INTERNATIONAL SEVEN JOURNAL
OF HEALTH RESEARCH
ISSN: 2764-9415

The healing effects of using tilapia skin to heal burns and wounds

DOI: 10.56238/isevjhv3n4-023
Recebimento dos originais: 11/06/2024
Aceitação para publicação: 31/07/2024

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ABSTRACT

Introduction: Tilapia skin, a freshwater fish, is being used to treat patients with severe burns. Objectives: The aim of this study was to identify the evidence on the use of tilapia skin in burn healing. Material and Methods: The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME) were used; evidence on the use of Tilapia skin in burn healing. Discussion: the good results with Tilapia skin, saline solution, hydrofiber with silver and silver sulfadiazine, however Tilapia skin and its derivatives showed better delineation of the wound edges, reduction of exudate, reduction of crust formation, maintenance of local humidity. This resulted in shorter healing times, fewer dressing changes and less pain related to dressing changes. Histological tests show biocompatibility between human skin and Tilapia skin, and in microbiological tests no

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bacterial growth was identified, and in biochemical analysis, Tilapia skin showed a higherpercentage of type I collagen than observed in human skin, and proved resistant in tensile tests. Conclusion: The studies included in this review showed that the use of Tilapia skin as a biologicaldressing is effective in the treatment of burns, as it adheres well to the wound bed, has good tensilestrength, no antigenicity, and reduces pain. The health care provided to burn patients is carried outdirectly by the nursing team, who perform all the dressings and assess the healing process. Using Tilapia skin as an alternative dressing for these patients allows nurses to provide better quality careand improve patient comfort.

Key-words: Healing, Skin Burns, Tilapia Skin.

INTRODUCTION

The healing process is characterized by a sequence of molecular and cellular events, with time varying according to the characteristics of each individual. Therefore, special attention is needed, especially with regard to the use of adjuvant therapies to speed up this process (MACEDO, 2021).

According to Amaral (2022), healing at more affordable costs has increased overtime. New healing therapeutic technologies from alternative sources are already known, such as those of plant origin (herbal medicines); physical origin (laser therapy and ozone therapy); and biological origin (skin therapies).

Kienzle (2022) cites in his experiments that the ideal dressing for skin lesions is one that is preferably low-cost, easy to obtain, easy to manipulate, malleable, resistant to traction,painless, maintains humidity, avoids bacterial contamination and, above all, favors the process of epithelialization and angiogenesis.

Thus, De Vasconcelos Pina (2021) defines that biological tissues of animal originhave been examples of dressings with these characteristics and have been used for this purpose. In this context, Tilapia (Oreochromis niloticus) skin has emerged as a low-cost alternative for treating skin lesions, as it is a waste by-product.

In Brazil, to treat burns, we normally use a cream that lasts 24 hours. Every day, you have to change the dressing, take the cream off, rinse the burned area, put the creamback on and make a new dressing (GARRITY, et al. 2023).

According to Lima Júnior et al. (2020), in burns lasting several days, depending on the severity of the injury, fish skin prevents the pain that results in the need to changethe dressing.

In other countries, the skin of other animals, mainly pigs, is used. However, a major advantage of using tilapia is that this fish is less likely to transmit diseases than land-based fish (DE MATOS, 2023).

According to Dias et al. (2022), tilapia skin has a higher amount of a protein calledtype 1 collagen, better resistance (similar to human skin) and an adequate degree of moisture which helps with healing. Due to its good adherence, the skin prevents externalcontamination and limits the loss of protein and plasma, which can lead to dehydration and ultimately cause the patient's death.

OBJECTIVES

The aim of this study was to identify the evidence on the use of Tilapia Skin in burn healing.

MATERIAL AND METHODS

The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. The health terminologies consulted in the Health Sciences descriptors(DeCS/BIREME) were used; evidence on the use of Tilapia Skin in burn healing.

The inclusion criteria were: original article, published in Portuguese and English,freely accessible, in full, on the subject, in electronic format and published in the last tenyears (2010 - 2024), totaling 27 articles.

DISCUSSION

Wounds and burns are injuries that can appear in any area of the human body andrequire care. Respecting the causative agents, extent and severity, it is necessary to be aware of how to differentiate them to the point of referring them for appropriate medicaltreatment (BATISTA et al., 2012).

