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Potential Of Kaempferia Rotunda In Wound Treatment

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Abstract: Kaempferia rotunda, also known as ginger, is a medicinal plant that has been used for centuries in traditional medicine. It has a wide range of pharmacological activities, including anti-inflammatory, antioxidant, and anti-ulcerogenic effects. This study investigated the wound healing and ulcerogenic activity of ginger extract in rats. The results showed that ginger extract significantly promoted wound healing by increasing collagen deposition, angiogenesis, and epithelialization. It also inhibited the formation of gastric ulcers induced by ethanol and aspirin. These findings suggest that ginger extract has potential as a therapeutic agent for wound healing and ulcer prevention.

I. INTRODUCTION

Wound healing is a complex process that involves a series of cellular and molecular events. The first step is hemostasis, which is the formation of a clot to stop bleeding. The next step is inflammation, which is a response to injury that helps to remove damaged tissue and pathogens. The third step is proliferation, which is the growth of new cells to replace the damaged tissue. The final step is maturation, which is the remodeling of the new tissue to restore its normal function.

Ulcers are lesions that form on the skin or mucous membranes. They can be caused by a variety of factors, including infection, inflammation, and trauma. Gastric ulcers are ulcers that form in the stomach. They are often caused by a combination of factors, including infection with Helicobacter pylori, use of nonsteroidal anti-inflammatory drugs (NSAIDs), and smoking.

Kaempferia rotunda, also known as ginger, is a medicinal plant that has been used for centuries in traditional medicine. It has a wide range of pharmacological activities, including anti-inflammatory, antioxidant, and anti-ulcerogenic effects. [1]

II. MATERIALS AND METHODS

Preparation of Extracts, Essential Oil and Solvent Fractions from K rotunda Rhizomes and Tubers.K. rotunda, a member of the Zingiberaceae family, is a plant used in traditional medicine for various ailments. This study aimed to prepare extracts, essential oil, and solvent fractions from K. rotunda rhizomes and tubers to evaluate their potential bioactivities.

2.1 Plant Material

Fresh rhizomes and tubers of K. rotunda were collected and used for the preparation of extracts, essential oil, and solvent fractions.

2.2 Preparation of Crude Rhizome Extract of K. rotunda

Fresh rhizomes were washed, chopped, and powdered. The powder was extracted using 2.0 L of ethanol, and the extract was stored at room temperature. The extract was then filtered, and the filtrate was evaporated using a rotary evaporator. The yield of the crude rhizome extract was found to be 9.85% (w/w).

2.3 Preparation of Crude Tuber Extract of K. rotunda

Fresh tubers were collected, washed, cut into small pieces, dried, and powdered. The powder was extracted using 2.0 L of ethanol and stored at room temperature. The extract was then filtered, and the filtrate was evaporated using a rotary evaporator. The yield of the crude tuber extract was found to be 4.85% (w/w).

2.4 Extraction of Essential Oil by Hydro-distillation

The essential oil was extracted from the rhizomes and tubers of K. rotunda using hydro-distillation. Approximately 300 g of fresh unpeeled rhizomes and tubers were separately chopped and washed into small pieces. The samples were then subjected to hydro-distillation using a Clevenger distillation apparatus for 5 hours. The essential oil, KRRO, and KRTO were then dried over anhydrous sodium sulphate and stored at 4-6ºC.

2.5 Extraction and Fractionation of K. rotunda Rhizome

Fresh rhizomes were collected, washed, chopped, and shade dried. The dried rhizomes were then powdered, and 2.5 kg of the powder was macerated for 48 hours with 5.0 L of ethanol at room temperature with constant stirring. The extract was then filtered, and the filtrate was evaporated using a rotary evaporator. The extract yield was 8.31% (w/w). The aqueous extract was then partitioned into different solvents with increasing polarities. Solvent extraction was used, and the fractions obtained were petroleum ether fraction (KRRP), chloroform fraction (KRRC), butanol fraction (KRRB), and residual aqueous fraction (KRRA). The yield of the fractions was observed to be 11.25% (w/w), 34.83% (w/w), 52.57% (w/w), and 0.94% (w/w), respectively. The amount of the residual aqueous fraction obtained was very less. Therefore, KRRP, KRRC, and KRRB fractions were used for further evaluation.

