WoundHealing activity of two honeys from the Southern regions of Senegal (Casamance)

Abstract :

Aim: The aim of this study was to evaluate the healing activity of two honeys from Casamance (Senegal) in a second-degree experimental burn model in the Wistar strain rat.

Methodology: Experimental burns were induced using a metal cylinder 3 cm in diameter and heated for 5 min. The cylinder was applied for 20 seconds, pressing lightly on the surface of the rats' shaved skin to induce second-degree burns.

Results: The daily application of honey induces a healing dependent on concentration and typology. The healing rate is higher with AF, with a score of 0.60 ± 0.48 vs 1.00 ± 0.00 for MZ which induces almost complete tissue repair after 21 days of treatment.

Conclusion: The results of this study demonstrate the use of traditional honey in wound healing and burns.

Keywords: Honeys, burns, wounds, cicatrization, Casamance

Legends : MZ : Mangrove Ziguinchor et AF : Anacarde Faoune

1. INTRODUCTION

Hippocrates (460-377 BC), the “spiritual father” of medicine, said that the use of honey led to greater old age, and prescribed it to combat fever, wounds, ulcers and purulent wounds [1]. In the Middle Ages, honey was used to make gingerbread, but also to make bandages without first disinfecting wounds [2]. During the First and Second World Wars, honey was used extensively to accelerate the healing of soldiers' wounds [2]. Wound healing is a dynamic physiological process initiated and influenced by many factors. This process can be divided into four phases: hemostasis, inflammation, proliferation (including granulation, contraction and epithelialization) and final remodelling [3]. The duration of each phase will depend on the nature of the wound, its severity and the care provided [4]. Today, many scientists have conducted therapeutic trials of honey in the treatment of wounds in Wistar rats, horses and humans [5, 6, 7, 8and 9]. Chemically, honey is composed of sugar (70-80%), water (10-20%), organic acids, minerals, vitamins, proteins, phenolic compounds and free amino acids. The main monosaccharide components of honey are glucose and fructose. Honey has long been used to treat wounds and other skin conditions [10, 11] and has been known to improve healing time, for example, in superficial and partial-thickness mild to moderate burns, although evidence of efficacy in others is inconclusive at present [12,13]. Honey has been shown to have antimicrobial effects [14,15and 11] which are due to a combination of low water activity, low pH, hydrogen peroxide production etc.[16]. Many of the compounds present in honey are also antioxidants [17, 18and19]. Various dressings and gels

containing honey are now available [7, 12and 13], but the effect of honey on wound healing parameters has not been well studied, especially in Senegal, where according to the bibliography no studies have been carried out to date. With this in mind, we set out to investigate the wound-healing effects of two honeys harvested in Casamance (Senegal) in a model of experimental second-degree burns in Wistar rats.

2. MATERIALS AND METHODS

2.1 Sampling

The honey was obtained from beekeepers owning honey production units on 17 Mars 2024.The honeys are of *Avicennia* (MZ) and *Anacardium* (AF) origin. They were placed in hermetically sealed jars and kept in the refrigerator at the Laboratory of Pharmacognosy and Botany at the Faculty of Medicine, of Pharmacy and of Odontology of the Cheikh Anta DIOP University (UCAD) of Dakar.

2.2 Animals

The weights of the rats varied between 167 and 356 g. The animals were housed in a cage under conditions of 25 ± 2°C temperature, 12 h light cycle and provided with food and water ad libitum.

2.3 Methodology :

Healing activity was assessed in an experimental rat burn model [20]. Twenty rats were divided into 4 batches of 5 as follows: - Batch 1: untreated rats - Batch 2: sulfadiazine (healing drug) -- Batch 3: rats treated with Mangrove Z honey (MZ) and Batch 4: rats treated with Anacarde F honey (AF). Rats were then anaesthetized with 3% chloral solution by intraperitoneal injection (1 mL /100 g). The rats' dorsal flanks were shaved and cleaned. Experimental burns were induced using a 3 cm diameter metal cylinder and heated for 5 min.[37] The cylinder was applied for 20 seconds by pressing a little on the surface of the rats' shaved skin to induce second-degree burns[21].

Healing activity was assessed by a method of determining scores varying according to the extent of the burn (Table 1) [22]. Scores were assessed every four days for 28 days.

2.4 Statistical analysis

Data were expressed as mean ± standard error of the mean (SEM). They were analyzed by GraphPad 10.0 software. A one-way analysis of variance (ANOVA) followed by Dunnett's post hoc test against the control group. P-values<0.05 Table 1: Scores of the evolution of experimental burns.