According to Leão et al. (2011), burns are generally caused by heat (thermal burn),such as fire, steam, tar or hot liquids. Burns caused by chemical substances are similar tothermal burns, while burns caused by radiation, sunlight and electricity tend to be significantly different. People who have been burned by fire often breathe in smoke fromthe fire (smoke inhalation). Smoke can suffocate people, but it also contains different chemicals produced by the burning substance. Some of these chemicals, such as carbon monoxide and cyanide, can be toxic.

Generally, thermal and chemical burns occur due to the contact of a heat source or chemical substances with part of the body surface, most often the skin. In this way, theskin can withstand most of the damage. However, a serious superficial burn can penetratedeep structures in the body, such as fat, muscles or bones (TAVARES, 2015).

According to Serra et al. (2010), when tissues are burned, there is a loss of fluid into them from the blood vessels, causing swelling. In addition, damaged skin and other body surfaces are easily infected, as they can no longer act as a barrier against invasive microorganisms.

More than two million people in the United States need treatment for burns each year and between 3,000 and 4,000 die from serious burns (JUNIOR, 2017).

Definitions classify the depth of the burn and the extent of tissue damage. The depth of a burn injury is described as superficial, partial thickness or full thickness. Burnsare classified as mild, moderate or severe. These classifications may not correspond to the common

understanding of these terms (DIAS, 2015).

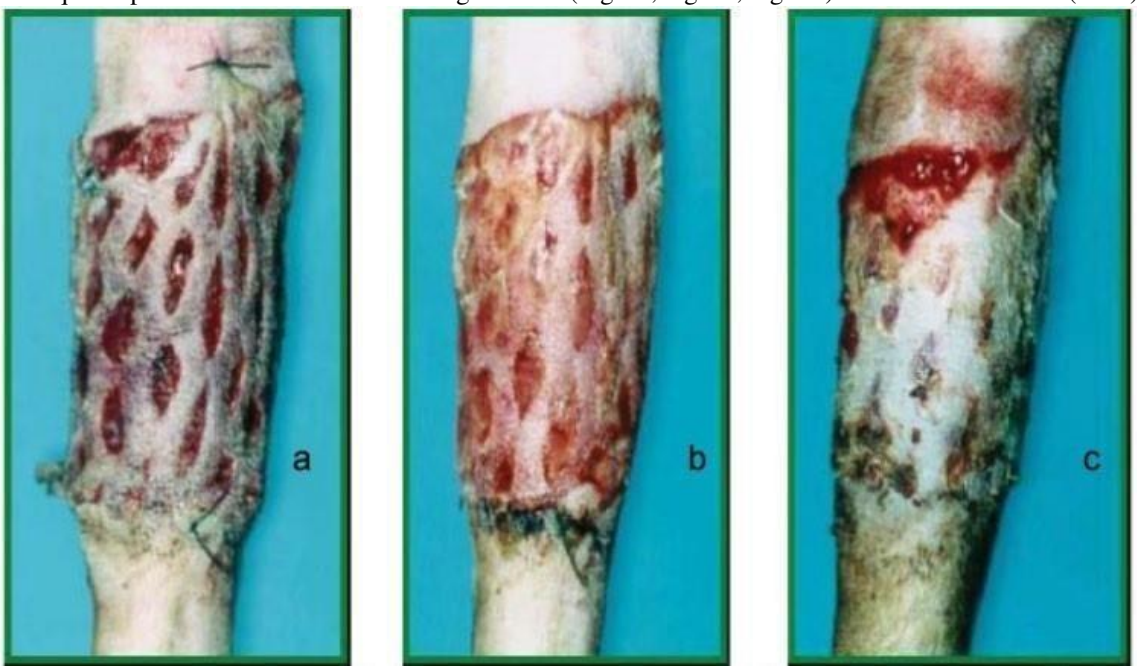
Severity determines the prognosis for healing and the likelihood of complications.Doctors determine the severity of the burn by its depth and by the percentage of the bodysurface with partial-thickness and full-thickness burns. Special tables are used to establishthe percentage of body surface corresponding to different parts of the body. For example,in an adult, the arm constitutes more or less 9% of the body. Different tables are used forchildren because their body proportions are different (TAVARES, 2015).