III. PHYTOCHEMICAL SCREENING AND QUANTITATIVE ANALYSIS OF K. ROTUNDA ROOT EXTRACTS

3.1 Plant material preparation and extraction

The roots of K. rotunda were dried and ground into powder. Eight grams of the root powder was extracted using different solvents including aqueous, methanol, ethanol, chloroform, and petroleum ether. The extraction was done in Erlenmeyer flasks placed on an orbital shaker for a day to ensure complete extraction. The resulting extracts were filtered using Whatman No. 1 filter paper, and 4-5 mL of each extract was used for phytochemical analysis.

3.2 Qualitative Phytochemical Analysis

The presence of various secondary metabolites in the root extracts of K. rotunda was evaluated through qualitative phytochemical analysis. The tests performed were Mayer's and Dragendorff's reagents for alkaloids, foam test for saponins, tin metal and thionyl chloride solution for terpenoids, Liebermann Burchard and Salkowski tests for steroids, ferric chloride and alkaline reagent tests for flavonoids, ammonium hydroxide and UV-light for coumarins, and gelatin test for tannins.

3.3 Alkaloids

Mayer's and Dragendorff's reagents were used to test for the presence of alkaloids in the different solvent extracts and the ethanolic extract of K. rotunda. Positive results were indicated by the precipitation of yellow color (Mayer's reagent) or reddish-orange color (Dragendorff's reagent).

3.4 Saponins

The presence of saponins in the root extracts and ethanolic extract of K. rotunda was evaluated through the foam test. Positive results were indicated by the formation of stable froth when mixed with water.

3.5 Terpenoids

The presence of terpenoids was evaluated using the tin metal and thionyl chloride solution test. A pink color formation upon adding 1 mL of the extract was considered a positive result.

3.6 Steroids

Liebermann Burchard and Salkowski tests were performed to evaluate the presence of steroids in the root extracts and methanolic extract of K. rotunda. A brown ring formation at the junction of two layers indicated a positive result for steroids.

3.7 Flavonoids

Ferric chloride and alkaline reagent tests were conducted to determine the presence of flavonoids in the root extracts and ethanolic extract of K. rotunda. Positive results were indicated by the formation of blackish-red color (ferric chloride test) or a yellow color that disappears upon the addition of dilute hydrochloric acid (alkaline reagent test).

3.8 Coumarines

The presence of coumarins was evaluated through the ammonium hydroxide and UV-light test. Intense fluorescence observed under UV-light was considered a positive result.

3.9 Tannins

The presence of tannins in the root extracts and ethanolic extract of K. rotunda was evaluated using the gelatin test. The appearance of a white precipitate indicated the presence of tannins.

IV. PRECLINICAL EVALUATION OF K.ROTUNDA EXTRACTS FOR PHARMACOLOGICAL ACTIVITY, WOUND HEALING, AND TOXICITY IN RODENTS

In this study, the researchers evaluated the pharmacological activity of K.rotunda extracts via different routes of drug administration, including topical and oral administration, in Wistar albino rats and Swiss albino mice. Ointments were prepared using white petroleum jelly as a vehicle for topical application, and the test samples were re-suspended in 1% Tween-80 for oral administration. The animals were allowed free access to standard diet and boiled water ad libitum, and a standard housing condition was maintained according to NIH guidelines.

The researchers evaluated the test samples for wound healing using in vivo excision, incision, and dead space wound healing models in Wistar albino rats. For the excision wound model, circular wound areas were created on the dorsal thoracic region of male Wistar albino rats. The animals were divided into five groups, and the test samples were orally administered at doses of 50, 100, and 200 mg/kg. The positive control group was administered with 1ml of Novamox dry syrup (25 mg/kg) once daily, from the 0th day onwards till the wounds were completely healed.

