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Ethnobotanical Knowledge of Rabbit Breeder's Community for Treating Livestock Diseases in Benin

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Abstract

The study aims to inventory the medicinal plants used in feeding, health and reproduction of rabbits. The surveys were carried out at 248 rabbit's breeders in southern Benin. The identification of frequent species has been carried out. The ethnobotanical data were analyzed using various quantitative indices calculated for each of the medicinal plants recorded such as Relative Frequency of Citations (RFC), Informant Consensus Factor (ICF), Relative Importance Index (RII), Use Value (UV), Family Importance Value Index (FIV), and Fidelity Level (FL). In addition, a linear regression was performed between RFC and UV and then between RFC and RII. The results showed 16 plant species, belonging to 8 botanical families, which were reported in the treatment of pathologies. *Moringaceae* was the most common family (1 species, 6.33%; FIV = 39.11) followed by the *Lamiaceae* (5 species, 31.3%; FIV = 35.08) and the *Asteraceae* (3 species, 18.8%; FIV = 32.66). The leaves are the most used part of the plant (60.82). The highest ICF (0.93) was recorded for coccidiosis. The Pearson correlation coefficient between RFC and UV (0.83 **), and between RFC and RII (0.88 **) showing a significant positive association between RFC and UV and RII. This study shows that phytotherapy takes place in the treatment of rabbits, thus contributing to overcome the non-availability most often associated with the reduced efficacy of synthetic molecules. In order to make a better exploit of these data, it will be necessary to study the efficacy of these medicinal plants for better use.

Keywords: Rabbit; Plants; Ethnobotanical Survey

Introduction

Rabbit breeding is a growing activity in Benin. Rabbit meat consumption increased further to bird flu in 2005 and of Ebola haemorrhagic fever in 2013. The participation of traditional rabbit breeding in Benin's economies is therefore increased [1]. However, the production and growth performance of rabbits were dependent on a good and readily available feeding and good breeding conditions. Productive breeding of these animals therefore requires non-seasonally dependent forage [2]. Rabbit breeding is confronted with health and food constraints that limit the expression of zootechnical performance of animals on farms and reduce the availability of meat per capita [3]. To this situation is added to the emergence of parasites resistant to many synthetic molecules, combined with inaccessibility and non-availability of veterinary products predispose the stock breeders to resort today to medicinal plants. Those plants would provide for this purpose a therapeutic response adapted to the financial means and the socio-cultural environment of the breeders. The hypothesis is that fodder medicinal plants would treat animals and can be used as substitutes for synthetic antiparasitic. This study aims to inventory the medicinal plants used in the feeding and parasitosis treatment of rab bits in Benin. Subsequently the plants most cited by the respondents will be selected. Efficacy and innocuousness of selected those plant will be studied in the laboratory to confirm or deny those properties.

Material and Methods

Study area

Ethnobotany survey was carried out in the six (6) departments of south Benin: Atlantic, Littoral, Mono, Couffo, Oueme, and Plateau. The study area is located between 6° 20 and 7°30′ Northern latitude, 1°40′ and 2°45′ of longitude East (Figure 1). It covers a surface of 11866 km^2 for a population of 5042628 inhabitants [4]. This area of Benin is characterized by several climates. Indeed, the departments of Atlantic, Littoral, Mono, Couffo and Oueme were essentially marked by a subequatorial climate characterized by two dry seasons and two rains seasons with on average rain gauge of 1200 mm by year and a variant temperature varying on average between 27 °C and 31 °C according the National Institute of Statistics and Economic Analysis [5]. The department of Plateau has a climate of Soudano-Guinean type of two-rain seasons, a pluviometry included between 800 mm and 1200 mm in its Western part between 1000 mm and 1400 mm in its East part [5].

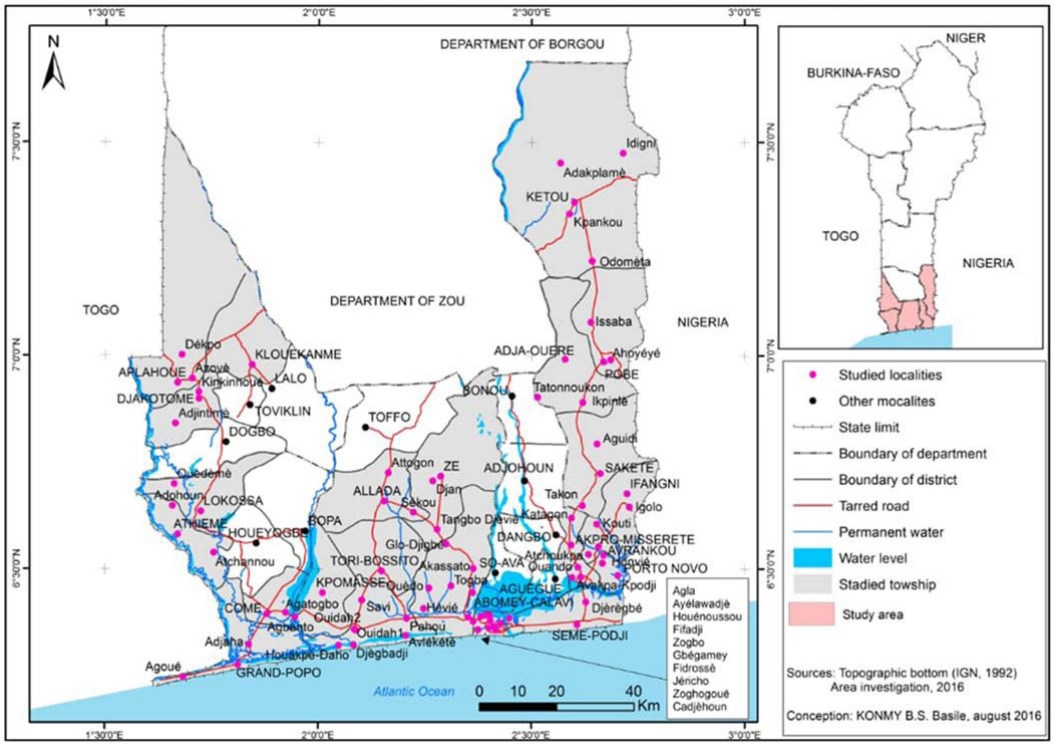

Figure 1: Map of the municipalities surveyed

Sampling and data collection

The methodology used is that of a retrospective survey on the pathologies and traditional therapies used by rabbit's breeders to prevent or treat pathologies as soon as they appear. An individual survey questionnaire was used. It provides information on the identity of the informant, the feeding of animals, the parasitic pathologies encountered, their causes, and the traditional herbal remedies used to treat them (plants, organs used, methods of preparation dosages and ways of administration). The study ran from September to November 2015. All breeders of rabbit were identified using the non-probabilistic "snowball" method [6]. However, the choice of stock breeders was based on their good knowledge of breeding practices and a good knowledge of the use of phyto-medicine in rabbit production. The survey allowed collecting information from 248 rabbits breeders. The medicinal plants used by the breeders were harvested and identified in situ using Benin's analytical flora, according to [7] and certified by the National Herbarium of Benin.

