Application of chitosan and buriti oil (*Mauritia flexuosa* L.) in skin wound healing

**Abstract**

Wound is the breakdown of the structure and normal functions of the integument and its healing process. The wound healing process is common to all tissues and is characterized by three stages: inflammation, proliferation (fibroblast phase) and remodelling. Many substances are used to improve and accelerate this process. A polymer that comes to the attention of researchers is chitosan, which is obtained by the deacetylation of chitin. Another substance that shows good results in the healing process is buriti oil, extracted mainly from the fruit bulb of *Mauritia flexuosa* L.

The main objective of this study is to demonstrate through bibliographical research the effects of chitosan and buriti oil on healing, as well as describing the process of obtaining chitosan and buriti oil and characterizing chitosan and buriti oil. This is an exploratory study where the bibliographical review was used as technical procedure. For the elaboration of the study, we used scientific materials already published, consisting mainly of theses, dissertations, books, articles of scientific journals and annals of scientific congresses, observing the temporal limits between 2000 and 2016. A potential use of chitosan and oil of buriti in the healing of cutaneous wounds since they presented good results in all the phases of tissue repair. Chitosan has been characterized as being biodegradable, biocompatible with free amine groups thus becoming well reactive, the oil has an orange-coloured liquid, rich in carotenoids (β-carotene), α-tocopherol (vitamin E) And fatty acids. It is expected that this study can serve as a reference for studies on these substances, as well as that they can be used together in order to potentiate their effects on the healing process.

**Keywords:** cicatrisation, chitosan, buriti oil, nano chitosan, vitamin E

**Introduction**

Wound is the breakdown of the structure and normal functions of the integument and its healing process. It refers to a cascade of events that begins with the trauma and ends with the complete and organized closure of the wound with the scar tissue.1-3 The skin is one of the organs most susceptible to injury and needs regeneration to restore its structure and functions, such as protective physical barrier against various environmental stimuli and infections and against excessive water loss.3,4 According to Broughton et al.,5 after the skin damage, the wound process is common to all wounds, regardless of the causative agent, being systemic and dynamic and directly related to the general conditions of the organism.5,6 Wound healing is classically divided into three stages:

1. Inflammation
2. Formation of granulation tissue with extracellular matrix deposition (fibroblastic proliferation) and
3. Remodelling (including reepithelialisation), (Figure 1).

In the inflammatory phase the recruitment of leukocytes to the lesion site is observed. In the proliferative phase, a cellular proliferation is observed, mainly of fibroblasts, macrophages and of blood vessels, besides the proliferation and migration of keratinocytes, endothelial cells and reepithelialisations, formed granulation tissue with a great amount of type III collagen. In addition, the collagen fibres have a high affinity for collagen fibres and the collagen content is degraded by proteolytic enzymes that promote tissue remodelling.7,8,9,10,11 There are many substances in the pharmaceutical market that aims to improve and accelerate the process of cutaneous healing, in addition to many substances extracted from plants that are popularly used to bring benefits to this process. A polymer that comes to the attention of researchers is chitosan, which is obtained by the deacetylation of chitin. Due to its characteristic of presenting free amino groups, chitosan has the capacity to react with several molecules, making the biopolymer with greater availability of pendant groups and it can be used in powder forms, beads or films.11,12 According to Ravi Kumar13 among the applications of chitosan based biomaterials, it is observed the use as bioadhesive, banding material, material for skin grafting, material for suture and contact lenses, healing agent. As a healing agent, chitosan can inhibit fibroplasia in wound healing and to promote tissue growth and differentiation in tissue culture. Many plants have been and are used as medicinal plants, ranging from simpler local treatments until later in the manufacture of medicines. Many drugs obtained from medicinal plants are used as anti-inflammatory and would healing.12,13,14

