Plants used for ethnoveterinary treatment of free-range indigenous chicken diseases in Ghana

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Research

Abstract

Background: Indigenous chickens raised in free-range production systems constitute a significant source of poultry products, particularly in rural communities. The free-range system exposes indigenous chickens to diseases, with access to veterinary services constrained by the remoteness of most rural settlements. Ethnoveterinary practice is used to manage indigenous chicken diseases in Ghana. This study aimed to take an inventory of the plant species used to treat indigenous chicken ailments and determine their cultural importance in the Adaklu district of the Volta region.

Methods: Ethnoveterinary data on botanicals used for treating chicken diseases were gathered from 120 respondents in the Adaklu district of the Volta region. The cultural significance of species for ethnoveterinary purposes was evaluated using quantitative ethnobotanical indices.

Results: A total of 36 plant species from 25 botanical families were identified to be used for treating chicken ailments. Word frequency of ailments using WordItOut revealed that Newcastle Disease (ND) symptoms, commonly associated with free-range indigenous chickens, were the most common conditions. *Mangifera indica* and *Gymnosporia senegalensis* were the most culturally important and versatile plant species applied to treat symptoms associated with Newcastle Disease.

Conclusions: Most plant species cited in this study can be grouped as belonging to fringes of cultural practices due to their infrequent number of mentions and low cultural importance indices. The study recommends documenting indigenous knowledge about ethnomedicine recourses in local communities before they are relegated to fringes of cultural practices.

Keywords: Volta region, Newcastle Disease (ND), *Mangifera indica*, *Gymnosporia senegalensis*, idiosyncratic knowledge, perceived efficacy

Background

In many African countries, indigenous chickens (*Gallus domesticus*) raised in free-range production systems are a major source of poultry products (Gueye, 1999; Enahoro *et al*. 2021; Ndlovu *et al*. 2021; Makalo *et al*. 2022). Most rural and peri-urban households rely on indigenous chicken production for their livelihood. Indigenous chicken contributes to food and nutritional security, income generation during the lean period, and the ritual practices of traditional African communities (Desta, 2021; Ndlovu *et al*. 2021, 2023; Makalo *et al*. 2022). Ghana is no exception; indigenous chickens contribute as an essential source of animal protein, income, gift payments and are used to accomplish various traditional and religious practices, particularly in rural communities (Aboe *et al*. 2006a; Aning, 2006; Asem-Bansah *et al*. 2012; Blackie, 2014a; Enahoro *et al*. 2021; Mensah *et a*l. 2023). Indigenous chicken production systems account for 60-80 percent of the national poultry population in Ghana (Gyening, 2006). In rural communities, it is the most common poultry production system (Aboah & Enahoro, 2022).

Indigenous chicken productivity in Africa relies on the free-range system where birds are left to scavenge with minimum or no supplementary feeding. The free-range production system subjects the chicken to predators, diseases, and parasitic attacks (Adenubi & Akande, 2019; Ndlovu *et al*. 2021; Makalo *et al*. 2022). The impact of diseases is severe for communities with limited access to modern veterinary services. In most rural communities in sub-Saharan Africa with limited access to veterinary services, traditional ethnoveterinary practices are widely accepted and used to treat and manage free-range chicken diseases (Endalew *et al*. 2018; Ndlovu *et al*. 2021, 2023; Chidembo *et al*. 2023). Ethnoveterinary practice has become a default choice for treating free-range poultry due to its availability, accessibility, lower cost, cultural acceptability, and apparent effectiveness.

In rural Ghana, almost all households keep free-range poultry (Aning, 2006; Ouma *et al*. 2023). The prevalence of parasites, bacterial, and viral pathogens is higher in free-range compared to the intensively managed poultry production system in Ghana (Mensah-Kumi, 2017; Asumang *et al*. 2019). However, access to veterinary services is constrained by the remoteness of most rural settlements (Enahoro et al., 2021; Ouma *et al*. 2023). Ethnoveterinary practice is a widely used method for the treatment of poultry ailments in Ghana (Turkson & Naandam, 2002; Aboe *et al*. 2006b; Adomako, 2009; Blackie, 2014b; Avornyo *et al*. 2016; Ouma *et al*. 2023). In the Ashanti region, for instance, Adomako (2009) found that 70 percent of people rearing free-range poultry rely on ethnoveterinary medication to prevent and control diseases. Indigenous chicken production systems have been identified to dominate the poultry sector in the Volta region of Ghana (Boafo *et al*. 2019) as it has a limited number of commercial farms relative to the Ashanti, Bono, and Greater Accra regions. However, there is a paucity of information on ethnoveterinary practices and the use of plants for treating chicken diseases. Currently, there is no known inventory of plant species used for ethnoveterinary treatment of chicken diseases and the cultural importance of the species used anywhere in the Volta region. The study aimed to document the plant species used to treat chicken diseases and their cultural importance to the local communities in the Adaklu district of the Volta region, where a free-range indigenous chicken production system is commonly practiced.

