Rhashid <i>et al.</i> , 2000). Use as forage for sheep and cattle (Alade <i>et al.</i> , 2010)	

C. absus (L.)	Annual herb up to 60(–100) cm tall, branched towards the top, with long rigid glandular hairs on all parts, lemon-scented (Lock, 1990; du Puy <i>et al.</i> , 2002; Baerts and Lehmann, 2005).	Presence of monoterpenoid imidazole, alkaloids chaksine and isochaksine (Harborne <i>et al.</i> , 1971); anthraquinones chrysophanol and emodin from the roots, flavonoids quercetin and rutin from the leaves, flavonoids apigenin, luteolin, hydnocarpin and iso-hydnocarpin (Hosanami, 1994). It also has hypotensive, antibacterial, antifungal and antitumor activity (Hosanami, 1994).	Used for anti-inflammatory (dried and powdered leaves, leaf extract or occasionally pounded ripe fruits), depurative, anthelmintic (Schmelzer <i>et al.</i> , 2010); antimicrobial activities (Silva <i>et al.</i> , 1996). Used as medicinal pasture plant to make silage (Nwude and Ibrahim, 1980; Neuwinger, 2000)	It's collected from the wild in Africa and cultivated in Pakistan and India for its leaves and seeds. (Schmelzer <i>et al.</i> , 2010). No risk of genetic erosion and no samples in seed banks.
D. microcarpum Guill. and Perr.	<i>D. microcarpum</i> occurs naturally in the drier regions of West and Central Africa, from Senegal and Gambia east to Sudan. Small tree up to 10 m tall; root system horizontal; bole usually straight, cylindrical, 30 cm in diameter; bark scaling on older branches, grey, brown or reddish; crown irregular (Adjonohoun <i>et al.</i> , 1989; Wittig and Guinko, 1998).	Presence of flavanes, 2 tetranorditerpenes, the clerodane diterpenes catechine and cis-2-oxokolavenic acid (0.5%), the diterpene copalic acid (1.7%) and coumarin (1%) (Abreu <i>et al.</i> , 1998), 4 clerodane diterpenes were isolated (Idu <i>et al.</i> , 2002), sucrose, D-galactose, D-mannose and D-glucose (Onweluzo and al., 1999). <i>Detarium microcarpum</i> is dark brown, rough and moderately heavy (Dione, 2001).	Presence of antiviral (methanol leaves extracts) (Mahmood <i>et al.</i> , 1993), molluscicidal (bark extract) (Lajide <i>et al.</i> , 1995), antimicrobial (Njoku <i>et al.</i> , 1999), moderate antitumor, antirheumatism, anthelmintic (Baerts and lehmann, 2002), anti-malarial. (Kerharo and Adam, 1974) activities. Used against skin infections (Baerts and Lehmann, 2002). dizziness, snakebites (Njoku <i>et al.</i> , 1999), convulsions and against bad spirits (Burkill, 1995), diarrhea, constipation and fever (Kouyaté, 2005) in cattle. . Pulp used as a substitute for sugar (Baumer, 1995; Okori and Amaechi, 2003). Leaves and flowers are used as fodder, and the seeds as pig feed (Okori and Amaechi, 2003).	Statistics on production and trade are scarce, despite the fact that the leaves and roots are commonly sold on markets throughout West Africa (Hugé, 2002). Not in ganger but over exploited. (Bationo, 2001; Hugé, 2002). Germplasm collections are held at the Institut d'Economie Rurale in Mali and at the Centre National des Semences Forestières in Burkina Faso (Schmelzer <i>et al.</i> , 2010).
K. senegale nsis (Desr.) A.Juss.	<i>K. senegalensis</i> occurs in savanna woodland, in areas with 650–1300 mm annual rainfall and a dry season of 4–7 months. It occurs up to 1500(–1800) m altitude. It prefers deep and well-drained alluvial soils and termite mounds, but can also be found on	Presence of limonoids (Caniato and Puricelli, 2003; Zhang <i>et al.</i> , 2007), rearranged limonoid (Fall <i>et al.</i> , 1999), limonoid 3 α ,7 α -dideacetylkhivorin (Zhang <i>et al.</i> , 2007), polyphenols from the bark (Androulakis <i>et al.</i> , 2006).	Presence of antifeedant and growth-inhibitory activities against some leaf worm antilarvicidal effect, antiproliferative, anti-inflammatory and pro-apoptotic effects on human colorectal cancer cell lines (Androulakis <i>et al.</i> , 2006), anti-inflammatory (Lompo <i>et al.</i> , 2007), strong antisickling activity (Pérez-Flores <i>et al.</i> , 2012), antiviral (Fall <i>et al.</i> , 1999) activity, .	<i>K. senegalensis</i> logs exported from West Africa (Nikles <i>et al.</i> , 2004). Bark and Seeds are harvested from natural stands and traded worldwide (Danthu <i>et al.</i> , 1999)., Seed is distributed (400-600 kg/year) by Centre National de Semences Forestières in Burkina Faso (Nikles <i>et al.</i> , 2004).