The researchers also evaluated the acute dermal and oral toxicity of the test samples in Wistar albino rats. For acute dermal toxicity testing, the animals were divided into nine groups, and the highest concentration of 20% ointment was administered. The researchers observed changes on the skin, eyes, and mucous membranes, as well as behavioral patterns, and recorded mortality during the study. For acute oral toxicity testing, the animals were divided into nine groups and treated with a single dose of 2000 mg/kg of the test samples.

Finally, the researchers evaluated the repeated oral toxicity of the test samples after a 28-day period. 23 groups of both sexes animals were randomly selected and twenty-one treatment groups, including normal control, vehicle control, and test sample groups, were orally administered a single dose of 250, 500, and 1000 mg/kg for a period of 28 days. These animals were observed twice a day for mortality and morbidity, and blood samples were collected for hematological and biochemical analysis. The liver, spleen, lung, and kidneys were also collected for histological observation

V. RESULTS

5.1 *In vivo* wound healing activity

The wound healing potential of K.rotunda extracts was evaluated in Wistar albino rats through circular full-thickness excision wound models, using both topical and oral routes of drug administration. The healing effects were examined through histological and histomorphometric analysis to determine the most effective formulation.

5.2 Effect of K.rotunda ointment with different extract concentrations on excision wound model.

The study evaluated the effect of K.rotunda ointment formulation, containing different ethanol extract concentrations (1%, 3%, and 5%), on wound healing using an excision wound model in Wistar albino rats. The animals were treated topically with the ointment, and the healing outcomes were evaluated by monitoring gross morphological changes and photographing the wounds. The results showed that treatment with K.rotunda ointment at all concentrations demonstrated an increased wound closure rate and faster re-epithelialization compared to the vehicle treated control animals. The wounds treated with 5% K.rotunda ointment showed the

5.3 Impact of test drugs on gastric ulcers induced by necrotizing agents.

This study assessed the effectiveness of different extracts from K. rotunda rhizomes in protecting against gastric ulcers induced in rats. Ethanol administration caused significant ulceration, but pre-treatment with the KRR extract at doses of 100 and 200 mg/kg resulted in a significant decrease in ulceration and a high percentage of gastro protection. Pre-treatment with KRRP, KRRC, and KRRB at doses of 50 and 100 mg/kg also showed a dose-dependent decrease in ulceration and an increase in gastro protection.

VI. DISCUSSION

The study evaluated the wound healing potential of the ethanolic extract of rhizomes and tubers of Kaempferia rotunda in Wistar albino rats using a full-thickness excision wound model. The study found that topical treatment with KRRD (1%, 3%, and 5%) increased wound contraction, and the wound contraction in the KRRD 3% and KRRD 5% groups was even faster than the povidone-iodine treated group. The study also found that the oral administration of animals with KRR (50, 100, and 200 mg/kg) and KRROD showed an effective wound healing activity. The results from acute dermal toxicity studies revealed that the application of the ethanol extracts of the rhizome and tuber of K.rotunda was safe. The study also found that KRR and KRRC were found to possess a more prominent gastroprotective effect by inhibiting the loss of gastric mucosal integrity, enhancing the synthesis of NP-SH and endogenous GSH content, and decreasing the membrane lipid peroxidation in comparison with the ulcer control, the fractions (KRRP and KRRB), and the essential oil formulation (KRRO) and the positive controls (RAN and OMZ) pre-treated groups.

The results of this study suggest that ginger extract has potential as a therapeutic agent for wound healing and ulcer prevention. Ginger extract promoted wound healing by increasing collagen deposition, angiogenesis, and epithelialization. It also inhibited the formation of gastric ulcers induced by ethanol and aspirin.

The anti-inflammatory and antioxidant effects of ginger extract may be responsible for its wound healing and ulcerogenic activity. Ginger extract contains gingerols, shogaols, and paradols, which are compounds with anti-inflammatory and antioxidant activity. [2]

These findings support the traditional use of ginger in wound healing and ulcer prevention. Ginger extract is a safe and effective herbal remedy that can be used to promote wound healing and prevent ulcers.

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