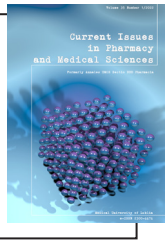
Current Issues in Pharmacy and Medical Sciences
Formerly ANNALES UNIVERSITATIS MARIAE CURIE-SKLODOWSKA, SECTIO DDD, PHARMACIA

journal homepage: http://www.curipms.umlub.pl/



Effect of broiler chicken egg white gel extract (*Gallus domesticus*) on wound healing duration in male *Mus musculus* mice

Sudarto Sudarto[1*], Ade Heryanto[1], Muhammad Ifham Hanif[2], Slamet Slamet[3]

[1] Department of Nursing, Poltekkes Kemenkes Pontianak, Pontianak, Indonesia
[2] Department of Internal Medicine, Medical Faculty of Sebelas Maret University/Dr. Moewardi General Hospital, Surakarta, Central Java, Indonesia
[3] Department of Medical Laboratory Technology, Poltekkes Kemenkes Pontianak, Pontianak, Indonesia

ARTICLE INFO

Received 03 October 2022
Accepted 22 December 2025

Keywords:
egg white gel extract,
Gallus domesticus,
wound healing,
Mus musculus.

ABSTRACT

Skin injuries that disrupt soft tissue integrity result in wounds. Wound healing is a complex and prolonged process involving tissue repair and remodeling in response to injury. When skin continuity is lost, its protective and regulatory functions are compromised. Therefore, appropriate wound management and treatment are essential to prevent infection and the development of chronic wounds.

This study aimed to compare wound healing duration following incision wounds treated with broiler chicken egg white gel extract. A quasi-experimental study with a post-test control group design was conducted. Two treatment groups were included. In Group I, wounds were cleansed with 0.9% sodium chloride (NaCl) solution, while in Group II, wounds were treated with a broiler chicken egg white gel extract ointment.

The results demonstrated a significant difference in wound healing duration between the two groups. Treatment with broiler chicken egg white gel extract (*Gallus domesticus*) ointment accelerated wound healing more effectively than the control treatment using 0.9% NaCl.

INTRODUCTION

Wounds are a condition that every human being experiences at some point in life. A wound is defined as damage to a part of the body that occurs on the skin in the form of tissue that is cut, torn, or otherwise disrupted due to various causes [1,2]. In traumatology, wounds are classified into several categories, including those based on etiology, such as incisions, contusions, puncture wounds, abrasions, and lacerations. Incised wounds are typically caused by sharp objects, such as knives, razors, or surgical scalpels, and are characterized by straight, well-defined wound edges [3].

Under normal conditions, wound healing occurs through a series of complex and dynamic processes. This process is generally divided into four main phases: the inflammatory phase, the destructive phase, the proliferative phase, and the maturation (remodeling) phase [3]. In practice, however, these phases may overlap. The progression of wound healing depends on various factors, including local wound conditions, systemic pathophysiological status, physiological changes associated with aging, psychosocial factors, and other influences [2,4].

The wound healing process is of critical importance because the skin is the body's primary interface with the external environment. The skin serves several essential functions, including protection, sensation, thermoregulation, metabolism, and sexual signaling. When skin integrity is disrupted, these functions cannot operate properly. Therefore, appropriate wound management and treatment are necessary to prevent infection and reduce the risk of progression to chronic wounds [5,6].

Protein plays a crucial role in all phases of wound healing, beginning with the formation of leukocytes, phagocytes, and macrophages that initiate the inflammatory response. Amino acids derived from proteins are also essential for neovascularization, fibroblast proliferation, collagen synthesis, and wound remodeling. Patients experiencing trauma or undergoing surgical procedures generally require increased protein intake. Although minor surgery may not substantially

* **Corresponding author**
e-mail: sudarto@poltekkes-pontianak.ac.id

elevate protein requirements, pre-existing malnutrition can significantly impair the wound healing process. In addition, carbohydrates serve as the primary energy source for the production of adenosine triphosphate (ATP) at the cellular level, particularly during angiogenesis and new tissue formation [7,8].