Calculation of indices

The ethnobotanical data collected were entered and organized by Microsoft Excel 2019, Sphinx Plus^2 (V5) and the R software version 3.6.3 for analysis and identifying the frequencies and percentages of the sociodemographic data of the respondents and various proportions of plant parts used, botanic families they belong to, and the number of plants used per each disease. The ethnobotanical survey's results were analyzed using various quantitative indices such as Relative Frequency of Citations (RFC), use value (UV), relative importance index (RII), in order to evaluate the importance of the recorded plant species and understand the degree of the potential utilization of each species. In this study, various diseases, were recorded. The result was analyzed using informant consensus factors (ICF) to determine the effectiveness of the medicinal plants in each ailment category according to [8] . Fidelity Level (FL) and family importance value index (FIV) were also used. The several ethnobotanical indices were calculated using the following statistical formula.

Use value (UV)

The relative importance of each plant species known locally to be used as a medicinal plant is reported as use value (UV). It was introduced by [9]. UV is calculated using the formula: $UV = \sum U/N$, where, U is the number of use reports cited by each informant for a given plant species and N is the total number of informants interviewed for a given plant. UVs are high when there are many use reports for a plant and low when there are few reports related to its use.

Relative Frequency of Citations (RFC)

RFC reveals the importance of each plant species known locally to be used as a medicinal plant. It is, the work as reported by previous studies [10], calculated using the formula: $RFC = \frac{FC}{N}$, (0<RFC<1), where FC (Frequency of Citation) is the number of informants who mentioned the use of the species and N is the total number of informants interviewed in the survey without considering the use categories. An RFC of 1 indicates that all informants recognized the plant as medicinal and cited at least one use, whereas, an RFC of 0 indicates that no informants cited a medicinal use of the plant.

Relative importance index (RII)

It was created by Califano and Echazu [11] and used by J Tardío and Pardo-de-Santayana [10] , based on the use categories of the species only and does not take into account the subcategories of use. It is calculated using the following formula: $RI_S = (RFC_{S(max)} + RUN_{S(\max)})/2$ where $RFC_{S\,(max)}$ is the Relative Frequency of Citation over the maximum, that is, it is obtained by dividing the FCs by the maximum value of all the species of the survey. [RFC = FC_S/ max (FC)], and $RNU_{S\,(max)}$ is the relative number of use categories over the maximum, obtained by dividing the number of uses of the species by the maximum value of all the species of the survey [$RNU_{S(max)}$ =NU_S / max (NU)].

The RII theoretically varies from 0, when no-one mentions any use of the plant species, to 1 in the case where the plant was the most frequently mentioned as useful and in the maximum number of use categories. The RII was used to rank the different species of plant. This ranking allowed comparison of the relative importance of the plants as perceived by the respondents and gave an overall picture of which plants were most used for several diseases.

Informant Consensus Factor (ICF)

According to [8], the ICF measures the consensus in using plants in a group about treating various diseases in the study area. It was calculated using the following formula: ICF = (Nur- Nt)/ (Nur- 1), where Nur is the number of use reports of a particular disease category and Nt is the number of plant species used for the particular disease category.

Fidelity Level (FL)

Fidelity Level (FL) was created by [12]. It is calculated to identify the level of agreement among informants on medicinal plant species used in the treatment of various diseases. The following formula: FL (%) = (Np/N) × 100 was used, where Np is the number of use reports for a given species reported being used for a particular disease category, and N is the total number of use reports cited for any given species.

Family importance value index (FIV)

Family importance value (FIV) was calculated by taking the percentage of informants mentioning the family; it is calculated as follows: FIV = FC (family) / N × 100, where FC is the number of informants mentioning the family, while N is the total number of informants participating in the study [13].

Statistical analysis

A descriptive analysis of the data was performed using Microsoft Office 2019 Excel and then R software (version 3.6.3). Pearson correlation coefficients were calculated to quantify the nature of the linear and monotonic relationship, respectively between the RFC and UV, and between RFC and RII. A p-value of less than 0.05 was considered to be statistically significant. The variable disease is allowed the frequencies and averages of the various parameters to be determined. Multidimensional analyses were also performed using the R software using the "FactoMineR" and "Factoextra" packages. Multidimensional analysis has been composed of:

− A Principal Component Analysis (PCA): was performed on the relative frequencies of citations to examine whether the citation was consistent between the phytodistricts. This made it possible to obtain a representation of pathologies and species mentioned in the form of projections on plans defined by the first factorial axes.

− An Ascending Hierarchical Classification (AHC), classification method (from the coordinates of the farms on the main factorial axes), which makes it possible to group the farms according to the traditional practices used in the therapeutics of the rabbits. The set of plants used to be represented in the form of a tree (dendrogram). The different groups of the typology corresponding to the main "branches" of the tree were then constituted.

Results

Respondents' demographic characteristics:

A majority of respondents (78.23%) were male (Table 1). A majority of respondents (50.1%) were adult (Figure 2a). The respondents (49.2%) have less than 10 years of experience (Figure 2b). Most respondents (22.58%) were illiterate. A majority of respondents were artisans (29 %) and civil servant 25.81% (Figure 2c).

Variables		Atlantic	Littoral	Mono	Couffo	Oueme	Plateau	Total
Gender	Male	36 (70.60)	37 (80.40)	21 (56.80)	21 (56.80)	37 (82.20)	45 (91.80)	194 (78.20)
	Female	15 (29.40)	9 (19.60)	16 (43.20)	2 (10.00)	8 (17.80)	4 (8.20)	54 (21.80)
Age	≤ 30	14 (27.50)	21 (45.70)	5 (13.50)	5 (25.00)	14 (31.10)	10 (20.40)	69 (27.80)
	30 – 40	15 (29.40)	10 (21.70)	14 (37.80)	6 (30.00)	16 (35.60)	11 (22.40)	72 (29.00)
	40 – 50	8 (15.70)	6 (13.00)	8 (21.60)	4 (20.00)	10 (22.20)	17 (34.70)	53 (21.40)
	50 – 60	4 (7.80)	7 (15.20)	6 (16.20)	2 (10.00)	4 (8.90)	7 (14.30)	30 (12.10)
	> 60	10 (19.60)	2 (4.30)	4 (10.80)	3 (15.00)	1 (2.20)	4 (8.20)	24 (9.70)
Experience	<10	23 (45.10)	25 (54.30)	15 (40.50)	10 (50.00)	19 (42.20)	30 (61.20)	122 (49.20)
	]10–20]	19 (37.30)	13 (28.30)	13 (35.10)	5 (25.00)	16 (35.60)	14 (28.60)	80 (32.30)
	]20–30]	8 (15.70)	8 (17.40)	9 (24.30)	5 (25.00)	10 (22.20)	5 (10.20)	45 (18.10)
	>30	1 (2.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)
Scolarisation	Illiterate	18 (35.30)	12 (26.10)	9 (24.30)	7 (35.00)	3 (6.70)	7 (14.30)	56 (22.60)
	Primary	18 (35.30)	13 (28.30)	13 (35.10)	7 (35.00)	13 (28.90)	9 (18.40)	73 (29.40)
	Secondary	11 (21.60)	5 (10.90)	11 (29.70)	6 (30.00)	7 (15.60)	18 (36.70)	58 (23.40)
	University	4 (7.80)	16 (34.80)	4 (10.80)	0 (0.00)	22 (48.90)	15 (30.60)	61 (24.60)

