Wound is a physical injury to any of the tissues in the body that results in a break in the continuity of soft parts of body structures. A process of healing of wound is a normal biological process that occurs naturally as long as it is not obstructed by infection. Many monoherbal and polyherbal formulations have been reported to hasten/accelerate wound healing activity in freshly prepared incisional and excisional experimental wound models. In the present review, an attempt has been made to throw light on importance of microbial infection in the process of wound healing and antimicrobial activity of herbal formulations. Different herbal formulations have been reported to hasten/accelerate the process of wound healing by enhancing epithelization, neovascularization, formation of granulation tissue, collagen synthesis, wound contraction, tensile strength, etc. As these studies have been conducted in freshly prepared non-infected wounds, it is difficult to ascertain the wound healing potential of these formulations in absence of microbial colonization/infection and results are not justifiable because the healing is limited to non-infected wounds. It would be more appropriate to ascertain the wound healing potential and not hastening/accelerating the wound healing property of newer herbal formulations on wound healing in experimental animals in presence of colonization/infection. Hence, it is recommended to strengthen these study protocols further using suitable controls to find out the antimicrobial activities of herbal formulations and their effect on wounds colonized/infected with pathogenic microbes in significant numbers to achieve more meaningful and concrete conclusions.

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reported to hasten/accelerate wound healing activity and found useful in the treatment of wound models (freshly prepared incisional and excisional wounds) in experimental animals and in vitro studies [7–17]. In a study carried out by Nayak et al. (2006) in incisional and incisional wounds in rats, aqueous extracts of Allamanda cathartica and Laurus nobilis have been found to enhance the rate of wound contraction, epithelization and formation of granulation tissue. A. cathartica was found to be more effective than L. nobilis in their study [7]. An alcoholic extract of Kaempferia galangal has also been reported to enhance epithelization and wound contraction rate [8]. Cecropia peltata leaf extract has also been shown to cause significant decrease in wound areas [9]. Similarly, ethanolic extract of Lawsonia inermis Linn. and aqueous extract of the roots of Radix paeoniae have been reported to cause increase in rate of wound contraction, epithelization and granulation tissue [10,11]. However, ethanolic leaf extracts of Lycopus europaeus was found to enhance collagenation, epithelization and also increase in the rate of wound contraction [12]. The topical application of the methanolic extract of Jasminum grandiflorum L. (Oleaceae) leaves to full thickness excision cutaneous wounds in rats has been found to improve the rate of wound healing by accelerating the rate of collagen synthesis, by causing significant increase in tissue growth and by improving the anti-oxidant status [13]. In a recent study, the ethanolic extract of Bambusa vulgaris leaves has been reported to promote wound healing in freshly created wounds in rats by enhancing epithelization, granulation tissue, collagen synthesis, contraction rate and tensile strength. It has also been reported to improve anti-oxidants level significantly [14].

In addition to these monoherbal formulations, some polyherbal formulations have also been reported to potentiate wound healing activities. In a study by Pushpangadan et al. (2008), a polyherbal formulation containing Uteria solficollia curcas, Clerodendrum infortunatus and Centella asiatica has been reported to cause wound contraction [15]. In another study, a polyherbal formulation containing Comphora officinarum, Shorea robusta, Apis mellifera, Acacia catechu, Sesamum indicum and Azadica indica has been reported to enhance wound contraction, epithelization and increase tensile strength of incisional wounds in rats [16]. Similarly, in a recent study by Talekar et al. (2017) use of a polyherbal formulation containing extracts of leaves of Vitex nigundo, bark of Emblica officinalis Gaertn and whole plant of Tridox procumbens in vitro as well as on excisional wound models in experimental animals has been found to accelerate wound healing by causing proliferation and mobilization of fibroblasts and keratinocytes, increase in neovascularisation, re-epithelization of epidermis and sub-epidermal cells, decrease in oxidative stress, and by regeneration of skin and wound contraction [17].

Earlier studies indicate that these mono- and poly-herbal formulations have potential to hasten/accelerate wound healing in freshly prepared wounds and their role as accelerating agent in the process of wound healing is beyond doubt. But it is obvious from the study protocol of these earlier reports that these studies have been conducted in freshly prepared non-infected incisional or excisional wounds which are not showing any sign of infection/colonization with microbes (microbe-free environment). Rather experimental wounds in animals were closely observed for sign of infection and the wound showing signs of infections were separated and excluded from the studies and replaced with newer one [12]. Also, no efforts have been made to throw light on antimicrobial activity of these herbal preparations in any of the studies reported above [7–17]. Although the effect of large number of medicinal plants on various aspects of wound healing is very fruitful, it is difficult to ascertain or reach the final conclusion regarding their potential as wound healing agent (and not as accelerating agent) of different herbal formulations on wound healing based on the reports of studies in a microbe-free environment in absence of microbial colonization/infestation of wounds [18,19]. As it has been proved beyond doubt that the wound healing occurs naturally unless it is obstructed by infection, trauma and ischemia, especially infection is the most important and leading cause for non-healing of wounds, and it is a scientifically proved fact that the presence of microbes or their products can cause disturbances in the orderly scheme of wound healing process. The presence of microbes or their products can affect each of the processes of wound healing [2–6]. Thus, it is difficult to ascertain the wound healing potential of any new formulation in absence of infection, which is a leading cause of non-healing of wounds. In absence of persistent tissue level of bacteria, it is very difficult to confirm the efficacy. Healing of wound by using these monoherbal and polyherbal formulations in such situations is not justifiable because the healing in most of these studies is limited to the non-infected wounds, which could heal naturally without any medication.

Hence, our recommendations are to strengthen the wound healing study protocols by including in vivo study design and appropriate controls to study the type of infection (monomicrobial/polymicrobial), type of wound (acute/chronic), duration of treatment required, outcome variables, etc. So that it would be more appropriate to ascertain the effectiveness of newer herbal formulations on wound healing in experimental animals in presence of colonization/infestation and also to study antimicrobial activity of these preparations to achieve more justifiable and meaningful results.

In a clinical situation where the chances of fresh wounds without colonization/infestation are very rare and hence, we need to strengthen these study protocols further to find out the antimicrobial activities of these preparations and their effect on wounds colonized/infected with pathogenic microbes in significant numbers. The positive results of these additional parameters will help to achieve more meaningful and concrete conclusions.

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Conflict of interest

None.

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