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Antimicrobial Action and Scaring of 10% Green Banana Shell in Chronic Wounds

Ana Beatriz Alkimim Teixeira Loyola[1], Rafael Vieira Fernandes[2], João Victor Braga Mendes[2], Nadir Alves de Oliveira Neta[2], Luiz Francisley de Paiva[3], Adriana Rodrigues dos Anjos Mendonça[4], Dênia Amélia Novato Castelli Von Atzingen[5]

[1]Department of Applied Health Sciences, Faculty of Health Sciences, The Universidade do Vale do Sapucaí, Pouso Alegre, Brazil
[2]Faculty of Medicine, Sapucai Valley University (UNIVÁS), Pouso Alegre, Brazil
[3]Laboratory of Microbiological Research, Sapucai Valley University (UNIVÁS), Pouso Alegre, Brazil
[4]Department of Applied Health Sciences, Sapucai Valley University (UNIVAS), Pouso Alegre, Brazil
[5]Department of Bioethics, Faculty of Health Sciences, Sapucai Valley University (UNIVÁS), Pouso Alegre, Brazil
Email: analkmim@hotmail.com, rafaelunivas@hotmail.com, sene.mendes23jo@gmail.com, nadir_oliveira292@hotmail.com, francisleybiologo@yahoo.com.br, drijar@hotmail.com, denianovato@gmail.com

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Abstract

The percentage of diabetic patients with contaminated lesions increases from 3% to 10%. Treatment with herbal products shows benefits in their use, as well as antioxidant and antifungal activities. Objective: to evaluate the antimicrobial action of 10% banana peel gel and the contraction of diabetic and venous wounds. Methods: individual, analytical, interventional, longitudinal, prospective, randomized study from February to December 2015. Five patients were included in the study; 3 with venous ulcer and 2 with diabetic wound. Application of 10% green banana peel gel and weekly samples were performed. After six days, the second collection was performed. The samples were seeded in the Mannitol salt agar culture medium, MacConkey agar and Saboraund agar with chloramphenicol for isolation of cocci and Gram-positive and Gram-negative bacilli; and fungi. The total counts of bacteria were determined by PCA (Plate Count Agar) and measurement of the lesion margin. There was a reduction of microorganisms with the use of the gel in 53.57% of the patients, and reduction of wound areas in 48.1%.

Keywords

Musa sapientum, Phytotherapy, Products with Antimicrobial Action, Healing, Wounds and Injuries

1. Introduction

The use of food and medicinal plants in the treatment of diseases has been increasing every day around the world. In Brazil it is not different, both in the big commercial centers and in the interior, the commerce and the use of medicinal plants are very widespread activities, which are attributed diverse medical, social, cultural, economic or philosophical causes [1]. Such use was built on experience and transmitted orally [2].

Some of these foods are rich in bioactive compounds, widely recognized for their health promoting properties and in technological applications, such as the mango bark (*Mangifera indica* L.) of the "Tommy Atkins" variety, in which the results demonstrated relevant activity Antimicrobial activity against strains of *Escherichia coli*, *Salmonella* sp., *Pseudomonas aeruginosa*, *Staphylococcus aureus* [3]. As the Mangifera bark indicates L. Tommy Atkins variety, other plant extracts such as cinnamon essential oils, cashew tree bark, cocoa, pepper rosemary, propolis, citrus grass and jaboticaba leaves [4]. The antimicrobial activity of the antimicrobial agent was similar to that of the antimicrobial agent, and the antimicrobial activity of the antimicrobial agent and economically feasible becomes an important event in the promotion of population health [5].

Banana (Musa spp.) is one of the most cultivated fruits in tropical countries, being the 2nd fruit of the world in terms of production, with an annual production of 106 million tons. Brazil ranks 4th in the world, with about 6.9 million tons per year [6]. The major chemical constituents of Musa are steroids, flavonoids and tannins [7]. Studies have shown that different extracts of banana peel in different stages of maturation have antioxidant potential, mainly due to the presence of phenolic compounds. In addition, by comparing the ripening stages, the green banana peel has higher antioxidant activity. One of the antioxidant components determined was gallocatechin, as it showed its maximum extraction in a non-polar solvent. This work suggests that banana peel is a potential product for the preparation of nutraceuticals because of its antioxidant potency [8].

