BIOLOGY, MEDICINE, & NATURAL PRODUCT CHEMISTRY ISSN 2089-6514 (paper)
Volume 13, Number 2, October 2024 | Pages: 517-522 | DOI: 10.14421/biomedich.2024.132.517-522 ISSN 2540-9328 (online)

Formulation and Evaluation of Hard Candy Preparation As an Innovative Internal Wound Medicine from Snakehead Fish (*Channa striata*) Albumin Extract

Ilvid Diana, Elfi Abidah Ardelia, Nazilatun Nadriani, Dilna Azizah, Dea Nova Widhyati, Mohammad Rofik Usman*
Pharmacy Department, Faculty of Health Science, Universitas dr. Soebandi,
Jl. Dr. Soebandi No. 99 Jember, Tel/Fax. (0331) 483536, Indonesia.

Corresponding author*
mrofik05@gmail.com

Manuscript received: 18 August, 2024. Revision accepted: 10 October, 2024. Published: 30 October, 2024.

Abstract

Snakehead fish (*Channa striata*) is another alternative source of albumin protein because it is known to contain important compounds for the human body including high protein, fat, water, and the mineral zinc (Zn). The albumin content in Snakehead fish is an important protein needed by the body and is useful for wound healing. This study aims to make preparations by modifying Snakehead fish albumin into hard candy while maintaining the albumin content. Thus, a more effective way to be consumed in accelerating wound healing was found. The treatment used is Snakehead fish albumin extract with concentrations including F1 (5%), F2 (10%), and F3 (15%). Tests were conducted physically (organoleptic test) and chemically (moisture content test, ash content test, and wound growth activity test). Formulation and evaluation of hard candy preparations of Snakehead fish albumin extract (*Channa striata*) can be declared successful, as evidenced by the formation of 5 successful formulations into hard candy preparations as evidenced by the results of organoleptic tests, water content tests and ash content tests that have met the standards.

Keywords: Snakehead fish (*Channa striata*); Hard candy; Steaming; Albumin; Effective.

INTRODUCTION

Wound is a condition of damage to tissue continuity, structure, and anatomical function of normal skin due to pathological processes originating from the internal or external environment and affecting certain organs (Sulakhiya et al., 2024). According to the Indonesian Ministry of Health in 2018, the incidence of slash/stab wounds in Indonesia was 20.1% with the highest rate in the 35-44 age group at 24.0%. In addition, the prevalence of patients with cuts/stab wounds in East Java Province was 18.2%. Meanwhile, in Jember District, the incidence of injuries due to traffic accidents in 2023 was 1381 cases, with details of 4 serious injuries and 1580 minor injuries.

Optimal wound care plays an important role in the wound healing process so that it can take place well and in a short time so as not to reduce productivity and increase wound care costs (Sahu et al., 2024). The general treatment of wounds consists of two things, namely external treatment and internal treatment. For external treatment, the things that need to be prepared are wound bed preparation and wound closure. Wound bed preparation is done through debridement, bacterial control, and wound exudate management. Wound closure is done when the wound has been well incised and can be done per-secundam, per-primam, skin graft, flap, and by using stem cells (Palakkara et al., 2020). As for internal treatment, antibiotics are needed to kill bacteria and speed up the wound healing process (Yuniar, Yasid, Nissatuljannah, Rijal, & Makmun, 2023).

Antibiotics as drugs to treat infectious diseases, their use must be rational, appropriate, and safe. The irrational use of antibiotics will cause negative impacts, such as the occurrence of microorganism immunity to some antibiotics, increasing drug side effects, and even resulting in death. The negative impact of irrational use of antibiotics, such as the use of antibiotics too often, excessive use of new antibiotics, and the use of antibiotics for a long time is the emergence of microorganism resistance to various antibiotics (*multidrug-resistance*). This results in ineffective treatment, increased patient morbidity and mortality, and increased health costs (Ministry of Health, 2005) (Bonine et al., 2019). Thus, there is a need for internal medicine that does not include antibiotics and is safe to use such as albumin.

