

# The Effectiveness of Original Honey Treatment toward Diabetic Foot Infection Wounds Healing

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Keywords: Diabetic Foot Infection and Original Honey

Abstract: Diabetes Mellitus (DM) is a group of heterogeneous abnormalities characterized by an increase in blood glucose levels or hyperglycemia. The impact is very broad which will affect the quality of patient's life. One of the most common complications is diabetic foot infection wounds; it is predicted surge up to 14.1 million people with prevalence rate of 6.67% in the adult population. Diabetic wounds are very easy to cause complications in the form of infections due to bacterial invasion and the presence of hyperglycemia being the optimal place for bacterial growth. Honey is believed since the time of ancestors in curing various diseases, including wound infections. This study aimed to determine the effectiveness of honey treatment for diabetic foot infection wounds healing. The study design was one group pre-post test with comparison group. The samples number were 20 respondents with wound care for 50 days, the study results were good indicators seen from changes in wound diameter from day to day. In this study, the data were analyzed with Wilcoxon test and the results were 0.001 ( $p < 0.05$ ). Then it showed that original honey usage was more effective in diabetic foot infection wounds healing. Recommendations from the study results that honey therapy can be done as one of the replacement therapies to treat wounds caused by diabetic foot infections.

## 1 INTRODUCTION

World Health Organization (WHO) 2012 estimates that the number of people with diabetes mellitus in Indonesia will increase by two to three times in 2030, coming from 8.4 million to even 21.3 million people. While Indonesia ranks fourth most DM sufferers in the world as many as 8.4 million, after that India reached 31.7 million, China 20.8 million, and US reached 17.7 million people with diabetic patients. Diabetic foot due to its complications is the most common non-traumatic cause. Extremities under the risk of amputation are more than 15-46 times higher in diabetics than non diabetics. Complications of foot injuries in diabetic patients are very difficult to treat and more routine in treating diabetic foot injuries so as not to expand the diabetic patient's foot injuries. In the treatment of these wounds it is better to use Honey because it has been widely used for the treatment of various types of infections with many types of wounds such as burns, venous legs of mixed etiology, diabetic foot ulcers).

While according to RISKESDA report (2016), the prevalence of diabetes diagnosed by doctors is 2.1%. The prevalence is higher than

RISKESDA (2007), which is around 1.1%. There are some provinces that have a higher prevalence than the national average, namely Central Sulawesi (3.7%), North Sulawesi (3.6%), South Sulawesi (3.4%) and East Nusa Tenggara 3.3%. The prevalence of diabetes tends to be higher in women than in men and is more common in urban communities (RI Health Ministry, 2016). Unlike in Western countries, in Indonesia there are several studies on the prevalence and factors related to DFU. The main complications of DM in Indonesia are neuropathy (13% - 78%), vascular microcomplications (16% - 53%) and DFU (7.3% - 24%) (Nuwa, 2018).

Diabetes Mellitus (DM) is a group of heterogeneous abnormalities characterized by an increase in blood glucose levels or hyperglycemia. The impact is very broad which will affect the quality of patients life, especially in patients with diabetic foot ulcer complications, one of the causes of this complication occurs due to nerve damage (neuropathy), in this condition patients can no longer distinguish between hot temperatures and cold, less pain. The patient leg who has neuropathy is twice as likely to develop a diabetic wound. Diabetic foot

ulcers are a major cause of morbidity and disability in diabetic patients. They often lead to lower limb amputations especially when associated with neuropathy and / or ischemia. At the national level, foot ulceration often occurs, it affects 6.9% of diabetics throughout their lives, moreover ulceration is the most common cause of hospitalization and precedes 80% of amputations of the lower extremities ( Jeffcoate W, 2017).

