INTRODUCTION

Burns are defined by the World Health Organization (WHO) as tissue injuries to the skin caused by heat, radiation, electric shock, radioactive materials and contact with hazardous chemicals. Skin damage caused by ultraviolet (UV) rays and disturbances in the respiratory system caused by inhaling too much smoke can also be categorized as burns. Burns are one of the most dangerous injuries and the leading cause of limb disability and death. According to the World Health Organization (WHO), burns can be interpreted globally as one of the serious problems. Fire cases that have been recorded in the world occur around 265,000 deaths each year. The number of deaths due to burns is something that needs to be considered in every country. Millions of burn victims who survived the disabilities in their bodies were rejected from their neighborhoods\(^1\).

Topical antibiotics that can treat wounds in humans and animals are very important to find\(^2\), but to prevent antibiotic resistance, alternative medicine can be used to heal burns\(^3\). A long history explains that honey is an ingredient that can treat wounds. Since ancient times, honey has been used for its nutritional and therapeutic effects. Honey can be used as a sweetener and flavor in a dish. Honey is very easy to find almost all over the world. Carbohydrates are the most important nutrients in honey because they are present in the form of glucose, fructose and monosaccharides. Honey contains nutrients that can act as anti-inflammatory, antioxidant and anti-bacterial agents so it is good for the healing process of wounds on the skin. In scientific literature, the function of honey has been to prevent coughing, increase fertility and wound healing because it has
antioxidant and antibacterial properties. Healing burns using honey still has to go through a further research process, therefore, the authors want to know the effect of honey on the wound healing process in burn patients. With the incident in antibiotics, the use of honey can be needed again to handle medical treatment. Seeing the many benefits of honey, therapy using honey needs to be developed, therefore the authors intend to examine the effect of honey on the healing process of burns.

**METHODS**

The research design used is descriptive research. This research will explain the effect of using honey topically for the treatment and healing process of burns. The method used is literature study. The population in this study were articles about burns, wound healing processes and honey. The journals used as references come from research with backgrounds in the health sector, especially skin medicine, nutrition, pharmacology, biology and beauty. The research sample is articles that have been published by national and international journals from 2015 to 2020 at least 10 articles that explain the process of healing burns using honey.

This research was conducted in Surabaya from April to Oktober 2020. This research get approval from the Ethics Commission for Health Research, Faculty of Medicine, Hang Tuah University.

**RESULT**

Samples in this study were taken from 10 international journals with the qualifications of 9 SCIMAGO indexed journals and 1 SINTA indexed journal about the role of honey in the healing process of burns.

**Healing time**

Jeffery et al., Stated that the average healing time using honey was 18.16 days. Moustafa and Atiba's research showed that the burns treated with honey on day 24 were more closed. According to Ait Abderrahim et al., The wound healing time using honey is about 25-27 days. Hendy and Lister argue that treatment using honey takes 7 days. According to Duncan et al., ALH can provide a healing time of 3 to 14 days, whereas according to Subrahmanyam all wounds treated with honey heal within 10 days.

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**Figure 1** The green line shows the burn healing time using pure honey.

**Wound Results**

Duncan et al., Reviewed facial burns, Figure 1 is a photo of 2 patients who were successfully treated with ALH honey. This process takes about 3 to 14 days.

Jeffery et al. Observed 3 cases of burns treated with revamil honey gauze and revamil gel. The three wounds took 14-26 days to heal completely as shown in figure 2.

Smaropoulos and Cremers also observed 2 cases of burns that produced good scars within 7-18 days.

Ait Abderrahim et al., Conducted an experiment and the burns improved within 26 days. In addition, Moustafa and Atiba's research and Hendy and Lister's research obtained satisfactory results in the honey.
group, this can be seen from the smaller burns diameter 7,9.

Histologically, honey has also been shown to increase angiogenesis, this is supported by 2 literature. El-Kased et al., Observed that the layer of skin affected by burns and then given honey, on the 9th day the honey-treated skin showed few new blood capillaries and fibroblastic cell proliferation 10. Furthermore, according to Schencke et al., The pure honey group experienced neoformation of blood vessels in all dermal scar tissue as shown in Figure 4 13.