The use of alternative materials in wound care represents an option alongside conventional medical treatments. Standard wound management commonly involves antiseptics such as povidone-odine, topical ointments, tulle dressings, and dry gauze. Eggs consist of three main components: the shell, egg white, and egg yolk, accounting for approximately 11%, 58%, and 31% of the total egg composition, respectively. Egg white is particularly rich in protein. Based on this background, the present study aimed to evaluate the effectiveness of broiler chicken egg white gel extract (*Gallus domesticus*) on wound healing time in male *Mus musculus* mice.

METHODS

Research design

This study employed a quasi-experimental design with a post-test control group. The research was conducted at the Poltekkes Laboratory, Ministry of Health, Pontianak, Indonesia. The initial stage of the study involved the preparation of broiler chicken egg white gel extract (*Gallus domesticus*).

Fresh eggs were washed with water and pasteurized by heating at 60°C for 3 minutes. The egg whites were then separated from the yolks. A total of 20 g of egg white was weighed and placed in a mortar or suitable vessel. One gram of hydroxypropyl methylcellulose (HPMC) was weighed and moistened with 4 g of glycerin. The moistened HPMC was subsequently mixed with the remaining distilled water and stirred slowly until a gel was formed. The HPMC gel was allowed to stand for 1 hour to ensure complete swelling. Afterward, the developed HPMC gel was mixed thoroughly with the egg white.

To preserve the formulation, 0.09 g of nipagin and 0.01 g of nipasol were dissolved in 1 g of propylene glycol. This preservative mixture was then added to the egg white gel and stirred until a homogeneous gel mass was obtained.

Experimental animals and wound induction

The experimental animals used in this study were 30 male Swiss Webster mice (*Mus musculus*), divided into two groups based on Federer's formula. Each group consisted of 15 mice. Prior to the intervention, all animals were acclimatized for two weeks to allow adaptation to laboratory conditions.

After the acclimatization period, the mice were topically anesthetized on the dorsal area using 0.1 mL of 1% lidocaine. The animals were placed in the prone position, and the skin was disinfected with 10% povidone-iodine. The dorsal hair was shaved, followed by antisepsis with 70% alcohol.

A standardized incision wound measuring 1 cm in length and approximately 0.2 cm in depth, reaching the subcutaneous layer, was created on the dorsal area using a sterile scalpel. The wound was then irrigated with distilled water until bleeding ceased.

Following wound induction, each group received a different intervention. Group I (control group) received wound cleansing with 0.9% sodium chloride (NaCl) solution, whereas Group II (treatment group) received topical application of broiler chicken egg white gel extract. Interventions and observations were performed daily at 17:00 WIB. Wound length was measured using a ruler. The study was considered complete when all wounds had healed completely.

Data analysis

Data were analyzed using the Independent Samples t-test to determine the effect of broiler chicken egg white gel extract (*Gallus domesticus*) on wound healing time in male *Mus musculus* mice. A significance level of $\alpha = 0.05$ was applied.

RESULTS AND DISCUSSION

Wound healing in mice was assessed macroscopically. Macroscopic observations were used to compare the wound healing process among the four experimental groups receiving different interventions. The results of the incision measurements in mice are presented in Table 1.

Table 1 Results of observation of cuts in mice

Mice	Days	
	Control NaCl 0.9%	Broiler chicken egg white gel extract
1	13	9
2	14	9
3	13	11
4	13	8
5	13	8
6	12	9
7	13	9
8	13	9
9	13	9
10	13	9
11	12	10
12	14	9
13	12	8
14	15	8
15	14	10
Means	13.13	9

As shown in Table 1, there was a clear difference in the time (days) required for complete wound closure between the two groups. In group I (0.9% NaCl), most mice achieved complete wound closure on day 12, with the longest healing time observed on day 15. The mean wound healing time in this group was 13.13 days.