Variables		Atlantique	Littoral	Mono	Couffo	Oueme	Plateau	Total
Activities	Breeding	10 (19.60)	4 (8.70)	10 (27.00)	4 (20.00)	2 (4.40)	13 (26.50)	43 (17.30)
	Agriculture	4 (7.80)	2 (4.30)	9 (24.30)	10 (50.00)	0 (0.00)	7 (14.30)	32 (12.90)
	Civil servant	7 (13.70)	8 (17.40)	7 (18.90)	3 (15.00)	20 (44.40)	19 (38.80)	64 (25.80)
	Trading	15 (29.40)	6 (13.00)	4 (10.80)	1 (5.00)	9 (20.00)	2 (4.10)	37 (14.90)
	Artisan	15 (29.40)	26 (56.50)	7 (18.90)	2 (10.00)	14 (31.10)	8 (16.30)	72 (29.00)

Table 1: Demographic characteristics of respondents in the study area (N =248)

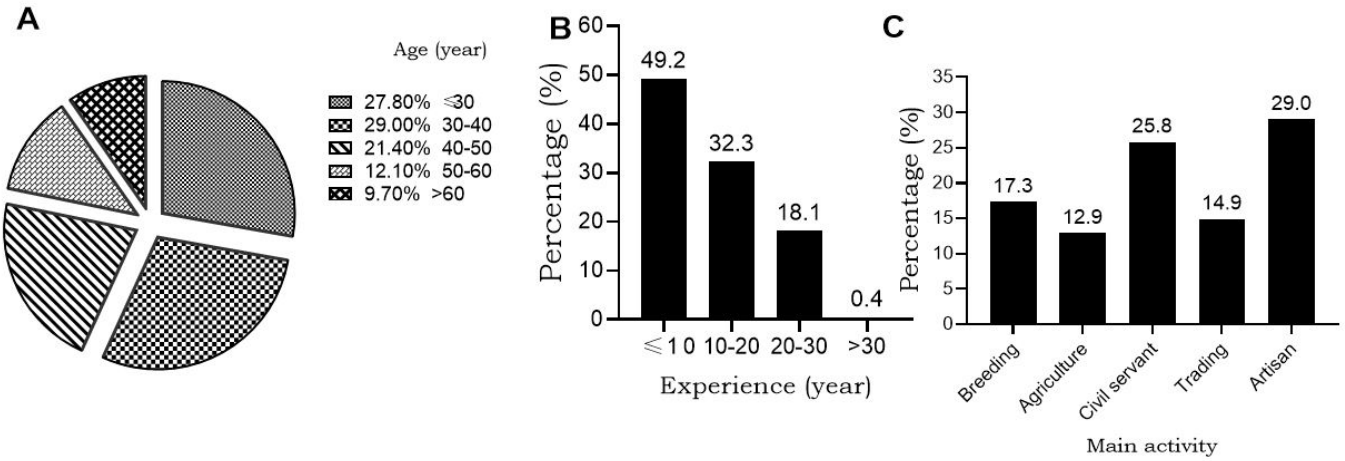

Figure 2: Characteristics of respondents in the study **(A)** Age characteristics of respondents; **(B)** Experience of respondents in rabbits breeding; **(C)** Mains activities of respondents

Management of livestock

The kits present in the breeding vary between 2 and 220 heads. Most respondents have a small number of rabbit's doe. 57.7% of respondents have a number of rabbit's doe fewer than 20 heads (Figure 3a). The mother rabbits have an average of 7 to 8 bunnies per farrowing (Figure 3b) with an annual reproduction cycle from 7 to 8 gestation on average (Figure 3c). All respondents used natural insemination for the animals' reproduction.

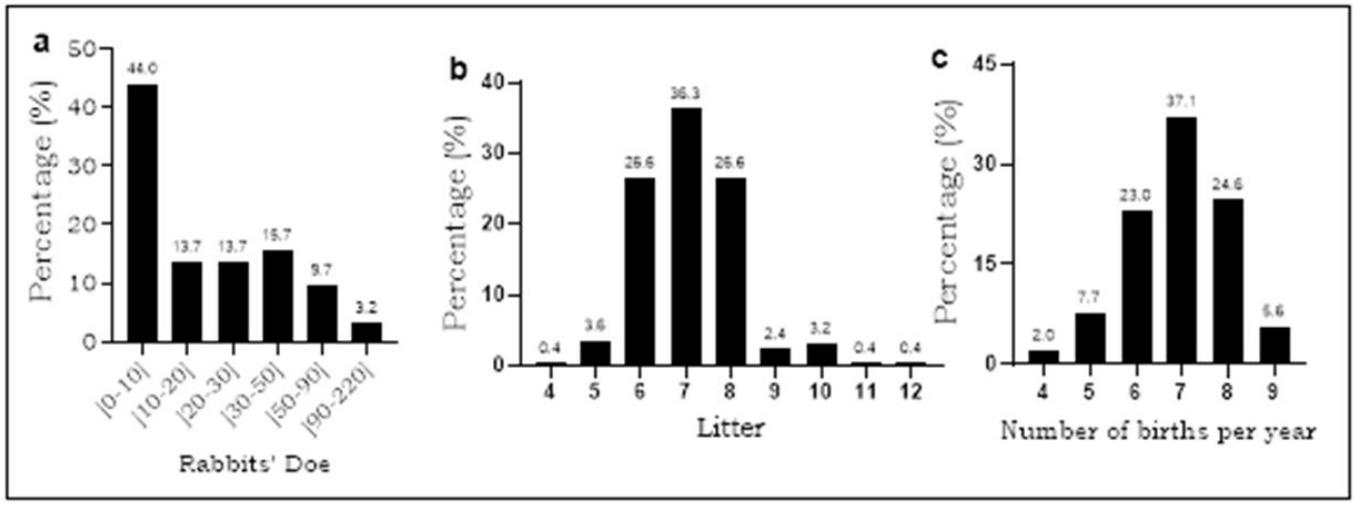

Figure 3: Characteristics of breeding **(A)** number of rabbit's doe; **(B)** litter per birth; **(C)** number of births per year

Medicinal plants recorded and used by respondents

In the study area, we recorded 16 species of useful plants, belonging to 8 botanical families, which were identified as having medicinal values and were used by the respondents in the study area against rabbit pathologies. The names of the plants, including their families, the parts of plants used and the conditions treated for each species, are presented in Table 2. Among the families (Figure 4a) that brought the most medicinal species in the study area, we find *Lamiaceae*, represented by 5 species (31.3%), *Euphorbiaceae* and *Asteraceae* each represented by 3 species (18.8%), followed by *Anacardiaceae*, *Caricaceae*, *Meliaceae*, *Moringaceae* and *Rutaceae* each represented by 1 species (6.3%).