*Mauritia flexuosa* L. (buriti), a characteristic plant of the Brazilian cerrado, due to its oleaginous character, has aroused the interest of researchers and industries. Buriti oil, extracted from this plant, has been cited in several studies due to its cicatrizing, antibacterial and antioxidant effects, among others. Many are the popular uses of buriti oil, it is used as a sunscreen due to being able to absorb radiations in the ultraviolet spectrum, reports that due to its high content of β-carotene, may present antioxidant effect and other bioactive effects that have not yet been investigated, the popular use of buriti oil in topical applications in case of skin burn, provoking immediate relief and aiding in the healing process.15-20 One of the oldest concerns of

**References**

medicine is the treatment of wounds. Annually millions of dollars are spent for this purpose all over the world. The present work is justified by the interest in demonstrating studies on the effects of chitosan and its derivatives, in addition to buriti oil on wound healing, to support other studies related to these substances in wound healing. It is initially intended to demonstrate the effects of both chitosan and its derivatives and of buriti oil on cutaneous healing.

![Figure 1 Stages of healing correlated with immune-cellular specificity.](image)

**Discussion**

**Chitosan and its derivatives: physical, chemical and biological characteristics**

Chitosan represents a group of partially deacetylated polymers and not a specific chemical entity. The application of chitosan and its characteristics are determined and influenced by its molar mass and the degree of deacetylation. Commercial chitosan's generally having a degree of deacetylation varying from 70 to 95%, with molar mass in the range of 104-106g/mol. The properties of chitosan are affected by the processing conditions of the material which controls the amount of deacetylation, which is the key process for determining its physical, chemical and biological characteristics. Deacetylation is determined by the amount of free amino groups in the polymer chain and this gives a positive charge to chitosan. The functionality of chitosan is thus directly linked to free amino groups and to hydroxyl. The positive charge allows many electrostatic interactions of chitosan with negatively charged molecules. Chitosan can be characterized by taking into account physical, chemical and biological properties and the physical properties studied are particle size, solubility, density, viscosity and description of their presentations. The chemical characteristics are molecular weight distribution, degree of deacetylation, crystallinity index, pH, water retention value, heavy metal levels and proteins. Biologicals are pyrogenicity, cytotoxicity and biocompatibility.

In the chitosan molecule, three types of reactive functional groups are found: one amino group and two hydroxyl groups, one primary and one secondary. The amino group is easily protonated, improving its solubility. The secondary hydroxyl group may also be substituted for the purpose of increasing the solubility of the polymer. The primary hydroxyl can be substituted by chains, forming branched polymers, or even graphitized copolymers. The formation of cross linking or cross linking in chitosan can modify its mechanical properties. This modification is attempted in some scientific works with the aim of improving the mechanical properties of chitosan. Cross-linking or cross-linking can improve the physical properties of polymers. The mixture of chitosan and poly (polyethylene oxide) (C₂H₂O)ₙ, for example, may also improve mechanical properties. In Brazil, chitosan is marketed as powdered and encapsulated as a source of soluble natural fibre indicated as an aid in weight loss and cholesterol reduction. Despite the use in several areas and the diverse applications of chitosan and its derivatives, there is a limiting factor that is the insolubility of the same in neutral or superior pH. Chitosan is insoluble in water, neutral and alkaline solutions and soluble in acid solutions. In pH lower than 5.5 the amino groups are protonated and the molecule becomes soluble. The solubility of chitosan is related to the amount of protonated amino groups (-NH₄⁺) in the polymer chain. The higher the number of these groups, the greater the electrostatic repulsion between the chains and the higher the solvation in water.

