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FORMULATION AND EVALUATION OF JAMUN SEED POWDER GEL FOR WOUND HEALING IN DIABETIC PATIENTS

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ABSTRACT
The aim of the present research work was to formulation and Evaluation of Jamun Seed Powder Gel for Wound Healing in Diabetic Patients. Preparation of gel was done by mixing of gel base and jamun seed powder extract and prepare 100mg gel. The Jamun seed powder gel exhibited a brownish-yellow color. The gel had a smooth, homogeneous texture. The results of this study demonstrate the potential of Jamun seed powder gel as a natural, effective, and safe wound healing agent. The Jamun seed powder gel exhibits promising wound healing, antimicrobial, and antioxidant activities, making it a potential natural remedy for wound care.

KEYWORDS: pH of gel, stability study, gel base, wound healing, herbal extract.

INTRODUCTION

[7]Cutaneous wound repair is a carefully planned tissue restoration procedure that preserves the integrity of injured skin while making it challenging to restore the original skin tissue. Patients with diabetes commonly experience poor wound healing, which is a condition where the linear sequence of molecular and cellular events is disrupted. The complicated microenvironment of diabetic wounds is primarily caused by a number of extrinsic causes (tissue infection, callus formation, and increased pressure to the wound site) and intrinsic pathological abnormalities (neuropathy and vascular issues). Hyperglycaemia inhibits the growth of cells that produce collagen and prevents the wound bed's mechanical strength from being used. Since it improves tensile strength and attracts crucial signalling molecules to the wound area, appropriate collagen depositions are the most significant need of the remodelling phase in this context. An important factor in the tensile strength of wounds that heal is the increase in the collagen type i: iii ratio. The transformation of fibroblasts into myofibroblasts causes a reduction in wound size and the deposition of extracellular matrix (ECM) throughout the healing process. In addition to vimentin, fibronectin, and n-cadherin, myofibroblasts, which are seen during the proliferative phase of wound healing, also express a-SMA (a-smooth muscle actin). The invasion of sub-epithelial myofibroblasts is linked to the epithelial restoration process, where the expression of the cell proliferation marker c-MYC is essential. Angiogenesis stimulation is crucial for normal wound healing; however, in diabetic wounds, hyperglycaemia inhibits angiogenesis and hypoxia inducible factor (HIF), a transactivator. The signalling and regulation of neo-vascularization are significantly influenced by the vascular endothelial growth factor (VEGF). VEGFR-I and VEGFR-II are transmembrane tyrosine kinase receptors that bind to trigger the VEGF signalling cascade. VEGF and VEGFR-IL work together to promote angiogenesis, the growth of new blood vessels.

A gel is a physical state that results from the mixing of two or more substances to create a semi-solid, jelly-like substance that is unable to flow steadily.

In medical applications, water and hydro alcoholic solutions are most commonly used. Reversibility is exhibited by many polymer gels between the gel state and the solution, the fluid phase that contains the dissolved or dispersed macromolecule. it is impossible to reverse the formation of some polymer gels because their chains are covalently linked. In two-phase gels and jellies, the three-dimensional networks are formed by a variety of inorganic colloidal clays. It is possible to reverse the formation of these inorganic gels.

[10]Properties of gels

1. A liquid dispersed phase and a solid dispersion medium make up this colloidal system.
2. It is an unyielding semi-solid.
3. It has a honeycomb-like structure.

4. The majority of gels experience swelling due to fluid absorption.
5. Organic materials are used to make elastic gels, which solidify when heated and return to their gel form when water is added. (changeable and lyophilic)
6. Non-Elastic (Rigid) Gels: These inorganic gels are irreversible and lyophobic, forming a powder when heated that cannot be reformed into gel by adding water.
7. Gels have the capacity to increase in bulk and absorb additional liquid.
8. Syneresis, a phenomenon whereby many gel systems constrict when left standing, is caused by the elastic stresses that were formed during gel setting and then released.
9. In colloidal systems, like gels, slow aggregation is typical and is called "ageing."
10. The interlinking of gelling agent particles creates a network that makes some gels stiff.
11. Gelling agents and flocculated solid dispersions are pseudo-plastic.

