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Ethnoveterinary practices amongst tribal pig farmers in Karbi Anglong district of Assam, India

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Folk traditional knowledge and practices are very rich and popular among the tribal farmers in different agricultural practices. The community-based cross-sectional study was carried out to know about pig farming patterns, ethnoveterinary knowledge and practices among various tribal pig farmers in Karbi Anglong district of Assam, India. Various field data pertaining to pig management were collected through personnel interviews, pre-tested semi-structured questionnaires, participatory rural appraisal, group discussions and field visits. This study attempted to evaluate the potential use of medicinal plants and their by-products as feed ingredients and traditional folk medicine. A total of 40 species of ethnoveterinary medicinal plants were recorded which are principally used to cure various major and minor ailments like fracture, parasitic infestation, maggot wound, diarrhoea, fever, etc. The use of locally available feed ingredients will help in the exploration of forest resources, minimize production costs. The present study recorded a total of 21 wild plant species which are used for feeding pigs with the most frequently used species belonging to *Broussonetia papyrifera*, *Colocasia esculenta*, *Alternanthera sessilis*, etc. The study will help the farmers, environmentalists, researchers, and other stakeholders to identify, document, familiarize and a better understanding of the distribution of rich medicinal plants in the hill region.

Keywords: Diarrhoea, Ethnoveterinary practices, Fever, Fracture, Tribal pig farmers

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The district Karbi Anglong is situated in the central part of the state of Assam and lies between 25°33′-26°35′N latitudes and 92°10′-93°50′E longitudes. The total geographical area of the district is 10, 438 sq. km with the highest altitude of 1360 m and falls in the hill agro-climatic zone of Assam. The forest area of the district is 7939 sq. km which is 76.09%[1] and the hill cover is 85% of the total geographical area. The temperature ranges from 6-32°C with an average annual rainfall of about 1572.2 mm[2]. It is one of the most economically backward districts in the state but its forest area is known for rich floristic diversity with various medicinal and aromatic plants. Demographically the district is inhabited by various ethnic tribal and non-tribal communities.

The total population of the district is 965,280 with 56.3% belonging to different tribal ethnic groups[3]. More than 85% of the population practice agriculture and allied activities as their basic source of livelihood and 90% of the tribal farmers reside in rural areas. Among the various agricultural practices, pig farming is one of the most popular enterprises among farmers. Piggery is an age-old traditional practice and about 75% of the tribal population reared pigs for subsidiary income generation and socio-cultural activities. The district accounts for the highest pig population of 1, 62, 295 (19th Livestock census, 2012) in the state of Assam contributing about 10% to the state's pig population[4]. Among the various tribes in the district, the Karbi tribe forms the largest accounting for 44.03% whereas other tribes such as Dimasa, Bodo, Kuki, Hmar, and Garo account for only 12.27%[3].

Pig rearing is considered one of the most profitable livestock enterprises due to its short generation interval, large litter size and ability to convert inedible kitchen waste materials into edible animal protein. Pig

husbandry in the district is practiced with a very low to no input basis through supplementation of feed with large numbers of locally available plant-based feed resources. The various factors such as poor socio-economic status, insufficient and non-availability of health services and farm inputs compelled the farmers to practice ethnoveterinary health practices with indigenous traditional knowledge in pig farming. The traditional health practices are accessible, affordable and culturally acceptable.

Their traditional knowledge has been verbally passed down from generation to generation without any documentation. Despite having vast potential in traditional pig farming, there is no systemic documentation on ethnoveterinary knowledge and practices followed by the tribal pig farmers in the region. Considering the above facts, the present study was carried out to document various ethnoveterinary practices in pig management in the Karbi Anglong district.

