

Dominant bacterial diseases in the extensive and semi-intensive animal breeding and their treatment method by ethnoveterinary medicine in Benin

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ABSTRACT

In Africa, various medicines are used in animal diseases treatment. This study aims to identify the medicinal plants that are often used to cure bacterial diseases in domestic animals, in order to promote their rational and sustainable use. The work was performed by working with 787 breeders in the 8 agro-ecological zones of Benin, from June to December 2013. An ethnobotanical survey has identified 32 medicinal plants species among which *Azelia africana*, *Crossopteryx febrifuga*, *Albizia chevalieri*, *Khaya senegalensis*, *Mangifera indica* and *Entada africana* are used for bovine pasteurellosis. The bronchitis is treated by 11 species of medicinal plants which include *Allium sativum*, *Garcinia kola*, *Terminalia laxiflora*, *Zanthoxylum zanthoxyloides* and *Detarium microcarpum*. For infectious coryza treatment, 8 plants have been identified among which, we have *Securinega virosa*, *Capsicum annum*, *Anacardium occidentale* and *Vitellaria paradoxa*. About cutaneous streptothricosis, 3 plants (*Zea mays*, *Piliostigma thonningii* and *Parkia biglobosa*) were cited for its treatment. Contagious bovine peripneumonia is treated by 3 plants (*Tamarindus indica*, *Oxythenanthera abyssinica* and *Khaya senegalensis*). Avian salmonellosis is also treated by 3 plants (*Bridelia ferruginea*, *Cissus quadrangularis* and *Ocimum gratissimum*). Concerning Blackleg and enterotoxemia, they are respectively treated by *Aganope stuhlmannii* and *Ocimum gratissimum*.

INTRODUCTION

Animal diseases are serious problem for livestock development. In African sub-Saharan zone, livestock production is confronted with diseases from various origins. This explains the drops not only of production but also of exaggerated import of meat products within the years despite the contribution of the livestock (25%) in the primary sector. Breeders' difficulties in animals' health care are related to the high cost of conventional medicine and their availability. Several strategies are implementing to revive of agricultural sector in Benin. So, to deal with animals' diseases, most breeders in developing countries use traditional herbal medicine. In view to value this

traditional practice, Ogni *et al.* (2014) have listed 6 dominant parasitical diseases treated by 67 medicinal plants in breeding in Benin. Nowadays, Medicinal plants are widely used in traditional medicine around the world. In addition, there are relatively lower incidences of adverse reactions of these remedies, compared with modern conventional pharmaceutical practices (Pahlaviani *et al.*, 2013). Antimicrobial properties of medicinal plants are increasingly reported from different parts of the world (Pahlaviani *et al.*, 2013). Considering the frequent cases of bacteria resistance to conventional antibiotics used around the world (Chin *et al.*, 2002 ; Benoît *et al.*, 2003; Abdullah *et al.*, 2005), it is important to resort to medicinal plants use for the dominant bacterial diseases in Benin. Thus, the present study aims to: a) evaluate the distribution of the dominant bacterial diseases related to each agro-ecological zones; b) identify medicinal plants used for their treatment and c) check off different recipes used in these treatments.

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MATERIAL AND METHODS

Areas of study

This work was done in the eight agro-ecological areas of Benin. In each agro-ecological area, municipalities were selected using the statistic of livestock registered according to CountryStat (2014). A total of 38 municipalities were chosen as it is shown on figure 1. Each municipality included in the study was selected according to breeders whose livestock gathers at least twenty animals (all species).

Data collection

Retrospective study was done from June to December 2013 in order to collect data on the diseases that occurred in livestock from 2009 to 2013. The technique of remembrance was used to collect data. A total of 787 breeders (89.45% men and 10.55% women) were included in the survey. The breeders were selected, taking into account their availability and accessibility to

answer the questionnaire. In each livestock, breeders had heterogeneous species of animals and practicing the semi-intensive or extensive management system. Data collection was focused on traditional treatment used by breeders to prevent or treat diseases of livestock. To perform the survey, a questionnaire was used to collect data about breeder's identity, bacterial disease occurred in the herd from 2009 to 2013, main diseases occurred these last five years, origin of the main bacterial diseases, the period of which the infection occurred and the plants or medicine used to treat animals. Animal diseases occurring in the livestock was recorded based on the description reported by the breeders. For each plant identified by breeders, information were collected on organ used, methods of preparation, dosages and routes of administration. The plants used by the breeders as medicine were collected at each stage of the survey and identified on field using analytics flora of Benin from Akoègninou *et al.*, (2006). Each of the plants described was also confirmed by an expert of the National Herbarium of the University of Abomey-Calavi.

