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ETHNO-MEDICINAL STUDY OF PLANTS USED FOR TREATMENT OF BUFFALO AILMENTS BY TRADITIONAL HEALERS IN MARWAR REGION, RAJASTHAN, INDIA

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ABSTRACT

The objective of this current investigation was to explore the ethnoveterinary practices concerning plant use and formulation techniques in an undisclosed area of India. Additionally, the study aimed to identify potential medicinal plants with notable consensus factor and fidelity values for subsequent in vitro analysis. A total of 60 individuals were interviewed using a semi-structured questionnaire to gather information. Within the study area, 63 medicinal plants from 40 different families were documented for treating ailments in buffaloes. Notably, the Amaranthaceae family was most frequently cited for buffalo treatment. Analysis of growth forms revealed a dominance of woody plants, with shrubs comprising 30.16% and trees 28.57%, followed by herbs at 31.16% and climbers at 09.52%. A majority of the plants were found to be wild (63.49%) and perennial (73.01%). Leaves and roots were the preferred plant parts for remedies, followed by whole plants and seeds. The informant consensus factor (ICF) ranged from 0.83 for ophthalmic and poison effects to 0.97 for respiratory ailments, indicating a strong consensus among traditional healers regarding plant usage for various ailments. Vernoia cinerea exhibited the highest Fidelity Level (FL) value (81.25%), followed by Tecomella undulate (72.72%) and Curcuma longa (71.11%). Plants with high ICF and FL values warrant further investigation through phytochemical and pharmacological studies to validate their efficacy scientifically.

Keywords: *Bubalus bubalis*, buffaloes, ethnoveterinary practices, Informant consensus factor (ICF), Fidelity Level (FL), traditional knowledge

INTRODUCTION

Knowledge can be sourced from either scientific methodologies or traditional practices. Traditional wisdom encompasses a reservoir of knowledge, customs, and beliefs that evolve through adaptive processes and are transmitted across generations through cultural means (Tolossa *et al*., 2013). India boasts a rich heritage of traditional healthcare practices, particularly in the treatment of animals, which has been passed down through generations (Khateeb *et al*., 2015). Even today, rural communities in India rely

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heavily on traditional remedies for both human and livestock healthcare, considering them cost-effective and safe (Rajakumar and Shivanna, 2012). Limited access to medical facilities in rural areas, especially during certain times of the year, reinforces the dependence on traditional medicine. Rajasthan, characterized by diverse geological, climatic, and ecological conditions, serves as an ideal habitat for a variety of ethnomedicinal plants (Ram *et al*., 2016).

India hosts a significant portion of the world's livestock population, including 56% of the global buffalo population and 16% of the cattle population (Jatolia *et al*., 2017). Buffaloes, particularly the Murrah breed, play a crucial role in agricultural intensification, especially in regions like Rajasthan, known for its arid and semi-arid conditions (Livestock Census, 2019). Here, rural communities engage in both crop production and buffalo husbandry, forming an integral part of their livelihood strategies. Traditional healers in the Marwar region possess profound knowledge of medicinal plants, leveraging them to treat buffaloes according to local conditions. The current study aims to document the ethnoveterinary practices of the Marwar region, focusing on the formulation techniques of reported plants, and identifying promising medicinal plants for further investigation through *in vitro* studies.

MATERIALS AND METHODS

Study area

Located in the northwestern region of India, Rajasthan spans an area of 342,239 square kilometers (132,139 square miles). Positioned between latitudes 23 degrees 3 minutes and 30 degrees 12 minutes north, and longitudes 69 degrees 30 minutes and 78 degrees 17 minutes east, Rajasthan encompasses diverse geographical features. The Marwar region within Rajasthan falls within arid and semi-arid climatic zones, characterized by sandy plains situated northwest of the Aravalli range. The Aravalli range intercepts much of the southwest monsoon's moisture, resulting in low annual rainfall ranging from 10 to 40 centimeters. Temperature extremes are notable, with summer highs reaching 45 to 50 degrees Celsius and winter lows dipping below freezing. Adjacent to the Aravalli range are the northwestern thorn scrub forests, while the remainder of the region transitions into the Thar desert. The Luni River serves as a prominent geographical feature within the Marwar plains. The Thar desert, particularly in western Marwar (Maru Pradesh), presents challenges for human habitation due to its harsh physical geography, including high wind velocities, shifting sand dunes, and scarce and saline water sources.

The rural communities in this area rely heavily on livestock for agriculture, economy, and sustenance. Traditional medicinal plants are often utilized by locals to treat ailments among their buffalo population, offering an alternative to costly veterinary medications.

