CLINICAL VALIDATION OF TRIBAL ETHNOVETERINARY PRACTICES USED IN TREATMENT OF CHRONIC DERMAL WOUNDS IN HIMALAYAN FOOT HILLS OF INDIA THROUGH FARMER PARTICIPATORY RESEARCH*

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ABSTRACT
Chronic dermal wounds cause intense trauma, affect draft-ability in work-animals, and impose immense economic encumbrance on the farmer. The pharmaceutical industry is still in despair about lack of progress in the advancement of fool-proof drugs capable of wound repair. The ethno-veterinary practice used by the tribal in the foot hills of Himalayas since antiquity can instil hope in such cases. This study entails clinical validation and subsequent monitoring of ethno-veterinary practices adopted for healing of three types of chronic dermal wounds in animals, viz., Sole crack in captive elephants (Sajan), non-specific chronic superficial wounds in cattle, and yoke-gall in bullocks by farmer participatory research method using farmers’ perception as the concurrent control, and allopathic treatment as the active comparator (Positive control). The data collected from the respondents on multi-faceted beneficial criteria of the clinical trial, viz., effectiveness, quickness, side effects, ease in preparation, availability, and cost-effectiveness, were subject to one way analysis of variance, and the differences between the means were compared by Tukey’s Honest Significant Difference (HSD) Test. The results revealed that ethno-veterinary formulations had no side-effects, easy to prepare, easily available and involved less cost in the treatment of sole crack and non-specific chronic superficial wounds, besides being more efficient in the treatment of yoke-gall than allopathic therapy (P<0.05). Follow up of the patients at weekly intervals up to 36 weeks during post-trial period did not exhibit relapse of the treated cases. This paper presents the composition, method of preparation, and application of the covert and select ethno-veterinary formulations used by the tribal in wound healing and their clinical validation, which were not investigated earlier.

KEY WORDS
Clinical validation, Dermal wound, Ethno-Veterinary Practice, Farmer Participatory Research

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3Corresponding author: sbiswaset@gmail.com *Part of PhD thesis (WBUAFS) of the first author. Date of Receipt: 20/02/2013, Acceptance: 09/10/2013. pp. 71-80.
INTRODUCTION

India is a massive repository of indigenous technical knowledge (ITK), particularly with regard to ethnomedicine, since time immemorial. However, its use has been abandoned, and R&D efforts have been neglected with the advent of modern European medicinal system (Allopathy). But ITK is a powerful source that can benefit the rural mass (Howes and Chambers, 1979). It needs resurgence.

The sub-Himalayan region of West Bengal (India) covered with evergreen and a deciduous forest is a habitat of Oraon and other tribes, who have access to the ethno-medicinal herbs, used in animal treatment. This study entails clinical validation trial and subsequent monitoring of the validated practices to encourage wider diffusion of ethno-veterinary medicine in animal practice.

MATERIALS AND METHODS

The study was conducted in selected villages in Jalpaiguri district of West Bengal (India), located at high altitude, in the forest fringe areas of Sub-Himalayan Terai zone of North Bengal, densely populated with the tribal, mostly the Oraon tribe.

This paper portrays the clinical validation of three ethno-veterinary practices related to wound healing (sole crack in elephant, non-specific chronic superficial wounds in cattle, and yoke-gall in bullocks) by farmer participatory research (FPR) method, using ethno-veterinary medicine as test treatment, allopathic medicine as positive control, and farmers' perception as the concurrent control, on the basis of effectiveness, quickness, side effects, ease in preparation, availability, and cost-effectiveness as the criteria in the trial. The selected respondents were interviewed through the structured schedule and clinical validation trial was conducted by 10 experimenter resource persons. The data were enumerated on the basis of scores ranging between least effective and most effective scores. The data were analysed by one-way analysis of variance. The differences between the means \( (P \leq 0.05) \) were tested by Tukey's Honest Significant Difference (HSD) test.

The herbs used in ethno-veterinary practice are presented in Table 1.