Materials and Methods

The study was conducted in the Karbi Anglong district of Assam, comprised of five community development blocks viz., Lumbajong, Bokajan, Howraghat, Samelangso and Nilip out of eleven community development blocks from April 2016 to March 2020 (Fig. 1). The blocks were selected based on the existence of a diverse representative tribal community which also has experience in pig farming. Data on pig farming, ethnoveterinary knowledge, and practices were collected through appropriate extension tools and techniques viz., Participatory Rural Appraisal (PRA), pre-tested semi-structured questionnaires, group discussion, personnel

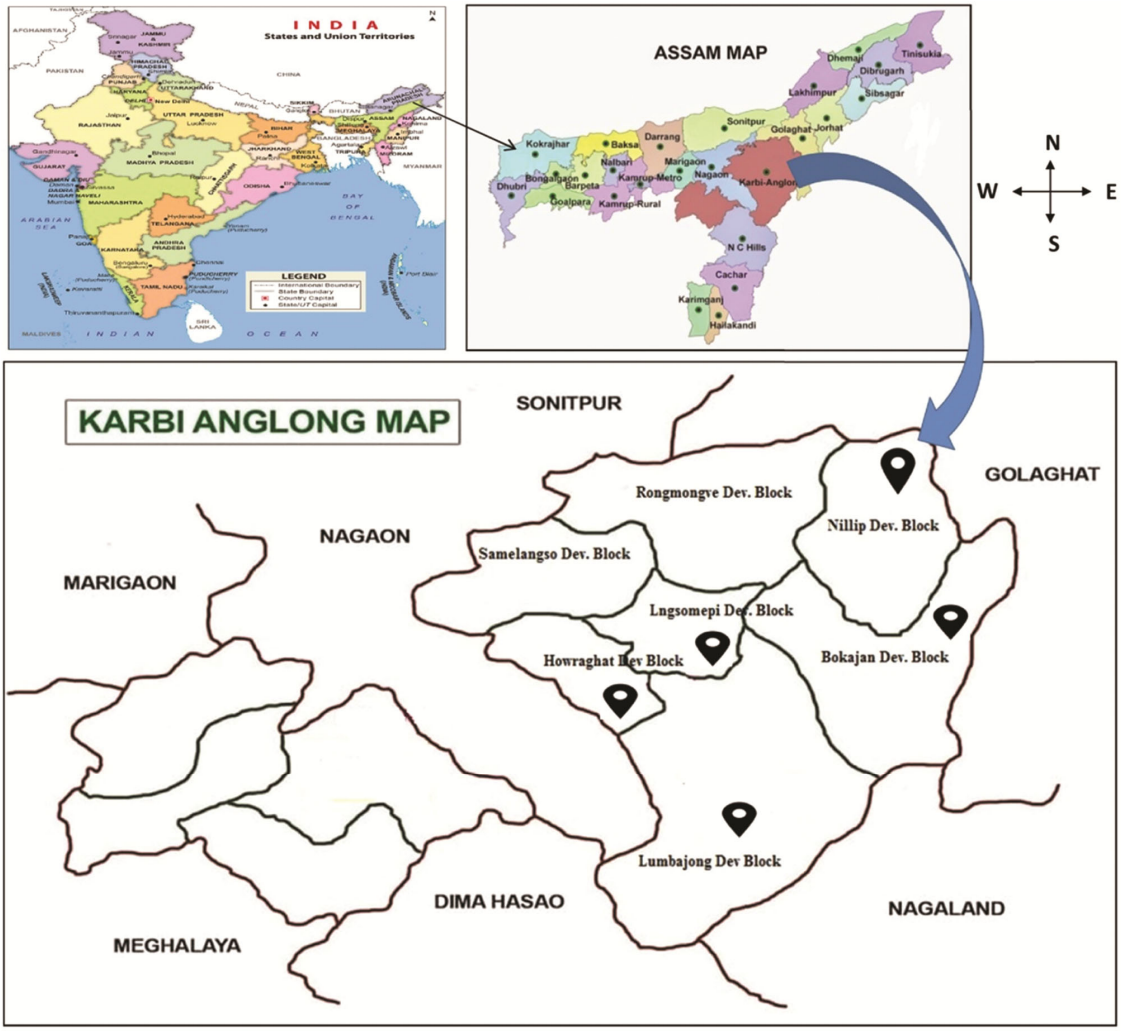

Fig. 1 — Map of Karbi Anglong district; location symbol indicating the community development block selected for data collection

Table 1 — The list of villages along with their respective community development block for data collection

