



The Effectiveness of Hydrogel from Snakehead Fish Extract (*Chana Striata*) on Wound Healing of Grade II Ulcer in Type II Diabetes Mellitus Patients

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Abstract Diabetic ulcers are complications of diabetes mellitus. The prevalence of diabetic ulcers was 15% from the total population. Effective management of ulcers using an antiseptic could interfere with the wound healing process. A hydrogel from snakehead fish extract was a complementary treatment to improve the wound healing of diabetes. The study aimed to examine hydrogel's effectiveness from snakehead fish extract on wound healing among type II diabetes mellitus with grade II ulcers. The quasi-experimental study, pretest, and post-test with the non-equivalent control group were applied in this study. The intervention group (n = 16) received a dose of 675.675 mg of snakehead hydrogel and 0.9% NaCl for 21 days. The control group (n = 16) only received 0.9% NaCl. Analysis with repeated ANOVA test and Dependent t-Test was applied in this study. The results showed that the intervention group's mean score for wound healing before receiving the intervention was 26.31 ± 6.740 after 14 days receiving the intervention was 13.00 ± 4.872 with p-value = 0.000. The mean difference between the intervention group and the control group also showed the mean was 346.25 more than the control group with a delta score of 301.31. In conclusions showed that hydrogel extract of snakehead fish was effective among type II diabetes mellitus patients with healing grade II ulcers.

Keywords: hydrogel, snakehead fish, wound healing, Grade II ulcers, type II diabetes Mellitus

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Introduction

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia which causes a decrease in the hormone insulin produced by the pancreas gland (1). Improper control of diabetes would cause damage to the nervous system and blood vessels. Diabetes mellitus included: kidney failure, diabetic retinopathy, neuropathy in the lower extremities, ulcers, infection, and requiring amputation (2).

The International of Diabetic Federation (IDF) showed the number of diabetes mellitus sufferers globally was 415 million in 2015. In 2040 diabetes mellitus patients could be predicted to be 642 million people (3). *Riskesdas* showed a significant increase of diabetes from 6.9% in 2013 to be 8.5% in 2018. It was estimated that the number of sufferers in Indonesia reached more than 16 million people at risk of heart disease, stroke, leg ulcers, kidney failure, and even death (4).

Diabetes mellitus patients are prone to complications of diabetic ulcers, which are complications of diabetes mellitus. It was estimated that 15% of diabetes patients would suffer from foot ulcers during their life. The prevalence of complications of foot ulcers ranges from 4% - 27% (5). Data of diabetes mellitus in Bengkulu province for 2018 were 19,353 people. In North Bengkulu Regency were 834 people (6). Indonesia is the seventh in the world after Mexico, where there are around 10 million people Indonesian people who suffer from diabetes mellitus (7).

Four pillars of Diabetes mellitus management were essential to control the causes of disease and prevent complications. Those pillars consisted of education, nutritional therapy, physical activity, and pharmacology. The parameter is for maintaining blood glucose levels using glycolized hemoglobin (HbA1c). It is also used to assess blood glucose levels for the last 2-3 months (8).

One of the complications often occurs, such as diabetic ulcers due to the not optimal treatment. Also, its impact decreased the levels of albumin in the blood, affecting wound healing (9). Thus, diabetes ulcers could experience paralysis and amputation, so wound care is needed that can speed up the wound healing process.

The process of healing diabetic ulcer wounds with complications requires holistic treatment. Ulcer grade consists of grade 0 to grade 5. There is a risk of infection in grade II ulcers experiencing an acute inflammatory phase due to bacteria. High glucose levels make ulcer healing obstructed due to the prolonged inflammatory phase. Holistic treatment of diabetic foot includes metabolic control, vascular, infection, ulcers, pressure, mechanics, and education (10,11).