Some researchers conducted research by using diabetic-foot herbs treatment namely original honey. Wound care used honey because it contains fructose and glucose which is a type of monosaccharide sugar that is easily absorbed by the intestine. Then the way to treat diabetic foot wounds regularly with honey would be better, from the era when it was very trusted by the public for various types of treatment including honey wounds, it was also easy to obtain besides it was effective in the wound healing process because of its low water content, also the PH of the acidic honey and its content of hydrogen peroxida could kill bacteria and microorganisms that enter our body. In addition, honey also contains antibiotics as an antibacterial and antiseptic to protect the wound from worsening (Nabhani and Widiyastuti, 2017).

Diabetic foot injury is a serious complication of diabetes, which can result prolonged hospitalization and can lead amputation of the lower limbs in. Research has shown more than 15% of diabetics suffer from diabetic foot. The annual incidence of diabetic foot injury is estimated at 25–80%. The prevalence of diabetic foot injuries worldwide has been reported to be 4–27%. In developed countries, more than 5% people with diabetes suffer from diabetic feet, and 20% health care resources spent on treating diabetic foot injuries. In US, the cost of diabetic foot is 7,000-10,000 USD, and this figure increases by 65,000 USD in complicated cases which require amputation of what diabetic foot injury, which indicates the high cost of health care (Karimi, 2019).

Diabetic foot injury is an important factor in the mortality and disability of diabetics. Despite, there is much progress in the diagnosis and treatment of diabetes; diabetic foot problems have not been resolved. Many patients suffer some degree of diabetic foot; as result, they are treated with drugs. After ineffective medical treatment, surgery is considered for the patient. One of the most challenging tasks in diabetes foot health care is the treatment of diabetic foot injuries. One of them is honey. Honey is used to cure diabetic feet, and its efficiency and effectiveness have been investigated

by many studies (Karimi, 2019). Honey has been known for thousands of years which can be used in the process of wound healing. Honey has antibacterial characteristics, stimulates the release of cytokines, and stimulates cell growth, so that the wound can undergo a healing process (Nuwa, 2018).

Diabetic wounds easily develop into infections due to the entry of germs or bacteria and the presence of high blood sugar becomes a strategic place for germ growth. If the diabetic wound is not handled properly it will cause disability and even lead to amputation. Honey has been used as a natural medicine for healing various diseases since thousands of years ago. Previous people have been using honey as a therapeutic treatment for several millennia and lately it has been rediscovered as a potential treatment in wound care mentioning that honey can accelerate the wound healing process. The study results conducted by Subrahmanyam et al (2015) about the effectiveness difference of wound care by using honey and sulphadiazin silver on 21<sup>st</sup> day, all wounds treated with honey underwent epithelialization, whereas wounds treated with silver sulphadiazine only 20% undergo epithelialization (Nuwa, 2018).

The benefits of honey are curing heartburn, enhance immunity, for beauty and moisturize the skin, cure asthma, increase intelligence and memory, and can also heal wounds quickly and can cure various other diseases. The research problem is to find out the effectiveness of original honey treatment is diabetic foot infection wounds healing. Several studies have shown that honey has the ability to repair, protect and prevent infection and make antibacterial moist healing. In addition honey has a debriding effect by osmotic action that causes lymph flow out, remove dead skin tissue from the bottom of the wound quickly, tissue regeneration, reduce pain during wound care and reduce edema by anti-inflammatory action. The same results seen in the Farouk A et al research mentioned in their study that many patients had ulcers that did not heal due to different causes and did not improve with conventional treatment; the results were good by giving honey to repair tissue in the wound (El-Nahas M, 2018).

By using native honey the wound healing process occurs faster, as evidenced within 2 weeks of tissue gradation in growing diabetic wounds. in honey contains a lot of vitamins, acids, minerals, and enzymes, which are very useful for the body as traditional treatment, antibodies, and inhibit the growth of cancer cells or tumors. In addition to organic acids, honey also contains amino acids that

are related in making body proteins (non-essential amino acids). In addition to non-essential amino acids there are also essential amino acids including lysine, histadine, tryptophan, etc. (Fain, A. 2017).