Sampling and data collection

Data collection occurred between November 2019 and February 2020, during which visits were made to local agriculture officers and representatives (Sarpanch) of the respective regions. They shared insights into key resource persons specializing in ethnoveterinary medicinal plants. Based on their recommendations, 60 informants renowned for their robust traditional knowledge of buffalo treatment were identified, comprising 50 farmers and 10 nomadic individuals.

Before proceeding with data collection, a preliminary group discussion was conducted with the informants to elucidate the primary focus of the study and obtain their consent for the dissemination of their traditional wisdom. This gesture aimed to recognize the informants' invaluable cooperation in safeguarding the area's traditional knowledge and instill confidence in them to provide dependable information. Subsequently, individual interviews were conducted with each informant in their native language (Marwari). Semi-structured questionnaires were prepared to delve into detailed ethnoveterinary practices concerning buffaloes. Informants were queried about the variety of plants they utilize for buffalo treatment, specific plant parts employed, formulation of remedies, and other pertinent inquiries.

Data organization

The data collected regarding ethnomedicinal plants and the ethnography of participants underwent organization and summarization employing statistical methodologies, primarily utilizing percentages. Plant habits were categorized into four groups: herbs, shrubs, trees, and climbers. Additionally, the utilization of plant parts was segmented into distinct categories including leaves, roots, stems, whole plants, seeds, fruits, and flowers. The applications of medicinal plants were further classified into 12 major categories encompassing gastrointestinal, respiratory, reproductive, dermatological, wound and burn treatments, bone and joint-related issues, fever and febrifuge, parasitic, foot and mouth diseases, ophthalmic conditions, urination problems, poison effects, and general body tonics. Recipes were also sorted into various groups such as decoctions, powders, infusions, juices, pastes, poultices, and concoctions. Furthermore, the administration routes were divided into three categories: oral, topical, and internal application.

Data analysis

We employed informant consensus and fidelity level assessments to validate the significance of medicinal plants.

Informant Consensus Factor (ICF)

The utilization of the Informants' Consensus Factor (ICF) in various research domains highlights the versatile applications of indigenous plant knowledge. This methodology serves to identify plants of significant interest across diverse study areas, particularly in the context of addressing specific ailments. By categorizing diseases and assessing the frequency of plant usage within each category, researchers can discern the pharmacological potential of different plant species. High ICF values indicate widespread agreement among informants regarding the efficacy of particular plants in treating a specific disorder, suggesting their potential for further pharmacological and phytochemical investigations. Conversely, low Fic values suggest a lack of consensus among informants regarding the preferred plant for a given ailment. The calculation of ICF involves determining the ratio between the number of citations for plant usage within each category (nur) and the total number of species used (nt).

$$ICF = \frac{nur-nt}{nur-1}$$

where ICF = informants consensus factor, nur = number of use citation in each category, and nt = number of species used.

Fidelity Level (FL)

The concept of Fidelity Level (FL) proves invaluable in identifying the most preferred plants employed in treating specific ailments by respondents (Friedman *et al*., 1986). FL values tend to be higher for plants that are highly favored compared to those that are less favored. These values are determined based on the percentage of informants who claim the use of a particular plant species for a given ailment. Essentially, FL values serve as indicators of the significance of certain plant species for specific purposes. To compute FL values, reported ailments are categorized into major classes. The formula used for estimating FL is

$$FL = \frac{Ip}{Iu} \times 100$$

where Ip denotes the number of respondents who reported the use of medicinal plants for a particular ailment, and Iu represents the total number of respondents who mentioned the same plant for any ailment. The underlying assumption is that medicinal plants frequently utilized by most respondents for a specific category are more likely to possess biological activity (Trotter and Logan, 1986).

RESULTS AND DISCUSSIONS

Habit, life span and growth form and parts used of medicinal plants

Analysis of the data presented in Table 1 indicates that the predominant growth form among the plants cited for their medicinal properties by informants is woody, comprising over 50% of the total (30.16% shrubs and 28.57% trees), followed by herbs (31.16%) and climbers (09.52%). This prevalence of woody plants is likely attributed to their resilience during extended dry seasons, which ensures their abundance and accessibility throughout the year in arid and semi-arid regions. Interestingly, this contrasts with the conventional trend observed in many medicinal plant surveys, where herbs typically dominate (Ahmad *et al*., 2016).

In terms of sourcing, the majority of plants used in the study area are wild (63.49%) rather than cultivated (36.51%). Regarding lifespan, perennial plants (73.01%) significantly outnumber annual (23.81%) and biennial (3.18%) varieties. Various plant parts including roots, leaves, stems, fruits, young shoots, and flowers were reported for use in medicinal preparations. Notably, leaves (24.05%) were most commonly utilized, followed by roots (16.46%), and the whole plant (13.92%). This prevalence of leaf usage might be attributed to their accessibility, as suggested by prior studies (Preeti and Sudip, 2019; Adhikari *et al*., 2018). Similarly, the frequent use of roots could be linked to their continuous availability in soil, even during prolonged dry periods in arid and semi-arid regions.