Materials and Methods

Study area

The Adaklu District (Figure 1) is situated at latitudes 00°20’1°E and 0.33361°E and longitudes 06°41’1°N and 6.68361°N and is bordered to the east by Ho-West, to the south by North-Tongu District, to the north by Agotime-Ziope District, and to the east by Akatsi-North District (Ghana Statistical Service, 2014). There are 38,649 people living in the Adaklu District, which has a total land area of 810 km^2 (Ghana Statistical Service, 2021). Poultry production in the district consists primarily of rural poultry flocks that scavenge and consume household waste (Ministry of Food & Agriculture, 2021). The free-range system, therefore, dominates the local poultry production in the district. The scavenging chickens are exposed to a range of intermediate hosts that can transmit various diseases making the flocks susceptible to many preventable diseases (Asumang et al., 2019; Mensah-Kumi, 2017). The study district is wholly rural with no urban locality (Adaklu District Assembly, 2021), and access to services, including veterinary services, is limited. Boakye *et al.* (2023) found local communities in the study area to rely on nature for folk medicine purposes and it is anticipated that the people will be knowledgeable about ethnoveterinary practices, hence the choice of the Adaklu district.

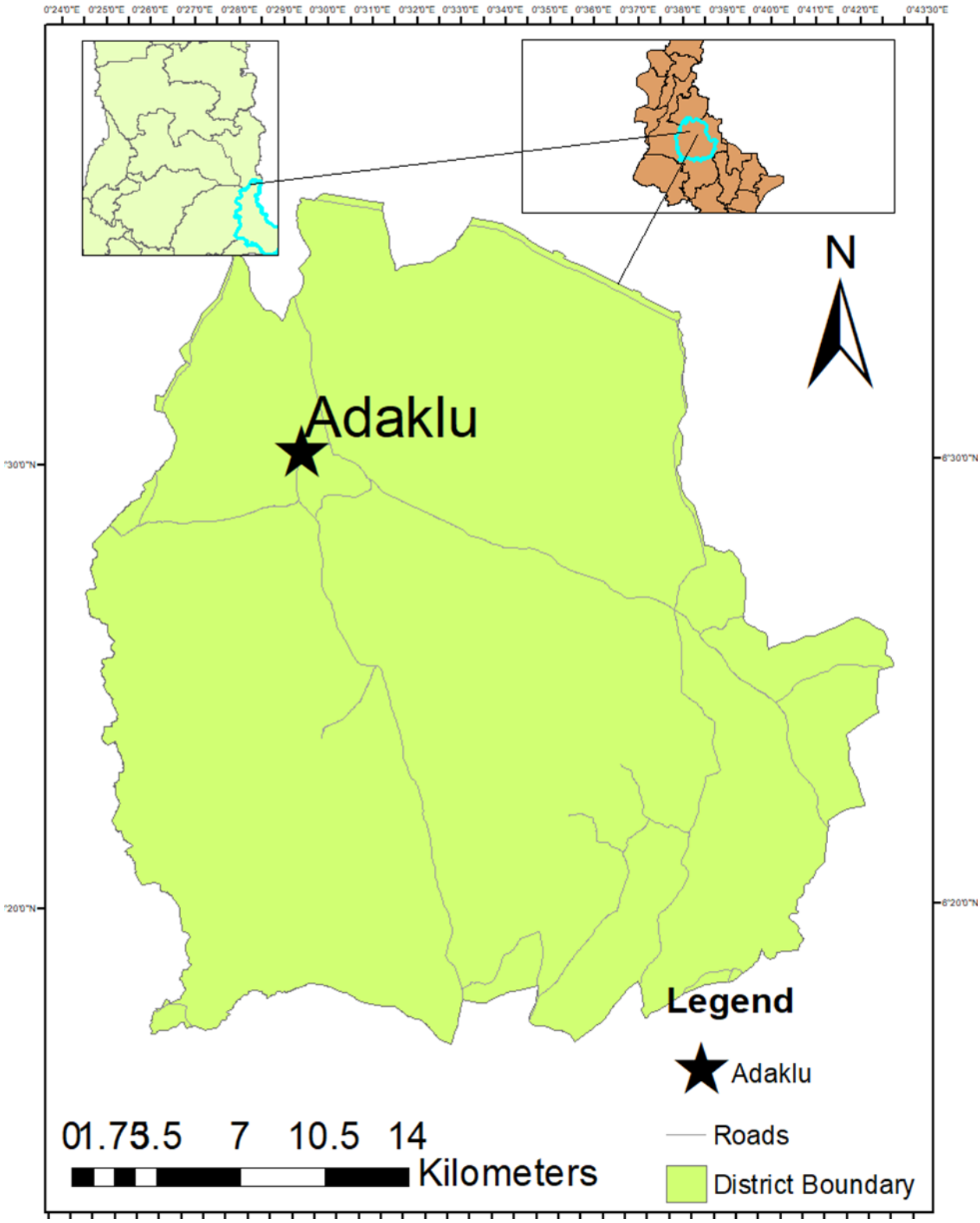

Figure 1. Map of Ghana indicating the Volta Region and Adaklu district

Sampling procedure and data collection

The criteria used to select the informants included the indigenous chicken production system (which had to be exclusively free-range), the type of housing enclosure (cage in the backyard), currently practicing ethnoveterinary using plants to manage chicken diseases, and responsibility for chicken disease management. With the assistance of the Adaklu District Department of Agriculture staff, 10 informants were chosen from each of the 12 operational zones in the district. The

purpose of the study was made known to the leaders in the various communities and their consent was sought before the research was undertaken.