Botanical name	Family	Plant parts used	Diseases treated	UV	FC	RFC	FL	RII
Moringa Oleifera	*Moringaceae*	Leaves	4	1.56	97	39.11	56.40	1.00
Ocimum gratissimum	*Lamiaceae*	Leaves	4	1.33	64	25.81	37.21	0.83
Vernonia Amygdalina	*Asteraceae*	Leaves	2	1.32	77	31.05	44.77	0.65
Zanthoxylum zanthoxyloides	*Rutaceae*	Leaves	1	0.20	35	14.11	20.35	0.31
Khaya senegalensis	*Meliaceae*	Bark	1	0.02	3	1.21	1.74	0.14
Flueggea virosa	*Euphorbiaceae*	Leaves	1	0.03	5	2.02	2.91	0.15
Chromolaena odorata	*Asteraceae*	Areal part	2	0.11	2	0.81	1.16	0.26
Carica papaya	*Caricaceae*	Leaves. Fruit	1	0.35	61	24.60	35.47	0.44
Hyssopus officinalis	*Lamiaceae*	Areal part	1	0.03	5	2.02	2.91	0.15
Hyptis suaveolens	*Lamiaceae*	Areal part	3	0.33	8	3.23	4.65	0.42
Taraxacum sp	*Asteraceae*	Areal part	1	0.01	2	0.81	1.16	0.14
Spondias mombin	*anacardiaceae*	Leaves	3	0.16	2	0.81	1.16	0.39
Ocimum basilicum	*Lamiaceae*	Leaves. tiges	3	1.01	9	3.63	5.23	0.42
Mentha spicata	*Lamiaceae*	Areal part	1	0.01	1	0.40	0.58	0.13
Euphorbia hirta	*Euphorbiaceae*	Areal part	2	0.01	1	0.40	0.58	0.26
Jatropha curcas	*Euphorbiaceae*	Leaves	2	0.40	38	15.32	22.09	0.45

Table 2: Medicinal plants traditionally used by the breeders with their use value Use Value (UV), Relative Frequency of Citation (RFC), Fidelity Level and Relative Importance Index (RII)

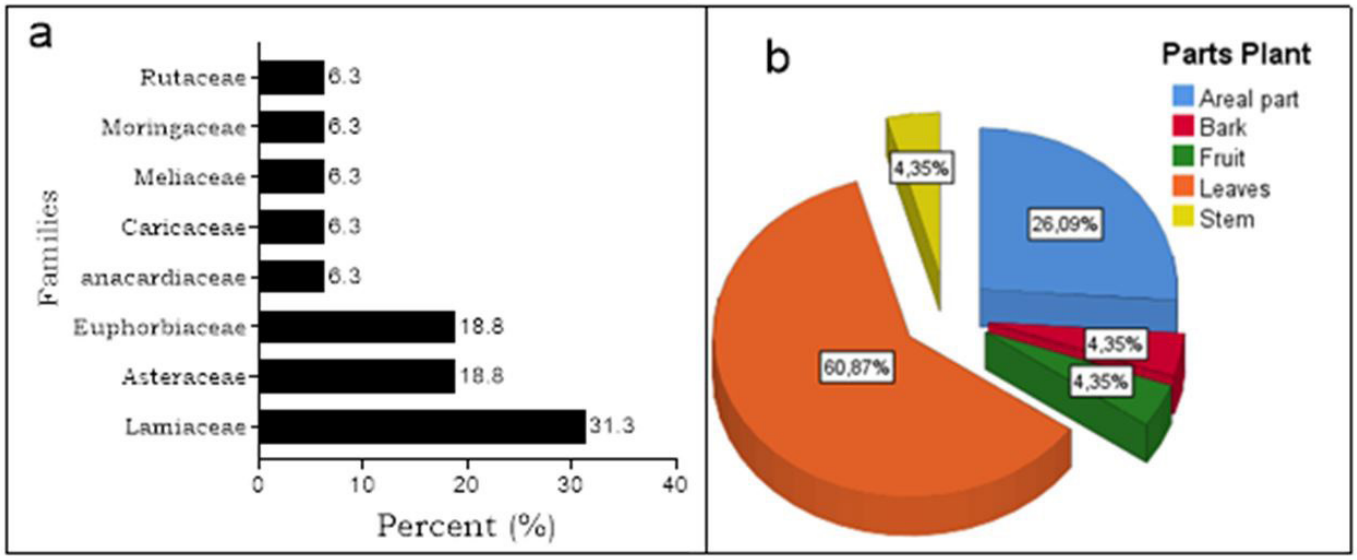

Figure 4: Characteristics of medicinal plants **(A)** family of medicinal plants; **(B)** parts of medicinal plants used

Part of the plants used

Respondents in the study area used different species of plants for animal care. The ethnobotanical survey revealed that leaves (Figure 4b) were the most commonly used part. The use of leaves represents 60.86%; followed by the aerial part of 26.09%; fruits, stems and bark come last with 4.35% each.

Calculation of various ethnobotanical indices

Use value (UV)

Use value (UV) is a measure of the types of uses attributed to a particular plant species. It determines the extent to which a species can be used. In this study, the UV values of the plants cited ranged from 1.56 to 0.01. According to the calculation based on UV. *Moringa Oleifera* was the most frequently used plant by respondents (1.56) with 143 reports of use, and was found to have the highest UV due to its therapeutic significance and good variety. *Euphorbia hirta, Taraxacum sp, Mentha spicata* all had the lowest UV (0.01) with only 2 use ratios (Table 2). This index can be low or high depending on the ease of access to the plant in question, it uses, accessibility and the knowledge of the users of the plant in the area concerned.

Relative Frequency of Citation (RFC)

The Relative Frequency of Citation (RFC) shows the local eminence of each species in reference to the informants who cited these plant species [27]. It also shows the traditional importance of each species with respect to the informants who cited these medicinal species. In the study area, the RFC ranged from 39.11% to 0.4% (Table 2). *Moringa Oleifera* was the plant species with the highest RFC, at 39.11%. It is used for many ailments (coccidiosis, scabies, abscesses, diarrhoea; it also facilitates digestion. *Moringa Oleifera* was followed by *Vernonia Amygdalina* (31.05%), *Ocimum gratissimum* (25.81%), *Carica papaya* (24.60%). The lowest RFC level was recorded for *Euphorbia hirta, Mentha spicata* (0.1%) each.

Relative importance index (RII)

The relative importance index (RII) of the medicinal species identified in the study area is presented in Table 2. It shows that *Moringa Oleifera* has the highest RII values (1.00) further proof that the species was the most versatile in our study area as it is widely used by local populations who have considerable knowledge of it, and for its use in the treatment of the greatest number

of pathologies; it also has the greatest number of medical uses. *Moringa Oleifera* is followed by *Ocimum gratissimum* (0.83) and *Vernonia Amygdalina* (0.65). *Flueggea virosa (*0.15), *Hyssopus officinalis* (0.15), *Khaya senegalensis* (0.14), *Taraxacum sp* (0.14) and *Mentha spicata* (0.13) reached the lowest values of the relative importance index and were therefore less versatile in the study area.

Fidelity Level (FL)

In this study, the fidelity level (FL) of the species reported in the study area ranged from 0.58% to 56.40% (Table 2). The plant with the highest level of fidelity was *Moringa Oleifera* (56.40%), *Vernonia Amygdalina* (44.77%), *Ocimum gratissimum* (37.21%), and *Carica papaya* (35.47%).

