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EFFECTIVENESS OF BANANA LEAVES (MUSA PARADISIACA L) AS A BANDAGE FOR HEALING DIABETES WOUNDS

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ABSTRACT
Diabetes mellitus is a chronic degenerative disease characterized by increased blood glucose levels that exceed normal limits. Complications often experienced by patients with diabetes mellitus are wounds. Wounds that are difficult to heal can result in amputation. Banana leaves have antioxidant activity and biological functions including anti-diabetic and have been proven to be a source of bioactive compounds that function to stop or inhibit the growth of bacteria and fungi that can cause infection in wound tissue. Objective: to analyze the effectiveness of banana leaves as a dressing in the wound healing process in diabetic patients. The study was a quasi-experiment with a pre-post control design. Thirty-two were applied in this study, 16 were intervention group and 16 were control group. Data were collected using the Bates-Jensen Wound Assessment Tool and analyzed using the Wilcoxon signed-rank test. There is a significant difference in wound healing in the intervention group before and after the use of banana leaves as a dressing ($p<0.001$). The results of this study can be a basis for nurses in applying or implementing banana leaves as wound dressings for the healing process of diabetic wounds, both chronic and acute wounds, and these results can support nurses in carrying out independent nursing care.

Keywords: banana leaves; diabetes mellitus; wounds

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INTRODUCTION

Diabetes Mellitus is a chronic degenerative disease characterized by increased blood glucose levels or hyperglycemia that exceed normal limits (Antar et al., 2023). Diabetes mellitus is at risk of experiencing health complications and a decrease in overall quality of life, so individuals who experience chronic diseases must receive attention in the treatment of diabetes, especially from health workers (Ahmad & Joshi, 2023). Diabetes mellitus is a condition in which there is an increase in blood sugar which can cause risks to macrovascular and microvascular (Mansour et al., 2023). Diabetes Mellitus is a metabolic disease characterized by high blood glucose levels (hyperglycemia) as a result of a lack of insulin secretion, impaired insulin activity, or both (Ojo et al., 2023).

Southeast Asia is the third place after North America and North Africa with the number of diabetes mellitus sufferers being 8.5% occurring at the age of 20-29 years, while in Indonesia

the prevalence of diabetes mellitus sufferers being 10.3 million and is estimated to increase in 2045 to 16.7 million people with diabetes mellitus (Ismah et al., 2022). Based on age category, the largest number of diabetes mellitus sufferers are in the 55-64 year age range, in addition, diabetes mellitus sufferers in Indonesia are more female (1.8%) than male (1.2%) and for urban areas (1.9%) there are more diabetes mellitus sufferers compared to rural areas (1.0%) (Oktora & Butar, 2022).

The increasing prevalence of diabetes mellitus is a global problem that can cause the highest death rate in the world, characterized by many complications such as diabetic ulcers and ending in amputations of the lower and upper extremities (Akkus & Sert, 2022). An amputated leg is part of the complications of diabetes mellitus which can cause health problems as well as socio-economic problems which have an impact on reducing the patient's quality of life and become a heavy economic burden on the patient's family (Perveen et al., 2024).

Delays in protection against diabetes mellitus can result in serious and detrimental effects and impacts on a person, such as the loss of some or all of the function of tissue and organs of the body that are injured, hematological disorders due to the emergence of sympathetic nerve responses, bleeding, and there will be a greater possibility of wider contamination resulting in the death of several important cells, diabetes mellitus sufferers will experience a long wound healing process and inhibit the final healing process to the remodeling stage (Luna et al., 2021). Treatment for patients with diabetes mellitus wounds must provide warmth and a moist environment for the wound and be appropriate in providing dressings for the wound which can speed up the wound healing process, prevent trauma, and damage to wound tissue in patients with diabetes mellitus wounds (Burgess et al., 2021).

