The present paper highlights the indigenous knowledge of camel owners or the local healers on the ethnoveterinary remedies of camel disease in Rajasthan. The information concerning the ethnoveterinary practices adopted for the treatment of diseases prevailing in the area, viz. *surra*, pneumonia, camel pox, diarrhea, constipation, internal and external parasites, wounds, food poisoning, inflammation, infertility, arthritis, anaemia, snakebite, sunstroke and ingestion of sand was collected using interview schedule in Bikaner and Udaipur districts of the state. The camel owners/healers were found familiar with the sand ball test or hair stick test for diagnosis of trypanosomiasis or *surra* and people use burnt diesel oil or kerosene along with camel urine on the infected parts of the camel. The results revealed that there is great agreement among the informants for the usages of jaggery, *Curcuma longa* L., *Dalbergia sisoo* Roxb., *Cucumis callosus*, *Azadirachta indica*, *Brassica juncea* oil, tobacco leaves, alum, *Allium sativum* L., *Zingiber officinale* Rosc., *Trigonella foenum*, buttermilk, vegetable oil, etc. The findings of the study would help the extension workers, policy makers and Scientists to have insight into the evolution of appropriate technology and for the discovery of new medicinal compounds.

**Keywords:** Camel, Diseases, Ethnoveterinary, Local healers, Rajasthan

**IPC Int. Cl.**
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Indigenous knowledge is characterized as the sum of experience and knowledge for a given ethnic group on specific aspects, which forms the basis for decision making in regard to familiar and unfamiliar problems and challenges. It is derived from interaction between people and their environment. It spans the entire range of human experience, including history, linguistics, art as well as technical aspects: agriculture, medicine, animal husbandry, engineering and fishing. It can play key role in designing of sustainable farming systems including animal husbandry practices thereby increasing the livelihood that rural populations would accept, develop and maintain innovations and interventions. For ages, human beings, in particular, the resource poor farmers and marginal societies around the world, have been utilizing locally available plant resources for formulating a wide range of plant based medicines for treating animal diseases as an economical, accessible, efficacious and ecologically sustainable means to animal healthcare practices. It is hardly surprising that due to these reasons, the domain of traditional veterinary knowledge has attracted a considerable amount of interest amongst scientific community, policy planners, extension workers and development agencies in recent times. Livestock raisers and healers over the world have traditional ways of classifying, diagnosing, preventing, and treating common animal diseases. Many of these ethnoveterinary practices offer viable alternative to conventional, western style veterinary medicines where the latter is unavailable. The present study was an effort in this direction to document the Ethnoveterinary remedies of camel diseases in camel dominant regions of Rajasthan, India.

**Materials and methods**

The study was carried out in Bikaner and Udaipur districts of Rajasthan, India. The average temperature in Bikaner during summers falls in the range of 41.8°C to 28.0°C. The average temperature in the winter season in Bikaner falls in the range of 23.2°C to 5.0°C. The days in Udaipur are bright, sunny and warm with minimum and maximum temperature around 20°C and 40°C during summer and 7°C and 29°C during winter.
A comprehensive survey was conducted to identify the Ethnoveterinary remedies of camel diseases adopted by the camel owners or the local healers. The list of diseases prevailing in the area (surra, pneumonia, camel pox, diarrhea, constipation, parasites, wounds, food poisoning, inflammation, infertility, arthritis, anaemia, snakebite, sun stroke and ingestion of sand) which are related to camels were identified with the help of experts in the related field. The interview schedule was developed with due consultation of field Veterinarians and experts from the university and research stations. A comprehensive list of camel keepers or local healers of 10 selected villages, viz. Husansar, Baderan, Jamsar, Kheechiya, Mahajan and Palana from Bikaner district; Ladia khedia, Rabbario ka guda, Ala ki dhani and Dedriyo ki dhani from Udaipur district was prepared on the basis of camel population in both Bikaner and Udaipur districts.