Sl No	Community Development Block	Villages
1	Lumbajong	Hmarthlangmawi, Tuipajang, P. Taijol, N. Taijol, Ram Teron
2	Nilip	Chokihola, Sarthe Teron, Diring Teron, Gudam Teron, Moi Kro
3	Bokajan	Tinglijan, Balipathar, Kordoiguri, Sarihajan, Joporajan
4	Samelangso	Manikpur, Ganeshpathar, Beltola, 2 No. Dighali Majgaon, Sonarijan
5	Howraghat	Jalugoti, Borganga, 1 No. Kalaigaon, 3 No. Kalaigaon, Narlongati

interviews involving elderly traditional healer, village headman (*Gaon Budha*) and practicing pig farmers. A total of 200 respondents were purposefully selected comprising five villages (Table 1) from each block and eight respondents from each village representing different tribal communities (Karbi, Dimasa, Bodo, Garo, Kuki, Hmar). Prior informed consent (PIC) was obtained from the informants, traditional knowledge holders, and farmers for the collection of field data. The medicinal plant species were collected from individual homestead gardens, forest areas, community areas through various field visits and the data generated were verified and cross-checked through field experts, various other line departments (Animal Husbandry and Veterinary Department, Forest Department, Department of Agriculture, Department of Fisheries, Karbi Anglong Autonomous Council, Karbi Anglong), farmers and various online sources.

Results and Discussion

Pig farming

Pig farming is one of the most popular livestock enterprises among tribal farmers and plays a vital role in income generation, nutritional support and socio-cultural purposes[5,6]. The study revealed that pig farming is predominantly a woman domain (90%) with a very low to no input production system. In a study, Bora *et al.*[7], reported women's participation in traditional pig farming and opined that backyard pig farming plays an important role in the enhancement of socio-economic status and women empowerment. The study on the distribution of family labour revealed that females (82%) participated more actively in different farm management practices such as feeding, cleaning, marketing, whereas male contributes (18%) to medication, procurement of feed, cleaning and housing depending on their time convenience. Pigs were mostly sold to meet emergency needs for cash or during celebrations, festivals and wedding ceremonies and were often slaughtered to cater the unexpected needs. Piglets are generally directly purchased from nearby farms (54%) followed by local markets (38%) and outside the district (8%). The study on colour preferences of pigs revealed that the majority of tribal farmers preferred black colour (68%). In a similar study conducted in Nagaland, it was reported that 74.77% of tribal farmers preferred black colour pig than other pig colours which might be due to its requirements in socio-economic rituals and thereby fetching more prices[8].

Table 2 — Pig farming/Housing practices followed by the tribal pig farmers (n=200)

Variables	Type	Percentage
Pig owner	Female	90
	Male	10
Family labour	Female	82
	Male	18
Procurement of piglet	Fellow farmers	54
	Local market	38
	Outside the district	8
Colour preferences	Black	68
	Black with a white stripe	16
	White	10
	Other	06
Knowledge of scientific housing	Yes	27.5
	No	72.5
Rearing pattern	Fencing system with or without a roof	53.5
	Girth tethering with or without shelter	32
	Intensive housing with GI roofed concrete floor, wall	11.5
	Scavenging	3
Roof	G. I. Sheet	46
	Plastic tarpaulin	38
	Thatch, rice straw, or locally available materials	16
Floor structure	Mud and raised wooden floor	78.5
	Concrete floor	21.5

The studies on housing practices (Table 2) revealed that the majority of the farmers (72.5%) are very less aware of scientific housing practices. Similar observations were also reported among pig rearers in Assam where dominated housing pattern found to be tethered and penned system in pig production[9]. In the