Family Importance Value Index (FIV)

In this study, the Family Importance Value (FIV) index of families reported in the study area ranged from 0.8 to 39.11 (Table 3). The most common family represented by its FIV was the *Moringaceae* family (1 species, 6.33%; FIV = 39.11), followed by the *Lamiaceae* (5 species, 31.3%; FIV = 35.08) and the *Asteraceae* (3 species, 18.8%; FIV = 32.66). The family with the lowest FIV was

Family	Especes' number	Percentage	FIV
Anacardiaceae	1	6.3	0.81
Asteraceae	3	18.8	32.66
Caricaceae	1	6.3	24.60
Euphorbiaceae	3	18.8	17.74
Lamiaceae	5	31.3	35.08
Meliaceae	1	6.3	1.21
Moringaceae	1	6.3	39.11
Rutaceae	1	6.3	14.11

Table 3: Botanical families reported and their Family Importance Value (FIV)

Anacardiaceae (2 species; 6.3%; FIV = 0.81).

Informant Consensus Factor (ICF)

ICFs for different diseases were calculated to test the homogeneity or consistency of informants' knowledge about a particular cure for a disease. Table 4 summarizes the ICF values obtained for the classified diseases. The results of the calculation of the Informant Consensus Factor (ICF) (Table 4) show that most of the diseases in this study were recorded with the highest ICF. This indicates

Type of diseases	ICF
Coccidiosis	0.93
Scabies	0.96
Diarrhoea	0.90
Abscess	0.73

Table 4: Mains disease and Informant Consensus Factor (ICF)

a significant degree of knowledge sharing among informants in the study area to address a particular condition in a given plant species. The ICF value for coccidiosis (Table 4) ranges from 0.93. The highest ICF value was recorded for scabies (0.96).

Pearson Correlation

Pearson correlation analysis was performed between RFC and UV, and between RFC and RII. The Pearson correlation coefficient between RFC and UV was 0.83** with a p-value of less than 0.005 (0.0001), which shows and proves a strong significant positive

correlation between the importance of plant species in the study area and the relative importance of their use. This shows that knowledge and use of a medicinal plant species increases with the number of informants (Figure 5a). However, the Pearson correlation coefficient between the RFC and the RII was 0.88** with a p-value less than 0.005 (0.0001), which also shows a strong positive significant correlation between the RFC of the plant used in the study area and the RII. This shows and confirms that the most frequently cited plant species correspond to those with the greatest number of medicinal uses and that the RFC of a medicinal

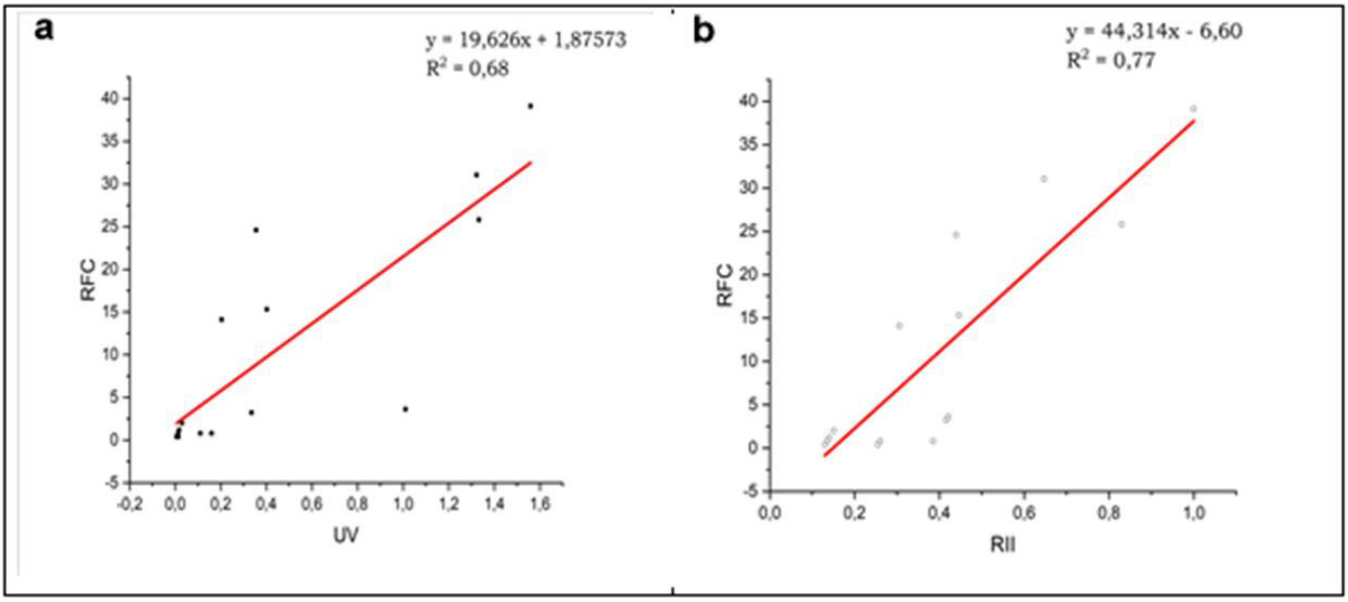

Figure 5: Pearson Correlation **(A)** Association between Relative Frequency of Citation (RFC) and use value (UV); **(B)** Association between Relative Frequency of Citation (RFC) and the relative importance index (RII)

plant species increases with the most versatile plant species (Figure 5b). Thus, the versatility of each plant species depends on its importance.

Identified livestock diseases

Its noted on average of 81% in cases of coccidiosis, 6.9% in cases of diarrhoea of various origins. External pathologies were also common with 58.5% scabies, 16.1% abscess cases on average. At the onset of these pathologies, 56.5% of the breeders mostly resort to synthetic products, while others (48.8%) make use of herbal medicine. In the prevention against these diseases, any breeders did not practice vaccination. Deworming was done in 91.1% of cases by the mixed use of synthetic molecules and phytotherapies products that constitute prophylactic measures.

Characterization of breeders according to pathologies encountered and phytosanitary care.

The analysis of the eigenvalues of the correlation matrix (Table 5) of the Principal Component Analysis (PCA) revealed that the

	Variance	% of variance	Cumulative % of variance
Dim.1	1.83	45.83	45.83
Dim.2	1.58	39.44	85.27
Dim.3	0.39	9.75	95.02
Dim.4	0.20	4.98	100.00

Table 5: Evolution of the cumulative percentage of the explained variance according to the first 4 factorial axis

first three dimensions explained 95.02% of the variability of the pathologies. As this shared of information is well above 50%, these first three dimensions can be used to adequately interpret the results of the PCA.