In March and April of 2023, semi-structured interviews were employed to collect ethnoveterinary data on plant species used to treat indigenous chicken diseases from the study participants. Aning (2006) reports that while guinea fowls, turkeys, and ducks are kept in selected regions of Ghana, almost all rural households raise some chickens. As such, the questions only addressed the chicken production system. The questions primarily focused on the free-listing of the plant species used for treating indigenous chicken diseases, the plant part used, and the mode of preparation and administration. Respondents who could not speak the English were interviewed in the Ewe language, which is widely spoken in the district.

The local names of plant species mentioned by the respondents were compared to those found in the literature (Abbiw, 1990; Irvine, 1961) to confirm their identity. Also, collected plant materials were compared with voucher specimens at the University of Health and Allied Sciences' Institute of Traditional and Alternative Medicine (UHAS-ITAM) for confirmation. The names and authority of plant species' were established using electronic databases Plants of the World Online (https://powo.science.kew.org).

Data Analysis

The Use Report (UR), Cultural Importance (CI), Frequency of Citation (FC), Number of Uses (NU), Relative Frequency of Citation (RFC), and Relative Importance Index (RI) for each plant species were identified using the ethnobotany R package (Whitney, 2020). For each plant part, the number of informants mentioning each use category and the total number of uses within each use category are counted to determine the UR values per species (Prance *et al.* 1987). The cultural importance index for each plant part in the data set is determined using the cultural importance (CI) index (Tardío & Pardo de Santayana, 2008). The number of uses (NU) per plant part is the sum of all categories that are considered useful for that plant part; the frequency of citation (FC) per plant part is the total number of informants that cite a use for that plant part in the dataset (Prance *et al*. 1987). Each plant species significance is determined by the relative frequency of citation (RFC), which takes into account the number of informants who reported using it (Tardío & Pardo de Santayana, 2008). By taking into account solely the use categories, the relative importance (RI) index determines the relative importance of every plant species in the data set (Tardío & Pardo de Santayana, 2008). The percentage of informants who use a plant for the same purpose relative to all uses of the plant is determined by the fidelity level (FL) per species (Friedman *et al*. 1986). To gain insight into the indigenous chicken ailments that plant species were used to treat, a word cloud visual representation of word frequency was employed using WordItOut. The size of the words corresponds to how frequently the participants mentioned that particular ailment.

Results

A total of 36 plant species from 25 botanical families were identified to be used for treating chicken ailments (Table 1). The Anacardiaceae, Arecaceae, and Poaceae families were the most represented, with three plant species each (8.33%), followed by the Euphorbiaceae, Sapindaceae, Fabaceae, Solanaceae, Meliaceae, with two species each (5.55%) representing these families. One plant species represented the remaining 17 families (2.77%) (Table 1). The use report (UR), cultural importance (CI), frequency of citation (FCs), number of uses (NUs), relative frequency of citation (RFCs), and relative importance (RIs) for the plant species used to treat chicken ailments are presented in Table 1. For UR, *Mangifera indica* had the highest number of mentions (n = 251) among the 36 plant species used to treat chicken ailments, followed by *Gymnosporia senegalensis* (n = 128) *Elaeis guineensis* (n = 34), *Zea mays* (n = 22), and *Sida alba* (n = 17). A single use report was recorded for nine plant species. The cultural importance (CI) index followed the same path as the use report, with *M. indica* recording the highest value (2.092) followed by *G. senegalensis* (1.067) *E. guineensis* (0.283), *Z. mays* (0.183), and *S. alba* (0.142). Similar to the UR and CI, the highest frequency of citation (FCs) was recorded for *M. indica* (96) followed by *M. senegalensis* (47) *E. guineensis* (30), *Z. mays* (21), and *S. alba* (9). *M. indica* had the greatest number of uses (NU) of a plant species for treating various categories of chicken ailments (n = 20), followed by *G. senegalensis* (14), *S. alba* and *Bridelia ferruginea* (n = 10; each), *Azadirachta indica* and *Ocimum basilicum* (n =8; each), *E. guineensis* and *Khaya senegalensis* (n = 7; each).

M. indica recorded the highest RFC value (0.800) followed by *G. senegalensis* (0.392) *E. guineensis* (0.250), *Z. mays* (0.175), and *S. alba* (0.075). The highest relative importance (RI) value was recorded for *M. indica* (1.000) that was followed by *G. senegalensis* (0.595) *E. guineensis* (0.331), *S. alba* (0.297), *B. ferruginea* (0.260), and *A. indica* (0.236). The conservation status of most of the species were of Least Concern (LC) (n = 20; 55.55%), Near Threatened (NT) (n = 10; 27.77%), Data Deficient (DD) (n = 4; 11.11), and Vulnerable (VU) (n = 2; 5.55%) (Table 1).

