

Article

Development and Evaluation of A New Povidone-Iodine and Glycerin-Based Hydrogel for the Treatment of Infected Wounds: an in Vitro and Animal Study

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Abstract: A novel hydrogel containing povidone-iodine (a potent antiseptic) and glycerol (a moisturizer and anti-inflammatory) was designed and its effects on healing infected wounds and reducing infection-causing bacteria were investigated. The study also evaluated the hydrogel's physicochemical properties, such as its ability to release iodine and glycerol in a controlled manner. Povidone-iodine, known for its antimicrobial properties, was combined with glycerol, a moisturizer that enhances skin hydration and barrier function, to produce a stable and effective topical treatment. This study aimed to develop and evaluate the efficacy of a novel formulation combining povidone-iodine (PVP-G-I) and glycerol for treating skin infections and promoting wound healing. The formulation was prepared by mixing 10% povidone-iodine with purified glycerol in the Central Laboratories of Tikrit University, resulting in a homogeneous mixture. Clinical trials were conducted on rabbit models with wounds. The treated group showed significant wound healing and a reduction in inflammation within days, while the untreated group developed infections. Physical and chemical analyses, including proton nuclear magnetic resonance (1H-NMR) and ultraviolet spectroscopy, confirmed the stability and structural integrity of the formulation, showing no significant changes in its properties over time or at different temperatures. The results demonstrated that the povidone-iodine and glycerol formulation is highly effective in accelerating wound healing, preventing infection, and maintaining skin health without side effects. The study recommends further laboratory and clinical trials to verify its efficacy and safety for human use, highlighting its potential as an effective and cost-effective treatment for dermatological applications.

Keywords: Povidone-Iodine, Glycerol, Wound Healing, Skin Infections, Topical Formulation.

1. Introduction

Povidone and glycerin are frequently incorporated into dermatological products due to their advantageous effects on skin health. Povidone, or polyvinylpyrrolidone (PVP), serves as a binder and stabilizer, delivering a calming influence on the skin while enhancing moisture retention. It creates a protective barrier that can defend the skin against external irritants, thereby minimizing the likelihood of allergic reactions. Furthermore, povidone exhibits antimicrobial properties, which contribute to safeguarding the skin from infections and inflammation [1].

Glycerin, recognized as a humectant, is celebrated for its capacity to draw moisture from the surrounding environment and the deeper layers of the skin, thereby improving hydration and reinforcing the skin's barrier function. This characteristic makes it particularly effective in formulations designed to alleviate dryness and irritation, which are prevalent symptoms of allergic reactions [2]. Glycerin's moisturizing properties help to calm the skin, alleviating the itching and discomfort often linked to allergic responses. Its contribution to enhancing skin elasticity and resilience further supports its application in anti-allergy creams [3].

Recently, an iodophor formulation of povidone-iodine (PVP-I) has shown significant promise for nasal Methicillin-resistant *S. aureus* (MRSA) decontamination by swabbing the anterior nares of patients in hospital settings, but the I₂ concentration in this treatment is less than 0.01% of total iodine species present and like all povidone-iodine formulations causes skin staining. Here we determine that a novel non-staining formulation of I₂ combined with the safe organic emollient glycerin delivers high local concentrations of the active antimicrobial entity (I₂) with minimal evaporative loss, exhibits activity at ~1 part per million against MRSA and other important Gram-positive and -negative human pathogens. This formulation for I₂ topical delivery produced similar reductions in mean bacterial burden and was associated with fewer treatment failures (<2-logfold reduction) than PVP-I in a murine model of MRSA nasal decontamination. Formulations of I₂ in glycerin emollient merit further exploration as topical disinfectants for human medical indications [4].

In 2025 study done by found skin contact reaction to iodine is not rare and has been reported in the literature since the 1950s. Most cases are related to cutaneous exposure to surgical disinfectant. In a study from the United States, iodine was the most frequently encountered surgical disinfectant accounting for 66% of available products. PVP-iodine is the responsible allergen in reactions to Betadine solution; the other components (polyoxyethylene nonylphenyl ether and glycerin) did not produce reactions on patch testing in a cohort of 10 patients and controls [5].