Mild burns are generally superficial and do not cause complications. However, deep partial- and full-thickness burns take longer to heal. In addition, deeper burns can cause scar tissue to form. This scar tissue shrinks (contracts) as it heals. If scars form ona limb or finger, the resulting contracture can restrict the movement of nearby joints (TAVARES, 2015).

Metsavaht (2017) cites that severe burns and some moderate burns can cause serious complications due to a large loss of fluids and tissue damage. These complicationscan take hours or days to develop. The deeper and more extensive the burn, the more serious the problems it tends to cause. Young children and older adults tend to be more seriously affected by these complications than other age groups.

Autografts can be solid pieces of skin or mesh grafts. For a mesh graft, doctors use a tool to make multiple small, evenly spaced incisions in the piece of skin. The incisions allow the donor skin to be stretched to cover a much larger area (often several times the area of the original piece of skin) (METSAVAHT, 2017).

Figure 1. The viable graft was pink, while the non-viable portion became whitish or blackish. Granulation tissue and subsequent epithelialization occurred in the graft clefts(Fig. 1a, Fig. 1b, Fig. 1 c). Source: Amaral et.al (2023).



According to Junior et al. (2018), mesh grafts are used in areas where the appearance is not so worrying, when the burns involve more than 20% of the body surfaceand when the donor skin is scarce.

Mesh grafts heal with an irregular grid-like appearance, sometimes with excessive scarring. Once the dead tissue has been removed and the wound has been cleaned, a surgeon stitches or staples the skin graft over the burned area. Artificial skin can also be used. Autografts are permanent (METSAVAHT, 2017).

According to Dias et al. (2015), allografts and xenografts provide temporary protection for the healing skin, but are rejected after 10 to 21 days by the person's immunesystem and will need to be removed. After removing the allografts and xenografts, an autograft will be necessary if the wound is full thickness (third degree) and too large to heal spontaneously. Burned skin can be replaced at any time several days after the burn has occurred.

Skin care is extremely important. It is essential to keep the burned surface clean, because damaged skin is easily infected. Cleaning can be achieved by periodically spraying the burns with a gentle jet of water. Wounds are cleaned and dressings changedat various intervals (usually once a day or less frequently), depending on the type of dressing. As with minor deep burns, skin grafts are needed to cover burns that don't heal(METSAVAHT, 2017).

And among the possibilities for skin recovery and regeneration, the use of tilapiaskin has stood out in recent years.

Tilapia is the common name given to several species of freshwater cichlid fish belonging to the subfamily Pseudocrocidolita and in particular to the genus Tilapia (FIGURE 2).

They are native to Africa, but have been introduced to many places in the open waters of South America and southern North America and are now common in Florida, Texas and parts of the southwestern United States, southern and southeastern Brazil (SCHULTER, 2017).

Figure 2. Tilapia. Source: engepesca.com.br/post/tilapia (2024).

Before being used, the fish skin undergoes a cleaning process in which the scales,muscle tissue, toxins and the fish's characteristic odor are removed. It is then stretched ina press and cut into strips measuring 10 cm by 20 cm. The result is a flexible tissue, similar to human skin. The strips of skin are stored in a freezer at a temperature of between2 and 4 degrees Celsius for a maximum of two years (MUKHERJEE et al., 2024).

Studies show that Tilapia skin (FIGURE 3) has good clinical applicability becauseit is abundant in type I collagen, has good tensile strength, prevents hydroelectrolytic losses and has similar characteristics to human skin (RIVAS et al., 2022).

According to Rey et al. (2023), tilapia skin shows satisfactory results in histological and histochemical tests compared to human skin, being useful in reducing treatment time and reducing exposure of sensitive and damaged skin to agents that causeinfection.

Moraes et al. (2024) reported that burns were the most frequently analyzed type of wound in both human and animal studies, with superficial and deep second-degree burns predominating. In the studies included, hydrofiber dressings with silver, saline 0.9% silver sulfadiazine, burn ointment (commercially available in China, but its composition was not described) and chitosan were used as control interventions.

