ABSTRACT

Objective: to analyze through the published literature, the knowledge produced about the biological activity of Musa spp. in the treatment of diseases. Method: integrative literature review conducted between January and February 2012, using the Latin American and Caribbean Health Sciences (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE), Scientific Electronic Library Online (SciELO) and SciFinder Scholar, the period from 2001 to 2011 with the added descriptor Musa alone and each with secondary descriptors: healing, antioxidant, products with antimicrobial action. The search was conducted between January and February 2012, eight articles were selected, who composed the study sample. Results: showed the lack of published research on the biological activity of banana diseases. However, there is evidence that this species has healing activity as an antioxidant, even with deficiency in the production world on the subject. To enjoy all the benefits that technology through basic research can offer is essential to link the knowledge from research to clinical practice, which allows the use of what nature has to offer. Conclusion: this integrative review on the biological activity of banana enabled the collection and an analysis of publications in the world context. It was identified the most research come from India and evaluate the healing potential of this plant species. New research, however, need to be developed, and one should explore further the therapeutic actions of Musa spp. Descriptors: biological therapy; Musa; healing.

RESUMO

Objetivo: analisar o conhecimento produzido sobre a atividade biológica da espécie Musa spp.(banana). Método: revisão integrativa da literatura, a fim de responder ao seguinte questionamento: o que tem produzido sobre a atividade cicatrizante, anti-inflamatória, antimicrobiana e de citotoxicidade dessa espécie vegetal, assim como outras atividades biológicas? O estudo foi realizado entre os meses de janeiro e fevereiro de 2012, utilizando-se da Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE), Scientific Electronic Library Online (SciELO) e SciFinder Scholar, entre 2001 a 2011, com o descritor Musa e agregado com os descritores secundários: cicatrização, antioxidante, produtos com ação antimicrobiana. A busca foi realizada com um formulário que contemplou informações sobre identificação do artigo, objetivo dos estudos, tipo de pesquisa, resultados e discussão, e ação terapêutica, entre os meses de janeiro e fevereiro de 2012. Dos 17 artigos que compuseram a amostra do estudo, oito foram selecionados, organizados em tabelas, e com a discussão apresentada em confronto com a literatura relacionada temática em questão. Resultados: apontaram a escassez de pesquisas publicadas sobre a atividade biológica da banana contra doenças. Entretanto, foi evidenciado que, essa espécie vegetal possui atividade antimicrobiana, cicatrizante, antioxidante e anti- helminthina. Para usufruir de todos os benefícios que a tecnologia por meio da pesquisa básica pode oferecer é imprescindível vincular o conhecimento proveniente de pesquisas à prática clínica, o que possibilita o aproveitamento daqueles que a natureza pode oferecer. Conclusão: a maioria das pesquisas é oriunda da Índia e avalia o potencial cicatrizante dessa espécie vegetal. Descriptors: terapia biológica; Musa spp.; cicatrização.
INTRODUCTION

The study of medicinal plants has been encouraged by the World Health Organization (WHO), in order to scientifically evaluate the benefits of using herbal medicines and know the risks of their misuse. Several natural or manufactured products have been studied in the search for effective alternatives to prevent inflammation, infection and wound healing.

The nursing professionals play a relevant role in the evaluation of available products in the market for treatment of wounds, because they have more contact with people with wounds, to monitor the wound, direct and perform the dressing, as well as, to hold the technical mastery. One of the types of treatments used through the plants becomes effective in controlling infections and in wound healing. The wound consists in a disruption in the continuity of body tissue caused by trauma, or be triggered by the condition that activates the organism's defenses. The process of wound healing is a complex event of reactions and interactions between cells and biochemical mediators, which aims to repair the injured area. In general, an infected wound heal itself by second intention, in consuming and prone process to complications, with slow and insufficient closing, especially if associated with clinical morbidities such as hypertension, diabetes, immunosuppression, etc.