Aim of the study

This study aims to develop an effective ointment or cream for the treatment of skin infections by manufacturing an advanced formula that combines glycerin and povidone with iodine.

The research seeks to determine the optimal chemical interaction between these compounds to ensure improved treatment effectiveness, increased iodine absorption on the skin, and an antibacterial and antifungal effect, while reducing possible side effects, also to evaluate the effectiveness of this formula in reducing skin infections and healing wounds more quickly. To treat allergic conditions on humans, rabbit skin.

2. Materials and Methods

Glycerol and povidone-iodine ointment was prepared in collaboration with Samarra Pharmaceutical Industries (SDI) according to the company's approved formulation.

Procedure

Preparation Method: One gram of 10% povidone-iodine Nano powder solution was mixed with 100 grams of glycerol by adding 100 grams of purified glycerol to a clean, dry glass beaker. Then, one gram of 10% povidone-iodine solution was added to the glycerol. The mixture was stirred thoroughly using a magnetic stirrer at laboratory temperature (25°C) until a homogeneous consistency was achieved. The final mixture was then transferred to an airtight container, preferably an amber-colored bottle to protect it from light. Finally, the product was stored in a cool, dry place, away from heat and direct sunlight [6]. UV, IR, and NMR spectroscopy were used.

Clinical Experiments

Clinical trials were conducted on male and female rabbits as follows: Three rabbits, male and female, were selected, their body fur was shaved, and two superficial wounds were made in the skin of each rabbit, in opposite directions, along its back [7].

The three rabbits were placed in a special box, and each rabbit was distinguished from the others using an ink marker. Treatment was applied to the three wounds of one group, twice daily, morning and evening, according to the direction of the wounds and the rabbit selected. The second group was left untreated for five days until infection appeared. A sample of the compound was placed in a glass beaker and exposed to air and light to determine the physical changes that occurred in the compound.

3. Results

The First Results:

The effects and results of the first and second groups' funds were followed up on. The first group, which was treated immediately after the wound was followed up, and the results were: The first day, all models showed the beginning of a response to treatment. The second day, some therapeutic responses appear, varying between doses. The third day, the effects of wound healing appeared with varying degrees. And after one week had passed, the results were: In the first group, the experiment was conducted on a rabbit with non-inflamed wounds that were treated to monitor the effect of wound healing and the occurrence of allergic reactions. Figure 1. The second group was left with wounds without treatment for 5 days until infection appeared.



a) Before treatment

b) Through the treatment

Figure 1. a) Before treatment and b) Through treatment.

After treatment Results:

After five days of treatment and wound healing, and non-inflammatory, this indicates the therapeutic effect of the composition in treating wounds and anti-inflammatory of different three different rabbits. The effect of the compound during 7 days was clear and effective, and did not leave any traces on the wounds Figure 2.



Figure 2. After treatment.

Physical Changes of the Mixture

The physical properties, such as color, smell, and texture, were studied in the laboratory at varying temperatures during the day and for a month, and no change was observed in them. In addition, the effectiveness remained the same and did not change with changing temperatures and time. This proves that the compound is homogeneous and stable and is not affected if kept at a temperature of 0-25C.

Analysis of a mixture

The $^1\text{H-NMR}$ spectrum of the POI and Glycerin mixture Figure 3 shows clear signals for each component. Glycerin appears at 3.35–3.80 ppm, while PVP gives signals from 1.60–4.00 ppm, reflecting its ring and backbone structure. Slight downfield shifts in hydroxyl regions ($\sim 0.03\text{--}0.06$ ppm) suggest hydrogen bonding with PVP [8]. Although iodine is NMR-invisible, its presence is inferred through de-shielding effects. DMSO- d_6 enhanced solubility and spectral resolution. These findings support the presence of non-covalent interactions and confirm the formulation's structural integrity, stability and support its continued application in dermatological settings [9].