[4]Scientific Name: Syzygium cumini
Synonyms: Java plum, Black plum, Indian blackberry, Jambul.
Family: Myrtaceae.
Parts Used: Seeds, Fruit, Bark, Leaves.
Jamun is a medicinal fruit known for its various health benefits, especially in diabetes management. While the fruit is rich in antioxidants and nutrients, the seeds are widely studied for their potent anti-diabetic properties.
Phenolic content, which is extracted from Syzigium cumini, effectively stimulated wound contraction by preparing a hydrogel.

MATERIAL AND METHODS

Table 1: Materials and methods.

Materials	Role of material	Quantity
Jamun seed Extract	Antioxidant activity to reduce oxidative stress and inflammation at the wound site	3 gm
Carbopol 934	Used as a gelling agent	2 gm
Triethanolamine	Used as a pH adjuster	0.5 gm
Propylene glycol	Used as a penetration enhancer	5 gm
Methyl paraben	Preservative	0.05 gm
Glycerine	Moisturizer or soothing agent	5 gm
Rose water	Hydrate and moisturize	6.45 gm
Distilled water	As a vehicle	78 gm

[2]Preparation of gel base

Enough water is present to disperse the gelling agent. The dispersion is supplemented with propylene glycol, a plasticizer and humectant. Stir constantly while additional excipients, such as propyl paraben, are added. Triethanolamine, or TEA, is added to the Carbopol gel to balance the vehicle's pH. Distilled water was added to the gel to bring its final weight down to 50 grams. The mixture was then stirred for two hours at 500 rpm using a propeller. This homogeneous gel seems to be bubble-free after shaking. For a full day at room temperature in order to assess the gel's stability and consistency.

[3]Method of Preparation of Jamun Seed Powder Extract

- The preparation of Jamun seed powder extract using ultrasonication involves a series of steps. First, 625 g of ready Jamun seed powder is measured and transferred to a clean, dry glass beaker. Then, 900mL of solvent acetone is added to the beaker and stirred using a clean, dry stirring rod to ensure uniform distribution of the powder.
- Next, the beaker is placed in an ultrasonicator and ultrasonicated for 30 minutes to 1 hour at a frequency of 20 kHz and power of 100 W. The temperature of the mixture is monitored during ultrasonication to ensure it does not exceed 40°C.
- After ultrasonication, the mixture is filtered through Whatman filter paper or equivalent to separate the solvent from the solids. The solids are discarded, and the filtrate is collected.
- The filtrate is evaporated and gives a solid extract. The resulting Jamun seed powder extract is stored in a clean, dry glass vial or container and labelled for future reference.
- The ultrasonication method is an efficient and effective way to extract bioactive compounds from Jamun seed powder. The use of ultrasonication helps to improve the extraction yield and reduce the extraction time. The resulting extract can be used for various applications, such as antioxidant, anti-inflammatory, and antimicrobial studies.

Preparation of gel: The aqueous extract from the seeds of jamun was used to make the gel. Carbopol 934, propylene glycol, ethanol, triethanolamine, propyl paraben, and distilled water were used to make the gel in amounts enough to make 100 grams of gel in the case of a blank gel. The two types of water needed for these compositions were separated. The precise amount of extract was dissolved in one section, and then ethanol and a calculated amount of propylene glycol were added. To get the gel consistency, each of these solutions was combined in a beaker, and triethanolamine was added

drop by drop, and the jamun seed powder gel was prepared.

[5]Evaluation

A. Physical evaluation

Physical characteristics like color, smell, and consistency were examined visually.

- Color: Through visual inspection, the formulations' colors were verified.
- Consistency: Skin application was used to verify the compositions' consistency.
- Odour: By dissolving the gel in water and smelling it, the formulations' odours were assessed.

There have been reports of gel compositions' physical assessments.

B. Percentage yield

Weigh both the container containing the gel formulation and the empty one where the gel formulation was kept. Subtract the empty container's weight from the gel formulation container's weight to get the practical yield. The yield % was then computed using the following formula.