The number of people with wounds has increased with the raise in life expectancy of the population, leading to significant increase in the cost of treatment. The development of chemically less elaborate products, such as herbal medicine has emerged with great advances in order that, in Brazil, approximately 100 million people lack access to manufactured drugs. This data stimulate research aimed at seeking the medicinal flora, alternatives for the treatment of diseases affecting humans and, in particular those that affect the system as cutaneous wounds.

Researches performed in several countries have demonstrated the great antimicrobial potential of various extracts, essential oils and substances extracted from plants to overcome the infection. In the case of wounds, the infection is the main factor that hinders healing. An example is a study in Pakistan, which used a native plant, the Berberis liceum, in which were tested the healing activities by the use of aqueous and methanolic extracts of the root, evaluating the repair of wounds in laboratory rats. After application of both extracts, it was observed that the area of epithelialisation had increased followed by rising in contraction of the wound, tensile strength of skin, and also presence of granulation tissue. The studies on the granulation tissue also indicated that there was an increase in collagen formation in the rats treated with the extract compared with others rats of the control group. The methanol extract was more effective than the aqueous extract, but both showed significant differences in comparison with control.

Another study, performed in Australia investigated whether two products, honey and essential oil derived from Lavandula x alliardii present healing activity in excisional wound of rats. The Medihoney®, patented therapeutic honey was used as positive control. Four wounds of eight millimeters were surgically made on the dorsal surface of each rat and it was applied to wounds honey or essential oil twice for day during four days. Wound healing was assessed by contraction of the wound edges and the capillary volume in period of five to 12 days.

Although the statistical data related to wound contraction have not shown significant differences between the groups treated with the essential oil or honey, in relation to the untreated group, both reduced the diameter at the wound site at day 12. Noting as well that these products have beneficial effects in non-infected wounds.

Different ethnic groups have contributed to the development of research on medicinal plants, taking into account the close relationship between the chemical structure of a particular compound and its biological properties. Thus, the research of medicinal plants is important to verify the pharmacological effects, such as natural sources of compounds for new therapeutic agents.

The banana, the fruit of banana tree (Musa spp), has ethnobotanical report to be used in natura or cooked for remedy diarrhea. This vegetable specie is native of Southeast Asia and there is evidence of its cultivation since 5000 BC., or even 8000 BC. In the XV and XVI centuries, the Portuguese colonists began systematic planting of banana plantations in the Atlantic Islands, Brazil and the West African coast. Economically, it is of great importance in tropical countries. Its fruit is appreciated for the ease of acquisition, consumption and for being a source of vitamins, minerals and energy.
One of the studies on banana reports about the action of green banana in form of flour, used in India for the treatment of patients with peptic ulcer. There are several ways to prepare the green banana, used to remedy ulcers, induced by aspirin, in rats, demonstrated effectiveness in both curative and prophylactic treatment. In this study it was also found that ripe bananas loses its therapeutic effect. The extract of green banana not only increases the density of the mucosa, but also aids in the incorporation of thymidine in the DNA of the cells, demonstrating the effect on cell proliferation.

An in vivo study using as animal model Wistar rats (Rattus norvegicus) showed that the topical preparation containing extract of epicarp of the fruits from the *Musa sapientum* var. *paradisiacal* (apple banana) has antimicrobial and healing property. The main chemical constituents of the *Musa* are steroids, flavonoids and tannins.

Thus, it was evidenced the need to seek references on the therapeutic use of *Musa* spp., in order to answer the following question: what has been produced on a healing activity, anti-inflammatory, antimicrobial and cytotoxicity of this vegetable specie, as well as other biological activities?

The option to develop an integrative review on this subject, as an initial step for preparing master’s thesis, due to the fact that such review allows the interpretation of academic studies on the use of banana as a healing and anti-inflammatory element, checking the antimicrobial and cytotoxic action and its use in nursing care, which will permit the development of future researches about this theme.