Ailments treated and Informant Consensus Factor (ICF)

During the field survey conducted in the study area, local sources identified 63 medicinal plant varieties spanning 40 different families, known for their efficacy in treating 12 ailments affecting buffaloes. The majority of these medicinal plants were found to belong to 5 main families, with Amaranthaceae being the most prevalent, comprising 5 distinct species. Following closely were Combretaceae, Fabaceae, Lamiaceae, and Liliaceae, each with 3 species documented (refer

to Table 2). This contrasts with previous studies by Appidi *et al.* (2008); Khan *et al.* (2014), which highlighted the frequent use of Fabaceae and Asteraceae species in ethnoveterinary practices.

Informants reported utilizing both internal and external applications for treating buffalo ailments, with oral administration being the most common (78.48%), followed by topical application (20.25%). Oral administration often involves the use of solvents or additives such as milk, butter milk, clarified butter, oil, or fodder, believed to aid in the delivery of remedies and minimize discomfort or adverse effects like vomiting and diarrhea, thus enhancing efficacy and healing conditions. Similar observations have been noted by Baidya *et al*. (2020); Khada *et al*. (2018); Nimblakar *et al*. (2020).

The plants identified were categorized into 12 groups based on their reported uses by informants. The study revealed a range of Informant Consensus Factor (ICF) values from 0.83 for ophthalmic and poison effects to 0.97 for respiratory ailments (see Table 3). These values suggest a strong consensus among traditional healers regarding the efficacy of specific plants against various ailments. Such findings can guide the selection of medicinal plants for further scientific research into disease treatment (Adeniran *et al*., 2020).

The highest number of plant species were reported to be used in treating gastrointestinal disorders (25 species, 39.68%), followed by reproductive problems (11 species, 17.46%), dermatological issues, wounds, and burns (7 species, 11.11%), and problems related to bones and joints (6 species, 09.52%). Additionally, plants were used for addressing parasitic infections, foot and mouth disease, poison effects (5 species, 07.94%), general body tonics (4 species, 6.35%), urination problems (3 species, 04.76%), and respiratory issues, fever, febrifuge, and ophthalmic conditions (2 species, 03.17%) as detailed in Table 3. The reliance on medicinal plants by local informants stems from a combination of ancestral knowledge passed down through generations and learning from others, driven by the unaffordability of modern veterinary drugs for treating buffalo ailments.

Fidelity Level (FL) of common medicinal plants

The recent investigation unveiled six potential medicinal plants exhibiting high FL values, as detailed in Table 4. Vernoia cinerea secured the top position with the highest FL value (81.25%), followed by Tecomella undulate in second place (72.72%), Curcuma longa in third (71.11%), Ziziphus nummularia in fourth (66.67%), Citrullus colocynthis in fifth (62.96%), and Azadiracta indica in sixth (56.25%). These plants, identified for their elevated FL values, suggest their efficacy in treating specific ailments, thereby warranting further validation of their bioactivity.

CONCLUSION

Farmers in the Marwar region rely on various medicinal plants to treat their buffaloes, as the cost of allopathic drugs is prohibitively high. However, the excessive harvesting of these plants for medicinal purposes raises concerns about their potential extinction in the future. It is imperative to safeguard these medicinal plants from extinction. The insights gained from studying these remedies could provide valuable leads for chemical, pharmacological, clinical, and biochemical research. Establishing a database of these remedies could facilitate the development of natural

Table 1. Ethnoveterinary plants used for the treatment of buffalo ailments in Marwar region of Rajasthan.

Scientific name; Family	Local name	Habit; Life span; Growth form	Use(s) / Ailments	Parts used and preparation	Route	Ref.
Abutilon indicum Linn.; Malvaceae	*Kanghi*	Shrub; Annual; Wild	Constipation	Paste of seeds (20 gm) is given to relief constipation.	Oral	Raja and Kaillasam (2015)
			Haematuria	Leaves (500 gm) along with fodder are given.	Oral	
Acacia nilotica (L.) Willd. Ex. Delile; Fabaceae/ Mimosodia	*Kikar/ Desi babool*	Tree; Perennial; Wild	Wounds and burn	Decoction of stem bark mixed with *Sesamum indicum* seed oil is applied on the effected parts.	Oral	Ali *et al*. (2012)
*Acacia nilotica (Linn.) indica (*Benth) Brenan*;* Mimosaceae	*Babool*	Tree; Perennial; Wild	To detach retained placenta	Decoction of old thorns (2-3 years) is given to the buffalo for easy removal of placenta after delivery.	Oral	Malviya *et al*. (2011)
Achyranthes aspera Linn.*;* Amaranthaceae	*Modo kanto*	Herb; Annual; Wild	Stomach-ache	Decoction of roots (100 gm and rhizomes of *Curcuma longa* (50 gm) is given to buffalo.	Oral	Hasan (2014)
			Removes retained placenta	Decoction of whole plant is given to easy removal of placenta.	Oral	
			Opacity	Leaf juice is used as eye drops.	Topical	
Aerva lanata (L.) Juss. ex Schult.; Amaranthaceae	*Kali bui/ Chotti bui*	Herb; Perennial; Wild	Snake bite	Roots (100 gm) are crushed and given.	Oral	Ramana and Vikram (2015)
Aerva persia (Burm.f.) Merrill.; Amaranthaceae	*Safed bui*	Herb; Perennial; Wild	Foot and mouth disease	Decoction of roots (250 ml) and extract of whole plant is given.	Oral	Chawla *et al.* (2013)