Table 1. Plant species use for treating chicken diseases in the Adaklu district with their ethnobotanical indices

Family	Scientific name (Voucher No.)	Local name	Conservation status	URs	CI	FCs	NUs	RFCs	RIs
Anacardiaceae	*Mangifera indica* L. **UHAS/ITAM/2021/SB009**	Mango	DD	251	2.092	96	20	0.800	1.000
Celastraceae	*Gymnosporia senegalensis* (Lam.) Loes. **UHAS/ITAM/2023/L007**	Wotsi notsi (Ewe)	LC	128	1.067	47	14	0.392	0.595
Arecaceae	*Elaeis guineensis* Jacq. **UHAS/ITAM/2023/L001**	Deti (Ewe)	LC	34	0.283	30	7	0.250	0.331
Poaceae	*Zea mays* L. **UHAS/ITAM/2023/L006**	Ebli (Ewe)	LC	22	0.183	21	3	0.175	0.184
Malvaceae	*Sida alba* L. **UHAS/ITAM/2023/L005**	Dameadame	LC	17	0.142	9	10	0.075	0.297
Meliaceae	*Azadirachta indica* A.Juss. **UHAS/ITAM/2023/L003**	Liliti (Ewe)	LC	15	0.125	7	8	0.058	0.236
Euphorbiaceae	*Bridelia ferruginea* Benth. **UHAS/ITAM/2023/SB001**	Akamiti (Ewe)	LC	10	0.083	2	10	0.017	0.260
Lamiaceae	*Ocimum basilicum* L. **UHAS/ITAM/2021/AP004**	Dzeviti (Ewe)	NT	10	0.083	5	8	0.042	0.226
Meliaceae	*Khaya senegalensis* (Desr.) A.Juss. **UHAS/ITAM/2021/SB007**	Logo (Ewe)	VU	9	0.075	6	7	0.050	0.206
Bignoniaceae	*Spathodea campanulata* P. Beauv. **UHAS/ITAM/2023/L014**	Adewudatsi (Ewe)	LC	8	0.067	5	5	0.042	0.151
Moringaceae	*Moringa oleifera* Lam. **UHAS/ITAM/2021/L011**	Babatsi, Yevutsi (Ewe)	LC	8	0.067	7	6	0.058	0.186
Rubiaceae	*Nauclea latifolia* Sm. **UHAS/ITAM/2021/R007**	Nyimoti (Ewe)	LC	6	0.05	1	6	0.008	0.155
Caricaceae	*Carica papaya* L. **UHAS/ITAM/2021/L023**	Adiba (Ewe)	DD	5	0.042	1	5	0.008	0.130
Fabaceae	*Phaseolus vulgaris* L. **UHAS/ITAM/2023/AP007**	Ayi (Ewe)	LC	4	0.033	4	2	0.033	0.071
Poaceae	*Bambusa vulgaris* Schrad. ex J.C. Wendl. **UHAS/ITAM/2023/L029**	Pampro (Ewe)	NT	3	0.025	3	1	0.025	0.041
Solanaceae	*Capsicum frutescens* L. **UHAS/ITAM/2021/FR006**	Atadi (Ewe)	LC	3	0.025	3	2	0.025	0.066
Combretaceae	*Combretum micranthum* Schumach. & Thonn. **UHAS/ITAM/2023/L028**	Ohwirem nini (Twi)	NT	3	0.025	1	3	0.008	0.080
Anacardiaceae	*Spondias mombin* L. **UHAS/ITAM/2023/FR001**	Akukoti (Ewe)	LC	3	0.025	1	3	0.008	0.080
Sapotaceae	*Vitellaria paradoxa* C.F. Gaertn.	Yorkumi/Tokuti (Ewe)	VU	3	0.025	1	3	0.008	0.080

	UHAS/ITAM/2021/FR005								
Zingiberaceae	*Zingiber officinale* Roscoe	Agumetakui (Ewe)	DD	2	0.017	2	2	0.017	0.060
	UHAS/ITAM/2021/RH002								
Amaryllidaceae	*Allium cepa* L.	Sabala (Ewe)	NT	2	0.017	2	2	0.017	0.060
	UHAS/ITAM/2021/BB001								
Sapindaceae	*Blighia sapida* K.D.Koenig	Atsa tsi (Ewe)	LC	2	0.017	1	2	0.008	0.055
	UHAS/ITAM/2023/L010								
Rutaceae	*Citrus limon* (L.) Osbeck	Dontsi (Ewe)	LC	2	0.017	2	2	0.017	0.060
	UHAS/ITAM/2023/L029								
Cucurbitaceae	*Momordica charantia* L.	Kakle (Ewe)	NT	2	0.017	1	2	0.008	0.055
	UHAS/ITAM/2021/AP003								
Poaceae	*Oryza sativa* L.	Morlu (Ewe)	LC	2	0.017	2	1	0.017	0.035
	UHAS/ITAM/2023/L027								
Fabaceae	*Senna siamea* (Lam.) H.S.Irwin & Barneby	Sagarati (Ewe)	LC	2	0.017	1	2	0.008	0.055
	UHAS/ITAM/2023/L028								
Asteraceae	*Gymnanthemum amygdalinum* (Delile) Sch.Bip.	Gboti (Ewe)	NT	2	0.017	1	2	0.008	0.055
	UHAS/ITAM/2023/L011								
Anacardiaceae	*Anacardium occidentale* L.	Yevutsa (Ewe)	LC	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/SB002								
Arecaceae	*Borassus aethiopum* Mart	Agor (Ewe)	LC	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L30								
Arecaceae	*Cocos nucifera* L.	Ene (Ewe)	NT	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L026								
Euphorbiaceae	*Manihot esculenta* Crantz	Agbeli (Ewe)	DD	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L004								
Musaceae	*Musa sapientum* L.	Akodu (Ewe)	LC	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L009								
Apocynaceae	*Cryptolepis nigrescens* (Wennberg) L.Joubert & Bruyns	Globo (Ewe)	NT	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/AP013								
Sapindaceae	*Paullinia pinnata* L.	Gbadzafeka (Ewe)	NT	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L025								
Solanaceae	*Physalis peruviana* L.	Tootoo (Twi)	LC	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L002								
Araceae	*Xanthosoma sagittifolium* (L.) Schott	Kontomire (Twi)	NT	1	0.008	1	1	0.008	0.030
	UHAS/ITAM/2023/L023								