**OBJECTIVE**

The inclusion criteria were articles published from 2001 to 2011 in national (in Brazil) and international journals in English, Portuguese or Spanish; complete articles published in these databases at any time, which reflect the theme of the use of *Musa* with biological property as a healing, anti-inflammatory and health care product, as well as their antimicrobial and cytotoxic actions. The study excluded articles that did not relate to the biological use and those in whom it was only possible to access the abstract (summary). Based on the established criteria, 17 articles were selected after reading the

### TABLE 1

<table>
<thead>
<tr>
<th>Descriptors/ Consulted sources</th>
<th>LILACS</th>
<th>MEDLINE</th>
<th>SciELO</th>
<th>SciFinder Scholar</th>
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<tbody>
<tr>
<td><em>Musa</em></td>
<td></td>
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<td><em>Musa</em> and healing</td>
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<td>E</td>
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</tr>
<tr>
<td><em>Musa</em> and anti-inflammatories</td>
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<td>E</td>
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<td><em>Musa</em> and antioxidants</td>
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<td>E</td>
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<td><em>Musa</em> and antimicrobial tests</td>
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<td>S</td>
</tr>
</tbody>
</table>

The review went through the following steps: preparation of the research question, establishing inclusion and exclusion criteria for sample selection, preparation of instruments for data collection, critical data review, interpretation and presentation of results. The search was performed between the months of January and February 2012, in databases: Latin American and Caribbean Health Sciences (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE) and the virtual libraries Scientific Electronic Library online (SciELO) and SciFinder Scholar.

To perform the search for articles, it was used the following descriptors and their combinations in Portuguese, English and Spanish: *Musa* spp., Antimicrobial, wound healing, anti-inflammatory, antioxidant and anthelmintic, sensitivity test by disk diffusion to antimicrobial; immunological tests. The search strategy grouped the descriptor - *Musa* each of the other descriptors, as shown in Table 1, being the character “E” related to the articles found and the “S” for selected articles sorting by reading the summaries.

- Analyze the knowledge produced on the biological activity of *Musa* spp.

## METHOD

One bibliographical study with the adoption of the integrative review method, which consists of an important tool in the health field, to gather and synthesize studies of determinate issue, allowing to generate a source of current knowledge about the problem and determine if the scientific knowledge is valid to be used in practice, as well as favoring the development of reflections for further studies. The realization of integrative review requires the same standards of accuracy and clarity used in primary studies.

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abstracts, 08 articles remained for inclusion in the review.

For data collection of articles, it was elaborated a form that included information on the identification of the article, objective of studies, type of research, results and discussion, and therapeutic action presented in two tables and the discussion was based on literature.

**RESULTS**

The eight articles selected for this study are shown in Table 1. There were no publications on this subject in journals specific to nursing. Although the quantitative of studies on Musa spp. (banana), alone, have been raised during the screening of articles it was noted that there are still few who focus on using the biological activity of this plant to treat diseases.

Most articles are of international origin, predominantly publications in English, especially in India, followed by Brazil and Thailand, which means that research in these countries reported ethnobotanical value of its flora investing in pursuit of new herbal medicines. It was not identified the professional category of researchers, however, all studies were performed in laboratories of experimental research or in clinical area of institutions belonging to universities, involving more than one area of knowledge, specifically Chemistry, Medicine and Pharmacy. The articles are described according to the journal / year, language of publication and country in Table 2.

As the frequency of publications, there is an unequal distribution in the production of articles in the last 10 years. It was found in relation to the selected articles that: one was published in 2001, two in 2003, one in 2007, another in 2010, and three in 2011.