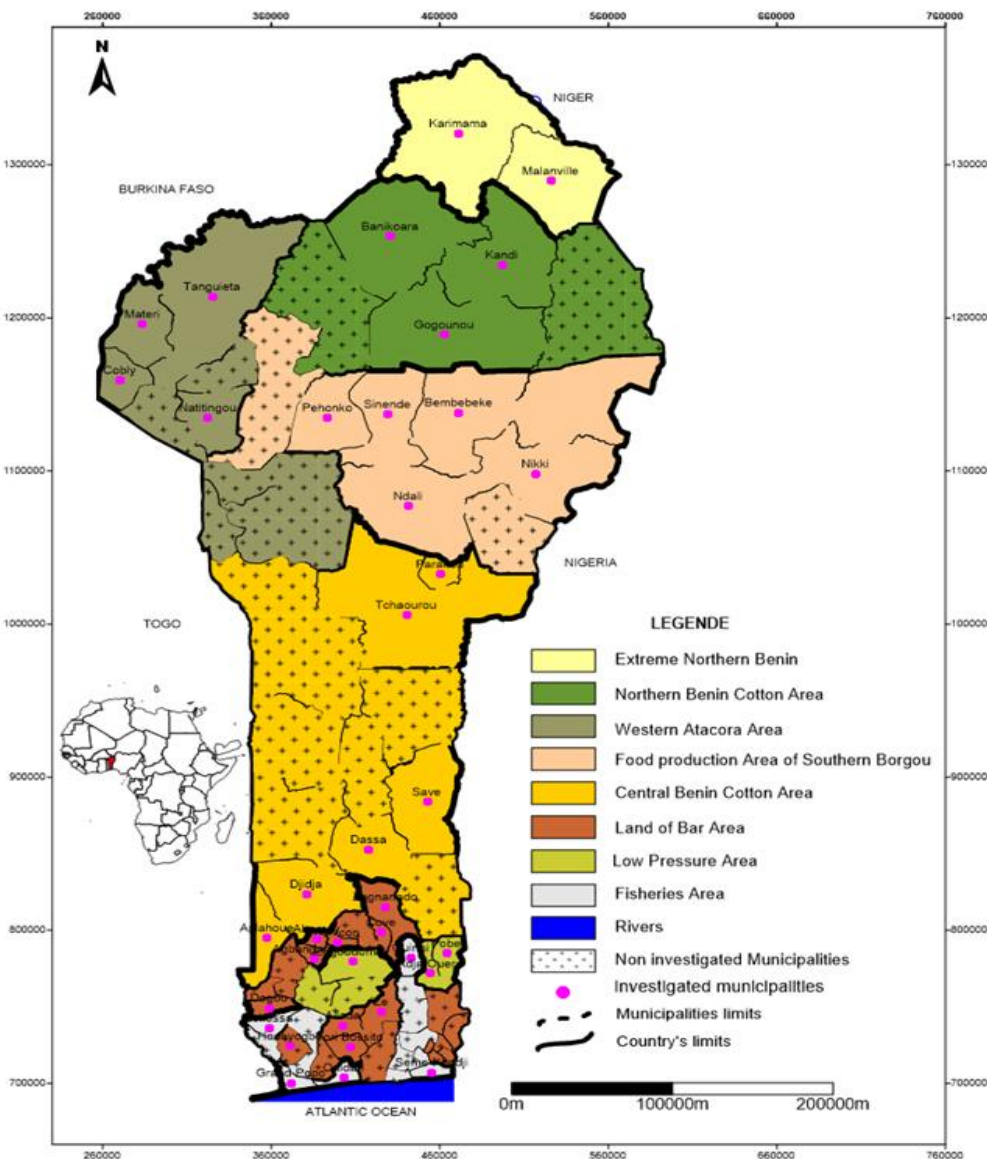


Fig. 1: study area.

Statistical analysis

Data collected were encoded and stored into database designed in Excel table. To determine main diseases, the citation frequency methodology was used. The number of citation of specific disease was determined according to the number of time this disease was reported by breeders during the survey. The formula used to calculate the frequency citation was:

$$Fc = \frac{n}{N} \times 100$$

Where **Fc** is citation frequency; **n** is citation number of specific disease and **N** is total number of diseases citation.

To assess distribution of bacterial diseases, frequency citation was used and variance analysis was performed taking into account agro-ecological areas. The F test was performed to measure any significant difference between frequencies of citation of a specific bacterial disease according to agro-ecological areas. The mean values were calculated and compared by agro-ecological zone using the student *t* test. To calculate frequency of each medicinal plant or traditional recipes used by breeders for the diseases treatment according to agro-ecological area, *Proc freq* procedure of STATA was used. The chi-square (χ^2) test was used to assess agro-ecological areas effect. The frequencies were compared to each other by using the bilateral Z test. For each relative frequency, confidence interval (CI) at 95% was calculated using the formula:

$$CI = 1.96 \sqrt{\frac{F(1-F)}{N}}$$

F is the relative frequency and **N** the sample size.

The statistical analyses were performed using SAS (Statistical Analysis System, 2006) software. The histogram and diagram of the most plants and organ used was performed using the computer program Excel.

