

Tilapia skin and its applicability in the treatment of burns

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Abstract

Burn accidents present a relevant frequency in Brazil and worldwide, maintaining high morbidity and mortality rates. Burn care requires long treatment, numerous consultations, dressing changes and long hospital stays, generating high costs for the health system. The objective of this study is to propagate the theme to increase the understanding of the recent biological dressing with the use of tilapia skin and its applicability in the treatment of burns. The innovative method created in Brazil, has as principle the use of tilapia skin for dressing on burns, with eminent potential in medicine for the treatment of these wounds, where the technique with "biological dressing" has been used since 2016. 19 contributed to a significant increase in burns due to the use of alcohol, both liquid and gel, in the home environment and many accidents with child burns. This study is of an applied nature, exploratory objective, qualitative approach and bibliographic procedure from reliable scientific bases, with a 10-year periodicity, where studies were found, reinforcing the effectiveness of the use of tilapia skin, as well as its benefits, histological features and tests in humans. The research was conducted at the Federal University of Mato Grosso do Sul (UFMS) – Faculty of Medicine (FAMED). The research demonstrated that the biological dressing with tilapia skin is an innovative method in the treatment of burns, being a high quality bioproduct, showing biological capacity to cover burns, collagen properties, tensiometric strength and a biomaterial potential in regenerative medicine.

Keywords: burns; tilapia; skin transplantation; biological dressings; tissue engineering

1. Introduction

Burn accidents present a relevant frequency in Brazil and worldwide, maintaining an association with high rates of morbidity and mortality, in addition to causing absence from work, limitations, functional and aesthetic sequelae, compromising the biopsychosocial balance and causing loss of quality of life. Generally, care for burns requires a long treatment, in addition to numerous consultations for dressing changes and long hospital stays, generating high costs for the health system and for the patient (MALTA *et al.*, 2020).

Currently, about 80% of the treatment of burns occurring in Brazil is offered by the Unified Health System (SUS). According to the seriousness of the case, patients are referred by regionalized networks and emergency rooms for care at different levels of complexity. Large-scale burns, chemical, electrical, for example, are usually referred to Burn Treatment Centers (CTQs) (BRASIL, 2021).

In Brazil, burns have a high rate of causes of injuries and deaths and injuries related to external causes, having a high incidence in the male population (METSAVAHT, 2017). According to Moraes *et al.* (2010):

Burns are skin lesions caused by heat, radiation, chemicals, certain plants and animals and can lead to infections. A study carried out in England with burn victims found that 20% of cases corresponded to work-related accidents. In this group, the absolute majority of work-related injuries were men, with a ratio of 11 men to one woman and the average age of 34 years. It should be noted that 35% of these workers sought care after five days of suffering the burn. The etiology of occupational burns were: chemical substance (23%), fire (14%), hot liquid (14%). In 70% of cases the burn was less than or equal to 1% of the body surface.

The biggest victims of accidental burns are children, and the main causes are scalds caused by overheated liquids, and these accidents mostly occur in the home environment, especially in the kitchen, where both hot liquids from the stove and others substances, such as chemical and flammable products used in the home, are left within reach of children, due to parental negligence (BARBIERI, 2016).

According to the World Health Organization (WHO), about 238,000 people in the world die annually from the consequences of burns, with the preponderance found in the regions of Africa and Asia (WHO, 2020). Estimates by the Ministry of Health of Brazil indicate that, annually, around one million new cases of burn victims appear in the country, with 2,500 deaths resulting from injuries (LEÃO *et al.*, 2011). In Brazil, burns have a high rate of causes of injuries and deaths, with a high incidence in the male population (METSAVAHT, 2017).

The method of using tilapia skin for burns was created in Brazil and has eminent potential in medicine for the treatment of wounds caused by second- and third-degree burns. The Instituto Doutor José Frota hospital (IJF), in Fortaleza - CE, used Tilapia skin as a therapeutic resource for burns, being used as a “biological dressing” that has been used since 2016 in the unit of the burn center.