<table>
<thead>
<tr>
<th>Image Number</th>
<th>Local Name/ Hindi Name</th>
<th>Part used</th>
<th>Sanskrit Name</th>
<th>English Name</th>
<th>Botanical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jam/ Jamun</td>
<td>Bark</td>
<td>Jambu</td>
<td>Black Berry</td>
<td>Syzygium jambolanum</td>
</tr>
<tr>
<td>2</td>
<td>Bhelo/ Bhilwa</td>
<td>Fruit</td>
<td>Agnimukh</td>
<td>Plum Berry</td>
<td>Semecarpus anacardium</td>
</tr>
<tr>
<td>3</td>
<td>Gurjo/ Guduchi</td>
<td>Plant</td>
<td>Guduchi</td>
<td>Gulvel</td>
<td>Tinospora cordifolia</td>
</tr>
<tr>
<td>4</td>
<td>Aam/ Aam</td>
<td>Bark</td>
<td>Aamra</td>
<td>Mango</td>
<td>Mangifera indica</td>
</tr>
<tr>
<td>5</td>
<td>Kadam/ Kadamb</td>
<td>Bark</td>
<td>Kadamba</td>
<td>Kadam</td>
<td>Anthocephalus indicus</td>
</tr>
<tr>
<td>6</td>
<td>Akanda/ Aak</td>
<td>Leaf</td>
<td>Arka</td>
<td>Crown flower</td>
<td>Calotropis gigantea</td>
</tr>
<tr>
<td>7</td>
<td>Setsimul/ Semul</td>
<td>Seed</td>
<td>Shalmali</td>
<td>Silk cotton</td>
<td>Bombax ceiba</td>
</tr>
</tbody>
</table>
Image-1. Jam tree (Source: health.wikinut.com)

Image-2. Semecarpus anacardium (Source: www.hear.org)


Image-4. Mango tree (Source: www.Indianetzone.com)

Image-5. Kadam tree (Source: www.keywordpicture.com)

Image-6. Akanda (Source: medplants.blogspot.in)
RESULTS AND DISCUSSION

Sole crack in elephants (Sajan)

Results of clinical trial: The ethno-veterinary medicine used to treat sole crack in elephants (Sajan) was prepared from Jam tree bark (50 g), Bheola fruit (8-10 pc), Gurjo lata (700 g), Alum (50 g), which were boiled together in tortoise shell. Earthen pot can be used to boil the mixture, if tortoise shell is not available. But, it may not elicit proper clinical response, as per the views of the local ethno-veterinary practitioners.

The affected foot pad and the surroundings were properly washed, and the balm was applied over the wound. The positive control, i.e., Nitrofurazone ointment was applied locally twice daily, besides intramuscular injection of Oxytetracycline @ 15mg/ kg body weight daily for 10 days. The clinical validation trial of the treatments is detailed in Table-2.

The clinical validation of the effectiveness (i.e. number of animals responded or cured satisfactorily) of ethno-veterinary practice in the treatment of sole crack (Sajan) revealed that it was in conformation with the farmers’ (Mahout) perception (P≥0.05), while allopathic treatment was more (P≤0.05) effective than ethno-veterinary treatment.

The clinical validation of quickness of healing, i.e., the healing time was significantly (P≤0.05) higher in case of

Table-2. Clinical validation trial of treatment of sole crack with allopathic and ethno-veterinary medicines.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Perception</th>
<th>Clinical Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Allo-treatment</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>7.0±0.00 a</td>
<td>8.0±0.00 b</td>
</tr>
<tr>
<td>Quickness</td>
<td>6.0±0.00 a</td>
<td>9.0±0.00 b</td>
</tr>
<tr>
<td>Side effects</td>
<td>10.0±0.00 a</td>
<td>4.8±0.20 b</td>
</tr>
<tr>
<td>Ease in preparation</td>
<td>6.0±0.00 a</td>
<td>10.0±0.00 b</td>
</tr>
<tr>
<td>Availability</td>
<td>8.8±0.20</td>
<td>7.2±1.11</td>
</tr>
<tr>
<td>Cost effectiveness</td>
<td>10.0±0.20 a</td>
<td>5.0±0.20 b</td>
</tr>
</tbody>
</table>

Note: (1) The figures are presented as Mean±SEM, based on five observations. (2) The Means bearing different superscripts differed at P≤0.05.
ethno-veterinary treatment than farmers’ (Mahout) perception, and was similar to the healing time in case of allopathic treatment, as there was no difference ($P\geq 0.05$) between the two systems of treatment. This belied the farmers’ (Mahout) perception that wound healing would be sluggish in ethno-veterinary treatment.