RESULTS

Distribution of bacterial diseases

Ten bacterial diseases were identified by the investigated breeders and presented in table 1. Distribution of diseases related

to livestock species and agro-ecological areas was also presented in table 1. Bovine pasteurellosis (69.05%), cutaneous streptothricosis (14.29%), blackleg (9.52 %) and bronchitis (7.14 %) were frequently recorded in extreme northern Benin. Investigation in cotton area of northern Benin showed that bovine pasteurellosis (64.52 %), avian salmonellosis (11.29 %) and cutaneous streptothricosis (9.68 %) were the livestock diseases frequently observed by the breeders. The Food producing area of Southern Borgou was characterized by the presence of bovine pasteurellosis (73.68 %) and cutaneous streptothricosis (21.05 %). Livestock diseases mainly reported in the West-Atacora area were avian salmonellosis (67.27 %) and infectious coryza (14.55 %). Cutaneous streptothricosis (15.56 %), enterotoxemia (15.56 %), bovine pasteurellosis (33.33 %) and avian salmonellosis (21.11 %) were the livestock diseases frequently observed by the breeders in cotton area of Central Benin. In agro-ecological areas as lands of bar area, low-pressure area and fisheries area, diseases frequently reported were avian salmonellosis, enterotoxemia and bronchitis. Taking into account distribution of diseases among agro-ecological areas, assessment of bacterial diseases showed that bronchitis disease related to poultry was more frequently observed in agro-ecological areas such as lands of bar area, in low-pressure area and in fisheries area. This disease was less observed in cotton area of northern Benin (1.6 %). Frequency citation observed for Blackleg was low. The highest value observed for Blackleg was registered in extreme northern Benin (9.52 %) and the lowest value was registered in West-Atacora area (1.82 %).

Fowl cholera and coryza infection were more frequently observed in West-Atacora area. Cutaneous streptothricosis related to cattle, sheep, and goats were mainly reported in Food producing area of Southern Borgou (21.05 %). Enterotoxemia related to Rabbit was more frequently reported by breeders in lands of bar area (22.00 %) and low-pressure area (23.53 %). The lowest frequency citation of enterotoxemia was registered in agro-ecological areas such as cotton area of northern Benin (1.61 %), food producing area of Southern Borgou (2.63 %) and West-Atacora area (3.64 %). Frequency citation of contagious bovine Peripneumonia (CBPP) was low.

Table 1: Bacterial diseases distribution in the agro-ecological zones of Benin.

Diseases	Animals species	Zone 1 (N= 42)	Zone 2 (N= 62)	Zone 3 (N= 38)	Zone 4 (N= 55)	Zone 5 (N= 90)	Zone 6 (N= 50)	Zone 7 (N= 34)	Zone 8 (N= 24)	Test of Significance
Bronchitis (%)	Poultry	7.14cd	1.61e	2.63de	9.09c	5.56d	24.00a	20.59ab	16.67b	**
Blackleg(%)	Cattle	9.52a	3.23b	0.00c	1.82b	0.00c	0.00c	0.00c	0.00c	***
Fowl cholera(%)	Poultry	0.00b	0.00b	0.00b	1.82a	0.00b	0.00b	0.00b	0.00b	***
Infectious coryza (%)	Poultry	0c	0.00c	0.00c	14.55a	0.00c	0.00c	8.82b	8.33b	**
Cutaneous streptothricosis(%)	Cattle	14.29b	9.68b	21.05a	0.00d	15.56ab	2.00c	2.94c	0.00d	***
	Sheeps									
	Goat									
Enterotoxemia (%)	Rabbit	0.00d	1.61c	2.63c	3.64c	15.56b	22.00a	23.53a	12.5b	***
CBPP (%)	Cattle	0.00d	4.84b	0.00d	1.82c	8.89a	0.00d	0.00d	0.00d	**
Bovine pasteurellosis (%)	Cattle	69.05ab	64.52b	73.68a	0.00e	33.33c	2.00d	2.94d	0.00e	***
Avian salmonellosis (%)	Poultry	0.00f	11.29e	0.00f	67.27a	21.11d	50.00b	41.18c	62.5a	***
Bovine tuberculosis (%)	Cattle	0.00b	3.23a	0.00b	0.00b	0.00b	0.00b	0.00b	0.00b	***

The percentages of the same line followed by different letters, differ significantly at the threshold of 5 %. ***: $p < 0.001$; **: $p < 0.01$.

Zone 1= extreme northern Benin; Zone 2= cotton area of northern Benin; Zone 3= Food producing area of Southern Borgou; Zone 4= West-Atacora area; Zone 5= cotton area of Central Benin; Zone 6= lands of bar area; Zone 7= low-pressure area; Zone 8= fisheries area; CBPP: Contagious bovine Peripneumonia.

The highest value of CBPP (8.89 %) was registered in cotton area of Central Benin and the lowest value (4.84 %) was reported by the breeders in cotton area of northern Benin. Frequency citation registered for Bovine pasteurellosis was very high in Food producing area of Southern Borgou (73.68 %) and the lowest value was recorded in lands of bar area (2.00 %). Avian salmonellosis was frequently registered in poultry in West-Atacora area (67.27 %) whereas the lowest frequency was observed in cotton area of northern Benin (11.29 %). Bovine tuberculosis was only recorded in cotton area of northern Benin (3.23 %).