Use report = (UR), Cultural importance = (CI), Frequency of citation = (FC), Number of uses = (NU), Relative frequency of citation = (RFC), Relative importance index = (RI)

Coughing (n = 81), was the most cited chicken ailment that plant species were used to treat among the 23 ailments mentioned in this study. Among the most cited ailment were difficulty in breathing (n = 77), nasal discharge (n = 65), diarrhea (n = 62), sneezing (n = 49), and abnormal feces (n = 43). The least cited ailments were convulsion, loss of feathers, and tremors; each recorded a single mention. Figure 2 presents a visual citation of the ailments identified in this study.

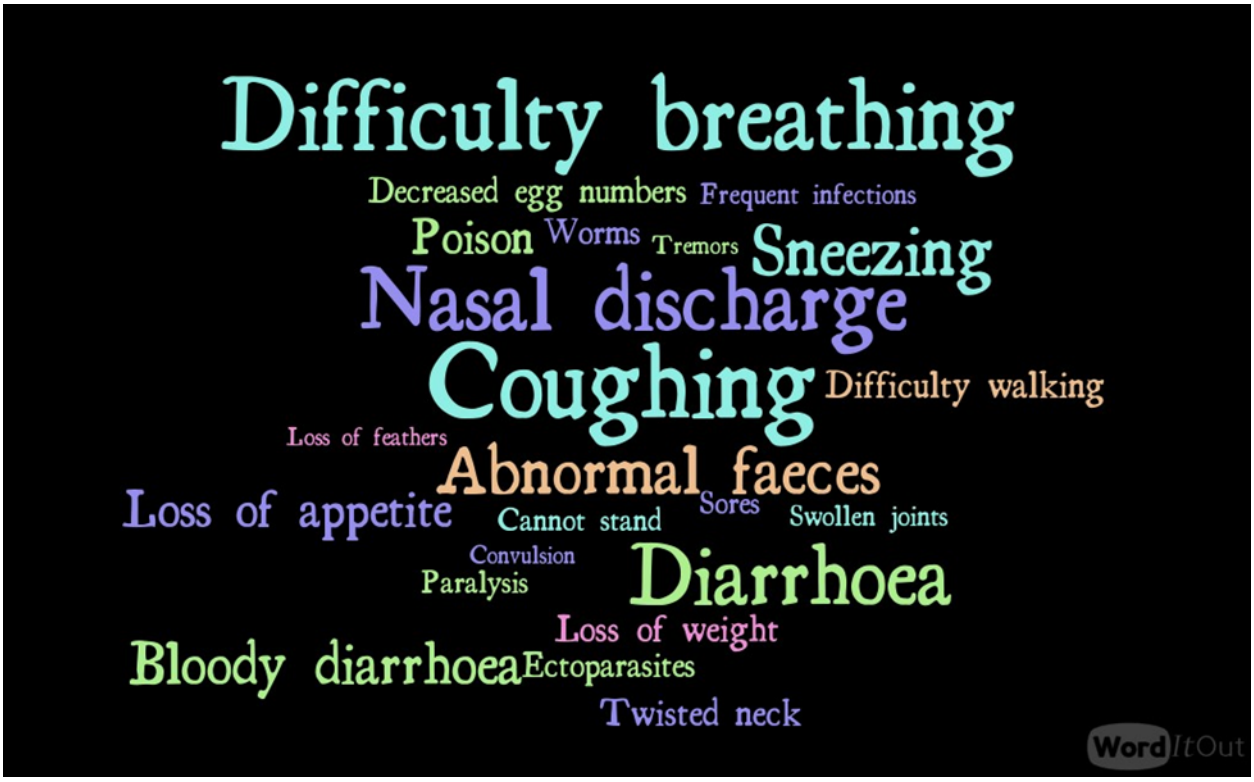

Figure 2. Indigenous chicken ailments mentioned by participants to be treated with medicinal plants in the Adaklu district of the Volta region. Maximum mentions are 81 for coughing.

Plant species contribution to the treatment of each ailment is presented in Table 2. Based on the fidelity levels (FL), *Gymnanthemum amygdalinum* and *Momordica charantia* were the most useful plant species for treating coughing. For the treatment of difficulty breathing, *Cocos nucifera*, *Blighia sapida*, *Combretum micranthum*, *G. amygdalinum*, *Carica papaya*, and *Vitelleria paradoxa* were the most useful plant species. For the treatment of poison, the most important species was *E. guineensis* based on fidelity level (Table 2). Regarding the plant parts used for the preparation of traditional pharmacopeia, the bark was mentioned the most (n = 69; 46.93%) that was followed by the leaf (n = 48; 32.65%), fruit (n = 9; 6.12%), root (n = 7; 4.76%), seed (n = 6; 4.08%), stem (n = 3; 2.04%), rhizome and bulb (n = 2 each; 1.36%), and peel (n = 1; 0.68%). Infusion (n = 115), maceration (n = 23), decoction (n = 6), and digestion (n = 3) were the most often used methods of preparation. With regards to the mode of administration the oral method was the most common (n = 133; 90.47%), followed by topical (n = 14; 9.52%) (Table 2).