present study, it was observed that pigs were kept mostly in a fencing system (53.5%) with or without a roof followed by girth tethering with or without shelter (32%), intensive housing with galvanized iron (GI) roofed concrete floor, wall (11.5%) and least by scavenging (3%) (Fig. 2). The average heights of pig houses are found to be about 4-7 feet with wooden, bamboo, or concrete post location on the farm. The roof of the sty is mostly made of G.I. sheets (46%), plastic tarpaulin (38%) and thatch, rice straw, or some locally available materials (16%). The floor structures (Table 2) are mostly non-concrete; mud and raised wooden floor (78.5%) followed by concrete floor (21.5%) which is based on the socio-economic status of the farmers. The sidewalls and fencing of the pigsty were constructed with wooden and bamboo. Contrary to this, a study revealed that most of the pigs housed under straw shed raised housing (42.5%) and least by free grazing (8.5%)[10]. In another study, girth tethering was found to be the most widely accepted and popular system of rearing[11]. Daily cleaning practices in housing are recommended to keep the floor dry and reduce odour[11]. In the present study, farmers practiced mostly cleaning their pig sties once a day (58%) followed by weekly (27.5%) and twice a day (14.5%) whereas no cleaning works are carried out on the tethering site. In a similar study, the frequency of cleaning practices was recorded to be 26.7% clean twice a day, 46.7% once a day, and the remaining 26.7% omit once a week[12].

Feeding management

Feed and fodder play a vital role in pig farming and constitute over 70% of the total cost of production[13]. To achieve optimum production and profitability, a balanced ration is of utmost necessity. Pig rearing is still an unorganized venture characterized by a low input production system with a locally available wide range of feed resources such as kitchen waste, vegetable, and agricultural by-products[14,15]. Farmers have evolved various feed-cost reducing strategies to minimize total production costs. The tribal pig farmers in the district fed their pigs with kitchen or various agricultural waste materials and locally available large numbers of non-conventional plant-based feed resources such as the leaves, fruits, tuber and other vegetation collected from the forest as well as agri-allied ecosystem. Some of the commonly used plants species for pig feed are shown in Fig. 3. These

Fig. 2 — Some commonly practiced pig rearing patterns by tribal farmers. a. Girth tethering of pig b. Intensive housing of pig with wooden wall and post c. Pig under scavenging condition

Fig. 3 — Some commonly used plants species for pig feed. a. *Alternanthera sessilis* b. *Broussonetia papyrifera* c. *Ipomoea aquatica*

feed materials are either used as such in raw form or cooked form or a combination of both. During the study, a total of 21 plant species that are used by various tribes inhabitants of the hill district were documented (Table 3). These plant species are mostly collected from wild forest areas except for a few species viz., *Musa* spp*, Cucurbita pepo*, *Carica papaya, Ipomoea batatas*, *Manihot esculenta, Colocasia esculenta* and *Ananas comosus* which are cultivated in a homestead garden. The most common and frequently used plant species for feeding include *Colocasia esculenta, Broussonetia papyrifera* and *Alternanthera sessilis.* In a similar study, different types of non-conventional feed resources such as *Bidens pilosa* L, *Borreria* hispida (L.) Schum, *Osbeckia* sp., *Spilanthesa cmella* L., *Vernonia anthelmintica* L., *Colocasia esculenta L*., *Manihot esculenta* Crantz, *Musa paradisiaca* L., *Saurauia nepaulensis* DC. and *Ficus hispida* L. f. were reported to be used in Nagaland for feeding pig according to availability[15]. The incorporation of various wild plant species such as *Bidens biternata*, *Hibiscus* sp., *Spilanthes* sp., *Mikania scanden*, *Amaranthus spinosus*, *Ipomea batata*, *Colocasia esculenta* and *Musa* along with other pig feed in Mizoram[16] was also reported. Most of the plant species are collected by the women farmers (80%) and fed after cooking with rice bran and kept for up to two days. No data could be retrieved on the contribution pattern of women farmers in the collection of pig feed of plant origin during the study. Making of local rice beer (Karbi-*Horcera*; Dimasa-*Judima*) is an old age traditional practice and the left-over rice is mixed with cooked plants depending on the availability. *Ipomoea aquatica,* an aquatic plant species is one of the most popular feed resources available primarily in low-lying areas with heavy vegetation during the rainy season. This plant is a rich source of vitamins and minerals and the farmers believed to use it mainly in pregnant and lactating pigs[17]. The other non-conventional plant species used for feeding pigs by the farmers include *Mikania scandens, Eichhornia crassipes, Dioscorea alata, Chenopodium album,* and *Cucurbita pepo.*