In the healing process of wound management, namely with the latest dressing techniques, this latest wound care provides a very large contribution to improving wound care management, especially for chronic wounds such as diabetic wounds. The principle of the latest care with this dressing is to improve wound healing and maintain tissue fluid loss and cell death (Pang et al., 2023). In the banana tree part, such as the leaves, there is antioxidant activity and biological functions including anti-diabetic and it has been proven to be a source of bioactive compounds that function to stop or inhibit the growth of bacteria and fungi that can cause infections in wound tissue (Singh et al., 2023).

Antimicrobials found in banana plants such as in their leaves play a role in inhibiting the development or growth of bacteria such as Staphylococcus aureus, Pseudomonas aeruginosa Proteus mira-bilis, Bacillus subtilis, Aspergillus niger, Candida albicans, Micrococcus sp, and Salmonella sp. namely compounds in methanol found in banana plants (Jouneghani et al., 2020). Banana leaves contain wax compounds commonly called epicuticular lipids, which contain long-chain fatty acid ester compounds, fatty alcohols, free fatty acids, dialcoholic fats (diol compounds), aldehydes, and alkanes. The compounds in banana leaf wax have a value of 0.15 to 1.41% which can maintain comfort in wounds and provide a cooling effect on wounds (Widoyanti et al., 2023).

Banana leaf compounds have water-resistant properties that can maintain moisture in the wound area so that they can maintain comfort in the wound and provide a cooling effect (Chendake et al., 2021). Metabolic compounds in banana leaves such as alkaloids act as anti-inflammatories, where alkaloid compounds can function to reduce inflammation and inhibit cyclooxygenase. Meanwhile, saponin compounds can interact with many lipid membranes

such as phospholipids which are the source of prostaglandins and can inhibit the formation of inflammatory triggers (Widoyanti et al., 2023). Banana leaves contain many vitamins such as vitamin A, vitamin C, and calcium carotene which function to stimulate the collagen synthesis process and collagen synthesis functions to stimulate the tissue proliferation process, increase blood circulation, and repair problematic DNA synthesis (Kumari et al., 2023). Therefore, this study aims to analyze the effectiveness of banana leaves as a dressing in the wound-healing process in diabetic patients.

METHOD

This study was a quasi-experimental study with a pre-posttest with control group design. This study applied 16 patients in the intervention group and 16 patients in the control group. The sample was selected using purposive sampling with inclusion criteria, namely 1) diabetic patients with never had a wound care visit; aged 18-50 years; and 3) a long history of diabetes. The stages of implementation in this study are described in the standard operating procedure, namely before carrying out the intervention stage, a pre-test stage is first carried out where the stages carried out include explaining the purpose of the activity, filling out a demographic questionnaire, assessing wounds using the Bates-Jensen Wound Assessment Tool (BJWAT) wound questionnaire, providing intervention on diabetic wounds using banana leaves after carrying out the pre-test, then the post-test is to fill out the BJWAT questionnaire again. In the control group, namely filling out the demographic questionnaire, assessing the BJWAT wound, providing intervention on diabetic wounds with calcium alginate and the tools and dressings used are sterile gauze, wound soap, calcium alginate, clean water or NACL and wound ointment (Metcovazin red, regular and gold).

In a study conducted by Asbaningsih (2014) using the Wegner scale and TIME instruments in evaluating the degree of healing of decubitus ulcer wounds with strong correlation results, namely a $p<0.05$ with a calculated r-value of 0.789, this instrument can be used as a research instrument in the assessment of diabetes mellitus wounds and is said to be valid. The BJWAT instrument is valid and can be used as a research tool in wound assessment and has a high reliability value of Cronbach's Alpha 0.837 so that this instrument can be used as an assessment tool (Khoerunisa, 2019). Data were analysed using Wicolxon signed rank test. This study has received ethical approval from the Health Research Ethics Committee, No. 01. 25 497/KEPK/POLTEKKES KEMENKES MEDAN 2024.