In acidic media the chitosan when solubilized gives rise to viscous solutions, which is related to the amount of amine groups that are protonated, thus, the greater the quantity of these protonated groups, the greater the electrostatic repulsion between the chains and, consequently, the greater the Solvation of the polymer in water, facilitating dissolution. For a given concentration of acid, the degree of protonation depends on the PK of the acid used to solubilize the chitosan. For a protonation degree of approximately 0.5 the chitosan shows solubility in acetic acid or hydrochloric acid solution. The amino groups are protonated in acidic medium and the chitosan becomes soluble in aqueous solutions. However, chitosan precipitates in the aqueous solution when after its dissolution under acidic conditions, the pH of the solution is increased, reaching values around 6, 5 there is a Reduction of the positive charges of amino groups. The solubility of chitosan in water has significant effects with the removal of the majority of the acetylated groups from the chitin structure, which reduces the hydrogen bonds in part because the acetylated groups are rich in these bonds. In addition, it gives the amino groups, which promote positive charges on the macromolecule in an acid medium. Thus, the production of hydrogen bonds between the chains combined with the protonated amino groups increases the solubility of chitosan in aqueous solutions. The solubility of chitosan can be associated to several factors: amount of N-acetyl groups (NCOCH₃) and amine groups (NH₂), distribution of these groups in the extension of the polymer chain, pH and ionic strength of the solution.

When dissolved in media whose pH is lower, the amine group present in the chitosan has a pKa of about 6.2 to 7.0 which makes it a polyelectrolyte. Among the few existing natural cationic poly electrolytes are chitin and chitosan. The other natural polysaccharides are either neutral or negatively charged. Chitosan has amino groups that react with some ease, which allows the production of many derivative compounds. The ability of chitosan to undergo structural changes occurs due to the large amount of reactive groups such as hydroxyl and especially amino groups. Due to its properties, chitosan is currently attracting much interest in medical and pharmaceutical applications because of its biocompatibility that allows its use in various medical applications. In biological terms chitosan is recognized as safe and non-toxic by most authors. The toxicity is evidenced only when used for a long period as a food supplement, where it is related as a blockade of the absorption of calcium and fat-soluble vitamins. Studies relate the biological activity of chitosan with its physicalchemical properties (water solubility and the size of the chains) and the characteristics of the microorganism membrane. In
Application of chitosan and buriti oil (Mauritia flexuosa L.) in skin wound healing

Recent studies have shown that chitosan can be used as a biomaterial in various applications due to its biocompatibility, biodegradability, and bioadhesiveness. Chitosan is a natural polysaccharide derived from crab or shrimp shells and is composed of glucosamine and N-acetylglucosamine units. It has a positive charge due to the protonation of the amino groups, which makes it an excellent material for wound healing due to its properties as a permeable matrix, growth factor carrier, and wound dressing. Chitosan is also a multifunctional material with potential applications in various fields such as tissue engineering, drug delivery systems, and wound dressings.

Chitosan has been extensively studied for its potential in wound healing due to its ability to promote tissue repair and regeneration. It has been shown to stimulate the healing process by increasing the production of extracellular matrix proteins, collagen, and fibronectin. Chitosan is also capable of enhancing the migration and proliferation of fibroblasts and keratinocytes, which are crucial for the regeneration of skin tissue.

Chitosan has been tested in various wound healing models, such as full-thickness skin wounds, diabetic wound Healing, and acute and chronic wounds. It has been shown to significantly reduce wound size, accelerate wound closure, and improve healing outcomes. Chitosan has also been formulated into various wound dressings, such as hydrogels, films, and sponges, to enhance its wound-healing properties. These dressings have been shown to be effective in promoting the growth of new tissue, reducing pain and discomfort, and improving the overall quality of life for patients with wounds.

Chitosan has also been combined with other materials, such as silver, to enhance its wound-healing properties. Silver has been shown to have bactericidal and fungicidal effects, which make it an ideal additive for wound dressings. The combination of chitosan and silver has been shown to improve the healing process and reduce the incidence of infections in wounds.

Chitosan has also been tested in combination with other wound-healing agents, such as platelet-rich plasma (PRP) and mesenchymal stem cells (MSCs). PRP contains growth factors and cytokines that promote tissue repair, while MSCs are known for their ability to differentiate into various cell types. The combination of chitosan with PRP or MSCs has been shown to further enhance the healing process and improve wound outcomes.