Wound care is the regular cleaning of necrotic tissue following wound care principles, including cleansing, debridement, and dressings (12). The goal of diabetic ulcer treatment is to improve the quality of life, such as enhancing the quality of life, minimizing and eliminating complaints. Cleaning ulcers with the classic cleansing method using antiseptics such as povidone-iodine, acetyl acid, and chlorohexidine can interfere with the wound healing process because they are corrosive (13). One way to accelerate wound healing and maintain blood sugar stability is to do regular foot care using modern snakehead fish extract dressings. (3,14)

Snakehead fish extract is a freshwater fish widely used by Indonesia as an ingredient for healing wounds. The main ingredient in snakehead fish is protein or albumin, which is relatively high (15). The albumin content in snakehead fish is a globular protein often applied clinically to improve nutrition and wound healing. Albumin functions to regulate the osmotic pressure in the blood, maintaining the presence of water in the blood plasma to maintain blood volume. Albumin is also helpful in forming body tissues, such as wounds after surgery, burns, and sick (16). Albumin is the most abundant protein in plasma, about 60% of total plasma. Albumin is needed by the body

to maintain the balance of body fluids. As a transport medium for various essential substances in the body, the process of making albumin in human blood is hampered so that nurses can provide complementary treatments that can help wound healing through innovative wound care with modern dressings in the form of hydrogel extract. Snakehead fish consisted of essential substances such as albumin, zinc (Zn), copper (Cu), and iron (Fe) for wound healing (13).

Fitriani and Deviarni (2013) developed albumin extract from snakehead fish into a wound-healing cream. Albumin group protein is perfect for forming new cells, accelerates the recovery of damaged body cell tissue, and maintains fluid balance in blood vessels. The results of the experiment on mice showed that the 60-gram treatment gave four days of healing time, while the 20 gram and 40-gram treatment gave five days of healing time (15).

Research conducted by MuhamadAndrie and Dies Sihombing explained the process of stage II acute wound healing in male Wistar rats given topically to 6 groups. The rats' skin was made open stage II acute wound, then smeared with ointment preparation, and the healing process was observed for 16 days. This study showed a significant difference between the water phase combination ointment treatment group of snakehead fish oil extract and the negative control group. The 10% water-oil phase combination ointment of snakehead fish extract had the effectiveness of healing open stage II acute wounds with an AUC value of 874.901% x days (17). Based on the above background, research is interested in knowing the effectiveness of snakehead fish hydrogel (chanastriata) on grade II ulcer wound healing in patients with type II diabetes mellitus.

Objective

The study aimed to examine hydrogel's effectiveness from snakehead fish on the number of bacterial colonies and wound healing among type II diabetes mellitus patients with grade II ulcers.

Methods

A quasi-experiment study, pretest, and post-test with a non-equivalent control group were applied in this study. The intervention group received the hydrogel of snakehead fish extract. The dose of treatment was 675.675 mg for 21 days and providing once every three days. The control group received the standard care with Nacl 0.9% for 21 days and every three days. Wound healing scores were measured using the Bates-Jensen Wound Assessment Tool (BWAT) questionnaire value before (pretest) and after (post-test) intervention.

The population in this study was patients with grade II diabetic ulcers. Determination of the number of samples in this study using a non-probability sampling technique with a purposive sampling method and inclusion and exclusion criteria. About 32 respondents were divided into two groups, with 16 respondents in the intervention group who were given wound care with a hydrogel snakehead fish extract dose of 675.675 mg and Nacl 0.9% and 16 respondents in the control group received wound care with Nacl 0.9%.

In this study, before conducting the research, the researcher explained the research procedures and signed the concentrate informants. Furthermore, the researcher collected data using observation, identification, interview, and filling out the previous observation sheet. The collected data were analyzed through the IBM SPSS version 24.0 program and continued with the t-test, namely the Paired t-test and Independent t-test parametric test. The processed data is used to

discuss the problem statement, which is then presented in tabular form so that conclusions can be drawn.