RESULTS

Table 1.
Respondent characteristics (n=32)

Respondent characteristics	Group		Total n (%)
	Intervention	Control	
Age (year)			
44	4	2	6(18,7)
46	7	5	12(37,5)
50	5	9	14(43,8)
Gender			
Male	14	10	24(72)
Female	2	6	8(28)
Duration of diabetes (year)			
3	3	4	7(25)
4	7	5	12(37,5)
6	6	6	12(37,5)
Occupation			
Traders	5	3	8(25)
Farmers	11	13	24(75)

Based on Table 1, it is known that the characteristics of respondents based on the average age of diabetic wounds are 50 years as many as 14 people (43%), 46 years as many as 12 (37.5%), 44 years as many as 6 people (18.7%), male gender as many as 24 people (72%), female as many as 8 people (28%), duration of diabetes for 6 years as many as 12 people (37.5%), 4 years as many as 12 people (37.5%), 3 years as many as 7 people (25%), occupation as traders as many as 24 people (75%), and farmers as many as 8 people (25%).

Based on Table 2, it is known that the data has been distributed normally so the test used in this study uses the Wilcoxon signed rank test, namely to compare the effectiveness of banana leaves as a bandage for healing diabetic wounds before and after intervention in each group. With the basis for decision-making on the normality test, namely if the significance value or sig (2-tailed) <0.05 then Ho is accepted.

Table 2.
Normality test results

Group	Statistic	df	Sig
Intervention			
Pre-test	0,188	16	0,136
Post-test	0,199	16	0,091
Control			
Pre-test	0,197	16	0,900
Post-test	0,131	16	0,962

Based on table 3 shows that the results of the Wilcoxon signed ranks test obtained the value of Asymp. Sig (2-tailed) <0.05 then the hypothesis is accepted, which means there is a difference in the pre and post-intervention groups. Thus it can be said that there is a significant difference in wound healing in the intervention group before and after the use of banana leaves as a dressing. Thus the use of banana leaf dressings is more effective than alginate dressings for healing diabetic wounds at wound clinics in Bengkulu City Province.

Table 3.
Statistic test

	Action-Result Group
Z	-4.945[b]
Asymp. Sig. (2-tailed)	<.001

DISCUSSION

Diabetes Mellitus is a chronic degenerative disease characterized by increased blood glucose levels or hyperglycemia that exceed normal limits (Dilworth et al., 2021). Diabetes mellitus is at risk of experiencing health complications and a decrease in overall quality of life, so individuals who experience chronic diseases must receive attention in the treatment of diabetes, especially from health workers (Sugandh et al., 2023). Diabetes mellitus is a condition in which there is an increase in blood sugar which can cause risks to macrovascular and microvascular (Mansour et al., 2023). Diabetes Mellitus is a metabolic disease characterized by high blood glucose levels (hyperglycemia) as a result of a lack of insulin secretion, impaired insulin activity, or both (Antar et al., 2023).

In the frequency distribution, the age of diabetes sufferers was 14 people, with 12 people aged 50 years and 12 people aged 46 years, 24 people were male and 8 people were female. In line with Markovič et al. (2022) study stated that people over 45 years of age experience drastic physiological changes so that the body no longer responds to insulin in the body and also Ciarambino et al. (2022) stated that the male gender is more susceptible to diabetes mellitus because men cannot control their diet, stress, and obesity. In this current study, men are more

likely to suffer from diabetes mellitus, which is characterized by causal factors such as smoking history, age, and gender and in line with research conducted by Nugroho and Musdalifah (2020).

Diabetes self-care is a self-care behavior carried out by diabetes patients themselves, which includes regulating diet, using insulin, exercising, and foot care to prevent foot wounds (Ahmad & Joshi, 2023). Research conducted by Modarresi et al. (2020) in Iran to assess the relationship between self-care management and HbA1c level of the patients with type 2 diabetes. The results showed that of 376 patients, 218 (%58) were women and 158 (%42) were male. The mean age of the participants in the study was 54.5 ± 10.9 years old and the mean duration of the disease was 9.53 ± 8.39 years. The mean HbA1C in the patients was 7.93% ± 1.38%. The mean of BMI was 28.93 ± 6 kg/ m2. The mean self-care score in the patients under study was 30.53 ± 11.4. There was a significant relationship between the mean of self-care score, BMI, age, and HbA1C ($p=<0.05$). According to Orem's theory, self-care is an activity or self-care activity carried out by an individual to maintain their health independently (Alligood, 2014).