The farmers’ (Mahout) perception that ethno-veterinary medicine had no side effect was confirmed in clinical validation trial, while the side effects of allopathic medicine were significantly ($P\leq 0.05$) higher than ethno-veterinary medicine.

The preparation and use of ethno-veterinary medicine was easy, and coincided with the farmers’ (Mahout) perception ($P\geq 0.05$), while treatment with allopathic medicines was not so easy ($P\leq 0.05$).

The availability of ethno-veterinary medicine was as per the expectation ($P\geq 0.05$) of the farmers (Mahout), and was not different ($P\geq 0.05$) from the availability of allopathic medicines in the study area ($P\geq 0.05$).

Ethno-veterinary medicine was found to be significantly ($P\leq 0.05$) cheaper than the perception of the farmers (Mahout), while allopathic medicine was costlier than ethno-veterinary medicine, and thus less cost-effective ($P\leq 0.05$).

The results of this study demonstrated that the ethno-veterinary medicine used in the treatment of sole crack (Sajan) was effective, quick acting, safe, easy to prepare, readily available, and cost effective, compared to the allopathic drugs.

**Discussion:** Pododermatitis in elephants (sole crack), locally known as Sajan is a life-threatening foot problem, encountered in captive elephants (Image-8), and may result in death in the event of delay in clinical intervention (Liu et al., 2004). Long-distance walk on rough surface and tar road, and protracted standing in dirty stables are the predisposing factors (Murray and Mikota, 2006). Incarceration for musth and continuous exposure to moist substrates may also lead to pododermatitis (Sarma et al., 2012).
Ulceration caused due to complicity of pathogens like *Streptococcus*, *Staphylococcus* (*S. aureus*), *Klebsiella*, *Proteus*, *Corynebacterium*, and *Escherichia coli* (Gamage et al., 1998), leads to lameness and tumor at the site of the wound, and ultimately may result in death due to metastases in vital organs, if remains unattended (Liu et al., 2004).

The ethno-veterinary medicine used for the treatment of sole crack in this study contained herbs with proven clinical efficacy. The wound healing property of *jam* (*Syzygium jambolanum*) bark (De et al., 2004), *Bheloa* (*Semecarpus anacardium*) seeds (Chakraborty and Bhattacharjee, 2006), and *Guduchi* (*Tinospora cordifolia*) plant (Mathias and Jayvir, 1998; Bedi, 2008) are already on record. However, collection of the ingredients for the preparation of ethno-veterinary medicine, from dense woods, where these rare plants grow, is wearisome and difficult, due to depleting resources of these plants in wild (Kar, 2004). Tortoise shell used in the preparation of the balm contained many medicinal elements, and has proved effective against skin problems like warts (Ross, 1979) and skin sores (Leung, 2004).

The herbal balm, used the treatment of sole crack wound in captive elephants (Sajan) by the ethno-veterinary practitioners in the study area is an exclusive therapeutic formulation, which was not reported earlier. This balm was effective, quick healing, cheaper, easily available, and had no side-effects, compared to allopathic therapy.

**Non-specific chronic superficial dermal wounds in cattle**

**Results of clinical trial:** The ethno-veterinary medicine used to treat non-specific chronic superficial dermal wounds in cattle was prepared from the bark of mango tree (50 g), bark of kadam tree (50 g), and silk cotton seeds (7 pc), which were crushed, and the extracts obtained from these ingredients were mixed together, and orally administered to the animals @ 50 ml twice daily. The allopathic treatment (Positive control), amoxicillin oral suspension was administered @ 7 mg/ kg body weight daily for 15 days. The clinical validation trial of the treatments is detailed in Table-3.
Table-3. Clinical validation trial on treatment of non-specific dermal wounds with allopathic and ethno-veterinary medicines.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Perception</th>
<th>Clinical Validation</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Allo-treatment</td>
<td>Ethno-treatment</td>
<td></td>
</tr>
<tr>
<td>Effectiveness</td>
<td>8.0±0.00a</td>
<td>7.8±0.20a</td>
<td>6.0±0.00a</td>
<td></td>
</tr>
<tr>
<td>Quickness</td>
<td>7.4±0.40a</td>
<td>8.0±0.00a</td>
<td>9.0±0.00b</td>
<td></td>
</tr>
<tr>
<td>Side effects</td>
<td>9.0±0.00a</td>
<td>8.0±0.00b</td>
<td>9.0±0.00a</td>
<td></td>
</tr>
<tr>
<td>Ease in preparation</td>
<td>6.8±0.20a</td>
<td>9.0±0.00b</td>
<td>6.0±0.00c</td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>9.0±0.00a</td>
<td>7.0±0.00b</td>
<td>8.0±0.00c</td>
<td></td>
</tr>
<tr>
<td>Cost effectiveness</td>
<td>10.0±0.20a</td>
<td>4.2±0.20b</td>
<td>9.0±0.20c</td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) The figures are presented as Mean±SEM, based on five observations. (2) The Means bearing different superscripts differed at P≤0.05.