Table 1. Scores of the evolution of experimental burns

Score	Cicatrization process evaluation
0	Healing is complete and tissue repair is complete
1	Tissue healing is almost complete

2	Remnants of the crust remain the size of the lesion decreases (skin reconstruction)
3	All dead tissues (scabs) are removed, wounds and oozing
4	Necrotic skin is partially removed, ulcerated and oozing
5	Necrotic skin completely covers the burned area

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1. Evolution of experimental second-degree burn scores in untreated rats

Seven days after induction of the experimental burn, the burned area was still covered with necrotic skin, corresponding to a score of 5. After 3 weeks, in the absence of treatment, the burned skin showed ulceration that was still oozing (score 4). After 4 weeks, the experimental burn consists of an open, oozing wound (score 2.75), corresponding to a total absence of healing.

3.1.2. Evolution of experimental second-degree burn scores in rats after daily application of sulfadiazine.

The experimental burn score in the sulfadiazine group after 2 weeks of treatment was not significantly different from that in the untreated group or after the application of Vaseline. After 3 weeks, the burn score was 3.5, corresponding to an oozing wound. Tissue repair, although significant, was incomplete after 4 weeks, confirming that this was indeed a second-degree burn.

3.1.3. Evolution of scores in a burn treated with MZ and AF honey.

Daily application of the honey showed a score equal to 2.75 after 14 days for MZ honey and a score equal to 1.6 after 14 days for AF. These scores were significantly different from those of the untreated group. The speed of healing is greater with AF honey, which induces almost complete tissue repair after 21 days (score 0.6) (Fig. 1).

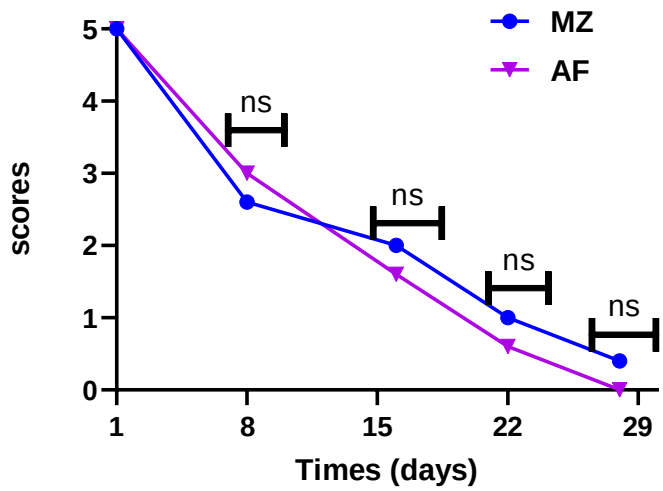
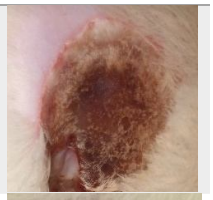
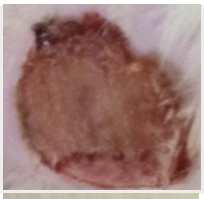
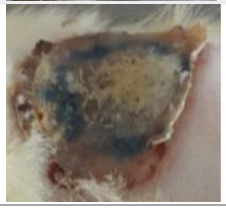
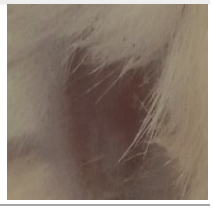


Fig. 1. Evolution of deep second-degree experimental burn scores in rats AF and MZ application. ns: no significant