<table>
<thead>
<tr>
<th>Table 2. Characterizing the integrative review articles. Maceió-AL, 2012.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
</tr>
<tr>
<td>The antiulcerative effect of Thai Musa species in rats.17</td>
</tr>
<tr>
<td>Banana leaf dressing for skin graft donor areas.18</td>
</tr>
<tr>
<td>Evaluation of banana leaf dressing for partial thickness burn wounds.19</td>
</tr>
<tr>
<td>Uso da bananeira (Musa spp.) no controle de parasitas de animais domésticos: do empirismo à ciência.20</td>
</tr>
<tr>
<td>Eficácia de resíduos da bananicultura sobre a inibição do desenvolvimento larval em Haemonchus spp. provenientes de ovinos.21</td>
</tr>
<tr>
<td>Antioxidant Activity and Protective effect of Banana Peel against Oxidative Hemolysis of Human Erythrocyte at Different Stages of Ripening.22</td>
</tr>
<tr>
<td>Evaluation of post-surgical healing in rats using a topical preparation based on extract of Musa sapientum epicarp.12</td>
</tr>
<tr>
<td>Antioxidant Potential of Peel Extracts of banana varieties (Musa sapientum).23</td>
</tr>
</tbody>
</table>

Source: Databases

All articles presented the objectives of this research clearly, facilitating the understanding of the reader. Regarding the methodological approach employed, it was observed that although not explicitly throughout the text, including the type of study, it was identified that all items used the quantitative methodology, with experimental design, as described below in Table 3.

Of the eight articles chosen for this research paper, three studies were experimental in vitro, two in vivo, two clinical studies and one with literature review focused for anthelmintic activity. Most of these studies chose sample selection by selecting subjects according to the needs of the study or criteria for inclusion / exclusion pre-established. However, none justified the sample size.
Table 3. Summary of articles included in the integrative review. Maceió/AL, 2012.

<table>
<thead>
<tr>
<th>Nº of Article/Objective</th>
<th>Type of Study</th>
<th>Result</th>
<th>Therapeutic Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. investigate the anti-ulcers/healing wound effect of peptic ulcer in laboratory rats. 17</td>
<td>In vitro experimental research</td>
<td>The lesions were induced by acetic acid. The group treated with the extract of banana had a significant improvement compared to the other.</td>
<td>Healing wound protector of the gastric mucosa</td>
</tr>
<tr>
<td>2. Compare the coverage of fresh banana leaf with Vaseline gauze in donor areas of skin grafts in burn. 18</td>
<td>Clinical Research</td>
<td>Performed skin grafts in 30 patients. The donor area was divided into 2 parts. One was covered with banana leaves and the other with Vaseline gauze. Treatment with the banana is less painful and healing occurs in a shorter time.</td>
<td>Healing wound at the donor area of skin graft</td>
</tr>
<tr>
<td>3. Compare the coverage of banana leaf with fresh bandage potato skins cooked in burned patients. 19</td>
<td>Clinical Research</td>
<td>Cover with banana leaves and one with skin potatoes were used in burn patients. Both covers have the same healing time, but the banana is cheaper.</td>
<td>Burn Healing</td>
</tr>
<tr>
<td>4. Collect information on the use of Musa spp. in the control of parasites in domestic animals. 20</td>
<td>Review Article</td>
<td>Studies on the chemical and chromatographic composition of banana should be implemented to isolate the components that have this activity.</td>
<td>Antihelmintic</td>
</tr>
<tr>
<td>5. To evaluate the aqueous extract of banana against gastrointestinal nematodes of sheep. 21</td>
<td>In vitro experimental research</td>
<td>Aqueous extract of the leaves, stalk and flower stem of the banana tree show properties against larvae of Haemonchus spp. Samples of barks of the green banana had higher antioxidant activity than the ripe. Fractions in water and ethyl acetate deriving the samples have larger quantities of phenolic compounds.</td>
<td>Antihelmintic</td>
</tr>
<tr>
<td>6. To evaluate the antioxidant activity of bark of banana against hemolysis of human erythrocytes in different stages of maturation. 22</td>
<td>In vitro experimental research</td>
<td>Phytochemical screening identified tannins in aqueous extract from the bark of green bananas. A 10% gel was produced from the extract. Rats with incisional lesions were divided into 3 groups. The group that received the gel extract showed the best results.</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>7. To evaluate the antimicrobial and healing action of the extract of Musa sapientum, in the form of topical preparations. 14</td>
<td>In vitro experimental research</td>
<td>Phenols were the chemical compounds present in the bark of this plant. Tests of DPPH and total phenols and proved the potential of free radical scavenging activity.</td>
<td>Antimicrobial and wound healing</td>
</tr>
</tbody>
</table>