The effectiveness of ethno-veterinary medicine in the healing of non-specific dermal wounds was significantly (P≤0.05) lower in the validation trial than the expectation of the farmers, while allopathic medicine was more (P≤0.05) effective than ethno-veterinary medicine, which could be due to the complicity of pathogens in chronic wounds.

The healing time of chronic wounds was significantly (P≤0.05) higher in ethno-veterinary practice in the validation trial than the expectation of the farmers, while the healing time in allopathic treatment was lower (P≤0.05) than ethno-veterinary treatment, which could be due to the complicity of pathogens in chronic wounds.

Ethno-veterinary therapy had no side effects (P≥0.05) that coincided with the expectation of the farmers (P≥0.05), while allopathic treatment caused side effects (P≤0.05), compared to ethno-veterinary treatment.

The preparation and use of ethno-veterinary medicine was easy, and coincided with the farmers' perception (P≥0.05), while treatment with allopathic medicines was not so easy (P≤0.05).

The availability of ethno-veterinary medicine was significantly (P≤0.05) less than expected, as the ingredients were to be collected from deep forest. Cotton silk seed, one of the ingredients of ethno-veterinary medicine was not available in village precincts at the time of the experiment, as this experiment was undertaken in off-season. The availability of allopathic medicine was more (P≤0.05) difficult than ethno-veterinary medicine in the remotely located tribal hamlets.

The cost effectiveness of ethno-veterinary medicine was lower (P≤0.05) than the expectation of the farmers due to non-availability of certain ingredients like cotton silk seed, as this experiment was undertaken in off-season. Allopathic medicine was costlier (P≤0.05) than ethno-veterinary medicine in the study area.

The results of this study demonstrated that the ethno-veterinary medicine used in the treatment of chronic superficial wounds was quick acting, safe, easy to prepare, readily available, and cheaper, but less effective, compared to the allopathic drugs.
Discussion: Physical injuries, such as cuts, bruises and laceration break the integument, facilitating the invasion and colonization of pathogens, stall the wound healing process due to release of oxygen free radicals at the site of infection/inflammation (Agyare et al., 2013). Many herbs contain anti-inflammatory, antimicrobial, and antioxidant properties, which assist the wound healing process (Houghton et al., 2005). Systemic antibiotic therapy could be more useful than topical application in the healing of clinically infected wounds (Lipsky and Hoey, 2009).

The ethnomedicinal herbs used in our study, such as mango (M angifera indica) bark (Nandagopal et al., 2011) and kadam (N elamarkia cadamba) bark (Patel et al., 2012) possess antimicrobial properties. The fruit of Silk cotton (Bombax ceiba) contains antioxidant and antihemolytic principles (Divya et al., 2012). The seed-paste of Silk cotton is used in healing chicken pox and small pox lesions due to its wound healing properties (Chakraborty and Bhattacharjee, 2006).

The preparation of ethno-veterinary medicine used in wound management becomes costlier at times, as some of the ingredient herbs like seeds of cotton silk are purchased from the open market during the lean period, which could have been procured free of cost during flowering season from the proximity of the tribal hamlets in the periphery of the forest.

The herbal decoction prepared for oral dispensation of non-specific chronic dermal wounds in cattle by the ethno-veterinary practitioners in the study area is an exclusive formulation, not reported earlier. It is effective, quick healing, cheaper, easily available, and had no side-effects.

Yoke gall in bullocks

Results of clinical trial: In the ethno-veterinary practice, mustard oil was rubbed first on the yoke gall, followed by the leaf latex of Akanda. Then, the lesion was thoroughly massaged. This led to inflammation of the wound that burst subsequently, the next day. Then, the yoke gall was pricked by a needle for aspiration of the exudates. The wound healed automatically. Injection of oxytetracycline along with pheneramine maleate into the yoke gall that continued for 5 days was the allopathic treatment offered to the affected animals. The clinical validation trial of the treatments is detailed in Table-4.