Snakehead fish (*Channa striata*) is another alternative as a source of albumin protein because it is known to contain important compounds for the human body including high protein, fat, water, and the mineral zinc (Zn) (Karlina & Luthfi, 2018). The albumin content in Snakehead fish is an important type of protein needed by the body and is useful for the wound healing process. Therefore, Snakehead fish has an important role in the wound healing process because it has a much better quality than egg albumin which is commonly used in healing post-surgical patients (Berlian, Riani, Kurniati, & Rachmawati, 2023).

The current way to process Snakehead fish is by steaming or frying. Processing fish with frying can reduce albumin levels or denatured. Meanwhile, processing fish by steaming produces albumin extract with an unpleasant odor. Both preparations do not last long, so a way is needed to process albumin so that it is not damaged and lasts long with an attractive taste.

MATERIALS AND METHODS

Equipment and Materials

The tools that will be used in this research are analytical scales (SOJIKYO Hp-1/2000), desiccator (Duran Vacuum Desiccator Type 300 mm), stirring rod, 10 mL measuring cup and tube rack, hot plate (Hi-Cook Tipe ES-155), watch glass, thermometer (Thermometer Alco - 10), beaker glass (Iwaki), porcelain rate, spatula, napkins, sieve, tissue, oven (Memmert UN 30 Universal Oven), Mold, glass funnel, Whatman -41 filter paper, aluminum foil, animal cages, scissors, scalpel, panic, stove, basin.

The materials used in this study were Snakehead fish extract, sucrose (Merck), isomalt (Merck), distilled water, lemon flavor (Zender), Striatamine, 70% alcohol (ONE MED), NaCl 0.9% (OTSU), male white mice (*Mus musculus*) aged 6-8 weeks with a weight of 18-20 grams.

Research Procedure

Extraction of Snakehead Fish (Channa striata)

Making albumin extract from Snakehead fish is done by steaming Snakehead fish that has been washed and cut into small pieces. To reduce the fishy odor of the extract, ginger, and turmeric can be added during steaming. Steaming is done using a large pot and stove for about two hours over low heat. Put the Snakehead fish that has been cut into small pieces into a large pot and add ginger and turmeric to reduce the fishy odor of the Snakehead fish.

Hard Candy Making

The process of making Snakehead fish hard candy includes the stages of taking albumin, mixing, heating, molding, and cooling. First, dissolve 60 grams of sugar (for healthy people and people with diabetes mellitus) in water that has been boiled to 100℃. After the sucrose is completely dissolved, the heating is continued until the temperature is 140C. The temperature is lowered slowly by turning off the heat source. The stirring process was continued and Snakehead fish extract was incorporated into the candy mixture. The end of cooking is determined by the thickened candy mixture. While still hot and thick, the candy mixture is put into the mold. The molding process is complete when the candy is cool and hard (do Nascimento, Pimentel, Garcia, & Prudencio, 2023).

Table 1. Hard candy formulations for healthy people and diabetics.

Material	Formulation (%)				
	F1 (5%)	F2 (10%)	F3 (15%)	F4 (5%)	F5 (10%)
Snakehead fish extract	5	10	15	5	10
Sucrose	60	60	60	-	-
Isomalt	-	-	-	60	60
Flavor	3	3	3	3	3
Aquadest	Ad 100 mL	Ad 100 mL	Ad 100 mL	Ad 100 mL	Ad 100 mL

Organoleptic Test

Organoleptic tests are carried out by describing the color, smell, taste, and texture of the preparation using the five senses.

Water Content Test

The water content test was carried out by weighing 2 grams of Snakehead fish hard candy, putting it in a cup, then putting it in an oven at 100-105 ℃ for 3-5 hours, then cooling it in a desiccator, then weighing it. The calculation of moisture content is done with the formula:

$$Water\ content\ = \frac{b-c}{b-a}\ x\ 100\%$$

Description:

a : weight of the cup (g)

b : weight of cup and wet sample (g)

c : weight of cup and dry sample (g) (Zarwinda, Nadia, & Rejeki, 2022).

Ash Content Test

A total of 5 grams of Snakehead fish hard candy is put into a porcelain cup that has a known weight, then

burned at 500℃ for 4-5 hours or until white ash is formed, then put the sample in a desiccator, then weigh the sample. Calculation of ash content is done with the formula:

$$Ash\ content\ = \frac{W_2 - W_0}{W_1 - W_0}\ x\ 100\%$$

Description:
W_0 : weight of the cup (g)
W_1 : weight of cup and wet sample (g)
W_2 : weight of cup and sample after ashing (g)
(Zarwinda et al., 2022).