In contrast, group II, treated with broiler chicken egg white gel extract ointment, showed significantly faster wound healing. Based on the table, wound closure in the gel extract-treated group occurred as early as day 8, with the latest complete closure observed on day 11. The mean wound healing time in this group was 9 days.

As shown in Figure 1, no significant difference in wound length was observed between the two groups on day 1. Mice treated with broiler egg white gel extract (group II) exhibited faster wound healing compared with the control group. In contrast, the 0.9% NaCl-treated group (group I) showed the slowest healing response, with complete wound closure occurring on average between days 13 and 14.

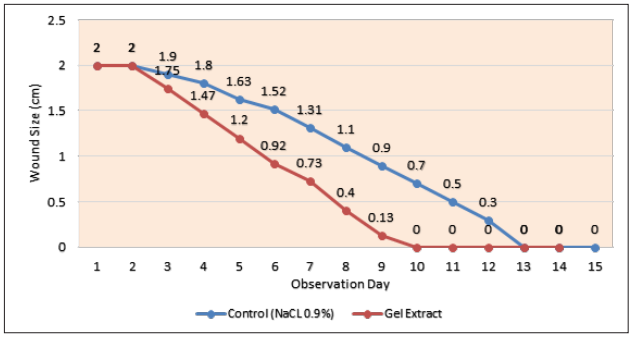


Figure 1. Average length of incision wound (cm)

As presented in Table 2, the mean wound healing time in the control group was 13.13 ± 0.8 days (range: 12.33-13.93 days), whereas mice treated with egg white gel extract showed a mean healing time of 9.0 ± 0.8 days (range: 8.2-9.8 days).

Table 2 Wound healing time

Group	Mean	Standard Deviation	Wound Healing Time (Days)
0.9% NaCl control	13.13	± 0.8	13.13 ± 0.8
Egg white gel extract	9	± 0.8	± 0.8

The independent samples t-test (Table 3) showed a statistically significant difference between the two groups ($p \leq 0.001$). This indicates that broiler chicken egg white gel extract significantly accelerated wound healing compared with treatment using 0.9% NaCl.

Table 3 Differences in wound healing between the control group and the Gel Extract

Group Statistics					P*	CI 95%	
Group	N	Lower Mean	Upper Std. Deviation	Std. Error Mean		Lower	Upper
NaCl 0,9%	15	13.133	0.8338	0.2153	≤0.001	3.5054	4.7613
Gel extract	15	9.000	0.8452	0.2182			

* Independent Samples Test, significant ≤0.005

In this study, wound healing activity was assessed based on the reduction in incision length. On the day of injury, an incision was made on the dorsal epidermis of the mice using a sterile scalpel, producing a wound approximately 0.2 cm in depth. Immediately after wounding, bleeding was observed as a result of damage to blood vessels, which is attributable to involvement of the papillary dermis, a layer that projects into the epidermis and contains capillaries and nerve fibers [9,10]. The bleeding was transient due to the body's physiological hemostatic mechanisms. Platelets rapidly exited the damaged blood vessels and, together with a fibrin network, aggregated to form a blood clot, thereby initiating the coagulation process [11].

After the incision was made on the dorsal surface of the mice, macroscopic observation revealed redness and swelling at the wound margins. In addition, the mice were observed scratching and biting the incision area. Incisional wounds undergo an inflammatory response characterized by erythema (rubor) due to capillary dilation, edema (tumor), and the release of various inflammatory mediators [11].

In group I, which was treated with 0.9% NaCl, the mice exhibited the longest time to complete wound closure, with a mean healing time of 13.13 days. Only minimal intervention was provided to support the wound healing process. Although no antibiotic therapy was administered, wound healing progressed, as evidenced by the presence of inflammatory signs and gradual reduction in wound size. This finding indicates that, in healthy organisms, the wound healing process can occur naturally through intrinsic physiological mechanisms.