Treatment of bacterial diseases

Treatment of bacterial diseases occurring in livestock was carried out by using 46 species of plants belonging to 24 botanical families. Most of the plants used belong to the family of Leguminosae-Caesalpinioideae and Leguminosae-Mimosoideae with 13.04% of each, and Euphorbiaceae, Leguminosae-Papilionoideae, Poaceae and Rubiaceae represented at 6.52% each. The main plants used by breeders to treat livestock diseases were described on figure 2. *Khaya senegalensis* was the main plant reported by the breeders to treat livestock bacterial diseases.

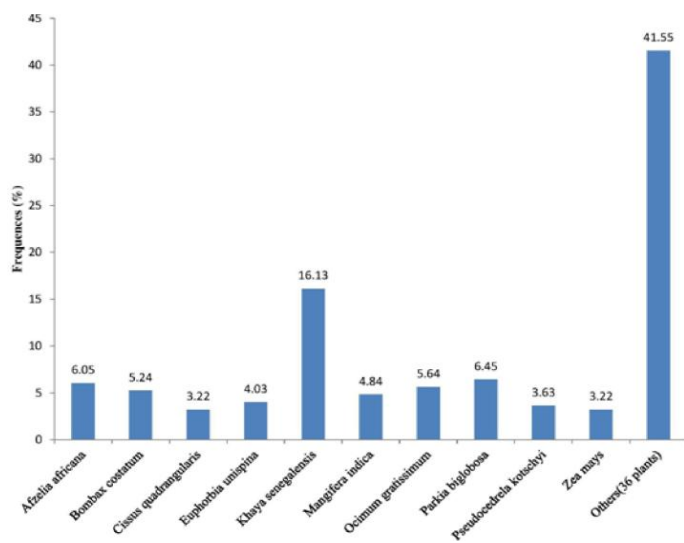


Fig. 2: Citation Frequency of the plants used of all diseases confuse.

Others plants such as *Vitellaria paradoxa* ; *Securinega virosa* ; *Bridelia ferruginea* ; *Albizia chevalieri* etc... were also reported by the breeders. The organs mostly used by the breeders were leaves, bulb, root, bark, fruit, stem, grain, bark or the whole plant. The organs frequently used on the plants for the preparation of remedies are bark at 56.84%, the roots at 15.79% and the leaves at 14.74%. The other organs (bulbs, serve cob, stem, and whole plant) are used at 7.34%. Taking into account each plant used, bark of *Khaya senegalensis* were frequently reported by the breeders (figure 3). To treat bronchitis, leaves of *O. gratissimum* was most frequently used, followed by the leaves of *Vernonia amygdalina*. The galleic form frequently used, was the liquid extract by trituration. Blackleg was treated using only the bark of *Aganope stuhlmanni*. The whole plant of *Euphorbia unispina* was

frequently reported by breeders to treat coryza infectious. *Coryza* infectious is also treated using leaves of *Securinega virosa*. The used forms of other plants were maceration and raw. To treat avian salmonellosis, most breeders used maceration of the whole *Cissus quadrangularis*. Sometimes, breeders used the leaves extract obtained after trituration of *Ocimum gratissimum* to treat avian salmonellosis. Liquid obtained from maceration of barks of *Khaya senegalensis* added with beef urine was used to treat CBPP. To stop cutaneous streptothricosis infection, the macerate of the corns of *Zea mays* was added to ampicillin. But sometimes, the pulp of *Parkia biglobosa* was also used. The leaves of *Ocimum gratissimum* was triturated and extract solution was used to stop enterotoxemia infection. Extract solution obtained from trituration of Bark of *Khaya senegalensis* was frequently used to treat Bovine pasteurellosis as well as extract obtained from the decoction of the bark of *Mangifera indica*.

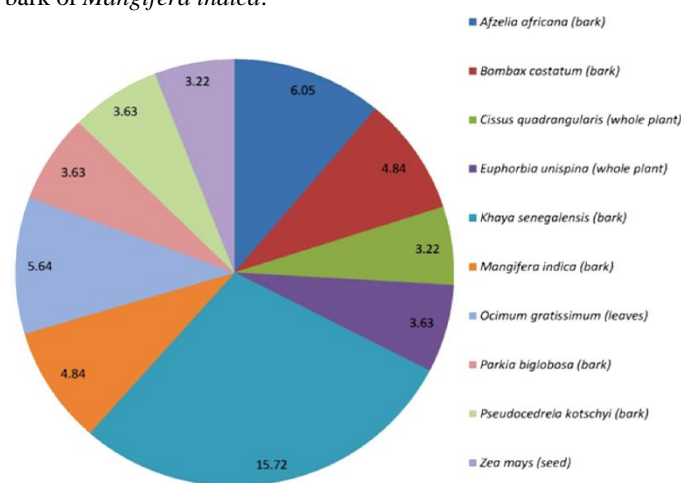


Fig. 3: Citation frequency of each plant organ used of all diseases confuse.