Disease management

Among the domesticated pig population, various infectious and noninfectious causes have been recorded in Assam from time to time[18,19]. The use of indigenous veterinary medicine is a cost-effective treatment option for livestock, especially in primary health care in remote areas[20]. Traditional/folk medicinal practices are still alive in remote areas because of the constant practicing of indigenous knowledge on agricultural practices, untimely availability of veterinary services and involvement of high cost, *etc*. In the present study, a total of 40 medicinal plant species were recorded which were used either singly or in combination with other plant parts or mixed ingredients (Table 4). Some of the

Table 3 — Commonly used plant species for feeding Pigs

Scientific name	English name/local name	Plant part(s) used	Method of use
Alternanthera sessilis (*Linn.*) R.Br. ex. DC	Sessile joyweed/Votokreng	Whole plant except root	Raw/cooked
Amaranthus spinosus Linn.	Prickly Amaranth/Dido Sudo	Whole plant except root	Raw/cooked
Amaranthus viridis Linn.	White Amaranth/Dido	Whole plant except root	Raw/cooked
Ananas comosus (L.) Merr.	Pineapple/Parokjangphong	Ripened fruits	Raw
Bambusa spp	Bamboo/Chek	Shoot	Raw
Broussonetia papyrifera	Paper mulberry/Thengpinihom	Leaf and tender stem	Raw/cooked
Carica papaya L.	Papaya/Mensupi	Fruits	Cooked
Chenopodium album Linn.	Wild spinach/Churu	Whole plant except root	Cooked
Colocasia esculenta (Linn.) Schott.	Colocasia/Henru	Leaves and petiole	Cooked
Cucumis melo Roxb.	Winter melon/Bonghomlenglu	Fruits	Cooked
Cucurbita pepo	Pumpkin/Bonghom	Flower, fruits and tender leaf/stem	Raw/cooked
Dioscorea alata Linn.	Yam/Phuroi	Tuber	Cooked
Eichhornia crassipes	Water hyacinth/Mirtika	Whole plant except roots	Raw/cooked
Ficus racemosa L.	Indian fig/Ingthumarong	Fruits	Raw
Ipomoea aquatica Forssk.	Water spinach/Kolmou	Whole plant	Raw/cooked
Ipomoea batatas Lamk.	Sweet potato/Ruidok	Modified root, leaves and vines	Raw/cooked
Manihot esculenta Crantz.	Tapioca/Rui pharkong	Tuber and leaves	Raw/cooked
Mikania scandens B.L. Rob.	Climbing hempweed/Bapthina	Whole plant	Cooked
Musa spp	Banana/Phinu	Pseudostem and flower	Raw/cooked
Nymphaea nouchali Burm.f.	Water lily/Bhetphul	Tuber	Raw
Paederia foetida Linn.	Stinkvine/Rikangmenthu	Whole plant excluding root	Cooked

Table 4 — Commonly used plant species as ethnoveterinary practices for management of pig diseases/ailments