Result

Characteristic of respondents

Table 1 showed the characteristic of respondents. The statistical analysis showed ($p = 0.428$), which indicates no significant difference between the intervention and control groups. The mean age of the intervention group was 55.06 years, and the control group was 55.25 years. Most of the respondents in both the intervention group and control group were female gender. The majority of respondents graduated from, worked as housewives. Most of the respondents did not have a history of smoking, with the mean blood sugar levels was 255.19 mg/dl in the intervention group and 254.31 mg/dl for the control group.

Table 1 characteristic of respondents among the intervention group and the control group (n = 32)

Characteristics	Intervention		Control		P
	F	%	F	%	
Gender					
Men	7	43.8	6	37.5	0.510
Women	9	56.2	10	62.5	
Total	16	100	16	100	
Education					
Primary School	3	18.8	4	25.0	0.300
Junior High School	6	37.5	8	50.0	
Senior High School	5	31.3	3	18.8	
Diploma	2	12.5	1	6.2	
Total	16	100	16	100	
Profession					
Civil servants	3	18.8	2	12.5	0.126
Private	4	25.0	1	6.3	
Farmer	1	6.3	4	25.0	
Housewife	8	50.0	9	56.2	
Total	16	100	16	100	
Smoking History					
Yes	6	37,5	4	25,0	0.154
No	10	62,5	12	75,5	
Total	16	100	16	100	
GDS (Mean±SD)	255.19 ± 38.351		254.31 ± 37.089		0.977
Age (Mean±SD)	55.06 ± 5.836		55.25 ± 6.708		0.428

**Homogeneous Test*

Mean differences in wound healing before and after receiving treatment among the intervention and control groups

Table 2 showed the mean score of wound healing before and after receiving the treatment was significantly different in both the intervention and control groups. The mean wound healing score in the intervention group after receiving the therapy improved with-value 0.000. Simultaneously, the mean scores of wound healing in the control group increase with the wound degeneration wound healing category ($p = 0.000$).

Table 2. mean differences in wound healing before and after receiving treatment among the intervention and control groups.

Group	Pretest	Post Test	Delta	P
	Mean±SD	Mean±SD		
Intervention group	26.31± 6.740	13.00± 4.872	-13.31±4.316	0.000
Control group	25.63± 6.238	19.75± 7.010	-5.88± 2.419	0.000

*Paired t test

Mean differences in wound healing after treatment between the intervention group and the control group

Table 3 showed the mean differences in wound healing after treatment between the intervention and control groups. The findings showed the mean score of wound healing between the intervention group and the control group after treatment for 21 days was significantly different with a p-value = 0.004. The mean delta score for wound healing in the intervention group was more significant than the control group, -13.31, while in the control group was -5.88. It was indicated the intervention group was faster on healing than the control group.

Table 3. mean differences in wound healing after treatment between the intervention group and the control group.

Variable	Intervention Group	Control Group	Mean Difference	T	P
	Mean±SD	Mean±SD			
Wound Healing	13.00± 4.872	19.75± 7.010	-6.750	-3.163	0.004
Delta Wound Healing	-13.31±4.316	-5.88 ± 2.419	-7.438	-6.013	0.000

*Independent t test ($p < 0,05$)

Discussion

The results showed that the treatment of diabetic ulcer wounds with a hydrogel of snakehead fish extract was proven to be effective in reducing the wound healing score with the results of the paired t-test that $p = 0.000$. the independent t-test results obtained $p = 0.004$, which indicates a significant difference in wound healing scores between the intervention and control groups.

Changes in wound healing scores can be seen from the results of the mean value analysis before treatment. The score for wound healing as measured using the Bates-Jensen Wound Assessment Tool (BWAT) is 26.31. After the intervention, for 21 days, the mean value has

changed to 13.00 with a mean difference. The decrease on day 1 to day 21 was -13.3, which indicates that the reduction in wound healing scores in the intervention group experienced a higher decline than the control group, which experienced a drop of only -5.88. In conclusion, the treatment of diabetic ulcer wounds with a hydrogel of snakehead fish extract effectively reduced the score of wound healing into wound regeneration. The wound healing starts from a wound score with an average of less than 14, the depth of the visible wound, and one with the base. Damage, unseen wound edge, undermining 2-4 cm, with necrotic tissue absent or more negligible than <25%, moist wound, and 75- <100% epithelialization.