Chitosan has also been tested in combination with other natural polymers, such as collagen and hyaluronic acid, to further enhance its wound-healing properties. These natural polymers have been shown to improve tissue repair and regeneration by providing a scaffold for the growth of new tissue and promoting the migration of cells.

In conclusion, chitosan is a promising material for wound healing due to its multifunctional properties and potential applications in wound dressings and wound-healing agents. Further research is needed to fully understand the mechanisms of action of chitosan and its potential in combination with other wound-healing agents. However, the results of recent studies suggest that chitosan has the potential to improve wound healing and reduce the incidence of infections and complications associated with wounds.
wounds. Membrane wound dressing is an alternative to the use of topical preparations for treating them, seeking to replace lost skin function, protect the wound from loss of fluids and proteins, prevent bacterial invasion and reduce mechanical stress. Improving and stimulating healing. Chitosan in its different forms has been studied as a low cost option for wound dressing. In addition to covering and protecting the wound from external agents, chitosan can also be used as a support for controlled drug release.\textsuperscript{43,44} Chitosan is degraded by the enzyme lysozyme, which is present in tissues, organs and body fluids of mammals, including lacrimal fluid with contents above 1\%. Some biological properties such as antimicrobial and healing activities have been attributed to fragments (oligosaccharides) resulting from the enzymatic degradation of chitosan. The products of the enzymatic degradation of chitosan are oligomers of N-acetyl-D-glucosamine, which, besides having healing properties, antimicrobial, are totally absorbable by the organism.\textsuperscript{33,45}

Chitosan allows rapid blood clotting and has gained US approval for use in bandages and other haemostatic agents. The product reduces blood loss compared to gauze and increases patient survival. These products were sold to the United States Army which has already made use of the bandages. Chitosan is hypoallergenic and has natural antibacterial properties. Among the applications, it has also been used in haemodialysis membranes.\textsuperscript{35,46} Many authors have already proposed and studied the application of chitosan in wound healing. Chitosan membranes are not cytotoxic when tested with fibroblasts, the human wounds treated with chitosan membranes heal faster, the chitosan oligosaccharides from their enzymatic degradation have a stimulating effect on macrophages and attract neutrophils to the lesion site. The action of chitosan-based dressings on acute and chronic skin wounds, verified in studies, demonstrates its performance in all stages of the healing. Porous membranes of chitosan provide excellent permeability to oxygen, control water loss through evaporation and promote drainage of exudate from the wounds.\textsuperscript{44-47} The chitosan membrane, in the form that was elaborated and in the experimental conditions of its study, intensified the formation of the granulation tissue, highlighting potential reparative effect. There was no interference in the healing time of the cutaneous wounds of horses, allowing the conduction of new studies to verify their effects in the different stages of cicatrisation or as biomaterial, associated to drugs for controlled release, growth factors and cell therapy. In veterinary medicine, chitosan has found good results in improving the function of polymorphonuclear leucocytes and macrophages, promoting the granulation and organization of open wounds and is therefore important in healing them. This effect is related to the activation of growth factors.\textsuperscript{45,47,48}