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Scientific name; Family	Local name	Habit; Life span; Growth form	Use(s) / Ailments	Parts used and preparation	Route	Ref.
Aerva pseudotomentosa Blatt & Hallb.; Amaranthaceae	*Bui*	Herb; Perennial; Wild	Knee pain and swelling	Inflorescence is crushed, warmed and applied on affected portion of buffalo's knee and swelling.	Topical	Pandey *et al.* (2017)
Alangium salvifolium (L.f.) Wang.; Alangiaceae	*Ankol*	Tree; Perennial; Wild	Poison	Roots (50 gm) are ground with buttermilk (500 ml) and given as an antidote.	Oral	Panara *et al.* (2016)
			Malaria	Paste of leaves (100 gm) is given in malaria fever.	Oral	
Allium sativum Linn.; Liliaceae	*Lahsun*	Herb; Biennial; Cultivated	Lumbago	Paste of crushed bulbs with milk is given.	Oral	Singh *et al.* (2014)
Annona squamosa L.; Annonaceae	*Sitafhal*	Tree, Perennial; Cultivated	Removal of endoparasites	Mixture of crushed leaves and fruits with butter milk and sweet oil is given to calf.	Oral	Balakrishnan Nair et al. (2017)
Aristolochia indica Linn.; Aristolochiaceae	*Gorisal*	Herb, Perennial; Wild	Fever	Root powder (10 gm) is given along with *Triticum aestivum* flour c*happati* to buffalo.	Oral	Sati *et al.* (2011)
Azadiracta indica; Meliaceae	*Neem*	Tree; Perennial; Wild	Leucorrhoea Endo parasites removal	Leaves are given as fodder or mix in fodder. Crushed leaves with either jaggery or *Triticum aestivum* flour is given to buffalo.	Oral	Sujarwo *et al.* (2016)

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Boerhavia procumbens Banks ex Roxb.; Nyctaginaceae	*Punarnava*	Herb; Biennial; Wild	Scorpion bite	Root paste is applied on scorpion sting.	Topical	Wajid *et al.* (2017)
			Eye problem	Root extract boiled with water is used as eye tonic	Topical	
Calligonum polygonoides Linn.; Polygonaceae	*Phog*	Shrub; Perennial; Wild	Urinary problem	Whole plant decoction given to the buffalo as a diuretic.	Oral	Jain and Pandey (2016)
			Constipation	Extract of whole plant is given to buffalo.	Oral	
Calotropis procera (Aiton.) R.Br.; Asclepiadaceae	*Aak*	Shrub; Perennial; Wild	Scorpion bite	Latex of this plant (50 ml), latex of *Mangifera indica* and Hydrochloride acid (50 ml) mixture is buffalo as antidote.	Oral	Upadhyay (2014)
Capparis decidua (Forsk.) Edgew.; Capparaceae	*Ker/ Kair*	Shrub; Perennial; Wild	Bone fracture	Stem ash of this plant ($^1/_2$ kg), paste of *Cissus quadrangular* ($^1/_2$ Kg) and roots of *Ziziphus jujube* ($^1/_2$ kg) are mixed with jaggery and milk and given to buffalo.	Oral	Singh and Singh (2011)
Careya arborea Roxb.; Lecythidaceae	*Kumbha*	Tree; Perennial; Wild	Diarrhoea	Fruit and bark extract (100 ml) is given to affected buffalo.	Oral	Ambardar and Aeri (2013)
Cassia fistula Linn.; Caesalpiniaceae	*Amaltas*	Tree; Perennial; Wild	Constipation	Decoction of pods and bark (100 gm) is given to the buffalo as purgative.	Oral	Pawar *et al.* (2017)