The study of the correlation between the three dimensions and the initial variables (Table 6) indicates that the variables coccidiosis, diarrhoea and scabies were positively correlated with axis 1, which explained 45.83% of the variability. In some breeding, coccidiosis was positively correlated with scabies and diarrhoea. Regarding axis 2, which accounts for 39.44% of the variability of the conditions, it showed a positive correlation with the variable's scabies, abscess and a negative correlation with the variable diarrhoea axis 2 informed us that the appearance of manage in some farms is concomitant with that of abscesses. During these affections, there is no diarrhoeal effusion. Axis 3, meanwhile, accounts for 9.75% of the variability and indicated a positive correlation with the variable scabies and a negative correlation with the variable abscess Scabies and abscesses were negatively

	Dim.1	ctr	cos^2	Dim.2	ctr	cos^2	Dim.3	ctr	cos^2
Coccidiosis	**0.93**	**47.02**	**0.86**	-0.19	2.35	0.04	0.00	0.00	0.00
Scabies	0.55	16.32	0.30	**0.72**	**32.69**	**0.52**	-0.41	43.86	0.17
Diarrhoea	**0.79**	**33.99**	**0.62**	-0.52	16.85	0.27	0.16	6.94	0.03
Abscess	0.22	2.68	0.05	**0.87**	**48.11**	**0.76**	0.44	49.20	0.19

Table 6: Correlation between variable at factorial axis

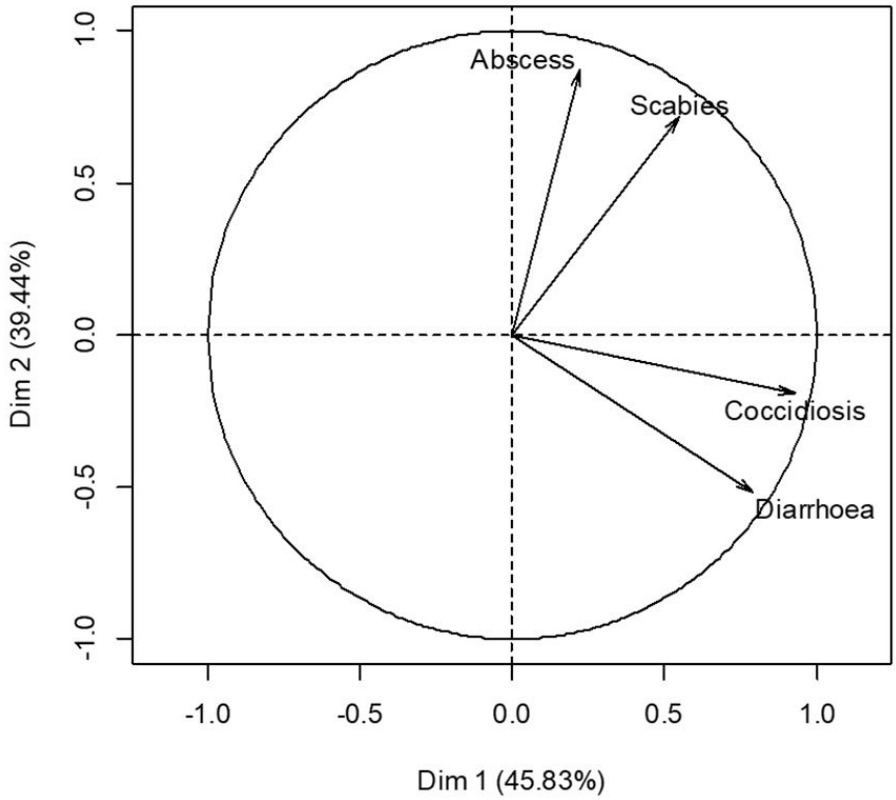

Figure 6: Correlation circle of PCA variables

correlated with some breedings. In these breedings, affections of scabies, were not followed by abscesses. Correlations between the different axis (1 and 2) were shown in Figure 6.

Identification of breeders' groups according to phytosanitary practices

Three categories of rabbit's breeders were distinguished by considering the configuration of the dendrogram of the ascending hierarchical classification (Figure 7). Those three groups (categories) each related to a profile according to precised and selected criteria.

The projection of the observations in the systems of axes 1 and 2 (Figure 8) showed that the members of the group 1 (69.23% of the respondents) were located in the negative parts of axis 1 and 2. This group corresponds to the rabbit's breeders who record in

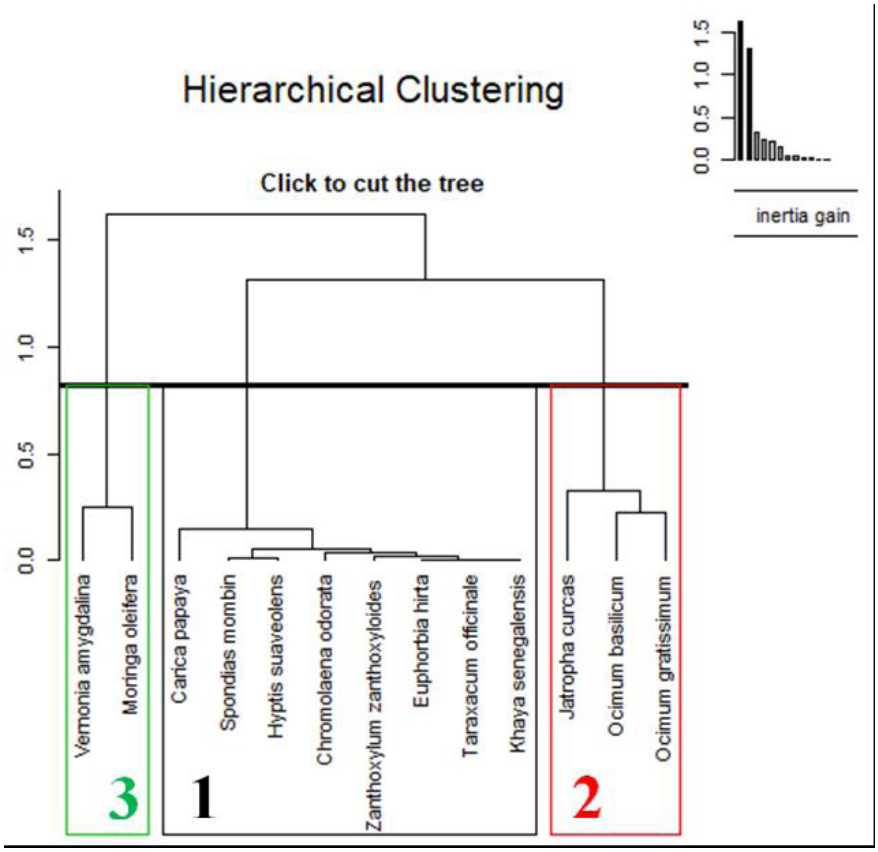

Figure 7: Dendrogram of Hierarchical Classification of rabbit's breeder's categorization