In group II with broiler egg white gel extract treatment, mice had the fastest wound healing time than the control group. The average healing time required is nine days. In practice, egg white is used clinically as a nutrient and has been used for a long time in wound healing through oral consumption.

Wound healing is a process of tissue repair and functional restoration that begins immediately after injury. It proceeds through several overlapping phases, starting with the inflammatory phase, which occurs upon tissue damage and typically lasts 1-4 days. During this phase, vasoconstriction of blood vessels helps control bleeding through the formation of platelet plugs and fibrin fibers. This is followed by the proliferative phase, characterized by the formation of new blood vessels, deposition of ground substance, and synthesis of collagen fibers that gradually infiltrate the wound area. Epithelial cells proliferate and contribute to capillary formation, providing nutritional support for tissue regeneration, while collagen deposition becomes well established within 6-7 days. Clinically, wound healing outcomes can be classified as good (dry wound, complete closure, and absence of infection signs such as redness, swelling, necrosis, or functional impairment), moderate (moist wound with closure and no signs of infection), or poor (moist wound with incomplete closure and signs of infection) [7,12].

Egg whites can modulate macrophage activity and contain bioactive components, such as ovomucin, ovotransferrin, and lysozyme, which are known to enhance monocyte and macrophage activity, increase cytotoxicity, and stimulate killer T-cell responses in vitro. Macrophages play a crucial role in the immune response and wound healing. Their primary function is the phagocytosis of foreign particles, antigenic macromolecules, and damaged or necrotic cells and tissues.

Following tissue injury, macrophages migrate to the wound site after neutrophils, typically within 48-72 hours, and become the predominant inflammatory cells after the third day post-injury. At the wound site, macrophages phagocytose debris and bacteria and secrete a variety of growth factors that are essential for extracellular matrix formation by fibroblasts and for neovascularization. Therefore, macrophages are a key component of the inflammatory and early proliferative phases of wound healing [13,14].

Fibroblasts are responsible for synthesizing extracellular matrix components and collagen and play a central role in maintaining connective tissue integrity. These cells

accumulate in the wound area through angiogenesis between two and five days after injury and become the predominant cell type during the first week of the wound-healing process [15,16].

Ovalbumin, the major protein component of egg white, serves as an important source of amino acids required for growth factor activity. These growth factors promote wound healing by stimulating fibroblast proliferation and collagen synthesis, leading to progressive filling of the wound area. A higher number of fibroblasts is associated with increased collagen density; however, fibroblast activity accounts for approximately 33.9% of dense collagen formation, with the remaining contribution influenced by other factors such as amino acid availability, oxygen supply, antioxidant status, and iron availability. Amino acids serve as the fundamental building blocks of collagen, while oxygen and iron are essential cofactors that enhance collagen production in the body.

Collagen is a major structural protein of the dermis and a key component of the extracellular matrix, playing a critical role in maintaining tissue integrity and shape. In general, collagen accounts for approximately 25-35% of the total protein content in the human body. During wound healing, type III collagen is synthesized within the first 1-3 days after injury and reaches its peak during the first week. As healing progresses into the maturation phase, type III collagen is gradually replaced by the stronger and more stable type I collagen, typically around the third week after injury [17-19].

The observed differences in collagen deposition density between the positive control and the egg white gel treatment may be attributed to the composition of the positive control, which contained 10% placental extract. Placental extract is known to contain fibronectin type III, a biogenic stimulator that can enhance skin cell proliferation and promote tissue regeneration. In addition, the smaller molecular weight of compounds in the positive control may facilitate better topical absorption compared with egg white gel.

Nevertheless, collagen deposition following egg white gel application increased progressively and continued until the end of the proliferative phase, which typically extends up to day 21. Based on these findings, it can be concluded that broiler chicken egg white gel extract has a positive effect on the wound healing process.