With prior informed consent (PIC) on sharing of information with reference to Ethnoveterinary remedies of camel diseases from authentic camel owners/local healers having thorough knowledge were identified with the help of local NGO’s and administrative officers. Thus, a total of 50 camel owners/healers from 10 villages were selected for collection of information on Ethnoveterinary remedies of camel diseases. Extensive and intensive survey trips were organized to cover for and wide selected villages under study at different seasons of the year. The data were collected through Participatory Rural Appraisal, focused group discussion and survey by empirical investigation. The voucher specimens of house hold and plant materials used in treating the camels were collected and reconfirmed by other informants to ensure their local identity. The specimens were brought to the laboratory and preserved in the form of herbarium maintained at All India Coordinated Research Project on Increased Utilization of Animal Energy with Enhanced System Efficiency, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan).

Results and discussion

When a camel is ill, the owner looks for medicaments by his own experience or by consulting a native healer. They are using products of plant origin or house hold items for the treatment of camels. The preparation of drug and method of administration varied as per the ailment treated. Further, the camel owners or the local healers living in the same location may use different traditional preparations to treat a specific disease and sometimes same treatment is used by people living in geographically different regions. It means that traditional ethnoveterinary remedies are working effectively as reported by Gueye.4 This is to say that traditional medicine can be a real source for insights for the discovery of new medicinal compounds5. The locally available and easily accessible ethnoveterinary remedies practiced by the local healers provide a cheaper treatment as compared to western drugs. The information on ethnoveterinary practices adopted by the camel owners or healers in the survey areas are discussed by disease/ailment wise presented below:

Surra/ Trypanosomiasis

The first sign is weakness at the time of getting up with a rider or with a load on the back of the camel. The eyes appear dull and the animal becomes lethargic. The symptoms are usually seen when there are lots of flies around the animal and it is seen during the rainy season from July to October. The body temperature increases up to 39°C in the morning and 41°C in the evening. Leese6 discussed the acute and subacute forms of camel trypanosomiasis at some length, indicating that the latter form may last 3 - 4 yrs before the animal finally succumbs. The camel owner’s diagnosis the disease by two methods, viz. sand ball test and hair stick test. Muhammad7 reported in their investigation that camel owners in Faisalabad (Pakistan) were not familiar with the Sand-ball test or Hair-stick test for diagnosis of trypanosomiasis.

Treatment

To keep the flies away, tumba (Citrullus colocynthis L.; EA164) and salt in water is applied on the body of the camel. Further, burnt diesel oil or kerosene along with camel urine are also be used by the camel healers on the infected part. The treatment strategy of trypanosomiasis is based on neutralizing the poison in the blood, awakening the camel’s sleeping body and keeping the affected camel strong and fit3.

Pneumonia

The camel suffering from pneumonia become dull, cud chewing and grazing are not proper, there may be watery discharge from the nostrils. Coughing and mucous discharge from nostrils may be the symptoms and the temperature rises by 0.4-0.6°C.
Treatment
The camels are fed with a mixture of saunth (Zingiber officinale Rosc.; EA282) and jaggery in lukewarm water. Apart from this, a mixture of methi (Trigonella foenum) with mustard oil (Brassica juncea) is also fed to the susceptible camels. The above mixtures are composite of those ingredients which keeps the body active, energetic and enhance the activities inside the body.

Camel pox
There is swelling of the lips in mild cases, at first of the upper lip and later also of the lower lip. In severe cases, wounds appear on the lips which may become infested with maggots and there is high fever.

Treatment
The local healers apply dalda ghee (hydrogenated vegetable oil) or camel milk on the infected parts of the camel body. However, supportive treatment can be given to affected calves, usually a soup which provides liquid, energy and protein.

Diarrhea
When the camel suffers from diarrhea, faeces become loose and they lose their round oval shape, loose or watery faeces are passed frequently. The animal gets weaker and weaker and if not treated timely, may die from anaemia.

Treatment
The local healers fed the camels with buttermilk and salt as one of the first treatment against diarrhea. However, dried bajra (Pennisetum typhoides L.) and ghee are also practiced by the camel owners. Shisham (Dalbergia sisoo Roxb.; EA169) leaves soaked overnight are given orally to camels in the morning relives the camels from diarrhea. Dalbergia sisoo has anti-inflammatory, antipyretic and analgesic activities. The root extract of Dalbergia sisoo contains alkaloids, carbohydrates, saponins, flavonoids, glycosides (cardiac glycosides, anthraquinone glycoside and saponin glycosides) and steroids.