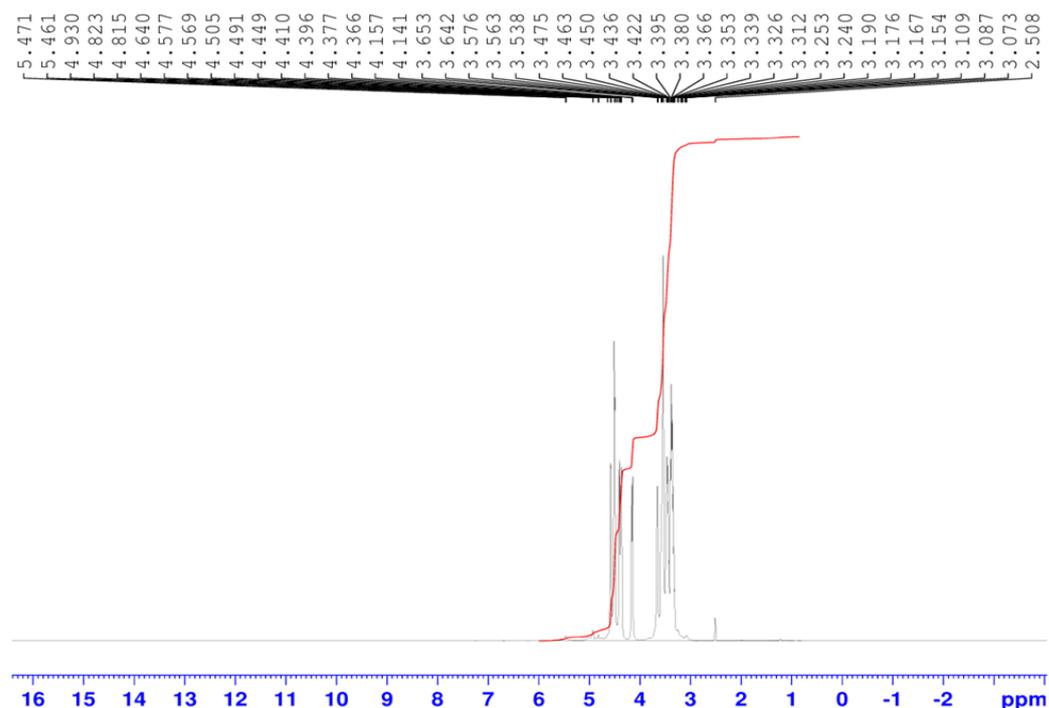


Figure 3. The $^1\text{H-NMR}$ spectrum of the POI and Glycerin mixture.

The observed UV absorption spectrum confirms the presence of the povidone-iodine complex (PVP-I), as showed in Figure 4 by a strong and sharp absorption peak between 290–310 nm. Iodine is the primary contributor to this absorption, due to its characteristic electronic transitions in the UV region. Povidone acts as a stabilizing agent, forming a complex with iodine that modifies its absorption properties and enhances its solubility and stability. Glycerin does not directly contribute to the UV absorption but serves as a solvent and humectant, improving the formulation's physical stability [10]. The extended tail after the main peak (approximately 400–500 nm) may be attributed to secondary electronic transitions, intermolecular interactions, or minor impurities. The absence of distinct peaks in the visible region (400–700 nm) indicates that the solution's color is primarily due to UV absorption rather than visible chromophores [11].