Banana leaves contain many vitamins such as vitamin A, vitamin C, and calcium carotene which function to stimulate the collagen synthesis process and collagen synthesis functions to stimulate the tissue proliferation process, increase blood circulation, and repair problematic DNA synthesis (Kumari et al., 2023). Banana leaves contain wax compounds commonly called epicuticular lipids, which contain long-chain fatty acid ester compounds, fatty alcohols, free fatty acids, dialcoholic fats (diol compounds), aldehydes, and n-alkanes. The compounds in banana leaf wax have a value of 0.15 to 1.41% which can maintain comfort in wounds and provide a cooling effect on wounds (Widoyanti et al., 2023).

This study has shown that the use of banana leaves is very effective for patients with diabetes mellitus wounds, supported by research conducted by Zulkefli et al. (2023) which states that the content of flavonoid saponin and tannin compounds acts as a proangiogenesis antioxidant and can increase oxygen supply and provide nutrition to injured skin. The content of compounds in banana leaves, one of which is flavonoids, is very important in fighting and inhibiting the growth of bacteria such as Staphylococcus aureus and E. coli in infected wounds (Jouneghani et al., 2020). Flavonoid substances can interfere with and damage the growth or development of bacterial cell walls. The tannin content in banana leaves can also damage and destroy the activity of bacterial cell walls until the bacteria die (Shamsudin et al., 2022).

Compounds found in banana leaves such as saponins, flavonoids, alkaloids, steroids, terpenoids, and tannins have their respective roles and functions in wound healing, ranging from antioxidants, accelerating epithelialization, antimicrobials and increasing TGF Beta Fibrolose receptors which synthesize collagen (Widoyanti et al., 2023). Banana leaves do not cause stickiness and do not cause pain and heal wounds faster than gauze (Chendake et al., 2021). When the banana leaf experiment was conducted on diabetic wound objects, good and effective results were obtained, where the banana leaf contains wax which produces water that can function to maintain wound moisture, the wax content in banana leaves is a lipid compound that is also commonly referred to as epicuticular wax which consists of a composition of long chain fatty acid ester compounds, alcohol fat, free fatty acids, dialcohol fat (diol compounds), aldehydes, and n-alkanes (Cheng et al., 2024). So that this wax compound plays an important role in maintaining wound moisture, preventing banana leaves from sticking as a dressing to the base of the wound, and preventing trauma to the base of the

wound when changing the dressing every 3 days (Chendake et al., 2021).

This experimental research is supported by several previous experimental studies conducted on mice and directly on humans, such as research conducted by (Cheng et al., 2024), where it was concluded that there was an influence of banana leaves on diabetic wounds in experimental animals and from this treatment, the wounds experienced a good wound healing process and showed no signs of side effects or rashes on the wounds. The results of this study have described the action of using banana leaves as a dressing that is more effective in healing diabetic wounds and patients feel comfortable and supported by several previous studies conducted on animals and humans so that banana leaves can be implemented in independent wound nursing practices as wound dressings for the healing process of diabetic wounds or acute wounds and chronic wounds and banana leaves are also natural which come from natural plants that do not have negative effects when used as a dressing for modern wound care in the world of independent nursing.

CONCLUSION

Based on the results of research and discussion on the use of banana leaves as a dressing for healing diabetic wounds at the Bengkulu City Provincial Clinic, it can be concluded that banana leaves as a wound dressing are effective in the healing process of diabetic wounds. The results of this study can be a basis for nurses in applying or implementing banana leaves as wound dressings for the healing process of diabetic wounds, both chronic and acute wounds, and these results can support nurses in carrying out independent nursing care.

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