Some plants were reported to be used in the treatment of more than two diseases. *Parkia biglobosa* involved in the treatment of bovine pasteurellosis, bronchitis, avian coryza and cutaneous streptothricosis. *Vitellaria paradoxa* was also recorded in the treatment of bovine pasteurellosis, bronchitis and infectious coryza. The association of *Prosopis africana*, *Mangifera indica* and *Detarium microcarpum* was reported to stop bovine pasteurellosis and bronchitis. *Khaya senegalensis* and *Tamarindus indica* are used to treat contagious bovine peripneumonia and bovine pasteurellosis. *Euphorbia unispina* is also involved in the treatment of bovine pasteurellosis and infectious coryza. *Ocimum gratissimum* was recorded in the treatment of bronchitis, enterotoxemia and avian salmonellosis. *Piliostigma thonningii* is frequently used in the preparation of medicine used for treatment of cutaneous streptothricosis and bovine pasteurellosis. *Vernonia amygdalina* is used to treat both bronchitis and infectious coryza. Tables 2 to 5 present respectively the remedies used for the treatment of these bacterial diseases. For each of them, the local name and the scientific name of the plant used for treatment, plant organs used, the method of preparation, dosage, route of administration, time of treatment and the numbers of citations were presented.

Table 2: Remedies used for treatment of the bronchitis and blackleg.

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
Bronchitis	Yandodou (F)	<i>Ocimum gratissimum</i> (leaves)	-	Trituration	1 glass twice a day	Oral	Until recovery	7
	Aloman (F)	<i>Vernonia amygdalina</i> (leaves)	-	Trituration	Once a day	Oral	-	3
	-	<i>Allium sativum</i> (bulb)	-	Pounding	-	Oral	-	1
	-	<i>Detarium microcarpum</i> (root)	-	Decoction	-	Oral	-	1
	-	<i>Parkia biglobosa</i> (bark)	-	Decoction	-	Oral	-	1
	-	<i>Prosopis africana</i> (bark)	-	Decoction	-	Oral	-	1
	Manga (F)	<i>Mangifera indica</i> (bark)	-	Infusion	1/2 L twice a day	Oral	3 days	1
	Héman (F)	<i>Zanthoxylum zanthoxyloides</i> (leaves)	-	Fodder	At will	Oral	-	2
	-	<i>Vitellaria paradoxa</i> (bark)	-	Powder	1/2 L twice a day	Oral	Until recovery	1
	Orogbo	<i>Garcinia kola</i> (fruit)	Sugar or salt	Trituration	Some gout 2 to 3 times / day	Oral	Until recovery	2
-	<i>Terminalia laxiflora</i> (bark)	-	Decoction	At will	Oral	Until recovery	1	
blackleg	-	<i>Aganope stuhlmannii</i> (bark)	-	Decoction	1L(adult) and 1/2L thrice a day (young)	Oral	Until recovery	1

(F) : Fon

Table 3: Remedies used for the treatment of the infectious coryza and the avian salmonellosis.

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
infectious coryza	Hesre (F)	<i>Securinega virosa</i> (leaves)	-	Raw	At will	Oral	Until recovery	7
	Yovovigbe (M)	<i>Moringa oleifera</i> (leaves)	-	Raw	At will	Oral	Until recovery	3
	Inandjo	<i>Capsicum annuum</i> (Fruit)	-	Pounding(Powder)	Pinch once a day	Oral	Until recovery	3
	Koyègou	<i>Euphorbia unispina</i> (whole plant)	-	Maceration	Twice a day	Oral	1 week	9
	Nare + Kare + Sisiri (P)	<i>Parkia biglobosa</i> + <i>Vitellaria paradoxa</i> + <i>Anacardium occidentale</i> (barks)	-	Maceration	Once a day	Oral	1 week	1
	Amanvive (F)	<i>Vernonia amygdalina</i> (leaves)	Tetracycline	Trituration	-	Oral	Until recovery	3
Avian salmonellosis	Ira (I)	<i>Bridelia ferruginea</i> (bark)	-	Maceration	-	Oral	Until recovery	2
	-	<i>Cissus quadrangularis</i> (whole plant)	-	Maceration	At will	Oral	Until recovery	8
	-	<i>Ocimum gratissimum</i> (leaves)	-	Trituration	3 - 5 spoonful for 2 - 3 times / day	Oral	Until recovery	4

(F) : Fon ; (M) : Mina ; (P) : Peulh ; (I) : Idaatcha

Table 3: Remedies used for the treatment of the infectious coryza and the avian salmonellosis