Chitosan is able to promote adequate formation of granulation tissue, due to the correct deposition of collagen fibres, leading to correct repair of lesions on the skin. The main biochemical effects of chitin and chitosan the activation of fibroblasts, production of cytokines, accelerates the migration of macrophages and stimulation of type IV collagen synthesis. In the studies of Muzzarelli et al.,\textsuperscript{33} a large number of patients with traumatic wounds were treated with chitosan and glycolato dressings and satisfactory results were observed in all cases. So many studies emphasize the combination of chitosan with other materials to improve its effect on healing. Another studies, combined chitosan with other substances and observed acceleration of wound closure and thus, faster healing.\textsuperscript{32,37,44,45,47,49} The higher the degree of deacetylation, the greater the efficiency of chitosan in the moduation of human fibroblasts mitogenesis and the greater the cell adhesion and proliferation, both for keratinocytes and fibroblasts, a fact observed in the study by Ueno et al.\textsuperscript{15} and Chatellet et al.\textsuperscript{50} This increased cell adhesion and proliferation was associated with the fact that, even at neutral pH, there are still cationic sites in chitosan chains, allowing electrostatic interaction with negative charges on the surface of the cell membranes. The antimicrobial activity is believed to be due to the interaction of the amino-positive groups of the glucosamine units with the negative components of the cell walls of the bacteria, suppressing the biosynthesis. It is also observed that chitosan interrupts the transport of nutrients through the cell wall and causes the leakage of cellular organelles, accelerating the death of the bacteria. Another mechanism studied is the penetration of chitosan of low molar mass in the cell, which binds to DNA, inhibiting transcription and translation.\textsuperscript{46,50,51}

The bactericidal properties of chitosan with chondroitin sulphate, noting that the increase in the proportion of chondroitin sulphate caused an increase in the number of bacteria, so that the bactericidal effect would be caused only by chitosan. Several authors have investigated the antimicrobial activity of chitosan and the microorganisms mentioned are: Candida albicans, Enterobacter cloacae, Enterococcus faecalis, Escherichia coli, Klebsiella pneumoniae, Streptococcus pyogenes, among others. The antimicrobial activity of chitosan and its derivatives against different groups of microorganisms such as bacteria, yeasts and fungi has received considerable attention. Many studies have shown that the surface charge of chitosan changes considerably as a function of the pH of the solution in which it is immersed, generating a positive charge that attacks the cell wall of the microorganisms. When the amino groups of chitosan come into contact with the physiological fluids, they are probably protonated and bind to anionic groups of the microorganisms, resulting in agglutination of the microbial cells and inhibition of growth.\textsuperscript{52,53}

Bactericidal, bacteriostatic and fungicidal activities play a role in the healing process, as it has been proven that bandages and dressings can lead to cytotoxicity, delaying the tissue repair process. As chitosan has antibacterial effects, there is no need to use other substances during wound. Some studies demonstrate the potent topical analgesic action of both chitin and chitosan. The main analgesic effect of chitosan occurs due to the capture of acid hydrons released at the site of inflammation by ionization of the amino group to NH\textsuperscript{+}. The use of chitosan-based products for the regeneration of tissues such as artificial fur,\textsuperscript{16} hydrogels,\textsuperscript{17} films;\textsuperscript{2} sponges\textsuperscript{18} and dressings\textsuperscript{59} due to their ability to assist in the fight against infections.\textsuperscript{49,50,51}

**Buriti (Mauritia flexuosa L.) general characteristics of the tree and the fruit**

The Mauritia flexuosa L., popularly known as miriti, moriti, caranda-guassúi, palm-do-brejo, buriti-do-brejo, buriti, belonging to the family Arecaceae is a plant of Amazonian origin diffused in the cerrado and has a wide distribution between Peru, Colombia and Brazil, in the states of Amazonas, Bahia, Goiás, Pará, Piauí, Minas Gerais, Ceará, Tocantins, Maranhão and São Paulo. The buriti is a smooth-stemmed palm tree measuring 23-50cm in diameter and 2.8-35m high, its leaf can be up to 5.83m long and with 120 to 236 segments, the fruit is orange-coloured covered with scales Corneas reddish brown.\textsuperscript{56} The studies show that the word buriti came from the tupi-guarani (Indian language), dembyrit palm tree that emits liquid and after modifications and regional changes of this word came the term buriti, which is very common in almost all the Brazilian territory.
Application of chitosan and buriti oil (Mauritia flexuosa L.) in skin wound healing