According Saldi's study (2012), the wound treatment by using 0.9% NaCl liquid to wash the wound and provide honey dressing to the wound. The observation results obtained wound healing process treated with 0.9% NaCl liquid and honey showed the results of the granulation process is quite fast, the tissue looks moist, and the pus contained in the wound dries quickly. Under these conditions, the researchers are interested in further researching about the effectiveness of wound cleansing by using 0.9% NaCl liquid and honey is given for the healing of diabetic wounds. Diabetic patients have poor blood circulation and lack the ability to fight infections. Diabetic foot infections can be treated by systemic antibiotics with long time usage that can develop drug-resistant organisms toward medicine and honey in wound treatment that have antibiotic-resistant bacteria.

Dunford C, et al, (2016), examined the effectiveness of honey in diabetic foot injuries and found that on the seventh day of observation, 87% of patients treated with foot injuries by using honey showed satisfactory epithelialisation and on the 21<sup>st</sup> day 92% epithelialization was achieved by wounds treated using honey. He identifies that time of diabetic foot wound healing by using honey is more effective.

To prevent diabetic wounds complications that last long time and prevent worse, it should be noted how to treat wounds in diabetics where there are four principles of diabetic wound management to optimize the process of healing diabetic foot wounds, namely: basic preparation of wounds, wound protection, wound dressing, and wound oxygenation. The usage of this principle is expected to be 80%, the problem of diabetic wounds will be cured, so as to avoid the amputation occurrence (El-Nahas M, 2018).

## 2 METHODOLOGY

The population in this study were all patients who suffered diabetic foot infection wounds of 20 respondents. This study used sampling technique with total sampling by using quasi-experimental method with one-group pre-post test approach.

This research used original honey which has water content less than 18%, gauze, anatomical tweezers, cirugis tweezers, plaster, nierbeken, NaCl

liquid, and observation sheets. Based on research conducted on 20 respondents with the provision of original honey for respondents as much as 3-5 cc, coupled with wound cleansing by using 0.9% NaCl liquid, then it is done dressing bandage on the wound which is applied original honey within period of 50 days conducted in 1 day treatment for diabetic foot injury. By inclusion criteria is willing to be respondents in writing, the foot injuries degree in grades 1 to 3. The exclusion criteria are not willing to be respondents, the degree of diabetes foot injuries in grades 4 and 5.

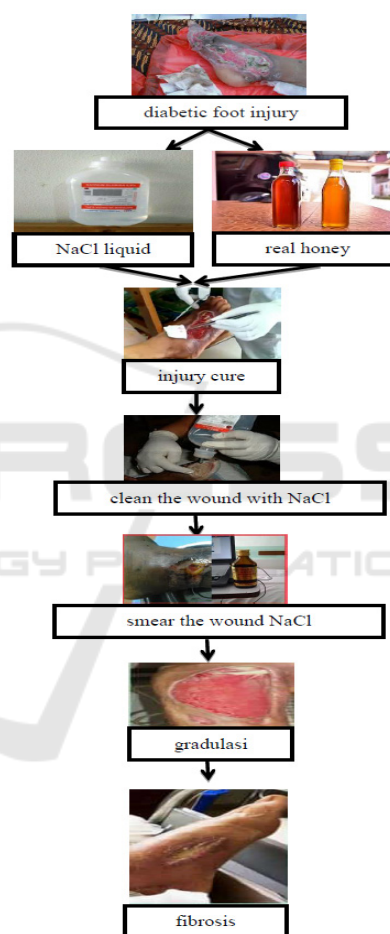


Figure 1: Research Conceptual Framework.

## 3 RESEARCH RESULT AND DISCUSSION

Based on the study results, it is known that the sample were all DM patients who have diabetic wounds. For the respondents of characteristics, based on the age of 40-49 years old and ≥ 60 years

old as many as 4 people or about 20%. And the age of the majority aged 50-59 years old as many as 9 people or about 45% and for minority ages aged 35-39 years old as many as 3 people or about 15%.

Based on gender characteristics, the majority were male as many as 16 people or about 80% and the minority were women as many as 4 people or about 20%.

Based on Occupation characteristics, the majority work were farmers as many as 9 people or around 45% and the minority work were civil servants as many as 3 people or around 15%. It can be seen in Table 1 below.