Given the above, this research consisted of conducting a literature review that presented the techniques, applicability and advantages of using tilapia skin as a treatment for burns and possible beneficial relationships with other types of tissue injuries.

2. Methodology

This is an applied study, exploratory objective, qualitative approach and bibliographic procedure, with research in different open access digital libraries in order to identify the applicability of tilapia skin with the treatment of burns.

The research was carried out at the Federal University of Mato Grosso do Sul (UFMS) – Faculty of Medicine (FAMED). Data analysis was sought in different open access digital libraries with a 10-year periodicity, since the technique is new and has recently gained notoriety in Brazil, using specifications

aimed at biomedical engineering and the treatment of burns. To this end, there was active research using the authors' computers during the months of August and October 2021, seeking results from 2011 to 2021.

Descriptors in two languages were used for searches in the databases chosen for the study, in order to filter the tools used for research with tilapia skin and its applications in burns, using the range 5 to 10 as a filter. years of publication, as descriptors or keywords combined and described below, in the DeCs (Descriptors in Health Sciences) and their combinations with the Boolean operators:

PORTUGUESE LANGUAGE

Keywords: Queimaduras, Tilápia; Transplante de Pele; Curativos Biológicos; Engenharia de Tecidos.

ENGLISH LANGUAGE

Keywords: Burns; Tilapia; Skin Transplantation; Biological Dressings; Tissue Engineering.

The results that brought articles with the theme "burn" with no link to the tilapia skin and those studies that did not bring results in line with the treatment of patients through this type of tool were excluded.

The following databases (Table 1) used for research were carried out in open access digital libraries, as well as the descriptors:

Table 1: Open access digital databases used in research.

DIGITAL LIBRARY	SITES
SciELO	https://www.scielo.org
MEDLINE/BIREME/OPAS	https://bvsalud.org
PUBMED	https://pubmed.ncbi.nlm.nih.gov
Health Sciences Descriptors	https://decs.bvsalud.org
Latin American and Caribbean Literature in Health Sciences	https://lilacs.bvsalud.org/

Source: Authors.

3. Literature review

In a comparative study carried out (LIMA-JÚNIOR et al., 2020) between tilapia skin and silver sulfadiazine, it was concluded that there was a significant decrease in the total number of dressings related to the use of tilapia skin, resulting in better good being of the child in the hospital environment.

The evolution of tissue bioengineering is a collective and constant concern, there are several increasingly advanced and modern materials, developed to be safe, efficient and of lesser value. Nile Tilapia skin shows biological capacity to cover burns, has collagen properties and tensiometric strength in its skin, even undergoing different treatments and sterilization methods (ALVES *et al.*, 2018).

For Lima-Júnior et al. (2017) An innovative method for treating burns is with the Nile Tilapia fish (*Oreochromis niloticus*), a high-quality bioproduct, microscopically similar to human skin, belonging to the cichlid family. Tilapia originates from the Nile basin, eastern Africa, and is widespread in tropical and subtropical regions.

These same authors indicate that, through a randomized pilot study in Fortaleza, Ceará, Brazil, the efficiency of glycerolized Nile tilapia skin (NTS) was verified in randomized clinical trials and, after carrying out the research, the positivity was verified. the temporary use of the skin for superficial burns having as a point of comparison the use of a silver impregnated sodium carboxymethylcellulose dressing.

4. Results and discussion

Table 2: Surveys covering studies between the years 2011 and 2021.