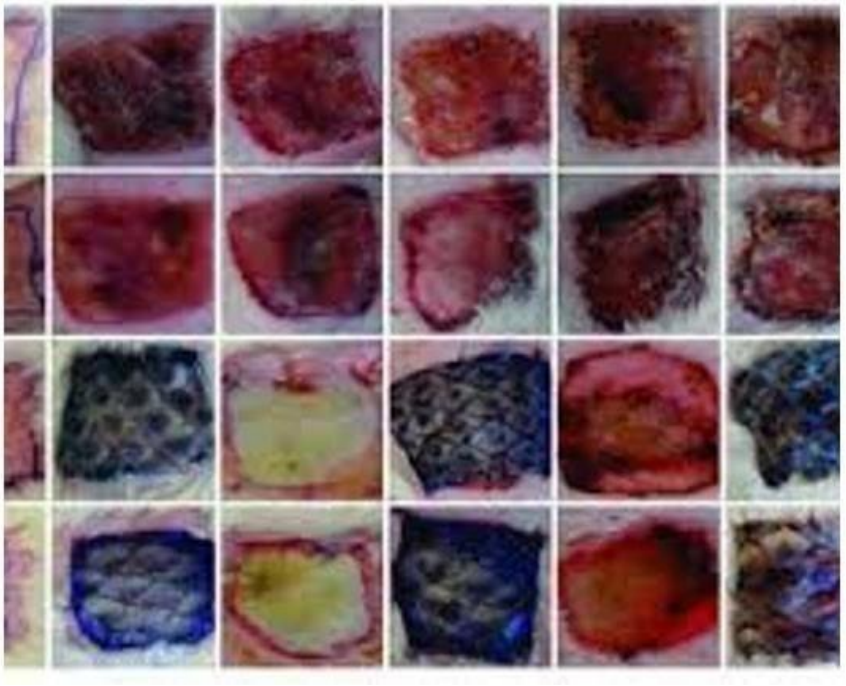
Figure 3. Tilapia skin used to heal burns. Source: www. agazeta.com.br/revista-ag/vida/pele-de-tilapia-ajuda-na-cicatrizacao-de-vitimas-de-queimaduras-0820

Tilapia skin, a freshwater fish, is being used to treat patients suffering from seriousburns. Still in the experimental phase, the Souza Aguiar Municipal Hospital, in the centerof Rio de Janeiro, was the first in the state to carry out the treatment, which is also beingdone in Ceará. According to medical studies, the technique is considered simple, cheap and less painful (QUADROS et al., 2024).

The technique is currently being evaluated by Anvisa and is undergoing experimental studies. Tilapia skin is rich in collagen, resistant and elastic, which contributes to healing at different levels (QUADROS et al., 2024).

The bandage made from the fish's skin covers the entire wound, as if it were a glue protecting the site, and can remain on the burned area for several days. In a statement,Anvisa said that those responsible for the treatment should contact the agency to start theregistration and regularization process. The Ministry of Health explained that SUS has reference centers for burn victims. With regard to treatment using tilapia skin in the SUS,the ministry also said that there is no procedure available and that so far it has not receivedany requests to incorporate this treatment (QUADROS et al., 2024).

Figure 4. Stages of burn healing using Tilapia skin. Source: Amaral et al (2023).



Other studies also point to the benefits of using tilapia skin for healing.

Luze et al. (2022) cites good results with Tilapia skin, saline solution, hydrofiberwith silver and silver sulfadiazine. However, Tilapia skin and its derivatives have shown better delineation of wound edges, reduced exudate, reduced crust formation and maintenance of local humidity. This resulted in shorter healing times, fewer dressing changes and less pain related to dressing changes.

Histological tests show biocompatibility between human skin and Tilapia skin, and in microbiological tests, no bacterial growth was identified, and in the biochemical analysis, Tilapia skin showed a higher percentage of type I collagen than that observed inhuman skin, and proved to be resistant in tensile tests (LIMA JÚNIOR et al., 2020).