Source: Databases

The articles of clinical studies and experiments in vivo followed the rules established by the Ethics Committee of its institutions, even some studies not leaving this information sufficiently clear. With regard to the themes of the articles, there is a predominant of the theme Musa and healing in four of the articles (50%), two clinical studies and two experimental in vivo.

The in vivo study that investigated the action of banana of different species of this plant existing in Thailand was conducted in rats, divided into groups untreated and treated with administration of aqueous extract orally, in two stages. In the first step, gastric ulcers were induced by acetic acid to verify the wound healing activity of banana. At the end of the experiment the animals were sacrificed and the stomachs were submitted for histologic studies.

The results showed that the rats treated with this plant presented, at histological analysis, signs of healing with a significant difference compared to the untreated group. In the second stage, the animals were divided into untreated and treated groups. The group treated initiated use of the extract orally three days before administration of indomethacin, which has side effect of causing gastritis. The histopathology analysis of stomachs of these animals confirmed the protective action of the extract on the gastric mucosa of treated rats. 17

The other study performed the phytochemical march of the aqueous extract from the bark of green banana identifying the
prevalence of tannins. After this identification was produced a gel containing 10% of extract, which showed antimicrobial activity and wound healing. Rats with incisional lesions on the cervical region were distributed in the treated group, untreated and placebo. The treated group, which received the gel from extract of banana, showed the healing of lesion in less time than the other.12

Of the three articles with in vitro experimental method, one investigated the anthelmintic activity of three parts of the banana tree (leaves, pseudostem and tassel flower). The feces from two sheep infected with ‘Haemonchus spp.’ were collected directly from the rectum and taken to the parasitology laboratory for performing the experiment. The extracts of selected parts were obtained from these portions separately dipping in distilled water at 60 ° C for 60 minutes and then brought to a drying oven at 40 ° C, until to get constant weight.

After this stage, it was obtained the crude extract that was tested in triplicate at concentrations of 25, 75 and 150 mg / mL. The results showed that the three extracts in concentrations equal to or greater than 75 mg / mL significantly reduced the larval development of nematodes, effectively up 96.9%. 21

The article that addressed the antioxidant activity of bark of the banana aimed to explore its potential against free radicals and to determine the changes in antioxidant systems in different stages of maturation of barks of bananas from the species Musa paradisiaca analyzed after in vitro incubation of extracts with fresh human erythrocytes. The results of this study show that different extracts of barks of bananas at different stages of maturation have antioxidant potential, especially on the presence of phenolic compounds. Moreover, comparing the steps of maturation, the bark of green banana has greater antioxidant activity. One of the determined components antioxidants was the gallicatechin, because it had shown its maximum extraction in a nonpolar solvent. This work suggests that bark of the banana is a potential product for the preparation of nutraceuticals due to their antioxidant potency. 22

Another in vitro study investigated and compared the phytochemical content with the antioxidant activity of ethanol extracts of bark of nine varieties of bananas from species Musa sapientum. For this purpose, qualitative assays were performed in vitro of capturing activities of free radical, removal assay like DPPH and inhibition assay of lipid peroxidation. As well as quantitative assays for the identification of total phenols, in particular the flavonoids. The results suggest that extracts of barks of banana from these varieties may be useful in combating diseases triggered by the presence of free radicals in the body.23

The results of review confirm the recommendations to the use of banana tree with anthelmintic activity derived from the popular knowledge, reported in technical publications and articles of scientific evidence. The best possibilities point to the use of the aqueous extract for a period of three to five days. The quantities to be offered according to the category and species of animals, still depend on more in-depth studies. Alongside the evaluations with animal, fractionation studies are necessary in order to identify and isolate the active components of this plant. 20