**Figure 2** The result of healing using ALH 10

**Figure 3** Giving revamil honey gauze to blister burns 6.

**Figure 4** Angiogenesis in honey treated skin 13
Degree of pain and patient satisfaction

Jeffery et al., Using revamil honey gel and revamil honey gauze, from all the cases he observed, the use was very easy even though there was a little exudate but still gave satisfactory results\(^6\). Smaropoulos and Cremers also described 2 cases of burns that were observed to be easy to use and painless in all patients\(^5\). According to the Subrahmanyam study comparing honey and vaseline treated with honey, 90% experienced zero pain or only mild pain, while the group treated with vaseline gauze 88% experienced zero or mild pain\(^11\).

Antimicrobial properties

Duncan et al, who stated that the bacteria contained in burns were Staphylococcus aureus and P aeruginosa, besides that, according to him, there was no abnormal bacterial growth in all burn cultures in patients who were given honey\(^10\). Just like Subrahmanym, the research results were taken on day 7 in both honey and vaseline groups and the results did not show any growth of any organisms\(^11\). According to Firdose et al., Honey has antimicrobial properties because it has a low pH and contains H2O2 or peroxide acid as shown in Figure 5\(^14\). According to Ait Abderrahim et al., S. Aureus which is a gram-positive bacteria is more sensitive to honey when compared to gram- negative bacteria, such as E. coli and P. aeruginosa, whereas C. albicans was more resistant to honey\(^8\).

| Strain            | MIC   |
|-------------------|-------|
| S. aureus         | 6     |
| E. coli           | 9     |
| P. aeruginosa     | 8     |
| C. albicans       | 22    |

Figure 6. The minimum inhibition of euphorbia honey on 4 microbes\(^8\)

Cost of treatment

According to Duncan et al., patients used between 1 to 4 tubes of product and the average cost of treatment was $ 26.15, with a range of $ 11.44 to $ 45.76 or IDR 170,000 to IDR 680,000\(^10\)

DISCUSSION

Honey can be an alternative treatment because it is easier to obtain in the village. The effectiveness of honey as a treatment for burns depends on the type of honey used, the time of administration and the degree of severity of the wound\(^9\).

Honey works in the wound healing process with the presence of hydrogen peroxide which can activate macrophages to release VEGF which stimulates fibroblast proliferation and angiogenesis in wounds. Honey is able to stimulate B lymphocytes and T lymphocytes, and activate neutrophil phagocytosis in cells. Honey also stimulates monocytes (MM6 cells) to secrete cytokines, tumor necrosis factor-a (TNF-a), interleukin-1 (IL-1) and IL-6, which activate the immune response to infection. TNF-a secretion can be induced by protein glycosylation. Furthermore, honey is able to degrade collagen IV through stimulation of matrix metalloproteinase 9 (MMP-9), a protease enzyme that plays a role in the release of keratinocyte cells from the basement membrane, thus allowing keratinocyte migration for re-epithelialization. Honey is able to induce cytokine production by leukocytes so that it will stimulate cell growth\(^15\).

The healing time for burns using honey therapy varies from 3 to 36 days with an average of 20 days. Honey as an autolytic debridement agent is considered effective in wounds containing ≥40% damaged tissue. Honey creates a moist wound environment, thereby stimulating wound healing\(^6\).
Honey gives satisfactory results for the healing of second degree partial burns because there is no abnormal bacterial growth, favorable patient satisfaction scores, lack of side effects and reasonable treatment costs support the use of honey as an effective, safe and economical form of treatment for burns.

CONCLUSION

Honey is beneficial for health, especially skin because it has a low pH, contains H2O2, has antioxidant properties and has a lot of ingredients, so honey can affect the healing process of burns. Honey can be used as an alternative for the treatment of burns because it can stimulate the proliferation of fibroblasts and angiogenesis, the healing time for burns with honey is 3 to 36 days, the results of wound healing are good, honey is easy to apply, causes mild pain and is easy to get, honey has antimicrobial properties, the bacteria most sensitive to honey is Staphylococcus aureus. The cost of treating using ALH honey is IDR 170,000 to IDR 680,000. It is not yet known the costs involved in treating other types of honey.