Table 2. Fidelity level (FL) of plants used for treating chicken ailments, parts used, mode of preparation and route of administration in the Adaklu District

Ailments treated	Scientific name	Plant part used	Mode of preparation	Mode of administration	FLs (%)
Coughing	*Gymnanthemum amygdalinum*	Leaf	Infusion	Oral	100.00
	Momordica charantia	Leaf	Infusion	Oral	100.00
	Azadirachta indica	Leaf	Infusion	Oral	71.43
	Capsicum frutescens	Fruit	Maceration	Oral	66.67
	Zingiber officinale	Rhizome	Infusion	Oral	50.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
	Mangifera indica	Bark	Infusion	Oral	45.83
	Gymnosporia senegalensis	Bark	Infusion	Oral	44.68
	Spathodea campanulata	Bark	Infusion	Oral	40.00
	Ocimum basilicum	Leaf	Infusion	Oral	20.00
	Moringa oleifera	Bark	Infusion	Oral	14.29
	Sida alba	Leaf	Infusion	Oral	11.11
Difficulty breathing	*Cocos nucifera*	Bark	Infusion	Oral	100.00
	Blighia sapida	Bark	Infusion	Oral	100.00
	Combretum micranthum	Bark	Infusion	Oral	100.00
	Gymnanthemum amygdalinum	Leaf	Infusion	Oral	100.00
	Carica papaya	Leaf	Infusion	Oral	100.00
	Vitelleria paradoxa	Bark	Infusion	Oral	100.00
	Zingiber officinale	Rhizome	Infusion	Oral	50.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
	Allium cepa	Bulb	Infusion	Oral	50.00
	Mangifera indica	Bark	Infusion	Oral	44.79
	Gymnosporia senegalensis	Leaf	Infusion	Oral	36.17
	Khaya senegalensis	Bark	Infusion	Oral	33.33
	Azadirachta indica	Leaf	Infusion	Oral	28.57
	Moringa oleifera	Bark	Infusion	Oral	28.57
	Sida alba	Leaf	Infusion	Oral	22.22
	Borassus aethiopum	Bark	Infusion	Oral	100.00
	Physalis peruviana	Leaf	Infusion	Oral	100.00

	Nauclea latifolia	Bark	Infusion	Oral	100.00
	Carica papaya	Leaf	Decoction	Oral	100.00
	Vitelleria paradoxa	Bark	Infusion	Oral	100.00
	Spathodea campanulata	Bark	Infusion	Oral	60.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
Nasal discharge	*Gymnosporia senegalensis*	Bark	Infusion	Oral	42.55
	Mangifera indica	Bark	Infusion	Oral	31.25
	Sida alba	Leaf	Infusion	Oral	22.22
	Khaya senegalensis	Bark	Infusion	Oral	16.67
	Azadirachta indica	Leaf	Infusion	Oral	14.29
	Moringa oleifera	Bark	Infusion	Oral	14.29
	Elaeis guineensis	Fruit	Digestion	Oral	3.33
	Nauclea latifolia	Root	Infusion	Oral	100.00
	Carica papaya	Leaf	Decoction	Oral	100.00
	Vitelleria paradoxa	Bark	Infusion	Oral	100.00
	Combretum micranthum	Bark	Infusion	Oral	100.00
	Spondias mombin	Leaf	Infusion	Oral	100.00
	Manihot esculenta	Peel	Infusion	Oral	100.00
Diarrhea	*Azadirachta indica*	Leaf	Infusion	Oral	42.86
	Gymnosporia senegalensis	Bark	Infusion	Oral	40.43
	Ocimum basilicum	Leaf	Infusion	Oral	40.00
	Mangifera indica	Bark	Decoction	Oral	29.17
	Sida alba	Leaf	Infusion	Oral	22.22
	Khaya senegalensis	Bark	Infusion	Oral	16.67
	Elaeis guineensis	Fruit	Maceration	Oral	3.33
	Momordica charantia	Leaf	Infusion	Oral	100.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
	Khaya senegalensis	Bark	Infusion	Oral	33.33
Sneezing	*Moringa oleifera*	Bark	Infusion	Oral	28.57
	Mangifera indica	Bark	Infusion	Oral	28.12
	Gymnosporia senegalensis	Bark	Infusion	Oral	27.66