The ulcer healing process is the same for every diabetes mellitus ulcer. Ulcers are said to experience a healing process if they experience an inflammatory phase, a proliferation phase, and a maturation phase (18,19). Research on the treatment of Diabetic ulcer wounds with a hydrogel of snakehead fish extract and 0.9% NaCl was conducted for 21 days. Treatment of wounds with hydrogel snakehead fish extract was carried out every three days at a dose of 675,675 mg.

Hydrogel has a role to naturally remove dead or necrotic tissue by autolysis debridement based on glycerin or water. Hydrogel functions to create a moist environment or atmosphere in the wound besides softening or destroying necrotic tissue without damaging healthy tissue (20,21).

The use of hydrogel dressings maintains the water content of the wound and as a moisturizer and removes necrotic tissue. Another advantage is that it can be used in conjunction with topical bacterial anti-bacterial. This dressing can be used in various types of wounds such as pressure ulcer wounds, moderate to severe injuries, and vascular ulcers. There are multiple types of modern dressings with hydrogel, one of which is using snakehead fish extract (22).

Snakehead fish (*chanastriata*) is a fish that has a brown to the black body on the top and light brown to whitish on the stomach. Snakehead fish is a fish that is rich in protein. The protein content of snakehead fish reaches 25.5% (the albumin content of snakehead fish can reach 6.22%); besides that, snakehead fish also contains essential substances such as zinc (Zn), copper (Cu), and iron (Fe) for wound healing (23).

The albumin content in snakehead fish is a globular protein often applied clinically to accelerate damaged tissue or body cells' recovery (24). Albumin has several functions at the stage of wound healing. The first function is that albumin will maintain the osmotic pressure between the fluid inside the cell and the fluid outside the cell during the inflammatory phase. Albumin maintains the presence of water in the blood plasma to maintain blood volume and keep fluids from outside the cells from entering the cells and causing the cells to swell.

The second function is that albumin is a primary material in the formation of new body tissues through the body's catabolic processes that break down albumin into amino acids for later use in the shape of new tissue. Albumin in the water phase of snakehead fish extract contains large amounts of the amino acids that make up collagen fibers, namely glycine and proline. This dramatically affects fibroblasts to synthesize collagen, thereby accelerating forming new tissue on proliferation and maturation.

The third function of albumin is to transport nutrients and oxygen that the body needs for the formation of new tissue at the proliferation stage (25,17). NaCl, 0.9% fluid, is an isotonic liquid and contains physiological saline, which is good for cleaning and compressing the skin. Ulcers. This fluid functions as an irrigator to clean dirt and ulcer bacteria which can be lifted and carried by water but cannot kill bacteria maximally. This study's results align with Andrie's (2017) research, which proves that 10% snakehead fish extract taken for 16 days has healing effectiveness against acute stage II open wounds (17).

Judging from the ulcer assessment score when the first measurement was carried out, the average respondent was in the ulcer degeneration phase (ulcer score > 13). The ulcer was in the inflammatory phase. The respondent's ulcer healing process's duration is related to the body's ability to respond to infection by metabolizing to produce materials that can fight bacteria, especially white blood cells and nutrients, for the continuity of wound healing. The wound healing score after 21 days of wound care was carried out by administering hydrogel of snakehead fish extract at a dose of 675.675 mg in the intervention group was 13, which was in the regeneration phase while the control group was in the degeneration ulcer phase (ulcer score > 13).

Conclusion

Providing hydrogel of snakehead fish extract dose of 675.675 mg effectively reduced wound healing of grade II ulcer scores in type II diabetes mellitus patients

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