MEDICINAL FORAGE PRESENT IN THE NATURAL PASTURE ...

shallow, rocky soils, where it usually remains much smaller. It tolerates flooding in the rainy season (Sokpon and Ouinsavi, 2004).

antibacterial, anticonvulsant, anti-malarial, antiplasmodial and antimolluscicidal properties, antitrypanosomiasis, antidiarrhea and antiulcer properties (Androulakis *et al.*, 2006). Used as fodder (Neya 2006). Seed oil is used in cosmetics and for cooking (Sokpon and Ouinsavi, 2004).

Vulnerable species (IUCN Red List) (Neya 2006). In-situ conservation by the Centre National de Semences Forestières in Burkina Faso (CIRAD, 2003).

Analyze

All classes of livestock has increased significantly over the past three decades (MAEP, 2011) and their number has increased 3-4 times faster in developing countries than in developed. The increasing of the human population is also expected in the coming decades in developing countries. To feed the additional population, there will need more land devoted to crops. This will reduce pasture and forage land. That's why we need new strategies for rational exploitation of existing forage resources. That approach will have a strong influence on the future feed resources and will determine future breeding systems.

Small ruminant sheep breeders in developing countries such as Benin are poor. They face two major constraints. First, they often live in areas of high population density, which forces them to focus on food production at the detriment of forage one. Secondly the lack of technical training, combined with financial difficulties requires the development of appropriate technologies for the small farmer. It needs therefore to propose simple solutions integrated into their environment and which able to solve both problems: nutritive and health of ruminants. This fully justifies the utilization of underutilized resource that is medicinal forage because of a low index of palatability.

The experience of more than three decades of international projects aimed at assisting developing countries has shown that the direct technology's transfer from developed countries had failed in the area of animal production as in other sectors. In the best case, the transfer of technology leads to self-sufficiency for some products (pork, poultry, eggs ...) but never autonomy. These systems have generally been based on high levels of imports: capital, food, animals with high genetic potential, equipment and technical assistance. This doesn't stopped milk, meat and eggs importing which destabilize national production. In addition, the intensive systems that have contributed to increasing pollution in developed countries are not necessarily a good model for developing countries. It is therefore necessary to develop appropriate technologies that use as much as possible local resources, including traditional knowledge of farmers. Regarding livestock feed, many resources are insufficiently known or poorly exploited and deserve to be studied.

The principle is to develop feed systems based on medicinal plants which have high nutritional values. For example we have *Boerhavia diffusa* Linn., *Bridelia ferruginea* Benth., *Chamaecrista absus* (L.) HSIrwin and Barneby, *Detarium microcarpum* Guill. and Perr. and *Khaya senegalensis* (Desr.) A. Juss. Substantial savings will be made in terms of expenditure on purchasing food supplements. The saved money will encourage job creation and decrease rural migration.

In many developing countries in general and particularly in Benin ruminants' food is based on natural resources. In this natural pasture there is some medicinal forage which ruminants could use. In this way, they do not compete with men or with monogastric animals. This biomass represents the most economical feed resource for ruminants. In addition, it is easily accessible to small farmers. Most commonly available feed resources in the tropics are unbalanced (high in fiber, low in nitrogen, minerals and vitamins). They require proper supplementation. In addition to the new technologies developed by the group of fodder resources of the FAO namely multinutrient blocks (Sansoucy, 1986), the ammonia treatment of straw, fodder trees (FAO, 1993), the restricted suckling calves (Preston and Ugarte, 1972), restricted feeding of young calves (Preston and Ugarte, 1972), have not managed to completely solve the problem of poor feeding ruminant livestock. It is therefore necessary to work on the development of neglected medicinal forage. It's in this order that we are interested in some neglected palatable herbs in Benin which are subject to an industrial use in some neighboring countries and Asia.

