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# STUDY AND DEVELOPMENT FOR THE PROPERTY OF GINGER IN WOUND HEALING AND ULCEROGENIC ACTIVITY

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## ABSTRACT

Wounds have been defined as a disruption of cellular, anatomical, andfunctional continuity of a living tissue and healing is the interaction of a complex cascade. It may lead to the restoration of structural and functionalintegrity of strength of injured tissues. The present study shows the wound healing and ulcerogenic property of *Kaempferia rotunda*(Ginger). *Kaempferia rotunda* (Ginger) is a plant belonging to ginger family. China is native place and has a subcontinent to India. It is reportedly naturalized in Java, Malaysia and Costa Rica. *Kaempferia rotunda* (Ginger) plant has many medicinal uses in Ayurvedic and allopathic medicinal systems. this is also known as *bhumichampa*.In this study, evaluation of wound healing potential of the extract and rhizomes and tubers of *K.rotunda*(Ginger)and its effect influence wound toprovide a lessoedematous, less painful, adequate antioxidant effect for healing.Evaluate the wound healing potential of the ethanol extract andrhizomes and tubers of *K.rotunda*(Ginger)onsurgical wound healing using a rat full thickness excision wound model.The active extract or essential oil with faster wound healing effect wasfurther subjected forthe active extract or essential oil with faster wound healing effect was subjected to successive solvent extractions with waterimmiscible organic solvents of increasing polarities and the woundhealing potential of each fraction was then evaluated topically *via*excision wound healing model.evaluate safety of the extracts, essential oil and the fractionsafter single and repeated dose (28-day) administration in animal model for safe wound healingand anti-ulcerogenic.

**KEYWORDS:** *Kaempferia rotunda* (Ginger), wound healing and anti-ulcerogenic, animal study.

## 1. INTRODUCTION

Human life revolves around the important concern of getting healthy andstaying healthy. Over the ages, man has realized the immense potential of medicinalplants. This has lead to the understanding of many of the underlying physical andchemical principles that account for the medicinal properties of plants.[1,2] Plants have been an integral part of traditional medicine across thecontinents, since time immemorial.[3,4] Wounds have been defined as a disruption of cellular, anatomical, andfunctional continuity of a living tissue. Healing is the interaction of a complex cascade which leading to the restoration of structural and functionalintegrity with regain of strength of injured tissues. Millions of people is been affected by acute and chronic woundsaround the world.[5,6] in the UnitedStates, Acute wounds are a common health problem around 12 millionpeople around the world is affected and approximately 500,000 people is been hospitalized yearly. Chronic wounds are the majorconcerns of patient.Chronic wound affected large number of people around the globe. This may reduce the quality of life. Around 6 to 8millions peoples are suffer from chronic wound all over the globe.[7,8]

*Kaempferia rotunda* (Ginger) is a plant belonging to ginger family. China is native place and has a subcontinent to India. It is reportedly naturalized in Java, Malaysia and Costa Rica.

*Kaempferia rotunda* (Ginger) plant has many medicinal uses in Ayurvedic and allopathic medicinal systems. this is also known as *bhumichampa*.[9,10]

In India, this Plant is found in various region. These may seldom in the wild. The plant was grown in herbal nurseries. Sanskrit name *bhumichampa* implies the indigo-coloured flower shoots from within the soil.[11,12]

## 2. MATERIAL AND METHOD

### *2.1 Preparation of crude rhizome extract of* K.rotunda *(Ginger)*

Fresh rhizomes of *K. rotunda* werewashed and chopped and powdered. The powder (1.0 kg) was successively extracted and stored at room temperature with2.0 L of ethanol.At last, the filtrate collected and put them into a rotaryevaporator and yield was found to be 9.85 % (w/w).

### 2.2 Preparation of crude tuber extract of *K.rotunda*(Ginger)

Fresh tubers of *K.rotunda*(Ginger)were collected, washed, cut into small pieces,dried and powdered. The powder (1.0 kg) was successively extracted and stored at room temperature with2.0 L of ethanol. The extractwas filtered. At last, the filtrate collected and put them into a rotaryevaporator and the extract yield was found to be 4.85 % (w/w).