Likewise, gokhru fruits (Tribulus terrestris L.; Aery46) are given to animal to cure the diarrhea. Kachari fruits (Cucumis callosus) crushed and mixed with sugar, oil and water are given to the camel during diarrheal condition. The aqueous extract of Punica granatum peel has anti-diarrheal effect.

Constipation
It is a condition associated with some diseases and usually happens when camels do not get timely feeding, watering and have hardly any assess to green fodder.

Treatment
The first treatment includes feeding of camels with Kachari (Cucumis callosus) fruits along with ajwayan (Trachyspermum ammi L.) to relief the animal from constipation. The traditional plants and other products used by camel owners for the treatment of constipation which is in accordance with the findings reported in the present study. Use of castor (Ricinus communis L.; Aery299) oil is also used by the camel owners as traditional remedy against constipation in camels. Some of the healers fed 75-150 gm bark/pods of amaltas (Cassia fistula L.; Aery105) boiled with 1 liter water fed after cooling. The use of 4-5 pods of Cassia fistula L. once a day till normal condition is attained to cattle suffering from constipation.

However, fruit pulp and root decoction of bitter melon (Citrullus colocynthis L.) is practiced by the local healers for relief in constipation. For the prevention of indigestion and halitosis all camel owners had practiced administration of ‘massaulas’ (physical drench/balls) along with common salt (average 250 gm) on weekly basis.

Internal parasites
All kinds of worms are found in camel like roundworms, flukes, tapeworms and ringworms. The common symptoms of the worm infestation are irregularity in rumination, loss of appetite, constipation, anaemia, dullness of eyes and become pale.

Treatment
The routine practice followed by the camel owners against internal parasites is giving neem (Azadirachta indica; EA21) leave extract with buttermilk and rock salt. Further, Trachyspermum ammi has been shown to possess anthelmintic activities. Many plant essential oils and phytochemicals are known to possess nematicidal activity. Plant essential oils and their components against pinewood nematode has also been reported. Azadirachta indica leaves could play a beneficial role as an alternate non-chemical oranic source of anthelmintic during epizootics of worm infection.
However, ethanol extract of *Annona reticulate* leaves have significant anthelmintic activity.

**External parasites**

Sarcoptic mange is one of the most common health problems of camel. Mange is widely regarded to be the most feared and widespread disease affecting the Arabian camel after trypanosomiasis.

**Treatment**

The traditional healthcare practices adopted to cure mange infection is the use of neem oil (*Azadirachta indica*) or lukewarm mustard (*Brassica juncea*) oil or garlic (*Allium sativum* L.; EA127) bulb paste on the skin of the camel. These results are also supported by other who suggested that the alliin metabolite allicin might be responsible for the oxygen scavenging properties of *Allium sativum*. The use of *Azadirachta indica* leaves (50-100 gm) crushed with mustard oil and the paste is applied on the body of the cattle. The efficacy of tobacco extract against lice can also be due to its nicotine content and nicotine sulphate has been used to dust animal pens against lice.

**Wounds**

It may occur due to biting by other camels on scrotum or by some sharp object. Wounds also occur due to infestation with maggots if not cared. In case of saddle galls, any loose skin should be clipped off and wound should be dressed.

**Treatment**

The survey results indicated that most of the camel owners use turpentine oil or apply alum, turmeric and oil paste over infected area. Leaf paste of *Kagla Ri Mehndi* (*Tridax procumbens* L.; EA143) and sitaphal (*Annona squamosa*) is also recommended by the local healers to stop bleeding. Leaf paste of *Annona squamosa* is applied externally on cuts, wounds and skin diseases. Some of the workers studied the effect of ethanol extract of *Lawsonia inermis* for the wound healing and recommended its use in healing of wound. Similarly, extract of *Calotropis procera* possesses significant prohealing activity on dermal wounds in Guinea pigs.

**Inflammation/ burns**

In most cases it is the back that is burnt by the fire but sometimes legs are also burnt. The burnt skin should be protected from sun and flies.

**Treatment**

*Aloe vera* (*Aloe barbadensis*) pulp or burnt engine oil is applied on the burned part. Further, paste of potash alum mixed with burnt machinery oil is also applied over the infected part. The local healers are applying leaf pulp of *Aloe barbadensis* directly over the burned parts.