Conclusion

Although the use of therapeutic plants is not perceived as profitable we are sure that poor pastoralists have used those plants since time immemorial. It necessary to evaluate scientifically food and therapeutic values of one or several of these plants in the goal to build a market by industrial culture in order to make them available to breeders. All of this will contributes to the improvement of meat production in rural area.

References

- Abreu PM, Rosa VS, Araujo EM, Canda AB, Kayser O, Bindseil KU, Siems K, Seemann A (1998).

- Phytochemical analysis and antimicrobial evaluation of *Detarium microcarpum* bark extracts. Pharm. & Pharmacol. Lett., 8(3): 107-109.
- Adesina SK (1979). Anticonvulsants properties of the rook bark of *Boerhavia diffusa*. J. Crude Drug Res., 17: 84-86.
- Adjanooun EJ, Adjakidje V, Ahyi MRA, Ake Assi L, Akoegninou A, d'Almeida J, Apovo F, Boukef K, Chadare M, Cusset G, Dramane K, Eyme J, Gassita JN, Gbaguidi N, Goudote E, Guinko S, Houngnon P, Lo I, Keita A, Kiniffo HV, Kone-Bamba D, Musampa Nseyya A, Saadou M, Sodogandji T, De Souza S, Tchabi A, Zinsou Dossa C, Zohoun T (1989). Contribution aux études ethnobotaniques et floristiques en République Populaire du Bénin. ACCT, Paris, France. 895 pp.
- Alade NK, Dilala MA, Abdulyekeen AO (2010). Phenotypic, genetic parameter estimates of litter size, body weights in goats International J. Sci. Nat., 1(2): 262- 266.
- Androulakis XM, Muga SJ, Chen F, Koita Y, Toure B, Wargovich MJ (2006). Chemopreventive effects of *Khaya senegalensis* bark extract on human colorectal cancer Anti-Cancer Res., 26(3B): 2397-2405.
- Athanasiadou S, Githiori J, Kyriazakis I (2007). Medicinal plants for helminthes parasite control: facts, fiction. Anim., 1(9). pp 1392-1400.
- Baerts M, Lehmann J (2002). *Detarium microcarpum* [Internet] Prelude Medicinal Plants Database Metafro-Infosys, Royal Museum for Central Africa, Tervuren, Belgium
http://wwwmetafro/prelude/view_plant?pi=04690
Accessed August (2004).
- Baerts M, Lehmann J (2005). *Cassia absus* [Internet] Prelude Medicinal Plants Database Metafro-Infosys, Royal Museum for Central Africa, Tervuren, Belgium
http://wwwmetafro/prelude/view_plant?pi=02550
Accessed March (2005).
- Bationo BA, Ouedraogo SJ, Guinko S (2001) Strategies de regeneration naturelle de *Detarium microcarpum* Guill et Perr dans la foret classée de Nazinon (Burkina Faso) Fruits. 56(4): 271-285.
- Baumer M (1995). Arbres, arbustes et arbrisseaux nourriciers en Afrique occidentale. ENDA, CTA, Dakar, Senegal 260 pp.
- Bhalla TN, Gupta MB, Bhargava KP (1971). Anti-inflammatory activity of *Boerhaavia diffusa*, L. J. Res. Indian Med., 6(1): 11-15
- Brunet S (2008). Analyse des mecanismes d'action antiparasitaire de plantes riches en substances poly phenoliques sur les nematodes du tube digestifs des ruminants. Thèse de doctorat Université Paul Sabatier 246 p.
- Burkill HM (1995). The useful plants of West Tropical Africa 2nd Edition Volume 3, Families J-L Royal Botanic Gardens, Kew, Richmond, United Kingdom 857 pp.
- Caniato R, Puricelli L (2003). Review: natural anti-malarial agents. Plant Sci., 22(1): 79-105.
- Chopra RN, Ghosh S, Dey P, Ghosh BN (1923). Pharmacology, therapeutics of *Boerhaavia diffusa* (punarnava), Indian Med. Gazette., 68: 203-08.