Wound Healing Activity Test

Our research has met the code of ethics for research involving animal testing with an ethics certificate number 330/KEPK/UDS/V/2024. The test animals used were 25 male white mice (*Mus musculus*) that were randomly grouped into 5 groups so that each group consisted of 5 mice and were treated as follows: Aquadest as the negative control group (K-). Striatamine as a comparison group (K+), 5% concentration of Snakehead fish extract in group 1 (P1), 10% concentration in group 2 (P2), and 15% concentration of group 3 (P3). The day before making the incision wound, the mice's back area was shaved and then a veet was used to shave the fine hairs in the back area. After shaving, the back area of the mice was cleaned with 70% alcohol. Next, an incision was made in mice with a sterile scalpel (scalpel) with an incision size of 1 cm long and 0.2 cm deep on the back of the mice. Then the skin that has been injured by the scalpel incision is applied with striatamine as much as 0.1g and Snakehead fish extract with 3 different concentration variations (5%, 10%, and 15%) evenly as much as 0.1g twice a day until the wound heals. Observations were made visually by paying attention to changes in wound length, observation of erythema, edema, crusts, and days of wound healing. Wound length measurements were taken using a caliper (Hertian & Muhaimin, 2021).

RESULTS AND DISCUSSION

Organoleptic Test

Organoleptic testing has been carried out on Snakehead fish albumin hard candy (*Channa striata*) with concentrations F1 (5%), F2 (10%), and F3 (15%) which can be seen in Table 2.

Table 2. Organoleptic Test Results of Hard Candy for Healthy People and Diabetics.

Hard Candy Snakehead Fish Extract	Texture	Color	Flavor	Odor
F1	Hard	Brownish orange	Sweet	Typical candy odor
F2	Hard	Brown	Sweet	Typical candy odor
F3	Hard slightly sticky	Brown	Sweet	Typical candy odor
F4	Hard	Brownish orange	Not too sweet	Typical candy odor
F5	Hard slightly sticky	Lemon	Not too sweet	Lemon
F6	Unsuccessful			

Organoleptic tests use the five senses which include observation of texture, color, taste, and smell. Based on the table above, the difference in the percentage of water addition greatly affects the level of hardness of Snakehead fish albumin hard candy. The more water is added to the sucrose dissolving process, the easier the candy will be destroyed (not hard), this can be caused because sucrose can bind water so that the candy will contain more water. In Table 2, it can be seen that the color variation is influenced by the amount of addition of Snakehead fish albumin extract. In F1, the resulting color is brownish orange, F2 produces a brown color, and F3 produces a deep brown color. The more the addition of Snakehead fish albumin extract, the more intense the color will be. Snakehead fish albumin hard candy has a sweet flavor. The flavor is not influenced by the percentage of Snakehead fish albumin extract added. The odor organoleptic test produced in F1, F2, and F3 has a typical candy smell. It can be seen that the color variation is not affected by the amount of addition of Snakehead fish albumin extract. In F4 the resulting color is brownish orange, and F5 produces a lemon color. Snakehead fish albumin hard candy for diabetics has a not-so-sweet flavor. The taste is influenced by the main ingredients used, because in the formulation for diabetics the sugar used is isomalt. An Organoleptic test of the odor produced in F4 is the typical smell of candy, and F5 the smell of lemon that comes from flavorings.

Water Content Test

Water content testing has been carried out on Snakehead fish extract (Channa striata) albumin hard candy with F1 (5%), F2 (10%), and F3 (15%) concentrations which can be seen in Table 3.

Table 3. Water Content Test Results of Hard Candy for Healthy People and Diabetics.

Hard Candy Testing	Water Content
F1	0,89%
F2	1,6%
F3	1,5%
F4	1,3%
F5	1,6%

Based on table 3, the lowest water content is found in F1 with 5% Snakehead fish albumin extract treatment, which is 0.89%, While the highest water content was found in F2 with 15% Snakehead fish albumin extract treatment, which was 1.5%. While in table 6 the water content of F3 is 1.3%, F4 is 1.6%. This research is in line with Regia (2019), the value of water content is different from one another. This is related to the water activity of food ingredients which is also reduced due to the effect of adding different concentrations of Snakehead fish albumin extract and different water. The different water content values are because during the cooking process, neither the temperature nor the length of heating time is measured. The moisture content of hard candy is said to be qualified if the quality is not more than 3.5% (SNI 3547.1: 2008). All four Snakehead fish albumin extract hard candy formulations meet the standard because they contain moisture content below 3.5%.