Table-4. Clinical validation trial on treatment of yoke gall with allopathic and ethno-veterinary medicines.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Perception</th>
<th>Clinical Validation Allo-treatment</th>
<th>Ethno-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>10.0±0.00a</td>
<td>8.0±0.00b</td>
<td>9.0±0.00c</td>
</tr>
<tr>
<td>Quickness</td>
<td>10.0±0.00</td>
<td>10.0±0.00</td>
<td>9.8±0.20</td>
</tr>
<tr>
<td>Side effects</td>
<td>8.0±0.00a</td>
<td>7.0±0.00b</td>
<td>8.0±0.00a</td>
</tr>
<tr>
<td>Ease in preparation</td>
<td>8.0±0.00a</td>
<td>4.0±0.00b</td>
<td>7.8±0.20a</td>
</tr>
<tr>
<td>Availability</td>
<td>10.0±0.00a</td>
<td>7.0±0.00b</td>
<td>9.8±0.20a</td>
</tr>
<tr>
<td>Cost effectiveness</td>
<td>10.0±0.20a</td>
<td>7.0±0.20b</td>
<td>10.0±0.20a</td>
</tr>
</tbody>
</table>

Note: (1) The figures are presented as Mean±SEM, based on five observations. (2) The Means bearing different superscripts differed at Ps0.05.
The effectiveness of ethno-veterinary medicine was significantly (P≤0.05) lower than the expectation of the farmers in the treatment of yoke gall, but was more (P≤0.05) effective than allopathic medicine.

Ethno-veterinary medicine did not provide quick relief to the animal as expected by the farmers (P≥0.05). Allopathic treatment also failed to deliver quick relief (P≥0.05).

There was no side effect in ethno-veterinary treatment, and it coincided with the perception of the farmers (P≥0.05). Allopathic treatment had more (P≤0.05) side effects than ethno-veterinary treatment.

The preparation and use of ethno-veterinary medicine was easy, and coincided with the farmers' perception (P≥0.05), while treatment with allopathic medicines was not so easy (P≤0.05).

Ethno-veterinary medicine was easily available, and coincided with the farmers' perception (P≥0.05), while availability of allopathic treatment was more (P≤0.05) difficult than ethno-veterinary medicine in the remotely located tribal hamlets.

Ethno-veterinary medicine was cost effective, and coincided with the farmers' perception (P≥0.05). Allopathic medicines were less (P≤0.05) cost effective than ethno-veterinary medicine.

The results of this study demonstrated that the ethno-veterinary medicine used in the treatment of yoke gall was effective, quick healing, cheaper, easily available, safe, and cost-effective, compared to the allopathic drugs.

**Discussion:** Yoke gall (Image-9), a work induced inflammation of skin and subcutaneous tissue due to the friction of the yoke placed on top of the neck of a draft animal is a serious problem in India, which renders thousands of bullocks unfit for work due to intense pain, with least hope of recovery due to ineffectiveness of the existing treatment modules, making them unsustainable, and thus forcing the farmers to sell them for slaughter (Manjunath et al., 2011). The ethno-veterinary treatment schedule adopted in our study offers a hope for the recovery of this painful and unrecoverable skin disorder in bullocks.

The therapeutic potential of mustard oil used in our ethno-veterinary preparation was not studied earlier. But, the use of mustard in wound healing has been documented (Mathias and Jayvir, 1998). The use of Akanda (Calolropis gigantea) latex (Ghosh, 2003) and leaf latex in the treatment of wounds (De et al., 2004) have been documented earlier.

The ethno-veterinary preparation used in our study for treatment of yoke gall is an exclusive formulation, not reported earlier. It is effective, quick healing, cheaper, easily available, safe, and cost-effective.

**CONCLUSION**

The ethno-veterinary preparations formulated by us in consultation with local ethno-veterinary practitioners for the treatment of chronic surface wounds (sole crack, non-specific chronic skin wounds, and yoke gall) were effective, quick healing, cheaper, easily available, safe, and cost-effective, compared to allopathic treatment. Follow up of the ethno-veterinary treatments at weekly intervals up to 36 weeks during...
post-trial period did not exhibit relapse of the treated cases.

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