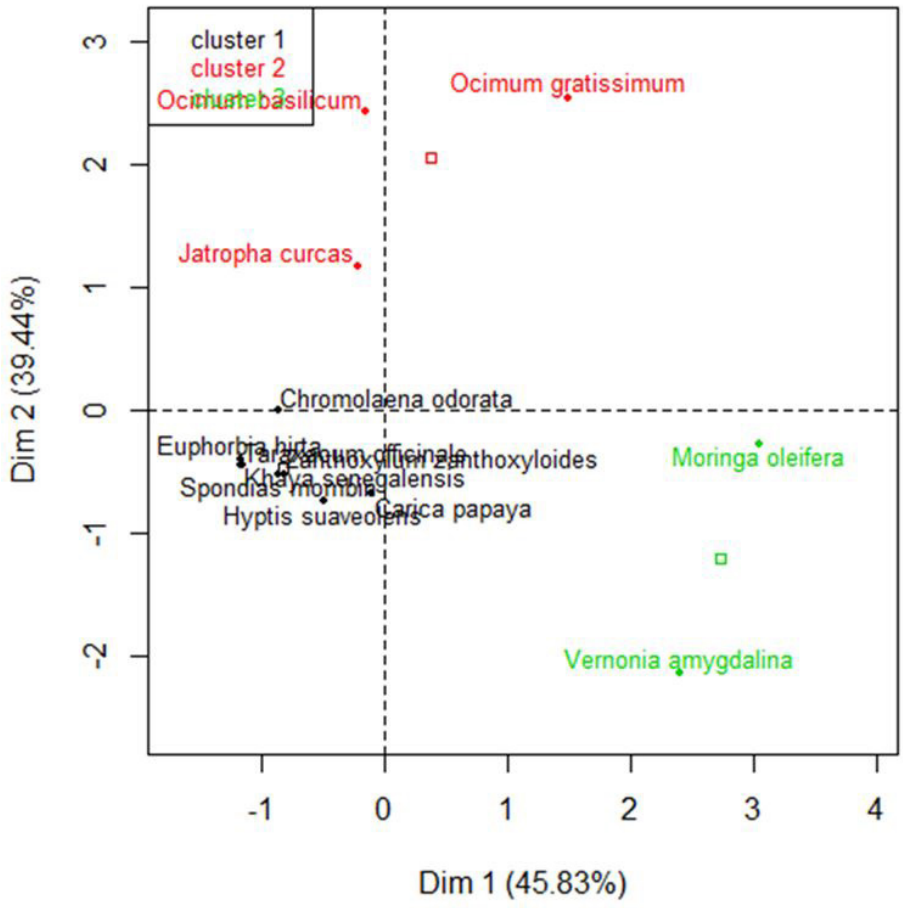

Figure 8: Point cloud relative to the position of medicinal plants used by rabbit's breeders in relation to the two axes

their breedings either scabies or abscesses. These rabbit's breeders often use the leaves of *Zanthoxylum zanthoxyloides*, *Taraxacum officinale, Spondias mombin* and *Euphorbia hirta* to treat animals.

Group 2 members (15.38% of the respondents) were located in the positive part of axis 2. This group referred to breeders who recorded cases of scabies associated with abscesses. These pathologies were treated with the leaves of *Ocimum gratissimum*, *Ocimum basilicum* and *Jatropha curcas*.

The members of group 3 (15.38% of the respondents) were located in the positive part of axis 1 and the negative part of axis 2. These groups of breeders corresponded to those who recorded cases of coccidiosis and diarrhoea. They were treated by the use of leaves of *Moringa Oleifera* and *Vernonia Amygdalina.*

The medicinal plants which have a high value for the indices (Table 2) and cited by at least 20% of respondents according to Tramil group [14] methods, and adopted by [15], will be used for the furthers studies.

Discussion

The results relating to the socio-economic characteristics of rabbit breeders showed great social diversity within breeders of rabbits. Both women and men, young people, adults, the elderly, the educated and the uneducated practice rabbit breeding too, etc. The predominance of men breeders (78%) generally recorded in southern Benin is similar to the results recorded by [16] in Abidjan (94.76% of men breeders against 5.24% of women) and those of [17] in the Democratic Republic of Congo which was 57.9%. Most rabbit breeding is recent. Most rabbit breeding is recent and most breeders have an experience of less than 10 years.

The use of green fodder is abundant in rabbit breeding as observed by [18]. The most used fodders were *Elaeis guineensis* (53.6%), *Tridax procumbens* (38.3%), *Sida acuta* (36.3%), *Moringa Oleifera* (24.2%) and *Leucaena leucocephala* (21.8%). These results were similar to [19] who reported that: *Tridax procumbens, Elaeis guineensis, Panicum maximum, Centrosema pubescens, Ipomoea aquatica, Ipomoea batatas, Sida acuta, Stylosanthes scabra secca, Boerhavia erecta, Gliricidia sepium, Paspalum vagitatum, Pueraria phaseoloides, Penisetum purpureum, Pennisetum purpureum, Vernonia pauciflora* were the plants used to feed rabbits and they were palatable. [20] showed that incorporation of *Moringa Oleifera* leaf increases the digestibility of dry matter, organic matter and crude protein in goats. The leaves of *Moringa Oleifera* have good nutritional values, more rich in proteins with a suitable profile in essential amino acids, a large proportion of which 80 to 92% remains potentially available in the intestine [21,22]. The survey revealed that breeders feed rabbits with a variety of foods: formulated foods (self-produced or purchased feeds), fodder and agricultural by-products. Provender was most commonly used to live in urban areas such as Cotonou and Calavi because green fodders were far from these places or difficult to access. This increases the cost of breeding in these areas. These results were similar to those recorded by previous studies [23] in the study of the rabbit market in Benin. During the survey, it was noted that coccidiosis (81.5%) is the most common pathology in rabbit breeding, followed by scabies (58.5%). This result agrees with those recorded by [3] which states that coccidiosis and scabies were very common in rabbits in Africa. However, it stated that the cases of scabies observed were most often due to lack of hygiene [3]. These results were also similar to those of [24] who describes coccidiosis, scabies, and diarrhoea as one of the major diseases that can be found in rabbit breeding. On the other hand, these results were contrary to those recorded by [17] in the Democratic Republic of Congo (DRC). These two authors estimate that in breeding, the most common pathology is scabies. To treat rabbits against these different pathologies, breeders make use of modern treatments and traditional treatments. Traditional treatments were based on the use of phytosanitary products, the most common of which were *Moringa Oleifera, Ocimum gratissimum, Carica papaya, Vernonia Amygdalina*. These plants were used for different purposes including the deworming of animals and the treatment of various pathologies. These results were similar to the work of several authors [25-30] who have shown that these different plants were used to treat different pathologies in both monogastric and polygastric herbivores. Various extracts of these plants have been tested to evaluate antiparasitic activity of these plants on animals.

Rabbit breeders decide on the number of buck rabbits in their breeding according to the number of rabbit's doe they own. We most often counted 1 to 2 buck rabbits for every 10 rabbit's does. Females were primarily reproduced for the first time around the fifth month on average. In rabbit breeding, the litter is 6 to 8 on average per farrowing. However, high litters (10 to 13 kits) were also recorded. These results corroborate the works of [31] who showed that the age of the rabbits for the first reproduction is about 5 months and that the rabbit doe give between 1 and 12 kits by farrowing of which 5 to 7 kits on average in the tropical zone. Stillbirth after weaning rabbits is high and averages around 10%. This showed that during fattening, kits were fragile to the new hostile sanitary environment. They most often succumb to a coccidia infestation, especially in the absence of regular monitoring. In contrast to rabbit's doe, kits do not benefit from any effective immunity transmitted by the rabbit doe. The work of [32,33], which states that rabbit doe did not transmit any protective immunity to her rabbits, demonstrated these results. There is no cross immunity between the species. Only cell-mediated immunity provides real protection to kits. These authors also emphasize the role of local immunity [32,33].

Conclusion

This study made it possible to assess the level of knowledge of the use of plants by breeders and agro-pastoralists in Benin to treat various parasitic pathologies in rabbits. This survey revealed that rabbit breeders have a good potential for indigenous knowledge that can improve animal health. Considering the diversity of plant species identified in this study, four (4) species have been given special attention depending on the number of pathologies they treat and their citation indices. These were *Moringa Oleifera*, *Ocimum gratissimum*, *Vernonia Amygdalina* and *Carica papaya*. In perspective, it is planned to carry out a bibliographic study of the most cited plants, and carry out efficiency tests of some of these plants for a better use by the rabbits breeders.