Ash Content Test

Ash content testing has been carried out on Snakehead fish extract (*Channa striata*) albumin hard candy with F1 (5%), F2 (10%), and F3 (15%) concentrations which can be seen in table 4.

Table 4. Water Content Test Results of Hard Candy for Healthy People and Diabetics.

Hard Candy Testing	Ash Content
F1	0,059%
F2	0,137%
F3	0,065%
F4	0,026%
F5	0,058%

Ash content testing has been carried out on Snakehead fish albumin extract hard candy (Channa striata) with concentrations F1 (5%), F2 (10%), and F3 (15%) which can be seen in the table below. Ash content is one of the determining parameters of hard candy, because the lower the ash content, the better the appearance of the candy. The treatment of different concentrations had a significant effect on the ash content of hard candy. The more sucrose and isomalt concentration added, the higher the mineral content. The high ash content of sucrose and isomalt will trigger foam formation during the heating of the sugar solution. In addition, high ash content leads to increased inversion and coloration. Ash content correlates with mineral content in general, the greater the mineral content, the higher the ash content obtained.

The ash content of Snakehead fish albumin extract hard candy (Channa striata) in F1, F2, and F3 for healthy people was 0.059%, 0.137%, and 0.065%, respectively. In the results of F2 with a composition of 10%, it is thought that it will affect the interaction between the components in the preparation because of the higher interaction than F1 and F3, the same thing was also obtained in Regia's article (2019) (Rakhmayanti & Hastuti, 2019). While the results for F4, F5 are 0.026% and 0.058%. When compared between F1 with F4 and F2 with F5, it shows that the results of ash content with sucrose as the main ingredient (F1, F2, F3) have a higher value than those made from isomalt (F4, F5), this difference can be caused by the difference in chemical structure between sucrose and isomalt, where sucrose has 2 rings that are difficult to denature, resulting in lower ash content compared to sucrose which is easily decomposed into gas because it only has one ring. However, the ash content of Snakehead fish albumin extract hard candy still meets the quality requirements, because SNI (354.1: 2008) states that the ash content of hard candy meets quality standards if it is not more than 2%.

Wound Healing Activity Test

Wound healing activity has been tested on test animals with 7 treatment groups which can be seen in table 5.

Table 4. Wound Healing Activity Test Results.

Concentration	Day 1	Day 7	Day 14
K+			
K-			
F1			
F2			
F3			
F4			
F5			

This study was conducted to estimate the wound healing effect of hard candy preparation of Snakehead fish albumin extract (Channa striata) experimentally by oral route administration. The incision wound was

measured using a caliper, and an elongated incision wound model was used to assess the in vivo wound healing activity of Snakehead fish albumin extract. The test animals used in this study were male mice, with body weights ranging from 16-20 grams. Mice to be used in this study were first acclimatized for one week in the laboratory under controlled environmental conditions.

Wounds are made on the dorsal (back) of the mice using a sterile scalpel, forming a wound approximately 1 cm long and 0.2 cm deep. The wound is then left untreated for several hours to allow hemostasis. Mice were divided into several treatment groups, namely the positive control group using triatomine drug, a negative control group (no treatment), and a group receiving Snakehead fish albumin extract hard candies with formulations of 5%, 10%, 15% for healthy people and formulations of 5%, 10% for diabetics. Treatments were administered orally daily for 14 days. The wound healing process was observed every day. Based on table 4.7, it can be concluded that the wound condition on day 14 was completely healed for all groups except the negative control group because there were still scabs on the incision marks. The cause of not fully recovering in mice is due to certain factors that are relative, such as health condition, organ condition, immunity, and some other relative factors.

CONCLUSIONS

Formulation and evaluation of hard candy preparations (hard candy) of Snakehead fish albumin extract (Channa striata) can be declared successful, evidenced by the formation of 5 successful formulations into hard candy preparations as evidenced by the organoleptic test results, moisture content test and ash content test that meet the standards. In addition, oral administration of Snakehead fish extract (Channa striata) to test animals in the wound healing process, in each group showed good results. Indicated by the return of the skin condition of the test animals as before treatment.