REFERENCES

1. Kashefi, N. and Dissanaike, S. Use of air transport for minor burns: is there room for improvement?. Journal of Burn Care and Research. 2016;37(5):e453–e460.

2. Olofsson, T. C., Butler, É., Lindholm, C., Nilson, B., Michanek, P. and Vásquez, A. Fighting off wound pathogens in horses with honey bee lactic acid bacteria. Current Microbiology. 2016;73(4):463–473.

3. Hixon, K. R., Klein, R. C., Eberlin, C. T., Linder, H. R., Ona, W. J., Gonzalez, H. and Sell, S. A. A Critical Review and Perspective of Honey in Tissue Engineering and Clinical Wound Healing. Advances in Wound Care. 2019: 8(8):403–415.

4. Meo, S. A., Al-Asiri, S. A., Mahesar, A. L., & Ansari, M. J. Role of honey in modern medicine. Saudi Journal of Biological Sciences. 2017: 24(5):975-978.

5. Smaropoulos, E. and Cremers, N. A. J. Treating severe wounds in pediatrics with medical grade honey: A case series. Clinical Case Reports. 2020: 8(3): 469-476.

6. Jeffery, S., Henry, N. and Radotra, I. Properties and use of a honey dressing and gel in wound management. British Journal of Nursing. 2019: 28(6): S30-S35.

7. Moustafa, A. and Atiba, A. The effectiveness of a mixture of honey, beeswax and olive oil in treatment of canine deep second-degree burn. Global Veterinaria. 2019: 14(2): 244-250.

8. Ait Abderrahim, L., Taibi, K., Ait Abderrahim, N., Boussaid, M., Rios-Navarro, C. and Ruiz-Saurí, A. Euphorbia honey and garlic: Biological activity and burn wound recovery. Burns. 2019: 45(2019):1695-1706.

9. Hendy, H. dan Lister, I. N. E. Tingkat efektivitas penyembuhan luka bakar derajat IIA dengan pemberian madu dan pemberian salep nebacetin pada tikus putih (Rattus Norvegicus). Jurnal Kedokteran Dan Kesehatan. 2019: 15(2): 130-134.

10. Duncan, C. L., Enlow, P. T., Szabo, M. M., Tolchin, E., Kelly, R. W., Castanon, L. and Aballay, A. M. A pilot study of the efficacy of active leptospermum honey for the treatment of partial-thickness facial burns. Advances in Skin and Wound Care. 2016: 29(8): 349-355.

11. Subrahmanyam, M. Honey dressing accelerates split-thickness skin graft donor site healing. Indian Journal of Surgery. 2015: 77(2):261 -263

12. El-Kased, R. F., Amer, R. I., Attia, D. and Elmazar, M. M. Honey-based hydrogel: In vitro and comparative in vivo evaluation for burn wound healing. Scientific Reports. 2017: 7(1): 1-11.

13. Schencke, C., Vasconcellos, A., Sandoval, C., Torres, P., Acevedo, F. and del Sol, M. Morphometric evaluation of wound healing.
in burns treated with ulmo (Eucryphia cordifolia) honey alone and supplemented with ascorbic acid in guinea pig (Cavia porcellus). Burns & Trauma. 2016: 4(25): 1-9

14. Firdose, A., Nisar, A., & Dsouza, M. R. Evaluation of in vitro antimicrobial activity of Indian honey on burn wound isolates. Journal of Chemical and Pharmaceutical Research. 2016: 2016(83): 1027-1034.

15. Oryan, A., Alemzadeh, E., and Moshiri, A.. Biological properties and therapeutic activities of honey in wound healing: A narrative review and meta-analysis. Journal of Tissue Viability. 2016: 25(2): 98-118.