	Sida alba	Leaf	Infusion	Oral	22.22
	Spathodea campanulata	Bark	Infusion	Oral	20.00
Abnormal feces	*Nauclea latifolia*	Root	Infusion	Oral	100.00
	Carica papaya	Leaf	Decoction	Oral	100.00
	Spondias mombin	Bark	Infusion	Oral	100.00
	Blighia sapida	Bark	Infusion	Oral	100.00
	Ocimum basilicum	Leaf	Infusion	Oral	40.00
	Sida alba	Leaf	Infusion	Oral	33.33
	Mangifera indica	Leaf	Infusion	Oral	23.96
	Gymnosporia senegalensis	Bark	Infusion	Oral	19.15
	Khaya senegalensis	Bark	Infusion	Oral	16.67
	Azadirachta indica	Leaf	Infusion	Oral	14.29
Bloody diarrhea	*Nauclea latifolia*	Root	Infusion	Oral	100.00
	Spondias mombin	Leaf	Infusion	Oral	100.00
	Combretum micranthum	Bark	Infusion	Oral	100.00
	Allium cepa	Bulb	Infusion	Oral	50.00
	Gymnosporia senegalensis	Bark	Infusion	Oral	23.40
	Mangifera indica	Bark	Infusion	Oral	18.75
	Azadirachta indica	Leaf	Infusion	Oral	14.29
	Moringa oleifera	Bark	Infusion	Oral	14.29
Loss of appetite	*Carica papaya*	Leaf	Decoction	Oral	100.00
	Phaseolus vulgaris	Seed	Maceration	Oral	75.00
	Zea mays	Seed	Maceration	Oral	42.86
	Khaya senegalensis	Bark	Infusion	Oral	16.67
	Gymnosporia senegalensis	Bark	Infusion	Oral	12.77
	Mangifera indica	Bark	Infusion	Oral	7.29
Poison	*Elaeis guineensis*	Fruit	Digestion	Oral	83.33
Decreased egg numbers	*Oryza sativa*	Seed	Maceration	Oral	100.00
	Zea mays	Seed	Maceration	Oral	33.33
	Mangifera indica	Bark	Infusion	Oral	1.04
	Anacardium occidentale	Bark	Infusion	Oral	100.00

Twisted neck	*Nauclea latifolia*	Root	Infusion	Oral	100.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
	Ocimum basilicum	Leaf	Infusion	Oral	20.00
	Spathodea campanulata	Bark	Infusion	Oral	20.00
	Gymnosporia senegalensis	Bark	Infusion	Oral	8.51
	Mangifera indica	Bark	Infusion	Oral	5.21
Difficulty walking	*Nauclea latifolia*	Root	Infusion	Oral	100.00
	Bridelia ferruginea	Bark	Infusion	Oral	50.00
	Azadirachta indica	Leaf	Infusion	Oral	14.29
	Sida alba	Leaf	Infusion	Oral	11.11
	Elaeis guineensis	Stem	Maceration	Topical	10.00
	Gymnosporia senegalensis	Bark	Maceration	Topical	6.38
	Mangifera indica	Bark	Infusion	Oral	4.17
Loss of weight	*Senna siamea*	Bark	Infusion	Oral	100.00
	Zea mays	Seed	Maceration	Oral	28.57
	Phaseolus vulgaris	Seed	Maceration	Oral	25.00
	Spathodea campanulata	Leaf	Maceration	Oral	20.00
	Gymnosporia senegalensis	Bark	Infusion	Oral	4.26
	Mangifera indica	Root	Infusion	Oral	2.08
Ectoparasites	*Musa × sapientum*	Fruit	Maceration	Oral	100.00
	Parquetina nigrescens	Leaf	Maceration	Topical	100.00
	Paullinia pinnata	Root	Infusion	Oral	100.00
	Bambusa vulgaris	Leaf	Maceration	Topical	100.00
	Citrus limon	Fruit	Maceration	Topical	50.00
	Ocimum basilicum	Leaf	Infusion	Oral	20.00
	Khaya senegalensis	Bark	Infusion	Topical	16.67
	Mangifera indica	Bark	Infusion	Topical	1.04
Worms	*Senna siamea*	Bark	Infusion	Oral	100.00
	Sida alba	Leaf	Infusion	Oral	22.22
	Moringa oleifera	Bark	Infusion	Oral	14.29
	Mangifera indica	Bark	Decoction	Oral	5.21

	Gymnosporia senegalensis	Leaf	Infusion	Oral	2.13
Cannot stand	*Bridelia ferruginea*	Bark	Infusion	Oral	50.00
	Mangifera indica	Leaf	Infusion	Oral	5.21
	Elaeis guineensis	Stem	Maceration	Topical	3.33
Sores	*Xanthosoma sagittifolium*	Leaf	Maceration	Topical	100.00
	Citrus limon	Fruit	Maceration	Topical	50.00
	Capsicum frutescens	Fruit	Maceration	Topical	33.33
	Ocimum basilicum	Leaf	Infusion	Oral	20.00
	Elaeis guineensis	Fruit	Digestion	Oral	3.33
	Mangifera indica	Bark	Infusion	Oral	1.04
Paralysis	*Bridelia ferruginea*	Bark	Infusion	Oral	50.00
	Azadirachta indica	Leaf	Maceration	Topical	14.29
	Mangifera indica	Bark	Infusion	Oral	3.12
	Gymnosporia senegalensis	Leaf	Infusion	Oral	2.13
Swollen joints	*Bridelia ferruginea*	Bark	Infusion	Oral	50.00
	Sida alba	Leaf	Maceration	Topical	11.11
	Elaeis guineensis	Stem	Maceration	Topical	6.67
	Mangifera indica	Bark	Infusion	Oral	1.04
Frequent infections	*Ocimum basilicum*	Leaf	Maceration	Oral	20.00
	Sida alba	Leaf	Infusion	Oral	11.11
	Gymnosporia senegalensis	Bark	Infusion	Oral	2.13
	Mangifera indica	Bark	Infusion	Oral	2.08
Convulsion	*Mangifera indica*	Leaf	Infusion	Oral	1.04
Loss of feathers	*Ocimum basilicum*	Leaf	Infusion	Oral	20.00
Tremors	*Bridelia ferruginea*	Bark	Infusion	Oral	50.00