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
infectious coryza	Hesre (F)	<i>Securinega virosa</i> (leaves)	-	Raw	At will	Oral	Until recovery	7
	Yovovigbe (M)	<i>Moringa oleifera</i> (leaves)	-	Raw	At will	Oral	Until recovery	3
	Inandjo	<i>Capsicum annuum</i> (Fruit)	-	Pounding (Powder)	Pinch once a day	Oral	Until recovery	3
	Koyègou	<i>Euphorbia unispina</i> (whole plant)	-	Maceration	Twice a day	Oral	1 week	9
	Nare + Kare + Sisiri (P)	<i>Parkia biglobosa</i> + <i>Vitellaria paradoxa</i> + <i>Anacardium occidentale</i> (barks)	-	Maceration	Once a day	Oral	1 week	1
	Amanvive (F)	<i>Vernonia amygdalina</i> (leaves)	Tetracycline	Trituration	-	Oral	Until recovery	3
Avian salmonellosis	Ira (I)	<i>Bridelia ferruginea</i> (bark)	-	Maceration	-	Oral	Until recovery	2
	-	<i>Cissus quadrangularis</i> (whole plant)	-	Maceration	At will	Oral	Until recovery	8
	-	<i>Ocimum gratissimum</i> (leaves)	-	Trituration	3 - 5 spoonful for 2 - 3 times / day	Oral	Until recovery	4

(F) : Fon ; (M) : Mina ; (P) : Peulh ; (I) : Idaatcha.

Table 4: Remedies used for the treatment of the CBPP, the Cutaneous streptothricosis and the enterotoxemia.

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
CBPP	Kahi (P)	<i>Khaya senegalensis</i> (bark)	Ox urine	Maceration	Once a day	Oral	Until recovery	2
	-	<i>Tamarindus indica</i> (fruit) + <i>Khaya senegalensis</i> (leaves) + <i>Oxythenanthera abyssinica</i> (leaves)	Potash	Decoction	1/2 L per animal for 1 - 2 times / day	Oral	1 - 2 days	1
Cutaneous streptothricosis	-	<i>Zea mays</i> (seed)	Ampicilline	Maceration	Some millilitre once a day	Injection	1 day	8
	Narehi (P)	<i>Parkia biglobosa</i> (fruit : pulp)	-	Powder + water	Sufficient quantity once a day	External	2 week	5
	Barkehi (P)	<i>Piliostigma thonningii</i> (root)	-	Decoction	Twice a day	Bath	Until recovery	2
Enterotoxemia	Tchiayo (F)	<i>Ocimum gratissimum</i> (leaves)	-	Trituration	At will twice a day	Oral	3 days	3

CBPP : Contagious bovine Peripneumonia ; (P) : Peulh ; (F) : Fon.

Table 5: Remedies used for the treatment of the bovine pasteurellosis.

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
Bovine pasteurellosis	Wariyanhi (P)	<i>Azelia africana</i> (bark)	-	Decoction	Twice a day	Oral	1 week	5
	-	<i>Crossopteryx febrifuga</i> (bark) + <i>Albizia chevalieri</i> (root)	-	Decoction	1L once a day	Oral	Until recovery	4
	-	<i>Albizia chevalieri</i> (root) + <i>Sarcocephalus latifolius</i> (root) + <i>Pseudocedrela kotschyi</i> (bark) + <i>Khaya senegalensis</i> (bark) + <i>Bombax costatum</i> (bark) et <i>Ficus gnaphalocarpa</i> (bark)	Potash	Decoction	1L (adult) et 1/2 L (young) once a day	Oral	3 days	1
	-	<i>Bombax costatum</i> (serve) + <i>Adenium obesum</i> (stem) + <i>Isobertinia doka</i> (bark)	-	Decoction	Small quantity once a day	Oral	Until recovery	1
	-	<i>Vitellaria paradoxa</i> (bark) + <i>Khaya senegalensis</i> (bark) + <i>Pseudocedrela kotschyi</i> (bark) + <i>Parkia biglobosa</i> (root) + <i>Piliostigma thonningii</i> (root) + <i>Annona senegalensis</i> (root)	Red salt	Decoction	1/2 L per animal once a day	Oral	3 days	2
	-	<i>Mangifera indica</i> (bark)	Sugar	Decoction	1L (adult) and 1/2 L (young) twice a day	Oral	5 days	7
	-	<i>Parkia biglobosa</i> (bark) + <i>Strychnos spinosa</i> (bark)	Potash	Decoction	1L (adult) and 1/2 L (young) once a day	Oral	1 week	3
	-	<i>Adansonia digitata</i> (bark)	-	Maceration	twice a day	Oral	5 days	2
	-	<i>Mangifera indica</i> (bark) + <i>Piliostigma thonningii</i> (bark)	-	Decoction	1 L (adult) and 1/2 L (young)	Oral	3 days	2
	-	<i>Vitellaria paradoxa</i> (leaves)	Sugar	Trituration	1 L once a day	Oral	Until recovery	1
	-	<i>Cassia sieberiana</i> (bark) + <i>Aganope stuhlmannii</i> (bark)	-	Decoction	1 L (adult) and 1/2 L (young) once a day	Oral	Until recovery	2
	-	<i>Khaya senegalensis</i> (bark) + <i>Pseudocedrela kotschyi</i> (bark)	-	Decoction	1 L (adult) and 1/2 L (young) once a day	Oral	1 week	5
	-	<i>Sarcocephalus latifolius</i> (root) + <i>Acacia polyacantha</i> (root) + <i>Pericopsis laxiflora</i> (root) + <i>Strychnos spinosa</i> (root)	<i>Allium cepa</i> + <i>Peper guinensis</i>	Maceration	At will once a day	Oral	Until recovery	1