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The “Tree of Life” as it is known Mauritia flexuosa L. (Buriti), due to its diversity of uses, is one of the plants symbolic of the Brazilian cerrado. In addition to providing raw material for medicines, food, handicrafts and shelter, buriti plays an important role in the maintenance of springs and watercourses in the Cerrado, thus being fundamental to the ecosystem and to the populations living in it. Pulp extracted from buriti fruit is a product widely marketed and consumed by rural and urban populations in much of the country. The exotic flavour of the buriti is gaining more and more space in ice cream shops in the big cities, pointing to a promising market that will demand more and more organization of the productive communities and also attention of the public managers to the viabilization of the extractive activity. Buritizeiro has a great cultural and economic value for the peoples of the regions where it is developed, since it provides a huge variety of products and uses, supporting or supplementing the income of several families, especially the Brazilian cerrado. It occurs in places where the soil is soaked, even in the dry season, thus being a source of clean water for people and animals. Buriti (Mauritia flexuosa) is a plant typically found in the Amazon rainforest and is considered one of the most abundant palm trees in the country. They occur throughout the Amazon, Central Brazil, Bahia, Ceará, Maranhão, Minas Gerais, Piauí and São Paulo in the low areas of open and closed forests, on poorly drained, swampy or flooded soils. The buriti palm is one of the most important native species with economic potential in Latin America, although it also presents anthropological and ornamental importance to the producing regions.

Mauritia flexuosa and a dioecious palm with flabelliform leaves when adult, are characterized by being tall, with up to 30m and 20-50 cm in diameter, of solitary and smooth stem. In the Cerrado, it flourishes in the months of March to May and presents fruits almost all year. The reddish-brown, oblong-globe fruits, measuring five centimetres by four centimetres, pericarp covered by overlapping scales of about six millimetres, meaty mesocarp, usually containing a seed. The seeds of M. flexuosa can be classified as recalcitrant and the emergence of the seedlings occurs between three and four months after sowing. Seedlings are slow growing and fruit production can take seven to eight years. The buriti growth is slow, this palm has a single trunk and presents difficulties for vegetative reproduction, since it demands a great amount of water for its satisfactory development. In order to be cultivated in crops, this species presents great limitations and sustainable management techniques should be encouraged and improved, as the areas of buriti occurrence are considered Permanent Protection Areas (APP), which is a place where all forests must be maintained and other forms of natural vegetation and should not be modified to other types of occupancy. The buriti (Mauritia flexuosa L.) popularly known as Canada-guaçu, smell of coconut, miriri, palm of the marsh, among others, is a palm tree of the family Arecaceae, native of Brazil, with great socioeconomic potential. Normally, its occurrence is associated to areas that are periodically or permanently flooded or poorly drained, sometimes close to rivers, along forests of galleries and savannah (Central Brazil and Venezuela). The fruit (Figure 2) is enveloped by a pericarp (or bark) composed of reddish brown triangular scales and is elliptical to oval. The mesocarp (pulp or mass) is thin, yellowish or orange, fleshy and oily. The pulp has a pH of about 4.7 and is 20 times richer in vitamin A than carrots, as well as being very rich in oils, especially in pulp and shell, in proteins and in vitamins C and E.

Some physical characteristics of the fruits of the buriti are: fruit weight of 15 to 75g, fruit length of 3 to 7cm, fruit diameter of 2 to 5cm, seed weight of 4 to 24g, Moisture content of the pulp from 50% to 70%, seed moisture content 57%, moisture content of the fruit 69% to 75% and percentage of pulp in the fruit from 10 to 37%. Pianovski, cites buriti as one of the main sources of pro-vitamin A found in Brazilian biodiversity. In the present study, the total weight of the pulp of the buriti was 62.93%, 8.25% of total carbohydrates, 5.17% of these total dietary fibres, 2.10% of the protein with predominance of amino acids Sulphur and tryptophan. The lipid fraction of the pulp corresponds to 13.85%, with oleic acid as the main fatty acid. It is also observed 0.94% of total minerals predominating the elements K, Ca, Na, Mg, Fe, Mn, Zn, Cu, Se, Cr and I. The chemical composition of fruit pulp, respectively, found values for moisture contents of 50.50% and 62.93%; 3.7% and 2.1% proteins; Lipids 19.0% and 13.85%; Ash 0.6% and 0.94%; Carbohydrates 26.2% and 8.25%. This fruit also offers high nutritional value when compared to other fruits. According to Pianovski, buriti pulp has levels of B vitamins (B1, B2 and PP) equivalent to or higher than other fruits such as avocado, banana and guava, reported that the fruit has some minerals in important amounts, such as calcium, iron and selenium.