CONCLUSION

Based on the results and discussion, the average wound healing time in the control group was 13.13 days, whereas mice treated with broiler chicken egg white gel extract ointment achieved wound closure in an average of nine days. A statistically significant difference in wound healing time was observed between the two groups. The broiler chicken egg white gel extract (*Gallus domesticus*) ointment was more effective in accelerating the wound healing process than the control treatment using 0.9% NaCl.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FUNDING

This research received no external funding.

ETHICAL ISSUES

Study ethics this research was conducted according to ethical standards for the use of animals for scientific purposes.

ORCID iDs

Sudarto Sudarto https://orcid.org/0000-0002-2575-1834
Muhammad I. Hanif https://orcid.org/0000-0003-1788-7982
Slamet Slamet https://orcid.org/0000-0001-7239-8650

REFERENCES

1. Broughton G II, Janis JE, Attinger CE. Wound healing: an overview. *Plast Reconstr Surg.* 2006;117(7 Suppl):1e-32e.
2. Guo S, DiPietro LA. Factors affecting wound healing. *J Dent Res.* 2010;89(3):219-229.
3. Wombeogo M, Kuubire CB. *Trauma and emergency health care manual*. Bloomington (IN): AuthorHouse UK Ltd; 2014.
4. Bereznicki L. Factors affecting wound healing. *Aust Pharm.* 2012;31(6):484-487.
5. Bowler PG, Duerden BI, Armstrong DG. Wound microbiology and associated approaches to wound management. *Clin Microbiol Rev.* 2001;14(2):244-269.
6. Wang Y, Guo M, He B, Gao B. Intelligent patches for wound management: in situ sensing and treatment. *ACS Appl Bio Mater.* 2021.
7. Gonzalez ACO, Costa TF, Andrade ZA, Medrado ARAP. Wound healing: a literature review. *An Bras Dermatol.* 2016;91(5):614-620.
8. Chester D, Brown AC. The role of biophysical properties of provisional matrix proteins in wound repair. *Matrix Biol.* 2017;60-61:124-140.
9. Sandjeu Y, Haftek M. Desmosealin and other components of the epidermal extracellular matrix. *J Physiol Pharmacol.* 2009;60(Suppl 4):23-30.
10. Wickett RR, Visscher MO. Structure and function of the epidermal barrier. *Am J Infect Control.* 2006;34(10 Suppl):S98-S110.
11. Sjamsuhidajat R, Wim de Jong. *Textbook of surgery.* Jakarta: EGC; 2010.
12. Pastar I, Stojadinovic O, Yin NC, et al. Epithelialization in wound healing: a comprehensive review. *Adv Wound Care* (New Rochelle). 2014;3(7):445-464.
13. Linehan E, Fitzgerald DC. Ageing and the immune system: focus on macrophages. *Eur J Microbiol Immunol* (Bp). 2015;5(1):14-24.
14. Franken L, Schiwon M, Kurts C. Macrophages: sentinels and regulators of the immune system. *Cell Microbiol.* 2016;18(4):475-487.
15. Wong T, McGrath JA, Navsaria H. The role of fibroblasts in tissue engineering and regeneration. *Br J Dermatol.* 2007;156(6):1149-1155.
16. Bainbridge P. Wound healing and the role of fibroblasts. *J Wound Care.* 2013;22(8):407-412.
17. Rangaraj A, Harding K, Leaper D. Role of collagen in wound management. *Wounds UK.* 2011;7(2):54-63.
18. Young A, McNaught CE. *The* physiology of wound healing. *Surgery* (Oxford). 2011;29(10):475-479.
19. Fathke C, Wilson L, Hutter J, et al. Contribution of bone marrow-derived cells to skin: collagen deposition and wound repair. *Stem Cells.* 2004;22(5):812-822.