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Declarations of interest

None.

References

1. Kpodekon M, Toleba S, Boko C, Dagnibo M, Djago Y, et al, (2015) Fréquence des *Escherichia coli* entéropathogènes chez les lapins (*Oryctolagus cuniculus*) dans la commune d'Abomey-Calavi en zone sub-équatoriale du Bénin. Rev Med Vet 166: 84-9.

2. Ahemen T, Abu AH, Iorgilim LK (2013) Physiological responses of rabbits fed graded levels of *Moringa Oleifera* leaf meal (MOLM): Some aspects of haematology and serum biochemistry. Arch Appl Sci Res 5: 172-6.

3. Licois D (2010) Pathologie d'origine bactérienne et parasitaire chez le lapin: apports de la dernière décennie. Cuniculture 37: 35-49.

4. INSAE (2013) Effectifs de la population des villages et quartiers de ville du Bénin, Benin.

5. INSAE (2004) Cahier des villages et quartiers de ville du Bénin, Benin.

6. Johnston LG, Sabin K (2010) Échantillonnage déterminé selon les répondants pour les populations difficiles à joindre. Methodological Innovations Online 5: 38-48.

7. Akoègninou A, Van der Burg W, Van der Maesen LJG (2006) Flore analytique du Bénin: Backhuys Publishers, USA.

8. Heinrich M, Ankli A, Frei B, Weimann C, Sticher O (1998) Medicinal plants in Mexico: Healers' consensus and cultural importance. Soc Sci Med 47: 1859-71.

9. Phillips O, Gentry AH, Reynel C, Wilkin P, Gálvez-Durand BC (1994) Quantitative ethnobotany and Amazonian conservation. Conserv Biol 8: 225-48.

10. Tardío J, Pardo-de-Santayana M (2008) Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econ Bot 62: 24-39.

11. Califano LM, Echazu F (2013) Etnobotánica en comunidades pastoriles: conocimiento tradicional sobre especies tóxicas para el ganado en la cuenca del Río Iruya (Salta, Argentina)= Ethnobotany in pastoral communities. Traditional knowledge about toxic species for the livestock in Iruya river basin (Salta, Argentina). Bol Soc Argent Bot 48: 365-75.

12. Friedman J, Yaniv Z, Dafni A, Palewitch D (1986) A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. J Ethnopharmacol 16: 275-87.

13. Vitalini S, Iriti M, Puricelli C, Ciuchi D, Segale A, et al, (2013) Traditional knowledge on medicinal and food plants used in Val San Giacomo (Sondrio, Italy)—An alpine ethnobotanical study. J Ethnopharmacol 145: 517-29.

14. Tramil 4 (1989) Vers une pharmacopée aux Caraïbes. Recherche Scientifique et Usage Populaire des Plantes Médicinales dans le Caraïbe: Robineau L (ed).

15. Koko I, Djego J, Gbenou J, Hounzangbé-Adoté S, Sinsin B (2011) Etude phytochimique des principales plantes galactogènes et emménagogues utilisées dans les terroirs riverains de la Zone cynégétique de la Pendjari. Int J Biol Chem Sci 5: 618-33.

16. Kimse M, Coulibaly K, Gnanda B, Zongo M, Yapi Y, et al, (2017) Caracterisation des systemes d'elevage cunicole dans le district D'abidjan (Cote D'ivoire). Agron Afr 29: 185-96.

17. Mutwedu V, Ayagirwe R, Metre K, Mugumaarhahama Y, Sadiki J, et al, (2015) Systèmes de production cunicole en milieu paysan au Sud-Kivu, est de la RD Congo. Livest Res Rural Dev 27: 10.

18. Colin M, Lebas F (1995) Le lapin dans le monde: Association Française de Cuniculture, Benin.

19. Adehan R, Kpodekon M, Houenon J, Ossenti TB, Lebas F (1994) Etude comparée de l'appétibilité de vingt-trois plantes fourragères chez le lapin, premiers résultats. vol. 8: Zaragoza : CIHEAM.

20. Sánchez NR, Spörndly E, Ledin I (2006) Effect of feeding different levels of foliage of *Moringa Oleifera* to creole dairy cows on intake, digestibility, milk production and composition. Livest Sci 101: 24-31.

21. Kakengi A, Kaijage J, Sarwatt S, Mutayoba S, Shem M et al (2007) Effect of *Moringa Oleifera* leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. Bone 1: 446.

22. Ndong M, Wade S, Dossou N, Guiro AT, Gning RD (2007) Valeur Nutritionnelle Du *Moringa Oleifera*, Etude De La Biodisponibilite Du Fer, Effet De L&Apos; Enrichissement De Divers Plats Traditionnels Senegalais Avec La Poudre Des Feuilles. Afr J Food Agric Nutr Dev 7: 1-18.

23. FAO (2018) Etude du marché de lapin au Bénin. FAO, Rome, Italy.

24. Akpo Y, Kpodekon M, Djago Y, Licois D, Youssao I (2011) Evaluation de l'innocuité des souches précoces de *Eimeria magna* et de *Eimeria media* issues du Bénin en vue de leur utilisation comme souches vaccinales. Int J Biol Chem Sci 5: 1682-7.

25. Al-Fifi Z (2007) Effect of leaves extract of *Carica papaya, Vernonia amigdalina* and *Azadiratcha indica* on the coccidiosis in free-range chickens. Asian Journal of Animal Sciences 1: 26-32.

26. El Banna H (2016) Anti-coccidial Activity of *Moringa Oleifera* Plant. Vet Anim Sci 4: 19.

27. Inbaneson S, Sundaram R, Suganthi P (2012) In vitro antiplasmodial effect of ethanolic extracts of traditional medicinal plant Ocimum species against *Plasmodium falciparum*. Asian Pac J Trop Med 5: 103-6.

28. Ogbu C, Onuh S (2015) Oocyst output, performance and haematological indices of broiler chickens infected with coccidian oocysts and fed *Ocimum gratissimum* leaf extract. Glob J Poult Farm Vaccin 3: 146-53.

29. Tipu M, Akhtar M, Anjum M, Raja M (2006) New dimension of medicinal plants as animal feed. Pak Vet J 26: 144-8.

30. Adediran O, Uwalaka E, Kolapo T (2014) Antihelminthic and anticoccidial effects of *Vernonia Amygdalina* in goats. J Vet Adv 4: 610-5.

31. Kpodekon M, Gnimadi A, Djago Y, Bhouin SFS (2000) Rabbit production and network in Benin in 1998. World Rabbit Sci 8: 103-10.

32. Pakandl M, Hlásková L, Poplstein M, Neveceralova M, Vodicka T, et al, (2008) Immune response to rabbit coccidiosis: a comparison between infections with *Eimeria flavescens* and *E. intestinalis*. Folia Parasitol 55: 1-6.

33. Renaux S, Quéré P, Buzoni-Gatel D, Sewald B, Le Vern Y, et al, (2003) Dynamics and responsiveness of T-lymphocytes in secondary lymphoid organs of rabbits developing immunity to *Eimeria intestinalis*. Vet Parasitol 110: 181-95.