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Catunaregam spinosa (Thunb.) Tiruv.; Rubiaceae	*Kharedi*	Shrub; Perennial; Wild	Diarrhoea	Whole plant (500 gm), jaggery (50 gm) and rhizome powder of *Curcuma longa* are given to buffalo as a fodder.	Oral	Patil and Khan (2017)
Celosia aregentea Linn.; Amaranthaceae	*Gorkha*	Herb; Annual; Wild	Food poisoning	Extract of root (100 ml) mixed with extract of fruits or leaves of *Tamarindus indica* is given.	Oral	Kanu *et al.* (2017)
Citrullus colocynthis (L.) Schard.; Cucurbitaceae	*Tumba*	Climber; Annual; Wild	Digestive disorder	Roasted fruits are given to the buffalo.	Oral	Hussain *et al.* (2014)
			Constipation	Decoction of roots is given to buffalo.	Oral	
			Easy delivery	Extract of roots (20 gm) mixed with mustard oil (20 gm) is applied internally for easy opening of uterus during delivery.	Internal	
Citrus medica; Rutaceae	*Nimbu*	Shrub; Perennial; Cultivated	Induce lactation	Juice of lemons (10) is given with sugar (750 gm) to induce lactation.	Oral	Chaudhari *et al.* (2016)
Clemoe gynandra Linn.; Cleomaceae	*Safed hulhul/ Karalia*	Herb; Annual; Wild	Eczema	Paste of leaves is applied on affected area.	Topical	Imanirampa and Alele (2016)

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Clemoe viscose Linn.; Cleomaceae	*Hulhul/ Singali*	Herb; Annual; Wild	Diarrhoea	Paste of seeds (50 gm) is given with water.	Oral	Joshi *et al.* (2017) and Upadhyay (2015)
Cocculus pendulus (Forst.) Diels; Menispremaceae	*Pilwani*	Climber; Perennial; Wild	Mastitis	Ash of stem (100 gm) mixed with cow's milk fat (100 gm) and given to the buffalo.	Oral	Jangir *et al.* (2016)
Cocos nucifera Linn.;Arecaceae	*Nariyal/ Khopra*	Tree; Perennial; Cultivated	Burn and wounds	Dried fruit ash mixed with clarified butter and applied on wounds and burns for healing.	Topical	Loomba and Jothi (2013)
*Corallocarpus epigaeus (*Rottl. & Willd.) Hook. F.; Cucurbitaceae	*Mirchiakand*	Climber; Perennial; Wild	Tonsillitis	Paste prepared from tuber of this plant and whole plant of *Tinospora cordifolia* is fed to the suffering buffalo.	Oral	Usha *et al.* (2016)
			Snake bite	Fresh tuber extract is given orally.	Oral	
Cordial dichotoma Forst. F.; Ethretiaceae	*Gonda*	Shrub; Perennial; Cultivated	Food and mouth disease	Juice of leaves mixed with honey is applied over the affected mouth and foot to cure swelling.	Topical	Jamkhande *et al.* (2013)

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Cucumis melo var momordica; Cucurbitaceae	*Kachra*	Climber; Annual; Cultivated	Gastric problem	Dried crushed fruits mixed with rock salt and butter milk are given to buffalo.	Oral	Yadav and Gupta (2014)
Curcuma longa L.; Zingiberaceae	*Haldi*	Herb; Annual; Cultivated	Foot and mouth disease	Rhizome powder (50 gm) and common salt (50 gm) are mixed with *Glycine max (L.)Merr.* oil and apply this paste on affected portion of mouth and foot.	Topical	Labbaon (2014)
			Cough and pneumonia	Rhizome powder of *Curcuma longa* (50 gm) and *Zingiber officinale* (10 gm) are boiled in water and given to suffering buffalo.	Oral	
Cuscuta reflexa Roxb.; Cuscutaceae	*Amar bel*	Climber; Perennial; Cultivated	Rheumatic pain and lumbago	Whole plant of *Cuscuta reflexa* (1 kg) and leaves of *Datura innoxia* (1 kg) are boiled in mustard oil (1 Lit). Massage of this oil is given to buffalo to get relief from pain.	Topical	Vijikumar *et al.* (2011)
Dalbergia sissoo Roxb.; Fabaceae	*Shisham/ Tali*	Tree; Perennial; Cultivated	Diarrhoea	Leaves paste (250 gm) is given to buffalo.	Oral	Bhattacharya *et al.* (2014)
			Dysurea	Leaves soaked overnight in water and next morning, these are fed to the buffalo to cure dysurea.	Oral	
Desmostachya bipinnata (Linn.) Stapf.; Poaceae	*Dab*	Herb; Perennial; Wild	Flatulence	Decoction of whole plant is given to buffaloes to treat flatulence.	Oral	Al-Snafi (2017)