Table 1: Respondent's characteristics distributon of giving original honey for diabetic foot injuries based on age, sex, and occupation.

Characteristic	N	%
Age		
35-39 thn	3	15
40-49 thn	4	20
50-59 thn	9	45
>60 thn	4	20
Total	20	100
Gender		
Male	16	80
Female	8	40
Total	20	100
Occupation		
Entrepreneurship	4	20
Farmer	9	45
Housewife	4	20
Civil Servant	3	15
Total	20	100

Based on univariate analysis on the diabetic foot injury degree before being given honey to diabetic foot injuries, the results showed that the majority of grade 3 injuries were 9 respondents or around 45.0% and the minority of grade 1 injuries were 4 respondents or around 20.0%. Based on univariate analysis on the diabetic foot injury degree after being given original honey to diabetic foot injuries, it was found that the majority of grade 2 injuries were 7 respondents or about 35.0%, and the minority of wound degrees in grades 0 and 3 were 4 people or around 20, 0%. It can be seen in Table 2 below.

Table 2: Respondent's distribution before and after original honey administration toward diabetic foot injuries.

Injuries Degree	Before		After	
	Subject	%	Subject	%
Grade 0			4	20
Grade 1	4	20	5	25
Grade 2	7	35	7	35
Grade 3	9	45	4	20
Total	20	100	20	100

The research results with wound care by using 0.9% NaCl liquid to wash the wound and provide honey dressing for the wound. The observation results obtained wound healing process treated with 0.9% NaCl and honey showed the results of the granulation process is quite fast, the tissue looks moist, and the pus contained in the wound dries quickly. Under these conditions, the researchers are interested in further researching about the effectiveness of wound cleansing by using 0.9% NaCl with Honey for Diabetic Wound Healing (Andriana, 2016).

It is proven by other studies, according to Faisol's research (2015), the Effectiveness of Giving Honey on Diabetic Wounds shows that after treatment, new granulation tissue growth, absence of inflammatory reactions, and reduced wound depth, reddish tissue color, and reduced amount of exudates.

Based on bivariate data, the results of willcoxon statistics on pre-test were conducted for 20 respondents and obtained a mean of 2.25 and std, deviation of 0.786, then the post carried out to 20 respondents and obtained a mean of 1.55 and std deviation of 1.050 then it was obtained p-value of  $0.001 < \alpha < 0.05$  then  $H_0$  is rejected and  $H_a$  is accepted, which means there is significant influence between the administration of original honey toward diabetic foot injuries.

It is also in accordance with Andriana opinion (2016), which states that honey helps the process of wound debridement and prevents the scar formation. Honey also increases the contraction time. If necrotic tissue around the wound is reduced, the wound base becomes more aligned indirectly with the skin around the wound. In addition, tissue growth gradation and epithelialization cause the wound base to be lifted so that the wound depth is reduced.

It is also in accordance with Professor Jennifer Eddy's theory from the University School of Medicine and Public Health; honey can kill bacteria because it is acidic, besides that honey is also

effective in avoiding the resistant nature of bacteria because it has antibiotic content. This chemical fact has been confirmed by scientists who met at the World Apiculture Conference which was held on September 20-26, 2015 in China. The conference discussed treatment using herbs derived from honey. American scientists say that honey, royal jelly, pollen, and propolis can be used as traditional medicine. Poland doctors also stated at the conference that honey can help heal diabetic foot injuries (Al-Maskari, 2015).

Wound care using 0.9% NaCl + Original Honey has many benefits such as being cheaper, easier to use and can be used in areas that are difficult to reach and are not toxic to tissue. NaCl 0.9% liquid is isotonic, which means it has the same properties as the liquid in the human body. NaCl 0.9% liquid is more recommended as a wound care fluid when compared with other fluids such as H<sub>2</sub>O<sub>2</sub>, povidone Iodine, rivanol and other liquids that are toxic to tissue. The principle of wound care products is to maintain the wound environment to remain moist to facilitate the healing process of the wound, maintain tissue fluid loss and cell death. A moist wound environment can accelerate the wound healing process by helping to eliminate fibrin that is formed in chronic wounds quickly (fibrinolytic) by neutrophils and endothelial cells in a humid atmosphere, reducing the incidence of infections compared with dry treatment, helping to accelerate the formation of growth factors which plays a role in the healing process, and accelerates neutrophil invasion followed by macrophages, monocytes and lymphocytes into the injured area (Riani, Handayani, 2017).