DISCUSSION

Information about the use of flora for the treatment of diseases, originated from the folk tradition, when combined with the laboratory research for identification, confirmation and isolation of active substances responsible for the therapeutic action is the object of study of ethnopharmacology.24The use of plants to treat diseases is still a traditional practice among the peoples of the world, especially in underdeveloped or countries in developing, such as India, Thailand and Brazil. 25

In Brazil, the Ministry of Health created the Política Nacional de Práticas Integrativas e Complementares (PNPIC) in 2006, linked to the National Health System, among which stand out those in the ambit of Traditional Chinese Medicine (Acupuncture), Homeopathy, Herbal Medicine, Anthroposophical Medicine and Thermalism-Crenotherapy, aiming to increase the access of all citizens to unconventional therapies. 26

The quantitative research considers that everything can be measured, which means translate into numbers the opinions and information to classify and analyze them. This requires the use of resources and statistical techniques and the results need to be replicated. Moreover, the experimental research occurs when it determines an object of study, select the variables that would be able to influence it, defining the forms of control and observation of the effects that variable produces the object. 27-8
The Indian folk medicine has knowledge about the treatment of diseases that affect the integumentary system, with emphasis on healing of wounds and burns. The data obtained from articles 2 and 3 prove the ability of Indians. The treatment of burns using the banana tree, a plant species present in much of the planet and easy access corroborates with other herbal treatment for wound healing, among them, those caused by burns that are adopted in traditional medicine India.²⁹

The research on the treatment of gastric ulcers and protective oil to gastric mucosal present in this Article 1, deployed from the ethnobotanical reports for the treatment of ulcers, has also been developed with other plant species such as *Piper betel*, *Emblica officinalis*, *Terminalia bellirica* and *Terminalia chebula*, obtaining similar results.³⁰

The in vitro anthelmintic activity, as described in Article 5 with the *Haemonchus spp.*, resembles the one developed with extracts of stem and roots from *Picrolemma sprucei* (Simaroubaceae) using a dose of 130 mg / mL, which had a mortality 85% to 90%. This fact indicates that *Musa* has a greater potential as an anthelmintic than the *Picrolemma*.³¹

In the articles 6 and 8, it was observed a strong antioxidant activity of *Musa* due to the presence of phenolic compounds in this plant species. Phenolic compounds of plants belong to different categories; among them are most commonly found flavonoids, coumarins and hydrolyzable and condensed tannins. These compounds have received much attention in recent years, to inhibit lipid peroxidation and in vitro lipoxygenase. The antioxidant activity of phenolic compounds is primarily due to its reducing properties and chemical structure, which play an important role in scavenging free radicals and chelation of transition metals, acting both as the initiation step in the propagation of oxidation process and, therefore, an essential element in the prevention of chronic diseases and in wound healing.³²

The review on the activity of *Musa* with potential anthelmintic, in the Article 4 this potential was identified, however argues that experimental studies should continue to give subsidies its use in a safely way. The resistance to anthelmintics commercially available has led the consumer market to seek new sources of treatment instead of chemicals products. However, these natural products must meet the criteria of efficacy, safety and quality control aimed at ensuring the administration to living organisms without risk to their health.³³

For the health care enjoys all the benefits that technology through basic research can offer, it is essential to link the knowledge from research to clinical practice. Thus, the findings that contribute to the technology enable the use of what nature has to offer.

**CONCLUSION**

The performance of this study enabled the collection and analysis of publications in the world context, identifying that most research is evaluating the healing potential of this vegetable species (*Musa spp.*), Were also found articles that described the antimicrobial activity, wound healing, antioxidant and anthelmint of this species in agenda.

We identified two publications in Latin America, represented by Brazil, revealing the lack of studies in Latin countries. This demonstrates that research on this topic is not yet consolidated, especially with regard to the use of banana tree in health care, showing the gap in global production on this theme, proving the need for further research with this approach addressed.

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