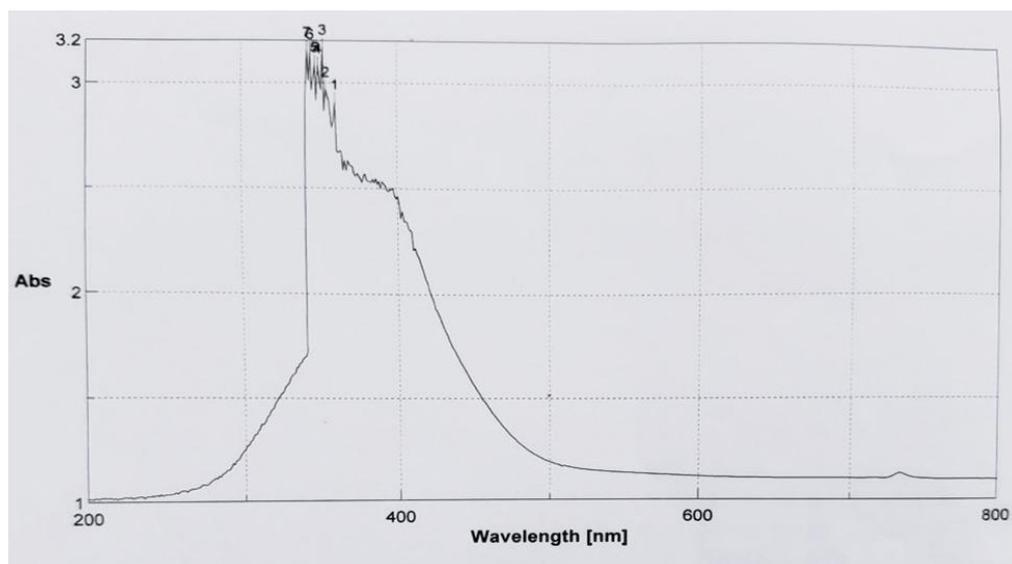


Figure 4. The UV absorption spectrum of the povidone-iodine complex.

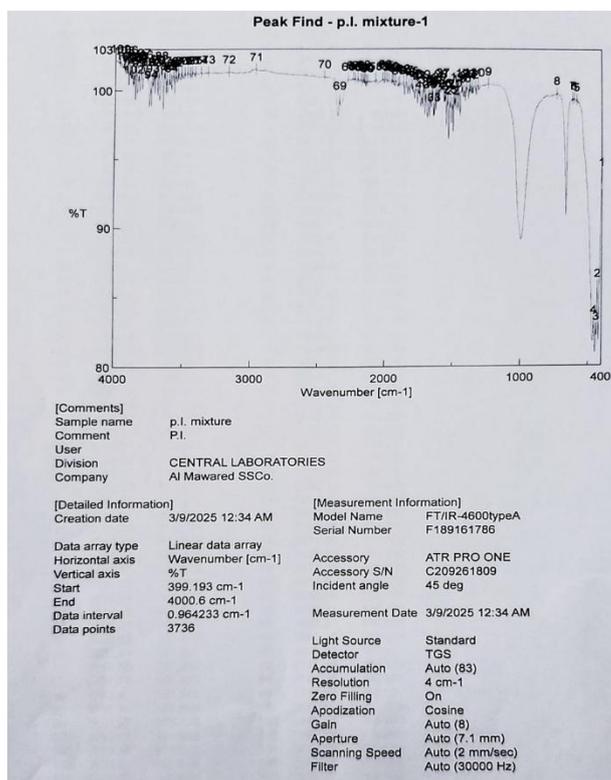


Figure 5. The IR absorption spectrum of the povidone-iodine complex.

The Final Results and Recommendation:

After observing the results, it was noted that (glycerin and povidone with iodine ointment), prepared in our laboratories, had greater and better therapeutic effectiveness in a shorter time. It can also be said that from an economic standpoint, the cost of preparing it is lower, but with greater effectiveness, which increases the profits of pharmaceutical companies [12], [13], [14].

As for the physical and chemical properties, such as (color, smell, texture, and chemical consistency in the laboratory), at varying temperatures during the day and night and for a period of a month, no change was observed in them. In addition, the effectiveness remained the same and did not change with changes in temperature and time, so we recommend the necessity of completing other laboratory experiments, such as Determine the chemical composition using modern devices and techniques and study the biological effectiveness on human skin of donors through specialists in pharmaceutical companies, as well as knowing the side effects for the purpose of adopting it in the future as an effective treatment for treating wounds and burns on human skin[15], [16].

4. Conclusion

The results of this study demonstrated that the development of a novel topical hydrogel based on the combination of povidone-iodine and glycerol resulted in a stable and homogeneous formulation with well-preserved physicochemical properties within the tested temperature range, exhibiting no significant changes over time. Spectroscopic analyses (UV, IR, and ¹H-NMR) confirmed the integrity of the molecular structure and the presence of non-covalent interactions that support stability. Animal studies in rabbits showed that the formulation significantly accelerated wound healing, reduced inflammation, and prevented infection compared to the untreated group. No side effects or allergic reactions were recorded during the follow-up period, reinforcing the safety of topical use. Furthermore, the formulation demonstrated cost-effectiveness due to its low preparation cost relative to its high therapeutic efficacy. Therefore, this formulation can be considered promising for dermatological applications, and further extensive clinical studies are recommended to confirm its efficacy and safety in humans.