### 2.3Phytochemical screening and quantitative analysis

The plant material of *K.rotunda*(Ginger)were dried in shade and powder. Eight grams of root powder was extracted in different solvents (aqueous, methanol, ethanol, chloroform and petroleum ether) in Erlenmeyer flasks. They were kept on orbital shaker for one day for complete extraction. Later, each solvent was filtered by using WhatmanNo.1 filter paper. From the resulting extract, 4-5ml of each extract was used for phytochemical analysis.

Qualitative phytochemical analysis was done to estimate the presence ofalkaloids, glycosides, saponins, terpenoids, phenols, steroids, flavonoids, proteins, anthraquinones, coumarines and tannins in the plant material of *K.rotunda*(Ginger)

**Alkaloids**

The presence of alkaloids in root extracts (aqueous, methanol, ethanol, chloroform and petroleum ether) and the ethanolic extract of *K.rotunda*(Ginger)were tested by Mayer's and Dragendorff's reagents.

**Mayer's reagent Test**– Extracts of *K.rotunda* (Ginger)were treated with HCl solution. After that, 1 to 2-3 drops of Mayer's reagent was added and observed for the precipitation of yellow colour.

**Dragendorff's reagent Test**– Extracts of *K.rotunda* (Ginger)were dissolved in 10 ml of 1% HCl. Then, they were transferred to a water bath for few minutes and treated with 4-5 drops of Dragendorff's reagent, and observed for the orange reddish precipitation.

**Saponins**

foam test is use for the detection of saponins. Extract were mixed with water and the formation of froth is observed. It should be hold for 15-20min for positive result.

**Terpenoids**

The root extracts and the methanolic extract of *K.rotunda*(Ginger)was tested for the presence of terpenoids.Extracts of *K.rotunda*(Ginger)were dissolved in two or three granules of tin metal in 2 ml thionyl chloride solution and then, adding 1 ml of the extract into the test tube and observed for the formation of a pink colour.

**Steroids**

The presence of steroids in root extracts and the methanolic extract of *K.rotunda*(Ginger)was tested by Liebermann Burchard test and Salkowski test.

**Liebermann Burchard Test**– acetic anhydride is use for the mixing of all the extracts of *K.rotunda*(Ginger). at the side of the test tube concentrated sulphuric acid was addedat the junction of two layers a brown ring is formed. Green coloration on upper layer and deep red colour in the lower layer indicate a positive test for steroids.

**Salkowski Test–** Extracts of *K.rotunda*(Ginger)were mixed with few drops of concentrated sulphuric acid. Acid was poured from the sides of the test tube and a brown ring is formed at the junction of two layers.

**Flavonoids**

The presence of flavonoids in root extracts and ethanolic extract of *K.rotunda*(Ginger)was tested by ferric chloride test and alkaline reagent test.

**Ferric chloride Test**– Extracts of *K.rotunda* (Ginger)were mixed with ferric chloride solution and observed for the formation of blackish red colour.

**Alkaline reagent Test**– Extracts of *K.rotunda*( Ginger)mixed with sodium hydroxide solution and observed to increase of yellow colour which would become colourless on addition of few drops of dilute hydrochloric acid.

**Coumarines**

Root extracts and the ethanolic extract of *K.rotunda* (Ginger)was tested for the presence of coumarines. extracts of *K.rotunda*(Ginger)were mixed with few drops of 10% $NH_4OH$.Kept two spots on filter paper and examined under UV-light and then observed for intense fluorescence.

**Tannins**

The root extracts and the ethanolic extract of *K.rotunda*(Ginger)was done for the presence of tannins.

**Gelatin Test**– extracts of *K.rotunda*(Ginger)were mixed with gelatin solution and observed for the white precipitate for the presence of tannins.

**2.4 Experimental animals**

For this study, Wistar albino rats and Swiss albino mice were taken. According to NIH guidelines a standard housing condition was maintained.

**2.4.1 Skin wounding and treatment with ointment formulations *via* topically**

Male Wistar albino rats weighted and selected for the presentstudy. The animalswere inflicted with excision wounds. All the animals were anaesthetized.This was done for the creation ofwounds with ketamine hydrochloride (30 mg/kg). The dorsal fur of the thoracic region of the animal, covering an area of about 1000 mm2, was shaved and animpression was made on the ethanol-sterilized region. By using a surgical blade, circular wound area impressed.