Based on Riani, Handayani research (2017) state that DM patients with diabetic foot injuries receiving wound care, a significant degree of wound reduction was obtained by using 0.9% NaCl + Honey. It shows improvement in wound condition i.e. reduced wound size, type and amount of necrotic tissue, amount of exudate in the wound, and increased epithelialization on the wound surface. In wound care management, the result from Honey + NaCl 0.9%, the most frequently encountered part by researchers is the number of exudates patient that appear to be diminishing, measurements of tissue granulation before wound care show that most (80%) patients have bright red granulation tissue or red flesh covering 25% of the wound area. While a small proportion (20%) of other patients have not yet experienced tissue granulation. Observation and measurement of tissue granulation after wound care showed that all (100%) patients had bright red or

flesh-red granulation tissue covering 75% to 100% of the wound area. Observation on the parameters of tissue epithelialization before treatment of wounds has not seen the appearance of tissue epithelialization in all patients.

Nuwa research, 2018 used original honey, honey works with its moist nature so that it supports the growth of granulation tissue and epithelialization which can support the reduction in wound size. Lomatull works by reducing edema of the wound, so that the size of the wound looks smaller. Necrotic tissue type shows that the majority (8%) of patients treated with honey do not have necrotic tissue. A small portion (2%) of patients have necrotic tissue in the form of non-living white tissue and / or peeling tissue that is yellowish and non-sticky. Patients treated with honey do not have necrotic tissue and only small proportion (2%) of patients have necrotic tissue with <25% of the wound bed. Researchers assume that the effects of moisture caused by honey in necrotic tissue will soften the necrotic tissue so that necrotic tissue in wounds treated using honey is easier to do. The parameter of exudates number in the wound care group using honey is obtained by the majority of patients do not release the exudate and it is only small proportion of patients still produced a small amount of exudate.

Honey that is used certainly has the same content or composition, namely amino acids, total carbohydrates, protein, vitamin A, vitamin C, calcium, iron, sodium (sodium), total fat and cholesterol, but the differentiate is water composition in honey. Quoted from The National Honey Board (2004) in Faisol Al Fady research (2012) Original honey has a water content of 17.10 grams. Honey quality standards in Indonesia, especially for commercial purposes, refer to SNI 01-3545-1994. Maximum water content from honey is 22%, however, laboratory testing must still be carried out beforehand. The activity of low water content and with high osmolarity in wound care agents is believed to be something that can prevent infection and speed up the wound healing process. This osmosis process absorbs water from bacteria in the wound so that it can inhibit the growth of bacteria due to lack of water and dry the bacteria so that the bacteria are difficult to grow and eventually die. Besides the water content contained in honey will provide moisture to the wound, so that the wound granulation process grows well (Rahman, Rahmayani, 2016).

Other content in honey that influences wound granulation is the presence of iron and sodium solution (NaCl). The content of iron is able to help

the process of red blood cells formation that function to provide a supply of nutrients and oxygen in the wound area, so that with this supply it is very helpful to stimulate the growth of new tissue in diabetic foot wounds. The sodium content (NaCl) which functions as a safe isotonic solution to assist in wound care (Rahman, Rahmayani, 2016).