**Infertility**

It is common in female camels which may be due to various reasons. Aborted animals have more chances to become sterile if not handed properly.

**Treatment**

The camel owners usually fed *kenvach* (*Mucuna pruriens* L.; Aery92) pods with jaggery or sprouted wheat grains (*Triticum aestivum* L.) with jaggery to the camels. One or two pods of *Mucuna pruriens* L. mixed with jaggery (*Saccharum officinarum* L.) or wheat bread is fed twice a day for 5 days to the female animals to bring it into heat. The feeding of 100 gm seeds power of Ajwain (*Trachespermum ammi* L.) is given with jaggery twice a day for 2-3 days to animal having lack of estrus.

**Arthritis**

This occurs in spring when there is a wide difference between the day and night temperature. There may be arthritis of knee, fetlock and shoulder joints.

**Treatment**

Massage of til (*Sesamum indicum* L.; Aery229) oil and sugar in equal proportion over the affected parts is given to get relief from the arthritis pain in camel. Further, decoction of bark of salar (*Boswellia serrata* Roxb., EA124) is given to the animals in arthritis.

**Anaemia**

It occurs due to worms and in most cases due to *surra* disease. It may also be due to over work and under feeding.

**Treatment**

The camels suffering from anaemia need to be fed with *Onion* (*Allium cepa* L.) or garlic (*Allium sativum* L.)
bulb along with mustard oil. Kumar et al.\textsuperscript{25} reported that feeding of 100 gm seed powder of \textit{Cassia tora} with fodder twice a day as a general tonic during anaemia is found to be beneficial in animals. The local healers also fed ginger (\textit{Zingiber officinale} Rosc.), \textit{chirata} (\textit{Swertia chirayaita}), \textit{methi} (\textit{Trigonella foenum}) seed and jaggery in ball form to the camels suffering from anaemia.

\textbf{Snakebite}

Camels and snakes live together in deserts but it seems that snakes and camels have some understanding to respect each other’s sovereignty to stay away from each other’s domain.

\textbf{Treatment}

In case of snakebite to the camels, healers apply bark paste of \textit{Gular} (\textit{Ficus racemosa} L.; Aery302) and feed with roots of \textit{Chhoti Bui} (\textit{Aerva lanata} L.; EA429). Some of the owners also feed cow’s ghee (2-3 kg) along with 100-200 gm black pepper (\textit{Piper nigrum}) to over come the poison from snakebite in camel. It has been reported that roots (100gm) of \textit{Chhoti Bui} (\textit{Aerva lanata} L.) are crushed and given orally as an antidote in snake bite to animals\textsuperscript{12,14}.

\textbf{Sun stroke/heat stroke}

When the camels are exposed to sun for longer duration may lead to sun stroke. The body temperature raises up to 43ºC or more. The eyes are closed and the conjunctive is highly congested.

\textbf{Treatment}

The traditional treatment includes bark infusion of \textit{Babul} (\textit{Acacia nilotica} L.; EA58) or leaf infusion of \textit{Shisham} (\textit{Dalbergia siso} Roxb.) to camels suffering from sunstroke\textsuperscript{10,14}. Further, some of the healers feed about 0.5 kg leaves of \textit{Nelumbo nucifera} twice a day for 2-3 days to relief the animals against sunstroke\textsuperscript{25}.

\textbf{Food poisoning}

In almost all poisoning cases main symptoms are vomiting, diarrhea, dysentery, dullness, asphyxia (difficult breathing), staggering, etc. and some times the outcome is fatal.

\textbf{Treatment}

The data reported from the study revealed that camel owners are drenching buttermilk (2-3 L) or extract of \textit{Emli} (\textit{Tamarindus indica} L.; Aery114) for treating the camels\textsuperscript{3}. Likewise, root juice of \textit{Celosia argentea} L. mixed with \textit{Tamarindus indica} L. fruits or leaves is given orally in poisoning\textsuperscript{12}.

\textbf{Ingestion of sand}

The symptoms of ingestion of sand before death included profuse vomiting, diarrhoea, tympany, colic and pain, although the temperature generally remained normal.

\textbf{Treatment}

Feeding with vegetable oil (1-2 L) along with 50-100 gm salt per day is used by the local healers for treating the camels against ingestion of sand. In some cases, camel owners are using \textit{Senna} (\textit{Cassia angustifolia}), vegetable oil, etc. to the camel suffering from impaction\textsuperscript{10}.