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Ephedra ciliate Fisch. & Mey. Ex C.A. Mey.; Gnetaceae	*Oont phog*	Shrub; Perennial; Wild	Constipation	Decoction of whole plant is given to buffalo.	Oral	Galav *et al.* (2013)
Euphorbia hirta Linn.; Euphorbiaceae	*Dudhli*	Herb; Annual; Wild	Diarrhoea	Paste of whole plant is given with water.	Oral	Asha *et al.* (2014) and Nyeem (2017)
			Fever	Leaves along with fodder are given.		
Euphorbia neriifolia Linn.; Euphorbiaceae	*Danda thor*	Shrub; Perennial; Wild	Skin disease	Latex is applied to treat skin disease like dermatitis, eczema, etc.	Oral	Mali and Panchal (2017)
Ferula asafoetida; Apiaceae	*Hing*	Tree; Perennial; Cultivated	Flatulence	Resin powder is given with milk.	Oral	Mahendra, and Bisht (2012)
			Nematode infection	Resin powder (10 gm) is given with water.	Oral	
Ficus religiosa Linn.; Moraceae	*Peepal*	Tree; Perennial; Wild	Dysurea and haematuria	Extract of leaves (5 kg) is given orally to the buffalo.	Oral	Gautam *et al.* (2014)

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Gloriosa superba Linn.; liliaceae	*Kalgari*	Climber; Perennial; Wild	Foot and mouth disease	Paste of tubers is applied on hooves of the buffalo.	Topical	Kavina *et al.* (2011)
Holoptelea integrifolia (Roxb.) Planch.; Ulmaceae	*Bandar bati*	Tree; Perennial; Wild	Eczema	Paste of leaves is applied over the affected area.	Topical	Kumar *et al.* (2012)
Leptadenia pyrotechnica (Forsk.) Decne.; Asclepiadaceae	*Khimp*	Shrub; Perennial; Wild	Increase milk	Tender shoots are cut into small pieces and mixed with fodder and given to buffalo.	Oral	Idrees *et al.* (2016)
			Joint pain	Stem boiled and given orally to buffalo to maintain the smooth movement.	Oral	
Leucas cephalotes (Roth) Spr.; Lamiaceae	*Khumbi*	Herb; Annual; Wild	Tonic	Whole plant is given to diseased buffalo for getting strength.	Oral	Kumar *et al.* (2003)
Linum usitatissium L.; Linaceae	*Linseed*	Shrub; Perennial; Wild	Foot and mouth disease	Paste of oil and rhizome powder of *Curcuma longa* is applied on ulcers.	Topical	Yadav and Rajput (2015)

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Nicotiana tabacum; Solanaceae	*Tambakhu*	Shrub; Perennial; Cultivated	Flatulence	Dried leaves (10 gm) and sodium carbonate (50 gm) are mixed with mustard oil and given to suffering buffalo.	Oral	Kishore (2014)
Ocimum americanum; Lamiaceae	*Bapchi*	Shrub; Perennial; Cultivated	Leucorrhoea	Paste of seeds (50 gm), *Terminallia catappa* (50 gm) and *Foeniculum vulgare* (50 gm) is given to buffalo with fodder.	Oral	Jain and Pandey (2016)
Ocimum sanctum Linn.; Lamiaceae	*Tulsi*	Shrub; Perennial; Cultivated	Scabies	Paste of leaves applied on the skin.	Topical	Joshi *et al.* (2017)
			Tonic	Paste of leaves with calf's urine is given to buffalo for weight gain and good health.	Oral	
Pedalium murex Linn.; Pedaliaceae	*Dakhani gokhru*	Shrub; Perennial; Wild	Heat effect	Whole plant is fed to the buffalo as a cooling agent during summer.	Oral	Rajashekar *et al.* (2012)
Phoenix dactylifera L.; Arecaceae	*Khajur*	Tree; Perennial; Wild	Diarrhoea	Crushed roots are given orally to buffalo.	Oral	Al-Alawi *et al.* (2017)

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Plantago ovate; Plantaginaceae	*Esabgol*	Herb; Annual; Cultivated	Diarrhoea	Thick paste of seed husk and butter milk is given to buffalo.	Oral	Verma and Mogra (2015)
Plumbago zeylanica Linn.; Plumbaginaceae	*Chitrak*	Shrub; Perennial; Wild	Flatulence	Decoction of leaves and *Trachyspermum ammi* seeds is given.	Oral	Sharma and Kaushik (2014)
Sesamum indicum; Pedaliaceae	*Til*	Herb; Annual; Cultivated	Horn wound	In seed oil added *Curcuma longa* rhizome powder and heated than cooled and applied on affected part of horn.	Topical	Anilakumar *et al.* (2010)
			Increased milk	Seeds mixed with jaggery and edible oil is fed daily to increase cattle milk production.	Oral	
Soymida febrifuga (Roxb.)A. Juss.; Meliaceae	*Rohin*	Tree; Perennial; Wild	Diarrhoea	Crushed bark is mixed in butter milk and given to the buffalo.	Oral	Meena and Yadav (2010)
Spermacoce stricta L.; Rubiaceae	*Agio*	Herb; Perennial; Wild	Vaginal prolapse	Decoction of the whole plant is given.	Oral	Ankad *et al.* (2015)