AUTHORS YEAR OF PUBLICATION	TITLE	OBJECTIVE	METHODOLOGICAL DESIGN	RESULTS
(LIMA-JÚNIOR <i>et al.</i> , 2020)	Pediatric Burn Treatment Using Tilapia Skin as a Xenograft for Superficial-Partial Thickness Wounds: a Pilot Study	Evaluate the effectiveness of Nile tilapia skin as a xenograft for the treatment of partial thickness burns in children	Phase II, open, monocentric, randomized pilot study conducted in Fortaleza, Brazil	Tilapia skin had good adhesion to the wound bed, reducing the number of dressing changes needed, the amount of anesthetics used and providing benefits for patients and health professionals alike, reducing the overall workload. The number of days to complete healing of burn wounds, the total amount of analgesics needed throughout treatment, burn improvement on the day of dressing removal, and pain throughout treatment were similar to conventional treatment with silver sulfadiazine.
(ALVES <i>et al.</i> , 2018)	Study of tensiometric properties, microbiological and collagen content in Nile tilapia skin submitted to different sterilization methods	Analyze Nile tilapia skin microscopically, as well as its tensiometric properties, when determining its Type I / III collagen ratio after being prepared by different sterilization methods	This is a qualitative study	The use of chemical sterilization, as well as radiosterilization in dosages of 35K Gy and 30K Gy, did not change the capacity of tilapia skin as a biological product, nor did they reduce its tensiometric properties
(LIMA-JÚNIOR <i>et al.</i> , 2017).	Use of tilapia skin (<i>Oreochromis niloticus</i>), as an occlusive biological dressing, in the treatment of burns	Evaluation of the use of Nile tilapia skin as a temporary occlusive dressing in superficial and deep second degree burns in rats. The method of processing, decontaminating and sterilizing tilapia skin and its application to burns and wounds was	This is a prospective, qualitative study.	Tilapia skin had good adhesion to the bed of wounds induced by burns in rats, positively interfering with the healing process. These results allow the continuation of investigations for research in human beings, to confirm its safety and efficacy as a biological curative

registered with the INPI under the number BR1020150214359.

(LIMA-JÚNIOR <i>et al.</i>, 2019).	A Randomized Comparison Study of Lyophilized Nile Tilapia Skin and Silver-Impregnated Sodium Carboxymethylcellulose for the Treatment of Superficial Partial-Thickness Burns	Evaluate the efficacy of freeze-dried Nile tilapia skin as a temporary skin substitute for superficial partial-thickness burns, comparing it to silver-impregnated sodiumcurativo de carboximetilcelulose	Randomized, prospective, open and controlled pilot study carried out in Fortaleza, Brazil, from April 2019 to December 2019	Lyophilized Nile tilapia skin shares the same characteristics as an "ideal" wound dressing demonstrated by glycerolized Nile tilapia skin in previous studies. Also, it demonstrated non-inferiority for burn management when compared to the silver-impregnated sodium carboxymethylcellulose dressing. The safety and efficacy of freeze-dried Nile tilapia skin demonstrated in this pilot study may allow for the development of larger phase II and III RCTs in the near future.
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4.1 Tilapia

A randomized, prospective, open, and controlled pilot study conducted in Fortaleza, Brazil, from April 2019 to December 2019, performed by Lima-Júnior *et al.* (2021) with glycerolized Nile Tilapia skin, obtained relevant results when used for burn treatment in randomized clinical trials, evaluating tilapia skin as a temporary skin substitute for superficial partial thickness burns, where its efficacy was proven with fewer dressings performed and less pain intensity.

4.2 Bandages

The evolution of tissue bioengineering is a collective and constant concern, there are several increasingly advanced and modern materials, developed to be safe, efficient and of lesser value. Nile Tilapia skin shows biological capacity to cover burns, has collagen properties and tensiometric strength in its skin, even undergoing different treatments and sterilization methods (ALVES *et al.*, 2018).

Menezes (2020), stated in his thesis that the Nile tilapia skin has been wasted in the fish processing industries, with that, the possibility arose for the enhancement of this by-product, in this way the maximum use is with the extraction of collagen, which has advanced value for biomedical applications.

4.3 Importances of Tilapia skin

The skin of the Nile tilapia (*Oreochromis niloticus*) appears as a probable by-product, with clinical purpose of new biomaterials usable for bioengineering, and the skin of this fish is a noble and high-quality product, has characteristic resistance to leather (FRANCO, 2013).

The microscopic qualities of tilapia skin are equivalent to the morphological structure of human skin, showing the dermis composed of compact, long and organized collagen bundles, in parallel/horizontal and transverse/vertical positioning, mostly, and showed high strength and extension to traction in smash (LIMA-JÚNIOR *et al.*, 2017).