In addition to its highly antioxidant power, this fruit also presents other important functions such as the gel to 4% of its bark, which promoted a great area of epithelialization in wound healing with second intention in rats [9]. The use of the 4% banana gel in surgical incisions in rats also has repercussion in reducing the area of the lesion, reducing vascular proliferation and increasing collagen concentration in the wound [10]. Currently, it is estimated that in the Brazilian population 3% of the individuals are carriers of different skin wounds; This percentage increases to 10% in the case of diabetic patients who may even have lesions contaminated with microorganisms such as *Staphylococcus aureus* [11], which stimulates the search for new resources and technologies for a lower cost solution, greater efficiency and to which the population is more accessible.

The objective of the present study was to evaluate the antimicrobial action of the gel on 10% of *Musa sapientum* green peel in microorganisms isolated from chronic wounds and the gel repercussion in the reduction of wound areas in pa-

tients with diabetic and venous wounds In the São João Ambulatory, in a city in the south of Minas Gerais.

2. Methodology

A clinical trial was conducted for February to November 2017 with 5 patients with venous or diabetic wounds attending the São João Outpatient Clinic, a city in the south of Minas Gerais. Three of the patients were male and two were female. Throughout the experiment, patients attended the UAPS to perform conventional treatment consisting of tap water lavage and wound debridement [12]. The inclusion criteria were patients with lower limb skin lesions due to type II diabetes and venous ulcers with diagnoses pre-established by a physician of the unit or individual, ranging from 45 - 70 years old. Informed consent was obtained from the patients and the trial by the ethic committee. Exclusion criteria were patients who is absent from treatment for one or more occasions, and who give up and who do not adhere to treatment.

The study was approved by the Research Ethics Committee of UNIVÁS (approval no.1.771.891) and performed in accordance with the Resolution 466/2012 of the Brazilian National Health Council (CNS) on research involving human beings. Written informed consent was obtained from all patients prior to their inclusion in the study, and anonymity was assured.

The debridement was performed manually, with the aid of a forceps, scalpel sheets 13 or 15 and gauze, for the removal of sloughs and devitalized tissue if necessary. The wounds were irrigated with tap water abundantly. Also the application of the 10% green banana peel gel was carried out. The banana's gel composition is under patent BR1020160301050. The wounds were treated every three days for 4 weeks, evaluated and measured. The gel was applied to patients with the aid of an individualized sterile dressing kit. The amount of gel was evenly distributed throughout the wound to full coverage of the wound. Transpore® Johnson & Johnson (São Paulo, SP) tape, 15 cm by 10 m coil, and then made a secondary dressing of Micropore®, made specifically for the experiment, were then wrapped in the patient.

In addition, wound samples were collected. The collection was performed weekly during dressing changes over a period of 4 weeks. During dressing change, the sample was collected after cleaning the affected area with sterile swab in an area of 3 cm^2 and transported in test tubes containing one ml of sterile saline solution. The lesion was washed according to protocol established by the São João ambulatory. Samples of venous ulcer secretion and diabetic secretions were collected during dressing change and after six days of treatment. During dressing change, the first sample was collected after cleaning the affected area with sterile swab in an area of 3 cm^2 and transported in test tubes containing one mL of sterile saline solution. After collection, 0.1 mL of each sample was seeded in the culture media mannitol agar, MacConkey agar and Saboraund agar with chloramphenicol for isolation of Gram positive cocci, Gram negative bacilli

and fungi. The sample was seeded with Drigauski loop for counting the microorganisms in the petri dish and incubated at 35˚C for 24 hs. After growth the isolated microorganisms were submitted to the in vitro susceptibility test to the herbal product used in the treatment.

Microorganisms from venous ulcers and diabetic secretions were submitted to the susceptibility test using the Agar diffusion method known as Kirby-Bauer.

For each isolate, the location of the 6 mm diameter Whatman No. 1 filter paper discs was marked on the bottom of the Mueller-Hinton plate and sheathed with phytotherapeutic ointment.

For the inoculum with the aid of a ring loop, 4 to 5 colonies from a pure culture will be transferred into the tube containing the BHI broth. The swab was incubated by 2 to 8. Subsequently, the swab was soaked in the cultures, eliminating the excess of liquid by compression in the walls of the tube. The inoculum was spread evenly on the surface of the agar, so as to cover it whole.