The difference in the degree of diabetic wounds before and after honey is given to patients with diabetic foot injuries is due to the process of honey content that maintains and keeps the wound environment moist to facilitate the healing process of wounds, maintain tissue fluid loss and cell death so as to accelerate the regeneration of wound healing. It is influenced by the achievement of good intensity during the intervention. When the intervention of honey is conducted in a pleasant place and atmosphere, it can increase the enthusiasm and motivation of respondents during the intervention. Some respondents who did not experience a reduction in diabetes after an intervention were affected by the condition of the wound (extent, depth of the wound, and length of wound care) and the costs incurred during wound care. Management of diabetic wounds should be carried out on a continuous basis which includes dietary foods that trigger delay in wound healing, so that no further complications such as amputation occur, so wound care is a nursing action aimed at preventing the risk of amputation, an analysis of the cost effective use of honey will be beneficial in wound care (Al-Maskari, 2015).

Nabhani and Yuli Widiyastuti (2017), treated diabetic foot wounds using NaCl and natural honey (water content less than 1896), where if the wound was treated using both combination, because NaCl has isotonic properties (safe for used as a clean wound) and the nature of honey itself can grow good granulation of tissue, and cause a moist effect (the wound will experience healing if the conditions around the wound are moist). To find out whether honey is used as natural or not and whether the water content is really below 1896, laboratory tests must be done first. But in this study, researchers used original honey and its water content was tested at 17%. In addition, it is not only honey that affects wound healing. The size, the depth and the degree of wound are also important factors in the wound healing process. The smaller of wound, the shallower the wound, and the smaller of wound degree, the healing is faster. Conversely, if the wound gets bigger, the deeper and the higher of wound degree, it will take quite long time to make the wound healing.

It proves that honey is suitable for grade 1 to 3 diabetic foot injuries. But honey can also be used for wounds that have more than 3 grades. Judging from the benefits of honey that can attract pus and make moist wound, honey can also be given more than grade 3. For example in grade 3 or 4 diabetes injuries, the wound has pus and there is a lot of dead tissue as a result, lack of oxygen in the wound area. Because the honey benefits can lift dead tissue, so the wound that has a lot of dead tissue can be removed easily by professional / expert nurses (surgeons). It is done so that no errors occur when removing dead tissue, because if wrong cut will result in bleeding in the wound.

The wound acidification process, on average, heals wounds very quickly as seen from when the wound is covered with honey because it can create moisture that is not affected by the environment. Honey is effective as a topical therapy because it contains nutrition which speeds up healing in the diabetic foot injury. Besides speeding up the wound healing, honey also helps debridement and prevents necrotic formation. The effect of honey on wound healing produces kind of chemical substance for debridement of damaged and dead tissue (Fain, A. 2017).

According to Karimi, 2019, the honey usage in the treatment of diabetic foot wounds has proven to be effective. Research conducted on 33 respondents who were treated with honey, 29 respondents showed success marked by a good healing process, and 3 respondents did not show good results because the client experienced immunodeficiencies. In this study diabetic foot wound healing was characterized by wounds becoming cleaner, signs of infection disappeared, inflammation, swelling, and pain were quickly reduced, odor was reduced, slough, and necrotic tissue was reduced, granulation and epithelialization increased and minimal wound healing in scars / tissue scar.

#### 4 CONCLUSIONS

Honey is very good as bandage in cases of diabetic foot injuries, especially in developing countries. Treatment of diabetic foot wound uses considerable amount of money and clinically effective pads. More important, it is very safe because it does not produce complications (local or systemic), or the emergence of bacterial resistance. It is very necessary to improve the general condition of patients to achieve optimal results. Furthermore, when taking the action of original honey administration, it must be patient

and there is trust between patient and medical staff, besides that the treatment must be routine and the patient must be obedient when done by the nurse so that it will get good results. From the data analysis results and willcoxon test with 20 respondents obtained  $p = 0.001 < \alpha = 0.05$ , it can be concluded that there is an influence of original honey usage on the diabetic foot infection wounds healing.

## 5 SUGGESTIONS

After the research concludes the research results, the researchers expect the following advices:

- a) For nurses, it is expected to further enhance their knowledge and be able to apply treatment of diabetic foot infection wounds given honey (alternative therapy)
- b) It is hoped that further studies can examine diabetic foot infection wounds to different degrees using other wound care techniques

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