Acknowledgments: The author would like to thank the Directorate General of Higher Education under the management of the Directorate of Learning and Student Affairs (Belmawa) through the student creativity program and dr. Soebandi University for supporting the author in completing this scientific article.

***Competing Interests*:** The authors declare that there are no competing interests.

REFERENCES

Berlian, G., Riani, C., Kurniati, N. F., & Rachmawati, H. (2023). Peptide derived C. striata albumin as a natural angiotensin-converting enzyme inhibitor. *Heliyon, 9*(5), e15958. doi:https://doi.org/10.1016/j.heliyon.2023.e15958

Bonine, N. G., Berger, A., Altincatal, A., Wang, R., Bhagnani, T., Gillard, P., & Lodise, T. (2019). Impact of Delayed Appropriate Antibiotic Therapy on Patient Outcomes by Antibiotic Resistance Status From Serious Gram-negative Bacterial Infections. *The American Journal of the Medical Sciences, 357*(2), 103-110. doi:https://doi.org/10.1016/j.amjms.2018.11.009

do Nascimento, R. R., Pimentel, T. C., Garcia, S., & Prudencio, S. H. (2023). Acacia gum candy with Limosilactobacillus reuteri and lemongrass essential oil: Effect of storage time on physicochemical characteristics and probiotic survival. *Food Bioscience, 56*, 103128. doi:https://doi.org/10.1016/j.fbio.2023.103128

Hertian, R., & Muhaimin, M. (2021). Uji efektivitas ekstrak daun ekor naga (Rhaphidohora pinnata (Lf) Schott) terhadap penyembuhan luka sayatan pada mencit putih jantan. *Indonesian Journal of Pharma Science, 3*(1), 11-20.

Karlina, I., & Luthfi, M. J. f. (2018). Comparative Anatomy of Labyrinth and Gill of Catfish (Clarias gariepinus) (Burchell, 1822) and Snakehead Fish (Channa striata) (Bloch, 1793). *7*. doi:10.14421/biomedich.2018.72.39-43

Palakkara, S., Maiti, S. K., Mohan, D., S, S., R, R., E, K., & Kumar, N. (2020). Healing Potential of Chitosan and Decellularized Intestinal Matrix with Mesenchymal Stem Cells and Growth Factor in Burn Wound in Rat. *Wound Medicine, 30*, 100192. doi:https://doi.org/10.1016/j.wndm.2020.100192

Rakhmayanti, R. D., & Hastuti, R. T. (2019). Formulasi Hard Candy Ekstrak Kayu Secang (Caesalpinia sappan L.). *IKRA-ITH Teknologi Jurnal Sains dan Teknologi, 3*(3), 1-6.

Sahu, K. K., Kaurav, M., Bhatt, P., Minz, S., Pradhan, M., Khan, J., . . . Yadav, K. (2024). Utility of Nanomaterials in Wound Management. In P. R. Solanki, A. Kumar, R. Pratap Singh, J. Singh, & K. Rb Singh (Eds.), *Nanotechnological Aspects for Next-Generation Wound Management* (pp. 101-130): Academic Press.

Sulakhiya, K., Soni, P., Tembhre, M. K., Kungumaraj, H. J., Paliwal, R., & Kumar, S. (2024). Physiology and Pharmacology of Wounds. In P. R. Solanki, A. Kumar, R. Pratap Singh, J. Singh, & K. Rb Singh (Eds.), *Nanotechnological Aspects for Next-Generation Wound Management* (pp. 21-54): Academic Press.

Yuniar, A. I., Yasid, N. W., Nissatuljannah, S. F., Rijal, S., & Makmun, A. (2023). The Potential of a Sumbawa Herbal Oil-Based Oleogel as Burn Wound Dressing. *12*. doi:10.14421/biomedich.2023.122.559-562

Zarwinda, I., Nadia, N., & Rejeki, D. P. (2022). Formulasi Permen Keras (Hard Candy) Kopi Defect Arabika Gayo. *Journal of Pharmaceutical and Health Research, 3*(3), 118-122.