- Cimanga K, Ying L, De Bruyne T, Apers S, Cos P, Hermans N, Bakana P, Tona L, Kambu K, Kalenda DT, Pieters L, Vanden Berghe D, Vlietinck AJ (2001). Radical scavenging, xanthine oxidase inhibitory activity of phenolic compounds from *Bridelia ferruginea* stem bark J. Pharm. & Pharmacol., 53: 757-761.
- CIRAD (2003). Forestry Department Acajou cailcedrat [Internet] Tropix 50
http://tropixciradfr/africa/acajoucailpdf. Accessed January (2008).
- Danthu P, Gaye A & Sarr A (1999). Long term storage of *Khaya senegalensis* seeds. Int. Tree Crops J., 10: 93-100.
- Dhar ML, Dhawan M, Mehrotra BN, Ray C (2011). Screening of Indian plants for biological activity Part I. Indian J. Exp. Biol., 6: 232-247.
- Dione FGB (2001). Etude des facteurs de la germination et de la multiplication vegetative chez *Detarium senegalense* Gmel et *Detarium microcarpum* Guill et Perr Memoire de DEA, Biologie vegetale Université Cheikh Anta Diop, Dakar, Senegal 63 pp.
- du Puy DJ, Labat JN, Rabevohitra R, Villiers JF, Bossier J, Moat J (2002). The Leguminosae of Madagascar Royal Botanic Gardens, Kew, Richmond, United Kingdom 750 pp.
- Edeoga HO, Ikem CI (2002). Tannins, saponins, calcium oxalate crystals from Nigerian species of *Boerhavia L* (*Nyctaginaceae*). South African J. Bot., 68: 386-388.
- Fall AB, Vanhaelen FR, Vanhaelen M, Lo I, Toppet M, Ferster A, Fondu P (1999). In vitro antisickling activity of a rearranged limonoid isolated from *Khaya senegalensis*. Planta Med., 65(3): 209-212.
- FAO (1993). Livestock, improvement of pasture, feed, forage Comite de l'agriculture, 12e session, point de l'ordre du jour n° 7, 26 avril - 4 mai 1993 Rome, Italie 19 pages.
- Gbangboche AB, Hornick JL, Adamou-N' Diaye M, Edoth AP, Farnir F, Abiola FA, Leroy PL (2005). Caracterisation et maitrise des parametres de la reproduction et de la croissance des ovins Djallonke (*Ovis amon aries*) Ann. Med. Vet., 149 : 148-160.
- Gilbert MG (2000). *Nyctaginaceae* In Flora of Ethiopia, Eritrea Volume 2, part 1. *Magnoliaceae* to *Flacourtiaceae*. The National Herbarium (Editors), Addis Ababa University, Addis Ababa, Ethiopia, Department of Systematic Botany, Uppsala University, Uppsala, Sweden pp 264-273.
- Githiori JB Athanasiadou S, Thamsborg SM (2006). Use of plants in novel approaches for control of gastrointestinal helminthes in livestock with emphasis on small ruminants, Vet. Parasitol., 139: 308-320.
- Gupta AK, Kawaljeet K, Nawazish A, Sayeed A, Agarwal OP, Perwez A (2012). Comparative Standardization of Roots of *Boerhavia diffusa* Linn from Two Different Geographical Regions. Res. J. Pharm. Technol. Vol., 5(1): 114-118.
- Harborne JB, Boulter D, Turner BL (1971). Chemotaxonomy of the *Leguminosae* Academic Press, London, United Kingdom 612 pp.
- Hosamani KM (1994). A rich source of novel 9-ketooctadecis-15-enoic acid from *Cassia absus* seed oil, its possible industrial utilization. Ind. Eng. Chem. Res., 33(4): 1058-1061.
- Hoste H, Torres-Acosta F, Paolini V, Aguilar-Caballero AJ, Etter E, Le Frileux Y, Chartier C, Broqua C (2005). Interactions between nutrition, gastrointestinal infections with parasitic nematodes in goats. Small Rum. Res., 60(1-2): 141-151.