Table 5: Remedies used for the treatment of the bovine pasteurellosis (continued)

Disease	Local name of plant	Scientific name of plant (used part)	Other combination	Preparation method	Dosage	Route of administration	Time of treatment	Number of citation
Bovine pasteurellosis	-	<i>Bombax costatum</i> (bark) + <i>Vitellaria paradoxa</i> (bark) + <i>Detarium microcarpum</i> (bark)	Sugar	Decoction	2 bamboo glasses /animal once a day on empty stomach	Oral	3 days	1
	-	<i>Khaya senegalensis</i> (bark) + <i>Acacia senegal</i> (bark)	-	Maceration	1 L (adult) et 1/2 L (young) once a day	Oral	3 days	2
	-	<i>Tamarindus indicus</i> (leaves) + <i>Opilia amantacea</i> (leaves)	Garlic + white onion + potash + salt	Pounding and trituration	At will 1 to 2 times on 3 days	Oral	Until recovery	5
	Baheri (P)	<i>Sorghum bicolor</i> (grain)	-	Decoction	1/2 L once a day	Oral	1 week	2
	Kahi (P)	<i>Khaya senegalensis</i> (bark)	Sugar + cow milk	Pounding and trituration	1 L once a day	Oral	5 days	14
	-	<i>Khaya senegalensis</i> (bark) + <i>Adansonia digitata</i> (bark) + <i>Parkia biglobosa</i> (bark)	-	Decoction	1 L once a day	Oral	5 days	2
	-	<i>Khaya senegalensis</i> (bark) + <i>Azelia africana</i> (bark) + <i>Bombax costatum</i> (bark)	-	Decoction	1 L once a day	Oral	Until recovery	10
	-	<i>Khaya senegalensis</i> (bark) + <i>Mangifera indica</i> (bark) + <i>Anogeissus leiocarpa</i> (bark)	-	Decoction	1/2 L once a day	Oral	1 week	2
	Narehi (P)	<i>Parkia biglobosa</i> (bark)	Mustard	Pounding and trituration	At will twice a day	Oral	2 - 4 days	1
	Fadawanouhi (P)	<i>Entada africana</i> (root)	-	Powder	1/4 to 1/2 L twice a day	Oral	Until recovery	5
	-	<i>Pseudocedrela kotschy</i> (bark) + <i>Khaya senegalensis</i> (bark) + <i>Prosopis africana</i> (bark) + <i>Cassia sieberiana</i> (bark) + <i>Mitragyna inermis</i> (root)	Sugar	Decoction	1/4 L (young) et 1/2 L (adult) twice a day	Oral	Until recovery	1
	Narehi (P)	<i>Parkia biglobosa</i> (bark)	Small red pepper in powder	Decoction	At will twice a day	Oral	2 - 3 days	1
	Banouhi (P)	<i>Pterocarpus erinaceus</i> (stem and leaves)	-	Decoction	-	Oral	-	1
	Gourohi (P)	<i>Euphorbia unispina</i> (stem)	-	Decoction	-	Oral	-	1

(P) : Peulh

DISCUSSION

The ethno-pharmacological survey focused on bacterial diseases observed in livestock has revealed that bovine pasteurellosis, cutaneous streptothricosis, contagious bovine peripneumonia, bronchitis, infectious coryza and avian salmonellosis were the main diseases registered in livestock. In this study, forty six plant species were used for treating several animal ailments. The number of species identified in this study provides an indication that study area has rich diversity of

ethnoveterinary medicinal plants and indigenous knowledge. In Seharti-Samre district of Northern Ethiopia, twenty two species of ethnoveterinary medicinal plants were identified for treating eighteen different livestock ailments and for total livestock population of 871,182 (Yirga *et al.*, 2012) whereas a total of 80 plants were revealed useful in various ethnoveterinary remedies in Loitoktok district of Kenya (Muthee *et al.*, 2011). Bovine pasteurellosis was frequently treated using about thirty two plants species in our study. Chabi China *et al.*, (2014) reported only one *Adansonia digitata* used as medicinal plant to treat bovine