Time in days	Without treatment	Sulfadiazine	MZ	AF
J4				
J8				
J12				
J16				

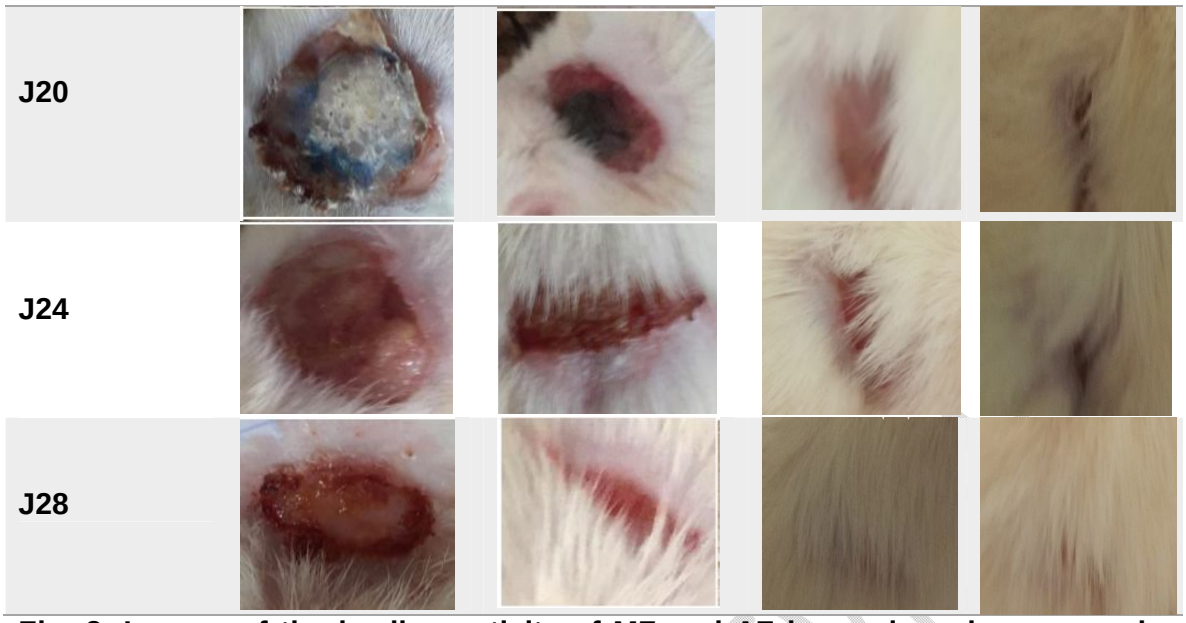


Fig. 2. Images of the healing activity of MZ and AF honey in a deep second-degree burn.

3.2 DISCUSSION

The aim of the present study was to demonstrate the healing activity of honey in a model of experimental second-degree burns in Wistar rats.

Sulfadiazine applied daily to the burn for 4 weeks, was not associated with complete healing. Sulfadiazine is most often used as a reference product in clinical trials of first-degree burns [23]. The lack of healing after four weeks of sulfadiazine treatment in this study suggests that the experimental burn caused at least a deep second-degree burn. Our results are similar to several other studies of honey in a second-degree burn model, and the rate of healing is almost complete beyond three weeks [5,24].

Honeys induce concentration-dependent wound healing in the Wistar rat model of experimental deep second-degree burns. Indeed, healing is faster with AF than MZ honey.

Four studies [25, 26, 27 and 28] have demonstrated the benefits of honey for ulcer healing. Results demonstrated shorter average healing times, higher total healing rates and more effective elimination of wound infection. According to [25], honey therapy has been shown to be cost-effective.

In a study by [29], wound odour and pain were reduced,but the difference in healing time was not statistically significant.

We have found that honey can be beneficial for wounds. It is a curative treatment used locally in various healing models. According to [30], honey's acidic pH and excessive tonicity are the main elements that promote burn healing. According to our experiments, honey can also promote wound healing when administered to rats. The

glycolytic enzyme activity in honey accelerates wound healing by providing sufficient energy for cell repair. Collagen formation, wound contraction and epithelialization remain crucial phases in wound healing. In this way, intervention in any of these stages can lead to stimulation or reduction of the collagen production phase of healing [31]. According to [32] complete healing is due to the presence of flavonoids and tannins in plants. In addition to the mechanisms involved in wound healing, there are also antioxidant, anti-inflammatory and antimicrobial properties present in plants [33]. These properties are also confirmed in different types of honey ([34] and [35]).

During our manipulations, we noted an absence of stench and tingling phenomena leading to scratching of the wounds. This finding has been observed by other authors in surgical wound treatments using honey [36].

4. CONCLUSION

The aim of this study was to evaluate the healing activity of Senegalese honey in a model of experimental second-degree burns in Wistar rats. AF honey achieved almost complete tissue repair after 22 days. This healing effect may be linked to the presence of hydrogen peroxide methylglyoxal. The results obtained highlight the therapeutic potential of these honeys in the treatment of second-degree burns, which would justify their use in traditional settings for the treatment of wounds and burns. Future studies should focus on the use of honeys in the healing process of surgical wounds.

Ethical Approval

The experimental protocols were conducted in accordance with the guidelines of the Institutional Ethics Committee (Research Ethics Committee of CADU).

Disclaimer (Artificial intelligence)

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Details of the AI usage are given below:

1.

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3.

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