Miranda et al. (2019) cited that marine peptides extracted from Tilapia skin havebeen shown to be effective in treating burns, as they have a low molecular weight, are easily absorbed and reduce scar tissue. There is evidence that the combination of chitosanwith marine peptides extracted from Tilapia has greater antibacterial activity on cell proliferation and migration, as well as healing.

For Lima-Junior et al. (2017), tilapia skin proved to be effective as an occlusivebiological dressing in the treatment of second-degree burns in adults, but was not superiorto silverhydrofiber dressings.

According to Costa et al. (2019), Tilapia skin proved to be a potential biological dressing

for the treatment of burns, with good adherence to the bed and positive action on healing. According to the author, the healing pattern of the groups treated with Tilapiaskin was superior to other types of experiments. Tilapia skin showed good adherence to the burned area and absence of antigenicity and toxicity, promoting complete re- epithelialization of the wound.

Hu Zhang et al. (2017) described that the experiments indicated that Tilapia skinis an effective and promising healing agent for the treatment of burns, being able to improve cell migration and promote skin regeneration, which demonstrates the potentialapplication in burn healing. Among the studies included, Tilapia skin was evaluated in IIdegree burns in adults, as well as superficial and deep II degree burns in animals.

According to Luze et al. (2022), burns are a challenge for public health, as they generate time for health professionals and a longer rehabilitation period. In Brazil, the majority of the population affected by burns is low-income and therefore seeks care in the public health system. The conventional treatment carried out in most public burns referral services is silver sulfadiazine ointment, which has a bactericidal and bacteriostaticaction. These dressings are applied daily or every other day and require the ointment to be completely removed when the wound is cleaned, resulting not only in pain but also a delay in the healing process.

Hu Zhang et al. (2017) mention that synthetic occlusive dressings as temporary skin substitutes can be effective, but they are expensive and are therefore more commonlyused in the private health network.

Tilapia skin dressings have emerged as a low-cost, biological occlusive dressing and temporary skin substitute. Tilapia is one of the most consumed fish in the world, andonly 1% of the skin is reused for handicrafts, the rest is discarded. Therefore, treatment using Tilapia skin can generate lower costs when compared to conventional treatment with silver sulfadiazine, since it would use a material that is discarded on a large scale (LUZE et al, 2022).

Lima Junior et al. (2019) show that Tilapia skin shows no difference when compared to silver sulfadiazine in terms of complete healing time, but it does show a significant difference in terms of: number of dressing changes and amount of analgesia, which contributes to greater patient comfort, less risk of contamination, dryness and trauma, and is therefore considered the appropriate choice.

In addition, it is histologically biocompatible with human skin, maintains local humidity, reduces healing time and is less expensive in the treatment of burns than conventional dressings (LIMA JÚNIOR et al., 2020).

FINAL CONSIDERATIONS

Corroborating these findings, a literature review points out that Tilapia skin adheres well to the wound bed and allows it to remain there until healing is complete, inaddition to occluding the nerve endings, promoting an instant improvement in pain. Onecase report also shows that the adherence of Tilapia skin to the wound bed prevents the loss of fluids and external contamination, since the structure of fish skin has antimicrobialand anti-inflammatory activity, thus reducing the formation of crusts and exudate.

The studies included in this review have shown that the use of Tilapia skin as a biological dressing is effective in the treatment of burns, as it adheres well to the wound bed, has a good anti-inflammatory effect and can be used as a dressing.
to the wound bed, has good tensile strength, no antigenicity and reduces pain.

The basic principle is not to further damage the skin, providing a suitableenvironment for re-epithelialization, being sterile, moist and protected from the external environment. Studieshave been carried out on second-degree burns, both superficial anddeep, and have proven their effectiveness.

Based on this review, it was possible to identify that Tilapia skin is a promising biological occlusive dressing for the treatment of burns, as it is low cost, allows for fewerdressing changes, reduces the pain caused by these changes, in addition to presenting histological compatibility with human skin and a high amount of type I collagen. However, more studies and research in humans are needed, since animal and in vitro research has already been carried out demonstrating its effectiveness.

The health care provided to burn patients is carried out directly by the nursing team, who perform all the dressings and assess the healing process. Using Tilapia skin asan alternative dressing for these patients allows nursing staff to provide better quality careand improve patient comfort.

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