With a flamboyant, cooled collet and the Bundsen's nozzle on, the discs were placed one at a time on the Petri dish, each one sheathed with the herbal ointment, placing the disc in place so that it was 1 cm from the edge and equidistant 2 cm. The disc was pressed onto the plate slightly so that it adheres to the surface of the medium. The plate was closed and incubated at 37˚C for 24 hours, at which time the presence and size of the halos formed were analyzed. The halos were measured in millimeters with the aid of a ruler. Each test was performed in duplicate to calculate the average of the halos. The antimicrobial action of the gel was analyzed during this period by these procedures. Total counts of bacteria were performed by PCA (Plate Count Agar). The reading was performed after 24 hours and 48 hours of incubation at 37˚C.

The reduction of the area of the lesion was monitored weekly during the experiment by measuring the contour drawing of the wound in sterile acetate, tracing a vertical and a horizontal line, in order to obtain a 90˚ angle between them; Values were recorded in centimeters.

The comparison between the values obtained provided the actual size of the wound in order to evaluate the healing by digital planimetry with the use of the software Auto CAD 14®.

3. Results

As to the percentage of reduction of microbial activity between the 1st and last week, a reduction was observed in patients 1, 2, 3 and 5. Only patient 4 experienced a 129.4% increase in microbial activity. Therefore, the median, the best measure of central tendency to elucidate the graph, was a 53.5% reduction in microbial activity (**Figure 1**).

Regarding wound areas, patients 1 and 2 underwent 100% healing, whereas in patients 3, 4 and 5 a lesion regression of 20%, 7.2% and 13.3%, respectively, occurred (**Figure 2**).

The **Figure 3** show the evolution of treatment with 10% Green Banana Shell in Chronic Wounds after a week (**Figure 3**).

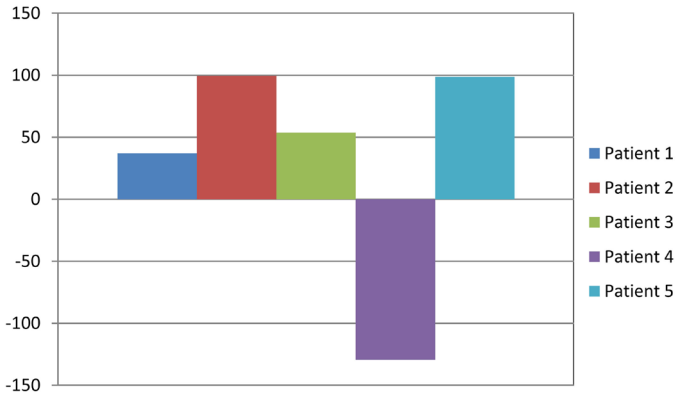


Figure 1. Percentage reduction of microbial activity during experiment.

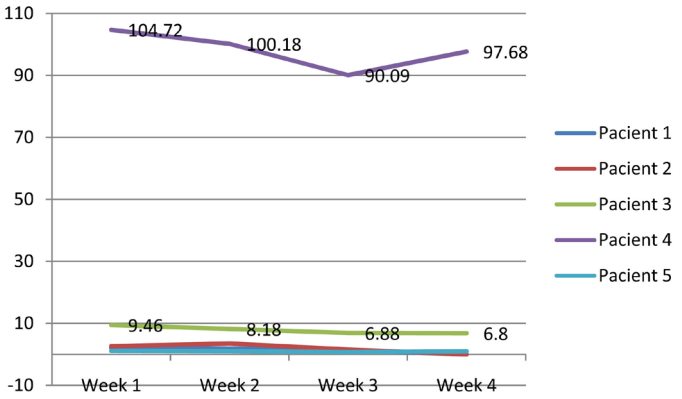
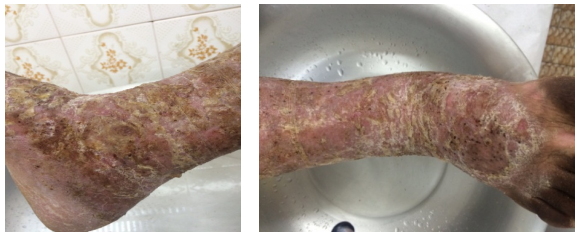


Figure 2. Regression of wound areas in square centimeters.