Discussion

The majority of the plant species used for poultry ethnoveterinary purposes have been mentioned in previous studies in Ghana and other states in Africa where ethnoveterinary is practiced (Moreki, 2012, 2013; Ekunseitan *et al.* 2016; Endalew *et al*. 2018; Chere, 2019; Sodjinou *et al.* 2022; Ndlovu *et al*. 2023). Symptoms associated with Newcastle Disease (ND) (gasping, coughing, sneezing, diarrhea, twisted necks) were the most common conditions treated with medicinal plants. Newcastle Disease is very prevalent among free-range indigenous chicken in Ghana (Blackie, 2014b; Enahoro *et al*. 2021). The use of *M. indica*, *Khaya senegalensi*s, *Capsicum frutescens*, *Carica papaya*, *Moringa oleifera*, *Azadirachta indica* for treating symptoms of Newcastle disease was consistent with previous studies (Guèye, 1999; Ekunseitan *et al*. 2016; Chere, 2019; Sodjinou *et al*. 2022; Moustapha *et al*. 2022; Ndlovu *et al*. 2023;). *Allium cepa*, *C. frutescens*, and *Z. officinale* ethnoveterinary applications in this study were consistent with a previous study in Ethiopia (Endalew *et al*. 2018). *E. guineensis* utilization for treating poison can be considered cultural knowledge in Ghana as its application in folk traditional medicine is endemic (Reddy *et al*. 2019; Domozoro *et al.* 2020).

The high cultural importance of *M. indica* and *G. senegalensis* indicates that these two species are significant for treating chicken diseases. Ethnobotanical resources with CI values of more than one suggest that the particular resource is highly versatile in its application and valued by local communities (Rossato *et al*. 1999; Boakye *et al*. 2022, 2023). These two plant species were the most frequently cited and versatile in treating numerous chicken diseases. Culturally important plant species treat the most prevalent diseases in a locality (Cunningham, 2001; Heinrich *et al*. 2009; Boakye *et al*. 2022). This was the case for *M. indica* and *G. senegalensis* which were applied to treat symptoms associated with Newcastle Disease (ND), a prevalent health challenge that affects raising free-range indigenous chickens in Ghana.

The ethnoveterinary application of *M. indica* to treating chicken diseases in this study is similar to other studies (Guèye, 1999; Sodjinou *et al*. 2022). However, the ethnomedicinal versatility of the total number of ailments treated with *M. indica* was higher in this study than in previous studies. *G. senegalensis* ethnomedicinal applications are well documented for folk medicine (da Silva *et al*. 2011) and ethnoveterinary application in treating livestock (Koné *et al*. 2008; Yirga *et al.* 2012). However, its mention in ethnoveterinary applications for managing poultry disease, particularly chicken diseases, is limited in other parts of Africa. The ethnoveterinary application of *G. senegalensis* for treating poultry diseases, coupled with its high CI and *M. indica* in this study, can be attributed to idiosyncrasies in knowledge. Idiosyncrasy in using of plant species accounted for the variation in the medicinal plants sold in local markets and the ethnobotanical application of plants in the study area (Boakye *et al*. 2022, 2023). Localized knowledge has also accounted for peculiarities in using animal body parts for traditional medicine purposes in Ghana relative to other African countries where the same animals were used for traditional medicine purposes (Boakye *et al*. 2015, 2019, 2021).

Within local cultures, the perceived efficacy of a resources influences its selection and application for folk medicine purposes. The effectiveness of a resource in treating folk illnesses does not lie in the mere mention of it in traditional pharmacopeia (Thomas *et al*. 2009). Cultural adaptation relegates some species to the fringes of cultural practice and makes them obsolete. Due to cultural adaptation, relegated species are typically less frequently mentioned as helpful in treating folk conditions cited by local communities (Heinrich *et al*. 2009). Most plant species in this study can be characterized as belonging to fringes of cultural practices due to their infrequent number of mentions. The majority of the species identified in this study (22 of the 36 plant species) receiving between 1-3 mentions proves these species belong to the fringes of cultural practices. The low CI of these species indicates that they are no longer perceived as effective in treating the specific ailments mentioned despite being listed in the traditional pharmacopeia.

Conclusion

This study took an inventory of plant species used in treating indigenous chicken diseases and determined their cultural importance and fidelity levels by local communities. Results from this study revealed a high cultural value attached to *M. indica* and *G. senegalensis* in treating free-range indigenous chicken diseases. Medicinal plants were commonly used to treat symptoms of Newcastle Disease. The study generally revealed a high fidelity level for the most culturally important species and prevalent diseases linked to the free-range indigenous chicken production system. A localized system of knowledge about the use of plant species has influenced the utilization of *G. senegalensis*. Most plant species in this study can be grouped as belonging to fringes of cultural practices due to their infrequent number of mentions. The study recommends documenting ethnomedicinal practices to ensure that knowledge about their application in traditional pharmacopeia is maintained.

Declarations

Ethics approval and consent to participate: Ethical approval for the study was granted by the Ethics Committee of the Ho Technical University (Reference HTU/EC2023-020). All the participants provided prior informed consent before the interviews.

Consent for publication: Not applicable

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Author contributions: MKB, SKA, AMA, EKB, and AOA conceived the research idea. AOA and EKB did the data collection. MKB, SKA, and AMA analyzed and interpreted the data. MKB drafted the initial manuscript, and SKA and AMA revised and improved the manuscript. All the authors read, reviewed, and approved the final version of the manuscript.

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