Table 1. Ethnoveterinary plants used for the treatment of buffalo ailments in Marwar region of Rajasthan. (Conitnue)

Scientific name; Family	Local name	Habit; Life span; Growth form	Use(s) / Ailments	Parts used and preparation	Route	Ref.
Tamarindus indica; Caesalpiniaceae	*Tamarind*	Tree; Perennial; Cultivated	Limb fracture	Affected part washed with *Azadiracta indica* leaves and alum water and then leaves of this plant is tied.	Topical	Kuru (2014)
Tecomella undulata (Sm.) Seem.; Bignoniaceae	*Rohida*	Tree; Perennial; Wild	Skin rashes	Bark oil is applied to heal rashes on skin.	Topical	Kali *et al.* (2014) and Rohilla and Garg (2014)
*Terminalia bellirica (*Gaertn.*)* Roxb.; Combretaceae	*Baheda*	Tree; Perennial; Cultivated	Digestive disorder	Pulp of fresh fruits or dried fruit powder is given.	Oral	Deb *et al.* (2016)
Terminalia chebula Retz.; Combretaceae	*Harad*	Tree; Perennial; Cultivated	Intestinal disorder	Dried fruit powder (50 gm), rock salt (50 gm), *Trachyspermum ammi* seed powder (50 gm) and jaggery (250 gm) are mixed and given.	Oral	Bag *et al.* (2013)
Tinospora cordifolia (Willd.) Miers. ex Hook F. & Thorns.*;* Menispermaceae	*Giloy*	Shrub; Perennial; Cultivated	Bloating and flatulence	Extract of leaves (1 kg), rhizome powder of Curcuma longa (200 gm), black salt (100 gm), and seed powder of *Trachyspermum ammi* with *Brassica nigra* seed oil is given.	Oral	Bhalerao *et al.* (2013)

Table 1. Ethnoveterinary plants used for the treatment of buffalo ailments in Marwar region of Rajasthan. (Conitnue)

Scientific name; Family	Local name	Habit; Life span; Growth form	Use(s) / Ailments	Parts used and preparation	Route	Ref.
Trigonella foenum-graecum Linn.; Fabaceae	*Maithi*	Herb; Annual; Cultivated	Tonic	Seed, *Pennisetum glaucum* seed and jaggery are cooked in water and given to the buffalo after parturition.	Oral	Yadav and Baquer (2014)
Vernoia cinerea; Asteraceae	*Kalajeeri*	Herb; Annual; Cultivated	Flatulence	Seed powder with *Sesamum indicum* seed oil is given orally to cure flatulence and in loss of appetite.	Oral	Prabha (2015)
Zanthoxylum armantum DC.; Rutaceae	*Timru*	Shrub; Perennial; Wild	Removal endoparasites	Raw fruits are given with fodder for removal of endoparasites.	Oral	Singh and Singh (2011)
Zingiber officinale; Zingiberaceae	*Adrak/ Saunth*	Herb; Annual; Cultivated	Stomachache	Dried rhizomes powder (10 gm) and *Piper nigrum* seed powder (10 gm) are heated with clarified butter (200 ml) then cooled and given.	Oral	Gupta and Sharma (2014) and Khan *et al.* (2016)
			Fever	Dried rhizome powder boiled with milk is given to cure buffalo fever.	Oral	

Table 1. Ethnoveterinary plants used for the treatment of buffalo ailments in Marwar region of Rajasthan. (Conitnue)

Scientific name; Family	**Local name**	**Habit; Life span; Growth form**	**Use(s) / Ailments**	**Parts used and preparation**	**Route**	**Ref.**
Ziziphus nummularia Burm. F.; Rhamnaceae	*Ber/ Bordi*	Shrub; Perennial; Cultivated	Vaginal prolapse	Grinded seed are fed to buffalo.	Oral	Hussain *et al.* (2017) and Verma (2016)
			Increases milk	Root powder ($^{1}/_{2}$ kg), *Sesamum indicum* seed oil (1 Lit), jaggery (2 kg) mixed with *Triticum aestivum* seed husk and water and kept for overnight and given to buffalo to induce and increase lactation.	Oral	

Table 2. Habit and parts used of ethnoveterinary medicinal plants.