Scientific name	Common name/Karbi name	Part(s) used	Disease conditions/ ailments	Methods of preparation and application
Acacia pennata Wild.	Rusty mimosa/ Thembra	Bark	Diarrhoea	Administered about 50-100 g cake orally on empty stomach for a period of 3-5 days. The cake is prepared by mixing chopped and dried thembra bark with grounded rice and clean water followed by sun-drying for 7-10 days.
Ageratum conyzoides L.	Billygoat-weed/ Bongnaiso	Leaves	Wound	Applied as a paste by crushing 25-30 nos. of fresh leaves on the cut wounds
Aloe vera (L.) Burm.f.	Aloe Vera/ Bap engsu	Leaves	Skin infection	Applied as paste on the skin lesion twice daily for 10-15 days. The paste is prepared by grinding 20-30 g of freshly collected Aloe Vera leaves.
Alstonia scholaris (Linn.) R.Br.	Blackboard tree/ Thengmu	Bark	Chronic diarrhoea and fever	An extract is prepared by soaking bark overnight in clean water. Drench the extract orally for 2-3 days
Amaranthus bicolor Linn.	Bishohori/ Mirve	Leaves	Freshly cut wound andpost castration	Applied as paste on the wounded area. The paste is prepared by crushing freshly collected 30-50 g of leaves and applied two times for 5-7 days
Amaranthus spinosus Linn.	Prickly Amaranth/ Dido Sudo	Whole plant except root	Hypogalactia	Raw/cooked Prickly Amaranth is mixed with pig feed @ 250-500 g twice daily
Averrhoa carambola Linn.	Star fruit/Thorte	Fruits & leaves	Diarrhoea and vomiting	An extract is prepared by proper chopping and grinding of 5-7 nos of ripned fruits and 50 g of leaves. The extract is then drenched orally @ 50ml twice daily for 2-3 days
Azadirachta indica A. Juss.	Neem/Nim	Bark	Worm infestation	About 50-70 g of dried bark is ground into powder. The powder is mixed with drinking water and fed orally once daily for about 3-5 days
		Leaves	Skin infection	Decoction of about 200 g of leaves then extract is applied over the skin lesion for about 7-10 days
Cannabis sativa Linn.	hemp/Bahang	Leaf	Inappetence	Both raw and dried leaves of Indian hemp is chopped and mixed with pig feed
Capsicum frutescens Linn.	African chilly/ Birikso	Fruit	Conjunctivitis	About 1-3 nos of African chilly is properly grinded along with 10 mL of mustard oil and applied on the infected eye
Carica papaya L.	Papaya/ Mensopi	Fruits	Diarrhoea	About 1 K g of papaya fruits is cut into small pieces, cooked with rice bran properly then fed twice daily for 5-7 days
Centella asiatica (Linn.) Urban	Asiatic pennywort/ Nonrongman	Whole plant	Diarrhoea/ dysentery and fever	About 50-100 mL of plant extract in water is prepared and drenched orally twice daily for 5-7 days
Cephalandra indica Naud.	Kavai fruit/ Kai krup	Leaves	Chronic diarrhoea	About 50-70 mL of fresh leaves extract is prepared and drenched orally twice daily for 5-7 days
Cissus quadrangularis Linn.	Edible stem wine/ Repi Chingthun	Whole plant except root	Fracture and deep-seated wound	Freshly collected plant part is crushed and made into a paste, applied directly on the fractured area once daily with the provision of a splint to support the immobilized joint part. The application is continued for a period of about 3-4 weeks.

(*contd.*)

Table 4 — Commonly used plant species as ethnoveterinary practices for management of pig diseases/ailments (*contd.*)

Scientific name	Common name/Karbi name	Part(s) used	Disease conditions/ ailments	Methods of preparation and application
Colocasia esculenta (Linn.) Schott.	Colocasia/ Henru	Corm	Cut wound	Applied as a paste directly by crushing about 30-50 g of the corm
Cordia dichotoma	Clammy Cherry/ Buwal tree	Bark	Diarrhoea/ dysentery	About 100-200 mL of bark extract is prepared by dipping overnight in clean drinking water. The extract is drenched orally in the morning once daily for 5-7 days
Curcuma caesia Roxb.	Black turmeric/ Hansoke-ik)	Rhizome	Skin infection	A paste is prepared with 30-50 g of the rhizome and applied to the affected part once daily for about one month
Curcuma longa Linn.	Turmeric/ Tharmit	Rhizome	Post castration	An amount of 50-70 g of crushed turmeric rhizome is thoroughly mixed with ash, mustard oil/coconut oil and applied immediately post castration and continued for 3-5 days
			Skin disease	Applied as paste on the affected skin
Cynodon dactylon Pers.	Dub/Tipli	Leaves	Skin abrasions	Applied directly as paste on the affected area
Drymaria cordata Linn.	Tropical chickweed/ Laijabori	Leaves	Diarrhoea/ dysentery and fever	Raw leaf extract prepared by crushing 50-100 g leaves in 100-150 mL clean water then administer orally after mixing with feed twice daily for 3-5 days
Ficus racemosa L.	Indian fig tree/ Thebo	Latex	Fracture	The latex of the plant is collected aseptically and applied to the fractured area followed by a provision of bamboo strips and tied for immobilization
Gendarussa vulgaris Ness.	Willow-leaved justicia/Bikholya Koroni	Leaves	Post castration	Applied as paste prepared from freshly collected 30-50 nos of leaves for a period 5-7 days
Hibiscus rosa sinenesis Linn.	China rose/Joba	Flower & leaves	Ripening of boil	Freshly collected tender leaves and flowers of about 50-70 g is crushed into a paste and applied for 12 h.
Hibiscus sabdariffa Linn.	Roselle/ Hanserong	Leaves & fruits	Constipation and fever	Decoction of about 250 g of leaves and fruits and fed with feed twice daily for 3-5 days
Houttuynia cordata Thunb.	Heartleaf/ Vorekjokk	Leaves	Fever and diarrhea	Leaf extract is prepared by crushing 30-50 nos of leaves along with 50-70 mL of clean water and administered orally for 2-3 days
Lasia spinosa Thwaites.	Lasia/Chosot	Offset	Worm infestation	Decoctions of about 200 g of freshly collected offset and administer the extract after mixing with feed once daily for a period 5-7 days.
		Tender stem, leaves	Maggot wound and external parasite infestation	Crushed and grind about 150 g of tender stem and leaves then applied directly through pasting and rubbing on the wounded and parasite infested area once daily for 3-5 days
Litsea laeta Benth & HK	Common Grey Mango Laurel. / Mukasong	Barks	Maggot wound	About 75-100 g of freshly collected bark is ground and applied on the affected part twice daily for 25-30 days
Mikania scandens B.L. Rob.	Climbing hempweed/ Bapthina	Leaves	Fresh cut wound and bleeding	Applied as paste prepared from freshly collected Climbing hempweed leaves until bleeding stops
Momordica dioica Roxb.ex. Wild	Spiny gourd/Kerela	Leaf	External parasite infestation	Applied as a paste directly on the parasitic infested skin area for duration of about 1-2 h. daily and continued for 2-3 days