pasteurellosis among all the plants species revealed to prevent or treat ailments of somba cattle breed in northern Benin. For treating bovine tuberculosis, no plants were identified during our survey. However, at Kedougou, in Senegal, Gning *et al.*, (2014) reported that *Vitellaria paradoxa* is more used for the treatment of bovine tuberculosis. Therefore in this study, bronchitis is treated using a total of 11 plants. However *Ocimum gratissimum* and *Vernonia amygdalina* is more reported by the breeders. In Zimbabwe's village poultry, Masimba *et al.* (2011) reported *Aloe vera*, *Albizia gummisera*, *Allium cepa*, *Euphorbia matabelensis* to be used in the control of respiratory problems including bronchitis. *Euphorbia unispina* and *Securinega virosa* are more mentioned by breeders to treat the infectious coryza. The cutaneous streptothricosis, BCPP and avian salmonellosis are treated by three species plants. According to Ndhlovu and Masika (2013), *P. angolensis* has been used for treatment of bovine streptothricosis in Zimbabwe. In addition, Luseba *et al.*, (2007) reported that *P. angolensis* had antibacterial activities. Against Bovine contagious pleuropneumonia, Giday and Teklehaymanot (2013) reported Leaves of *Aloe trichosanthes*; flower of *Caralluma* sp; roots or leaves of *Citrullus colocynthis*; stem of *Euphorbia* sp. and root of *Sericocomopsis pallida* in Ethiopia. During our study, it's noticed that Blackleg is treated using *Aganope stuhlmannii*. In contrast, Tamboura *et al.* (1998) reported that in Burkina Faso, *Guiera senegalensis* was used by breeders to treat blackleg. In this study, plants identified by breeders to treat bacterial diseases were frequently from family of Leguminosae-Caesalpinioideae, Leguminosae-Mimosoideae, Euphorbiaceae, Leguminosae-Papilionoideae, Poaceae and Rubiaceae. This observation is however different from that of Muthee *et al.* (2011) who reported that the highest families of plant which were more cited in Loitoktok district of Kenya were Fabaceae, Euphorbiaceae and Rutaceae. Moreover, in Plateau State of Nigeria, Offiah *et al.* (2011) revealed that Fabaceae, Combretaceae, Rubiaceae and Euphorbiaceae were the highest occurrences families. Euphorbiaceae is common family reported in this study. This may be due to the fact that survey is essentially focused on bacterial diseases but not on all animal ailments. It was also observed that the barks (56.84 %) is the most organ used, followed by Roots (15.78 %) and leaves (14.74 %). These results are similar to the observation made by Yinegar *et al.* (2007) and Offiah *et al.* (2011).

Medicinal plants are rich in variety of secondary metabolites of antimicrobial properties such as saponins, tannins, alkaloids, flavonoids and terpenoids (Lewis and Ausubel, 2006; Abdallah, 2011). The active components in the crude extract may be acting synergistically to produce antimicrobial effects (Elloff, 1998; Joshua and Takudzwa, 2013). According to Magaji and Yaro (2006) as well as Kawo *et al.* (2009), phytochemical components are responsible for both pharmacological and toxic activities in plants. Most of the medicinal plants which are cited in this study by the breeders contained saponins, tannins, alkaloids, tyrosin, flavonoids, phytosterol substances, triterpenoids, quadrangularins, parthenocissin, terpenoids and antibacterial

activity as reported by some authors for *Ocimum gratissimum*, *Securinega virosa*, *Khaya senegalensis*, *Azelia Africana*, *Parkia biglobosa*, *Mangifera indica* *Cissus quadrangularis* (Pahlaviani *et al.*, 2013; Aiyelero *et al.*, 2012; Ugoh *et al.*, 2014 ; Kamur *et al.*, 2010 ; Builders *et al.*, 2012 ; Akinpelu *et al.*, 2008 ; Elloff, 1998 ; Joshua and Takudzwa, 2013; Joseph and Raj, 2011; Murthy *et al.*, 2003). Most of the plants identified to treat bacterial diseases are also inventoried by Ogni *et al.* (2014) in a previous study to treat parasitic diseases. *Adansonia digitata*, *Anogeissus leiocarpa*, *Mitragyna inermis*, *Prosopis africana*, *Mangifera indica*, *Tamarindus indica*, *Detarium microcarpum* were frequently cited by breeders to treat internal parasitic diseases. This may be relating to the experience of breeders and their indigenous knowledge on pest plants control. According to Tchoumboungang *et al.* (2009), pest control plants contain some phenolic groups that have a powerful effect on parasites. Similarly, Satrani *et al.* (2007) and Amarti *et al.* (2010) have shown through their work that phenols contain the highest antibacterial factor.

Previously, no ethno-pharmacological study was focused on assessment of the vegetation potential of our Savannah to treat only livestock bacterial diseases. Most of the Ethno-botanical studies that have been done in breeding, dealing with parasitic diseases or taking into account all type of livestock diseases. This differentiation may be due to the fact that parasitic diseases are macroscopically more noticeable. Thus, they call more the breeders' attention than of the infectious diseases that are not less important.

CONCLUSION

Data collected from the breeders showed that ethno-veterinary medicine is a common practice used in Benin to improve the performance of animal production. In addition to modern medicine, breeders use as well medicinal plants to treat their animals. Despite traditional pest control by plant knowledge, this study has helped to identify a certain number of useful plants that treat bacterial diseases. It would be interesting to expand this survey to the viral diseases, to better promote the medicinal plant potential of Benin found in forests and savannas, for breeders community to benefit from it.

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