General attributes	Total plants	Percentage
Habits		
Herbs	20	31.75
Shrubs	19	30.16
Trees	18	28.57
Climber	6	09.52
Life span		
Perennial	46	73.01
Annual	15	23.81
Biennial	2	03.18
Growth form		
Wild	40	63.49
Cultivated	23	36.51
Parts used		
Leaves	19	24.05
Root	13	16.46
Whole plant	11	13.92
Seed	9	11.39
Stem	8	10.13
Fruits	8	10.13
Rhizome	5	06.33
Flower, thorn and shoot	4	05.06
Bulb and pods	2	02.53

Table 3. Informant Consensus Factor (ICF) of ailments treated by medicinal plants.

S.No.	Disease category	Plant species	Nt	Nur	ICF
1	Gastrointestinal	*Abutilon indicum* (5), *Achyranthes aspera* (8), *Calligonum polygonoides* (12), *Careya arborea* (7), *Cassia fistula* (15), *Catunaregam spinosa* (6), *Celosia aregentea* (5), *Citrullus colocynthis* (17), *Clemoe viscose* (9), *Cucumis melo var momordica* (13), *Dalbergia sissoo* (16), *Desmostachya bipinnata* (4), *Ephedra ciliate Fisch* (4), *Euphorbia hirta* (6), *Ferula asafoetida* (14), *Nicotiana tabacum* (12), *Phoenix dactylifera* (3), *Plantago ovate* (9), *Plumbago zeylanica* (6), *Soymida febrifuga* (4), *Terminalia bellirica* (11), *Terminalia chebula* (12), *Tinospora cordifolia* (15), *Vernoia cinerea* (26), *Zingiber officinale* (8)	25	247	0.90
2	Respiratory	*Corallocarpus epigaeus* (3), *Curcuma longa* (32)	2	35	0.97
3	Reproductive	*Acacia nilotica indica* (7), *Achyranthes aspera* (5), *Azadiracta indica* (10), *Citrullus colocynthis* (8), *Citrus medica* (4), *Cocculus pendulus* (8) , *Leptadenia phyrotechnica* (12),*Ocimum americanum* (9), *Sesamum indicum* (6), *Spermacoce stricta* (3), *Ziziphus nummularia* (14)	11	86	0.88
4	Dermatological, wound and burn	*Acacia nilotica willd* (8), *Clemoe gynandra* (6), *Cocos nucifera* (12), *Euphorbia neriifolia* (5), *Holoptelea integrifolia* (5), *Ocimum sanctum* (6), *Tecomella undulate* (16)	7	58	0.89
5	Bones and joints related problem	*Aerva pseudotomentosa* (6), *Allium sativum* (8), *Capparis deciduas* (8), *Cuscuta reflexa* (9), *Leptadenia phyrotechnica* (12), *Tamarindus indica* (6)	6	49	0.90
6	Fever and febrifuge	Aristolochia indica (3), *Euphorbia hirta* (7)	2	10	0.89
7	Parasitic	*Alangium salvifolium* (4), *Annona squamosa* (8), *Azadiracta indica* (18), *Ferula asafoetida* (11), *Zanthoxylum armantum* (2)	5	43	0.90
8	Foot and mouth disease	*Aerva persia* (3), *Cordial dichotoma* (6), *Curcuma longa* (8), *Gloriosa superb* (4), *Linum usitatissium* (13)	5	34	0.88
9	Ophthalmic	*Achyranthes aspera* (2), *Boerhavia procumbens* (5)	2	7	0.83
10	Urination problem	*Abutilon indicum* (5), *Calligonum polygonoides* (2), *Ficus religiosa* (9)	3	16	0.87
11	Poison effect	Aerva lanata (5), *Alangium salvifolium* (2), *Boerhavia procumbens* (4), *Calotropis procera* (12), *Corallocarpus epigaeus* (2)	5	25	0.83
12	General body tonic	Leucas cephalotes (8), *Ocimum sanctum* (4), *Pedalium murex* (5), *Trigonella foenum-graecum* (9)	4	26	0.88

Table 4. Fidelity level (FL) values for common medicinal plants used by aliment category.

S. No.	Plant spp.	Disease category	Ip	Iu	FL%
1	*Vernoia cinerea*	Gastrointestinal	26	32	81.25
2	*Citrullus colocynthis*	Gastrointestinal	17	27	62.96
3	*Curcuma longa*	Respiratory	32	45	71.11
4	*Ziziphus nummularia*	Reproductive	14	21	66.67
5	*Tecomella undulate*	Dermatological, wound and burn	16	22	72.72
6	*Azadiracta indica*	Parasitic	18	32	56.25

veterinary drugs, offering safer alternatives to allopathic medications that often induce side effects in buffaloes. The prevalence of gastrointestinal infections in the region underscores the importance of providing buffaloes with high-quality fodder and water. Plants exhibiting high ICF (Informant Consensus Factor) and FL (Fidelity Level) values merit further in vitro and in vivo investigations, potentially leading to the discovery of novel drugs.

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