4. Discussion

The results are consistent with studies that reported the use of a 10% gel was produced from the banana peel extract, analogous to the present study, in incisional lesions in rats, demonstrating as therapeutic action the antimicrobial and healing effect of *M. Sapientum*, as the inhibition of the growth of enterobacteria and pyogenic bacteria. This study also identified, through phytochemical screening, tannins in the green banana extract, exhibiting significant antioxidant effects, suggesting that the banana peel extract could be useful to combat free radical-mediated diseases [13]. This study was promoted in rats, showing the pioneering nature of the present study in using *M. sapientum* bark gel in humans. The banana peel has also a large amount of phenols, measured by the method of sequestration of the stable free radical 2,2-diphenyl-1-picrylhydrazyl (DPPH) and total phenols, which proved the potential of free radical scavenging activity [14], again suggesting the effectiveness of banana peels to combat free radical-related diseases. Another study demonstrates the use of a 4% gel of green banana peel in surgical wounds in rats, resulting in an increase of polymorphonuclear cells in the first week of experiment, and later reduction of the area of the lesion, reduction of vascular proliferation and Concentration of collagen fibers in the third week of study [10].



(a)

(b)

(c)

(d)

(e)

Figure 3. First and last week of treatment with 10% green banana shell in chronic wounds. **Legend:** (a) Patient 1 (26/11/15-04/12/15); (b) Patient 2 (04/12/15-Total cicatrization); (c) Patient 3 (26/11/15-04/12/15); (d) Patient 4 (26/11/2015-11/12/15); (e) Patient 5 (26/11/15-11/12/15).

The present study demonstrated that 80% of the patients presented a great reduction of the microbial activity against the use of the gel based on the extract of the bark of the green banana *Musa sapientum* species to 10%, occurring in 40% of the patients a reduction of approximately 99% of the activity Microbial. This data reaffirms the power of green banana peel to inhibit the growth of microorganisms, such as enterobacteria and pyogenic bacteria, which are prevalent in diabetic wounds and venous ulcers.

The study has some limitations such as a small sample due to a huge number of patients were absent from treatment for one or more occasions or give up and who do not adhere to treatment. But even so, it deserves special attention because it is a gel that has shown a reduction of the microbial activity and the size of the lesion.

Other studies also demonstrate the healing effect of *M. sapientum* on gastric ulcers, which induced by acetic acid and after treatment with the banana extract had a significant improvement in the condition [15], and other injuries [16]. In another study, skin grafts were performed in 30 patients. The donor area was divided into 2 parts. One was cover with leaves of the banana tree and the other with vaseline gauze. The treatment with the banana tree was less painful, as well as healing occurred in a shorter time, demonstrating as a therapeutic action the healing effect on wounds of the banana leaf in a skin graft donor area [17]. In addition to the banana leaves, the 4% gel of the *M. sapientum* green bark also promoted a greater epithelization area in wound healing with second intention in rats [9], showing the diversity of therapeutic actions that come from Of the banana, its bark, the leaves of the banana tree, and its derivatives.

The present study demonstrated not only the decrease in microbial activity, but also the reduction of the wound area and consequent improvement of the lesion. Observing **Figure 1** and **Figure 2** we can see the improvement of skin appearance, reducing erythema and edema, and assisting in the healing process of the lesion.

As for the choice of banana maturation, the banana green peel samples have a higher antioxidant action than the mature ones, since fractions from these samples have a higher amount of phenolic compounds [8].

Further studies are needed to ascertain the existence of other effects of green banana peel gel on wound healing, such as toxicity and other forms of administration. Phenolic compounds of plants belong to several categories, among them the most found are flavonoids, coumarins and condensed and hydrolysable tannins. These compounds have received much attention in recent years, since they inhibit lipid peroxidation and lipoxygenase in vitro. The antioxidant activity of phenolic compounds is mainly due to its reducing properties and chemical structure, which play an important role in the sequestration of free radicals and chelation of transition metals, acting both in the initiation stage and in the propagation of the oxidative process. And therefore an essential element in the prevention of chronic diseases and wound healing [18]. Research with a larger sample is also necessary in order to confirm the healing pharmacological activity

of the green banana peel.

5. Conclusion

Reduction of microorganisms against the use of gel 10% of the green banana peel (*Musa sapientum*) in patients with a median of 53.57%, and reduction of wound areas on average of 48.1% with a significant improvement of the picture.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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