- Huge J (2002). Inventaire des agents pollinisateurs des fleurs et etude de la diversite genetique chez *Detarium microcarpum* Guill et Perr au Mali. Memoire de DEA University of Gent, Gent, Belgium 112 pp.
- Idu M, Ijomah JU, Omonhinmin AC (2002). Histomorphology of the tracheary elements of some Fabaceae hardwood. *Discov. Innovat.*, 14(1-2): 46-50.
- Jain A, Katewa SS, Chaudhary BL, GalavP (2004). Folk herbal medicines used in birth control, sexual diseases by tribals of southern Rajasthan, India. *J. Ethnopharmacol.*, 90: 171-177.
- Kadota S, Lami N, Tezuka Y, Kikuchi T (1989). Constituents of the roots of *Boerhaavia diffusa* L: Examination of sterols, structure of new rotenoids, boeravinones A, B. *Chem. Pharm. Bull.*, 37: 3214-3220.
- Kathriarachchi H, Hoffmann P, Samuel R, Wurdack KJ, Chase MW (2005). Molecular phylogenetics of *Phyllanthaceae* inferred from five genes (plastid atpB, matK, 3'ndhF, rbcL,, nuclear PHYC). *Mol. Phylogenet. Evol.*, 36: 112-134.
- Kerharo J, Adam JG (1974). La pharmacopee senegalaise traditionnelle Plantes medicinales et toxiques. Freres Vigot, Paris, France 1011 pp.
- Kone MW, Atindehou K (2006). Inventaire ethno medical et evaluation de l'activite anthelminthique des plantes medicinales utilisees en Cote-D'ivoire contre les helminthiases intestinales. *Pharm. Med. Trad. Afr.*, 15: 55-72.
- Kouyate AM (2005). Aspects ethnobotaniques et etude de la variabilite morphologique, biochimique et phenologique de *Detarium microcarpum* Guill, Perr Au Mali. PhD thesis Faculty of Agriculture, Appl. Biol. Sci. Univ. Gent., Belgium 207 pp.
- Lajide L, Escoubas P, Mizutani J (1995). Termite anti-feedant activity in *Detarium microcarpum*. *Phytochem.* 40: 1101-1104.
- Lesse DPAA (2009). Transhumance et Changement climatique: Productivite et capacite de charge des paturages naturels des communes riveraines de la Reserve de Biosphere Transfrontaliere du W (Benin). These de fin de formation du diplome d'ingenieur agronome Faculte des sciences Agronomiques Departement de Production Animale Laboratoire d'Ecologie Appliquee 121p.
- Lock JM (1990). *Cassia senslat (Leguminosae-Caesalpinioideae)* in Africa *Kew Bull.*, 43(2): 333-342.
- Lompo M, Guissou IP, Dubois J, Dehaye JP, Ouedraogo S, Traore A, Some N (2007). Mechanism of the Anti-inflammatory Activity of *Khaya senegalensis* A Juss (Meliaceae) *Int. J. Pharmacol.*, 3(2): 137-142.
- MAEP (2011). Annuaire Statistique du Ministere de l'Agriculture, de l'Elevage et de la peche. Service Statistique, Cotonou, 25 p.
- Mahmood N, Pizza C, Aquino R, Piacente S, Colman S, Burke A, Hay AJ, de Tommasi N (1993). Inhibition of HIV infection by flavanoids. *Antivir. Res.*, 22(2-3): 189-199.
- Maurya R, Sathiamoorthy B, Deepak M Flavonoids (2007). phenyl glycosides from *Boerhaavia diffusa*. *Nat. Prod. Res.*, 21: 126-34.
- Misra AN, Tiwari HP (1971). Constituents of roots of *Boerhaavia diffusa* *Phytochem.* 10: 3318-3319.
- N'guessan K, Fofie YBN, Coulibaly K, Kone D (2012). Evaluation De La Toxicite Aigue De *Boerhaavia diffusa* Chez La Souris. *Agron. Afr.*, 24 (1).
- Neuwinger HD (2000). African traditional medicine: a dictionary of plant use and applications. Medpharm Scientific, Stuttgart, Germany. 589 pp.
- Neya O 2006 Conservation of tree seeds from tropical drylands PhD thesis, Wageningen University, Wageningen, Netherlands 160 pp.
- Ngueyem TA, Brusotti G, Caccialanza G, Finzi V (2009). The genus *Bridelia*: A phytochemical, ethnopharmacological Review. *J. Ethnopharmacol.*, 134(3): 339-349.
- Nikles GD, Reilly DF, Robertson RM (2004). Conservation, genetic improvement in the Northern Territory (Australia) of *Khaya senegalensis* (African mahogany): a valuable species endangered in part of its homelands Paper presented at the Workshop Prospects for high-value hardwood timber plantations in the 'dry' tropics of northern Australia 19-21 October (2004), Mareeba, Australia 22 pp.
- Njoku OU, Obioma U, Frank EU (1999). Investigation on some nutritional, toxicological properties of *Azelia africana*, *Detarium microcarpum* seed oil. *Boll. Chim. Farm.*, 138(4): 165-168.
- Nwude N, Ibrahim MA (1980) Plants used in traditional veterinary medical practice in Nigeria. *J. Vet. Pharmacol. Ther.*, 3: 261-273.
- Okoli RI, Aigbe O, Ohau-Obodo JO, Mensah JK (2007). Medicinal Herbs used for Managing Somme Common Aliment among Esan people of Edo State, Nigeria. *Pakistan J. Nutr.*, 6(5): 490-496.
- Okorie SU, Amaechi EC (2003). Effects of roasting, soaking on the proximate composition, functional properties of selected tropical legumes *Global J. Pure Appl. Sci.*, 9(2): 177-182.
- Olajide OA, DT Okpako, JM Makinde (2003). Anti-inflammatory properties of *Bridelia ferruginea* stem bark Inhibition of lipopolysaccharide-induced septic shock, vascular permeability. *J. Ethnopharmacol.*, 88: 221-224.
- Onweluzo JC, Leelavathi K, Rao PH (1999). Effect of *Detarium microcarpum* (dm) *Mucuna flagellipes* (mf) gums on the quality of white bread. *Plant Foods Hum. Nutr.*, 54(2): 173-182.
- Perez-Flores J, Eigenbrode SD, Hilje-Quiroz L (2012). Alkaloids, Limonoids, Phenols from *Meliaceae* Species Decrease Survival, Performance of *Hypsipyla grandella* Larvae. *Am. J. Plant Sci.*, 3: 988-994.
- Preston TR, Ugarte J (1972). Rearing dairy calves by restricted suckling. *Rev. mond. Zootech.*, 3: 28-30.
- Rawat R, Vashistha DP (2011). Shortlisting of cultivable herbal plants in the Bhabhar Garhwal Himalaya, Uttarakhand, India. *Int. J. Med. Arom. Plants.*, 1(1): 23-27.
- Rhashid MA, Gustafson KR, Cardellina JH, Boyd MR (2000). A new podophyllotoxin derivative from *Bridelia ferruginea*. *Nat. Prod. Lett.*, 14: pp 285-292.
- Rochfort S, Parker AJ, Dunshea FR (2008). Plant bioactive for ruminant health, productivity *Phytochem.*, 69(2008): 299-322.
- Sansoucy R (1986). The Sahel: manufacture of molasses-urea blocks *Rev. Mond. Zootech.*, 57: 40-48.