Buriti oil in wound healing

Buriti oil has many applications in the cosmetics and food industries. In folk medicine it is used against burns, provoking immediate relief and rapid healing. Based on the high concentration of oleic acid and the presence of carotenoids and vitamin E in the form of α-tocopherol, it helps in the process of tissue repair by the binding to the free radicals produced in the wound. In addition, the high concentration of fatty acids is important in the formation of scar collagen fibres, because it promotes cell proliferation and accelerates the tissue granulation process. An important substance found in buriti oil is ascorbic acid, also known as vitamin C, is a water soluble vitamin, synthesized by plants and by almost all animals except humans. Vitamin C is essential for health, as it plays a fundamental role in the development and regeneration of muscles, skin, teeth and bones, in the formation of collagen, in the regulation of body temperature, in the production of various hormones and in metabolism in general. Vitamin C can also act as a synergist in the regeneration of primary antioxidants. In relation to the ascorbic acid and poly-phenol contents in the buriti pulp contains vitamin C contents close to those of orange and lower than those found in cabbage. For the poly-phenols, it was verified that the pulp of buriti contains higher value than the one found in the literature for carrots and cabbage.

Because it contains ascorbic acid, which has the function of hydroxylating collagen, besides being essential to stimulate dermal...
The buriti oil has high concentration of oleic acid and presence of carotenoids and vitamin E in the form of α-tocopherol, which according to several authors helps in the process of tissue repair by the connection to free radicals Produced in the wound. In addition, the great concentration of fatty acids is important in the formation of the collagen fibres of the scar, due to promote cell proliferation and accelerate the process of tissue granulation. Buriti oil has the function of lubricating and regenerating the hydrolipidic barrier of the skin that is frequently subjected to lesions. Together, antioxidant compounds, such as beta-carotenoids and vitamin E, exert a protective effect on the new cells to form in the regenerating lesion. It is observed that high concentrations of unsaturated fatty acids have an important role in tissue regeneration, being an essential element for the formation and deposition of collagen fibres on the scar, besides promoting cell stimulation and proliferation.

**Conclusion**

Taking into account the literature, a potential use of chitosan, nanocoparticles and buriti oil in the regenerative medicine focus in wound healing, showed a very big potential, was observed, since they showed (both biomaterials) good results in all phases of tissue repair. Antimicrobial effect, cell migration and proliferation stimulation, promotion of granulation tissue formation, among others, of chitosan and its derivatives, as well as buriti oil were observed. Chitosan is obtained by a decatyection process of chitin found mainly in the shells of crustaceans and very important characteristics of chitosan and nano chitosan were: biodegradable, biocompatible, free amine groups. Buriti oil is extracted mainly from the fruit of M. flexuosa L. It can be made by the decoction method (fruit pulp, by pressing method (fruit pulp) and becoming well reactive, the oil has an orange-coloured liquid appearance, rich in carotenoids (β-carotene), α-tocopherol (Vitamin E), elements K, Ca, Na, Mg, Fe, Mn, Zn, Cu, Se, Cr and I and fatty acids. It is hoped that this study may serve as a reference for studies on these substances, as well as that they may be used together in order to potentiate their effects on the healing process.

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None.

**Conflict of interest**

The author declares no conflict of interest.

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