Tilapia skin has morphological characteristics similar to human skin as well as non-infectious microbiota, high amounts of type I collagen, so it is being studied and suggested as a potential xenograft for the treatment of burns. (LIMA-JÚNIOR *et al.*, 2019).

Through a randomized, prospective, open and controlled pilot study carried out in Fortaleza, Brazil, from April 2019 to December 2019, the efficiency of glycerolized Nile tilapia skin (NTS) in phase II and III randomized clinical trials was verified, This study aimed to evaluate the efficacy of lyophilized NTS (LNTS) as a temporary use of the skin for superficial burns, with the use of a silver impregnated sodium carboxymethylcellulose dressing as a comparative point (LIMA-JÚNIOR *et al.*, 2019).

In another study Lima-Júnior *et al.* (2019) highlighted that tilapia skin is a cheap source and is rich in collagen and through histochemical and immunohistochemical analysis, the ultrastructural aspects of Nile tilapia skin were evaluated, evaluating its quantity and organization of collagen, it was observed that even after sterilization predominates a significant amount of type I collagen.

4.4 Advantages of using cost-effective tilapia skin

The use of tilapia skin as a potential biomaterial in regenerative medicine tends to leverage ongoing research, linking low cost to an innovative, safe and national product (MAGALHÃES *et al.*, 2020).

Moraes (2018) states that skin healing is faster, and that tests were carried out with 300 adult patients with burns, of which 30 were children, and that no infection occurred, which is common with traditional dressings for burns, so the treatment is faster, less painful, with less risk of contamination and loss of fluid.

Dressings made with tilapia skin withstand longer time intervals than those made with common dressings, thus, they avoid discomfort for the patient, result in savings in materials and hospital labor, the reduction is significant in daily hospitalization costs, the patient has a better quality of life during the recovery process, when using this biological dressing (BEZERRA, 2018).

A survey carried out by the Medicine Research and Development Center (NPDM), of the Federal University of Ceará (UFC), in partnership with the Institute for Support to Burning (IAQ) and the Doctor José Frota Institute (IJF), concluded that the use tilapia skin reduces costs with recovery, material, anesthetics and medical staff.

Collagen was shown, through an investigative study carried out on the physicochemical properties, biosafety and biocompatibility, to have potential as a biomedical material by presenting the type of collagen characterized as type 1 (WEN-KUI SONG, 2019). It is noteworthy that tilapia skin has a greater composition of type I collagen than human skin (ANDREA, 2020), therefore, it is the most abundant protein in the connective tissue in the healing phase (CAMPOS, 2007).

Its use implies the inexistence of dressing change, which entails a lower risk of infection and also a lower cost of treatment, linked to the fact that the production of tilapia corresponds to 45.5% of the total fish production in Brazil (MARCELO, 2018).

Miranda (2019) in her research concluded that Nile Tilapia skin is effective as an occlusive biological dressing. There was a similarity between the groups for the average number of days of treatment (complete wound healing) and for the report of pain during the dressing. Through research in the literature, it was observed that tilapia skin had good adhesion to the bed of wounds induced by burns, positively interfering in the healing process and not causing relevant changes in hematological and biochemical parameters of renal and liver function, being a potential biological curative for the treatment of this nature (Lima-Júnior *et al.*, 2017).

5. Conclusion

Based on the literature review, although no studies have been found that demonstrate the efficacy of using tilapia skin in other types of tissue injuries, it is observed that there is a consensus on the use of tilapia skin for the treatment of burns in humans, where the results outweigh the costs, demonstrating high healing capacity, ease of debridement of necrotic tissues and fighting local infection.

Thus, the cost/benefit ratio must also be considered as a criterion for choosing between dressings. and in this sense, the health team working in Burn Units needs to keep up-to-date, not sticking to conventional treatments without scientific foundation. Therefore, the indication and application of biological products such as tilapia skin in burns should be carried out based on a careful assessment of the wound, the client's clinical conditions, as well as a systematic analysis of the evidence in the literature.

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