- Schmelzer GH, Achigan-Dako EG, Bosch CH (Editors) (2010). Medicinal plants of Tropical Africa Conclusions, recommendations based on PROTA 11(1): 'Medicinal plants' PROTA Foundation, Nairobi, Kenya, 148 pp.
- Silva O, Duarte A, Cabrita J, Pimentel M, Diniz A, Gomes E, (1996). Antimicrobial activity of Guinea-Bissau traditional remedies. J. Ethnopharmacol., 50: 55-59.
- Sinsin B (1992). Phytosociologie, ecologie, valeur pastorale, production et capacite de charge des paturages naturels du perimetre Nikki-Kalale au Nord-Benin. These de doctorat. Universite libre de Bruxelles, Belgique, 350p.
- Sokpon N, Ouinsavi C (2004). Gestion des plantations de *Khaya senegalensis* au Benin. Bois For. Trop., 279(1): 37-46.
- Stark TD, Mtui DJ, Balemba OB (2013). Ethnopharmacological Survey of Plants Used in the Traditional Treatment of Gastrointestinal Pain, Inflammation, Diarrhea in Africa: Future Perspectives for Integration into Modern Med. Anim., (3): 158-227.
- Wanzala W, Zessin KH, Kyule NM, Baumann MPO, Mathias E, Hassanali A (2005). Ethnoveterinary medicine: a critical review of its evolution, perception, understanding, the way forward. Livest. Res. Rural Dev., 17(11).
- Wittig R, Guinko S (1998). Plantes medicinales et leurs usages chez les *Mossis* de *Sampodogo* et *Oueguedo* Etudes flore et vegetation Burkina Faso 4 Verlag Natur, Wissenschaft, Solingen, Germany 44 pp.
- Yelne MB, Sharma PC, Dennis TJ (2000). Database on Medicinal Plants used in Ayurveda CCRAS. 1: 360 pp.
- Zhang H, Wang X, Chen F, Androulakis XM, Wargovich MJ (2007). Anti-Cancer activity of limonoid from *Khaya senegalensis*. Phytother. Res., 21(8): 731-734.