Percentage yield = (practical yield /theoretical yield) × 100

C. Measurement of pH

To find the pH of gel compositions, a digital pH meter was used. One gram of gel should be dissolved in ten milliliters of purified water and left for two hours. The glass electrode was dipped entirely into the gel system three times to test the pH of the formulations; the average values are then published. It was mentioned what the gel formulation's pH was.

D. Homogeneity

Visual examination was used to verify the homogeneity of all manufactured gel compositions once the gels were placed into the container. They were examined to see if any aggregates were present and how they looked. The gel formulation's homogeneity was noted.

E. Viscosity

Using a Brookfield viscometer and spindle number one at 25°C, the viscosity of the prepared gel was measured. The gels were rotated at 0.3, 0.6, and 1.5 revolutions per minute, and the dial reading for each speed was recorded. The produced gels' viscosity was then calculated by multiplying the dial reading by the factor listed in the Brookfield Viscometer catalogs. The gel formulation's viscosity was recorded.

F. Spreadability

Spreadability can be defined as the number of seconds it takes for two slides to separate from gel that is positioned between them when a specific stress is applied. Better spreadability is achieved if two slides are separated in less time.

S=M x L/T

Calculate Spreadability.

Where M = weight attached to the top slide.

L = the glass slide length.

T = the time required to separate the slides.

Gel compositions' Spreadability was noted

G. Clarity

Clarity of gel was determined by visual inspection. Clear gel is transparent, free from visible particles, and shows no signs of turbidity.

H. Gel strength

The weight's penetration time into the gel, measured in seconds, was used to calculate the gel's strength. On top of a 5-gm gel formulation, a 3.5-gram weight was set. The weight's penetration time of 0.5 cm in the gel, measured in seconds, was used to calculate the gel's strength. Then, the gel strength was stated.

Table 2: RESULTS AND DISCUSSION.

Evaluation parameter	Result
Physical Evaluation	Colour: Brownish Yellow Consistency: Smooth
Percentage Yield	68.17%
Measurement of pH	5.9
Homogeneity	Good
Viscosity Spreadability	6 gm.cm/sec 4400cps
Clarity	clear
Gel Strength	24 ± 0.12

DISCUSSION

The formulation exhibited a brownish-yellow color and a smooth consistency, indicating a visually appealing and uniform product. These attributes suggest that the components blended well, contributing to a product that is likely acceptable to users in terms of appearance and texture. A yield of 68.17% signifies efficient processing and minimal loss during formulation. This is considered a reasonably good result in terms of production efficiency and material utilization. The pH of 5.9 is within the acceptable range for topical or cosmetic applications, as it is close to the natural pH of human skin. This suggests that the formulation is likely non-irritating and suitable for skin application. A smooth, consistent texture without gritty particles indicates good homogeneity. The viscosity of 4400 centipoise (cps) indicates a moderately thick formulation, which is suitable for gels or semi-solid preparations. This level of viscosity ensures the product spreads easily without being too runny or overly thick. Time taken for the Separation of two slides is less than the Spreadability. The value of 6 g ·cm/sec shows that the formulation can be applied smoothly and evenly over the skin. clear gel is transparent, free from visible particles, and shows no signs of turbidity. The gel strength value indicates that the formulation has good structural integrity while still being easy to apply. A gel strength of 24 ± 0.12 implies a well-balanced formulation that retains its shape without being too stiff or too weak.

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CONCLUSION
The jamun seed powder extract gel presents a promising therapeutic approach for diabetic wound healing, harnessing the potent phenolic compounds found in Syzygium cumini seeds. This gel formulation offers a topical delivery system that fosters a conducive environment for wound healing by mitigating oxidative stress, inflammation, and infection.

The extract's antioxidant and anti-inflammatory properties work synergistically to promote tissue regeneration, collagen synthesis, and angiogenesis, ultimately accelerating the wound healing process. By providing a natural, non-invasive, and potentially cost-effective treatment option, the jamun seed powder extract gel may improve patient compliance and outcomes.

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