(*contd.*)

Table 4 — Commonly used plant species as ethnoveterinary practices for management of pig diseases/ailments (*contd.*)

Scientific name	Common name/Karbi name	Part(s) used	Disease conditions/ ailments	Methods of preparation and application
Moringa oleifera Lam.	Drumstick tree/Sondon	Root	Maggot wound	Grind and mixed thoroughly about 30 g roots epidermis, 3 nos. of naphthalene ball, 30 mL of coconut oil and applied on the wounded area for 3-5 days
		Bark	Fungal infection	Grind and mix thoroughly about 100 g of bark, 20-30 g of sugar, 3-5 nos of naphthalene ball and 30-50 mL of coconut oil and apply the mixture directly on the parasitic infested lesion
Nicotiana tabacum Linn.	Tobacco/Doma	Dried leaves	Maggot wound	Dried tobacco leaves are ground into powder form and mixed properly with dissolved lime. The mixture applied to the maggot wounds twice daily for 3-5 days
			External parasitic infestation	Extract from dried leaves are externally applied for 5 days to get rid of mites, tick infestation
Ocimum killimandscharicum Guerke.	Holy basil/ Lopongbirik	Leaves	Navel cord infection	About 30-50 mL of fresh leaves extract is prepared and applied twice daily for 5-7 days on the cut site of the navel cord
			As fly repellant, other external parasitic infestation	About 50-70 mL of fresh leaves extract is mixed with 500-700 mL of water then spray on the whole body surface
Ocimum tenuiflorum L.	Black tulsi/Tulohi	Tender leaves & stem	Skin infection	About 30 g of freshly collected tender leaves and the stem is crushed into a paste and applied to the infected area for 3-5 days
Oroxylum indicum (Linn) Benth.ex Kurz.	Broken bone tree/Nopakban	Bark	Bone fracture	Make Paste from the bark then applied directly to the lesion for 5-7 days
Prunus persica (L.) Batsch.	Peach fruit/ Sompho	Leaves	Maggot wound	Applied directly on the lesion as paste twice daily for 3-5 days. The paste is prepared by crushing 20-30 nos of fresh leaves
Psidium guajava Linn.	Guava/Sopreem	Tender leaves	Diarrhoea	About 50-70 mL of guava leaves extract and 5-7 g of common salt is mixed and administered orally once daily for 5-7 days
Spondias mombin L.	Amora/Siming	Bark & fruits	Severe diarrhoea	Bark and matured fruits extract of about 50-100 mL is drenched orally for 5-7 days
Vitex negundo Linn.	Chinese chaste tree/Vorekabap	Leaves	Dysentery	Prepare about 50-70 mL of leaf extract and administer along with feed twice daily for 3-5 days
Zephyranthes candida (Lindl.) Herb.	White rain lily/ Mirharsun	Bulbs	Complete/simple/ multiple Fracture	Applied as a paste by crushing 15-30 nos of fresh bulbs and applied on the fractured area once daily for 3-4 weeks
Zizyphus jujube Mill.	Jujube/Bokori	Fruits	Constipation	Decoction of about 20-25 nos of Jujube fruits for 15-20 min. The extract is fed twice daily for 3-5 days