\textbf{New findings}

The findings of the study clearly revealed that camel owners/local healers are using many household and plant materials for treatment of their camels. In total, 16 ailments of camels have been documented from the study areas which are treated by traditional remedies. The use of 31 plant materials and 13 household materials have been recorded during the present study. These plant material includes \textit{tumba} (\textit{Citrullus colocynthis} L.), \textit{saunth} (\textit{Zingiber officinale} Rosc.), \textit{methi} (\textit{Trigonella foenum}), turmeric (\textit{Curcuma longa} L.), \textit{bajra} (\textit{Pennisetum typhoides} L.), \textit{shisham} (\textit{Dalbergia siso} Roxb.), \textit{gokhru} (\textit{Tribulus terrestris} L.), \textit{kachari} (\textit{Cucumis callosus}), \textit{ajwayan} (\textit{Trachyspermum ammi} L.), \textit{amlata} (\textit{Cassia fistula} L.), \textit{bitter melon} (\textit{Citrullus colocynthis} L.), \textit{neem} (\textit{Azadirachta indica}), \textit{garlic} (\textit{Allium sativum} L.), \textit{tobacco} (\textit{Nicotiana tabacum} L.), \textit{rohira} (\textit{Teconomia undulata}), \textit{aakda} (\textit{Calotropis procera} Br.), \textit{kagla ri mehndi} (\textit{Tridax procumbens} L.), \textit{sitaphal} (\textit{Annona squamosa}), \textit{Aloe vera} (\textit{Aloe barbadensis}), \textit{kenvach} (\textit{Mucuna pruriens} L.), \textit{wheat grains} (\textit{Triticum aestivum} L.), \textit{onion} (\textit{Allium cepa} L.), \textit{ginger} (\textit{Zingiber officinale} Rosc.), \textit{chirata} (\textit{Swertia chirayaita}), \textit{gular} (\textit{Ficus racemosa} L.), \textit{chhoti bui} (\textit{Aerva lanata} L.), \textit{babul} (\textit{Acacia nilotica} L.), \textit{black pepper} (\textit{Piper nigrum}), \textit{mustard oil} (\textit{Brassica juncea}), \textit{til} (\textit{Sesamum indicum} L.) oil, and \textit{emli} (\textit{Tamarindus indica} L.). Among these plant species, 07 were new which are used by the camel owners/local healers in treatment of their camels. The use of \textit{tumba} (\textit{Citrullus colocynthis} L.) in flies control, \textit{gokhru} (\textit{Tribulus terrestris} L.) and \textit{kachari} (\textit{Cucumis callosus}) in diarrhea, \textit{amaltas}
(Cassia fistula L.) in constipation, tobacco leaves and rohira tree bark in tick infestation, kagla ri mehndi (Tridax procumbens L.) and sitaphal (Annona squamosa) in wounds and chhoti bui (Aerva lanata L.) in snake bite has been reported as new uses in ethnoveterinary remedies of camels.

**Conclusion**

Study highlights that there is great agreement among the informants for the usages of *Citrullus colocynthis* L. (sura), Zingiber officinale Rosc. and *Trigonella foenum* (pneumonia), *Tribulus terrestris* L. and *Cucumis callosus* (diarrhea), *Cassia fistula* L. (constipation), *Azadirachta indica* (internal and external parasites), *Nicotiana tabacum* L. (external parasites), *Ficus racemosa* L. and *Aerva lanata* L. (snakebite), *Tamarindus indica* L. (food poisoning); and these species have great potential as herbal drugs for camel healthcare management. Further, research on these herbal formulations for veterinary healthcare management will require safety and efficacy testing.

It can be concluded from the study that by evaluating ethnoveterinary remedies, it becomes easy to understand the local resources, practices and conditions. These ethnoveterinary remedies are very important in areas which are far away from cities or where modern medicines are not available. Still there is a need to preserve and promote many more therapeutically sound ethnoveterinary practices after scientific validation. Other than this, government and non-governmental organizations must also provide some monetary assistance to the traditional healers, so that we may conserve these rich ethnoveterinary remedies for our future generations.

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