REFERENCES

- [1] G. Khilnani and A. K. Khilnani, "Inverse agonism and its therapeutic significance," *Indian Journal of Pharmacology*, vol. 43, no. 5, pp. 492–501, 2011.
- [2] L. H. Kircik, "The role of polyvinylpyrrolidone (PVP) in dermatological formulations: A review," *Journal of Drugs in Dermatology*, vol. 15, no. 4, pp. 435–441, 2016.
- [3] S. Verdier-Sévrain and F. Bonte, "Skin hydration: A review on its molecular mechanisms," *Journal of Cosmetic Dermatology*, vol. 6, no. 2, pp. 75–82, 2007.
- [4] S. Uchiyama, S. Dahesh, V. Nizet, and J. Kessler, "Enhanced topical delivery of non-complexed molecular iodine for Methicillin-resistant *Staphylococcus aureus* decolonization," *International Journal of Pharmaceutics*, vol. 554, pp. 81–86, 2019.
- [5] H. Kennedy, "Contact dermatitis secondary to povidone-iodine: A systematic review," *Contact Dermatitis*, vol. 92, no. 1, pp. 2–8, 2025.
- [6] E. Waleka, Z. Stojek, and M. Karbarz, "Activity of povidone in recent biomedical applications with emphasis on micro- and nano drug delivery systems," *Pharmaceutics*, vol. 13, no. 5, p. 654, May 2021, doi: 10.3390/pharmaceutics13050654.
- [7] F. Mauvais-Jarvis, A. P. Arnold, and K. Reue, "A guide for the design of pre-clinical studies on sex differences in metabolism," *Cell Metabolism*, vol. 25, no. 6, pp. 1216–1230, 2017.
- [8] D. Sperger, "Solid-state NMR analysis of excipients and drug-excipient interactions in the amorphous state," 2010.

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- [9] S. Castelnovo, "Povidone iodine 0.66% to fight *Pseudomonas aeruginosa* in contact lens wearer: A case report," *Case Reports in Ophthalmology*, vol. 13, no. 2, pp. 398–407, 2022.
- [10] P. Cazón, G. Velazquez, and M. Vázquez, "UV-protecting films based on bacterial cellulose, glycerol and polyvinyl alcohol: Effect of water activity on barrier, mechanical and optical properties," *Cellulose*, vol. 27, no. 14, pp. 8199–8213, 2020.
- [11] M. A. Maquirriain, C. A. Neyertz, C. A. Querini, and M. L. Pisarello, "Crude glycerine purification by solvent extraction," *Brazilian Journal of Chemical Engineering*, vol. 39, no. 1, pp. 235–249, 2022.
- [12] M. Patel and A. Dehadaray, "Povidone-iodine and glycerine for treatment of acute otitis externa," *Saudi Journal for Health Sciences*, vol. 7, no. 3, pp. 178–182, 2018.
- [13] P. Lachapelle, "A comparison of the irritant and allergenic properties of antiseptics," *European Journal of Dermatology*, vol. 24, no. 1, pp. 3–9, 2014.
- [14] E. E. Vermeulen, J. J. H. H. van Hattem, and D. T. Ubbink, "Topical silver for treating infected wounds," *Cochrane Database of Systematic Reviews*, no. 3, Art. no. CD005486, 2007.
- [15] S. Bigliardi, M. Alsagoff, C. El-Kafrawi, J. Pyon, P. Wa, and H. Villa, "Povidone iodine in wound healing: A review of current concepts and practices," *International Journal of Surgery*, vol. 44, pp. 260–268, 2017.
- [16] World Health Organization (WHO), *WHO Guidelines on Hand Hygiene in Health Care*, Geneva, Switzerland: WHO Press, 2009.