important medicinal plant species collected from the study areas are shown in Figure 4.

Decoction of offset of *Lasia spinosa*, bark powder of *Azadirachta indica* are commonly practiced for deworming pigs. A similar study on medicinal plants among Naga tribes suggested the efficacy of leaf extract of *P. guajava*, *C. asiatica*, and *L. spinosa* (stalk) against a filarial parasite, *Setaria cervi*[21]. Some commonly used plant species for the treatment of maggot wound infection includes *Nicotiana tabacum*, *Laisa spinosa*, *Moringa oleifera*, *Prunus persica* and *Litsea laeta*. On another occasion, work on the use of many plant species viz., *Hibiscus sabdarifa* for constipation, diarrhoea, and fever[22,23] for treatment of multiple ailments had been established. In a similar study, application of *Moringa oleifera* against maggot wound and fungal infections[24], *Centella asiatica* against diarrhoea/dysentery, constipation, and fever

Fig. 4 — Some commonly used medicinal plants a. *Zephyranthes candida* b. *Cissus quadrangularis Linn* c. *Hibiscus sabdarifa* d. *Mikania scandens* e. *Houttuynia cordata Thunb* f. *Oroxylum indicum*

were documented[25]. Application of a mixture of dried leaf powder of *Nicotiana tabacum* along with lime or Naphthalene powder, coconut oil, raw turmeric, and garlic is highly practiced almost among all the ethnic tribal populations. The various plant parts of *L. spinosa* had been recorded in different parts of the world due to its anthelmintics and nutritional properties[26,27]. Various studies on application of *Nicotiana tabacum* against external parasite and skin infections had been recorded by different researchers[27,28]. Apart from this, application of *Ocimum tenuiflorum*, *Curcuma longa* and *Azadirachta indica* were also reported for skin infection/lesion[29-31]; *Cordia dichotoma, Averrhoa carambola, Acacia pennata* and *Drymaria cordata* for diarrhoea/dysentery[32-34] and *Centella asiatica,* and *Houttuynia cordata Thunb* during fever[35,36].

Conclusion

From the study, it can be concluded that pig farming is an integral part of a majority of tribal farmers in the Karbi Anglong district contributing to income generation and nutritional security. Pig farming is predominantly a woman domain (90%) enterprise with a very low to no input production system. Although pig rearing is an age-old practice awareness, adoption, and application of scientific pig farming are found to be limited. Pig farming is still in subsistence form and there is ample scope for promoting pig farming through capacity building programmes, off/on-farm scientific piggery farm demonstration, quality piglet production, and improvement of animal husbandry extension services. Ethnoveterinary practices play an important role in pig production and health care among tribal communities in the district. A total of 40 plants species were documented having medicinal properties used for treating major and minor ailments in pigs. Similarly, 21 plant species (whole or parts of the plant) were found to be used for feeding pigs thereby helping to minimize total production cost. The traditional knowledge system is of much significance for new or alternative drug discovery. There is an urgent need for documentation and scientific validation of ethnoveterinary practices along with an effort to conserve rich floral resources distributed in the hill district.

Acknowledgment

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Conflict of Interest

The authors declare that no conflict of interest exists in the study.

Authors' Contributions

MKD: Conceptualized the study, data collection and drafted the original manuscript; NB, SM, JS and RH: reviewed and edited the manuscript; MN and PKP: supervised the entire study. All authors discussed the findings and contributed to the final manuscript.

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