**2.4.2 Skin wounding and treatment with extracts *via* orally**

On the dorsal thoracic region of male Wistar albino rats, a circular wound area wascreated. These animals then divided into five groups of twelve animals. Group I, 1ml of 1% Tween-80 were administered. The animals of group II, III and IV are administerthe extract ofdoses 50, 100 and 200 mg/ kg and Group V, the positive controlgroup was administered with 1ml of Novamox dry syrup (25 mg/kg) once daily,from $0^{th}$day onwards till the wounds get completely healed.

**2.4.3Acute dermal toxicity of test samples**

According to the guidelines of OECD, acute dermal toxicity test was conducted.Wistar albino rats (160-250 g) were selected. The fur was removed from trunk of all the animals. by using clipping or shaving of skin and only animals with intact skin. The animalsdivided into nine groups. Group I, the controlanimals (physiological saline). Group II, the vehicle control animals (ointment base) and the animals of Group III- Group IX has highest concentration of 20 % ointment.The gauze and tape were carefully removed.The change were observed on skin, eyes and mucousmembranes, behavioural patterns, etc. during study Mortality wasrecorded.

**2.4.4Acute oral toxicity of test samples**

According to the guidelines of OECD, acute oral toxicity studies were done. The test dose is 2000mg/kg was used. Around 18 hours of fasting animals were used for the experiment. In Group 1, 1ml of saline were administrated. In group 2, the 1 % Tween-80 were administrated or used as a vehicle. In group 3 to 9 the animals were orally treated with 2000mg/kg of single dose. After that all animals were allowed for food and water. The toxic symptoms are observed in first 4 hour of administration. After that animal were observed by 14 days. During the study mortality were observed. If any mortality were observed it will be expressed as $LD_{50}$.

**2.4.5 Evaluation of repeated oral toxicity of dose after 28-day**

This test was performed according to OECD guidelines. 23 group of both sex animals(male and female) were randomly selected and twenty-one treatment groups (n = 12 each; 6 males and 6 females). 1ml of saline were administrated into normal control and vehicle control groups and the animalswith test samples (KRR, KRTE, KRRP, KRRC, KRRB, KRROand KRTO) with a dose of 250, 500 and 1000 mg/kg.for a period of 28 days animals were orally administrated a single dose. This follow up is been observed for next 14 days. These animals then anaesthetized and blood sample collection were collected for haematological andbiochemical analysis.

**2.4.6Ulcerogenic activity of *K.rotunda* (Ginger) in Wistar albino rats**

The anti-ulcerogenic activity of the test samples were evaluated *via* differentulcerative models induced by necrotising agents, non-steroidal anti-inflammatorydrugs, water immersion stress and pylorus ligation in Wistar albino rats.

**2.4.6.1 Gastric mucosal lesions**

In gastriclesion model the gastroprotective activity of the test samples were assessed. Wistar albino ratswere distributed into different groups with six animals each and they werefasted for 36 h with free access to water *ad libitum* prior to the experiment. Theanimals were grouped into normal control, vehicle (ulcer) control, different testsamples and the positive controls treated groups. 1 ml of 1 % Tween-80 were orally administered. The animals of test sample treated groups were orally administered withthe crude ethanol extract, different solvent fractions, essential oil, thechromatographic sub-fractions and the pure compoundin separate experiments. The animals of positive control treated groupsreceived orally ranitidineand omeprazole, 1 hprior to the experiment. After this pre-treatment, the animalswere gavaged with 80 % ethanol to induce gastric ulcers.

**2.4.6.2 Indomethacin-induced gastric ulcer**

The indomethacin induced gastric ulceration was created as per the modifiedmethod. The animals were chosen into eight groupsof rats. Group 1, the normal control and Group II, the Indomethacin controlwere orally administered with 1 % Tween - 80 as vehicle. The animals of group IIIand IV orally administered with KRR at a dose of 100 and 200 mg/kg. While the animals of Group V and VI were pre-treated with KRRC at adose of 50 and 100 mg/kg respectively and the animals of Group VII and VIIIwere pre-treated with the positive control, ranitidine andomeprazole respectively. 30 min after drug administration, animalsof group II - VIII were orallyadministered with 30 mg/kg indomethacin in a volumeof 8 ml/kg of saline. 6 h after indomethacin administration, all the animals wereeuthanized by CO2 inhalation and the stomachs were excised out.

**2.4.6.3 Water immersion stress-induced gastric ulcer model**

With *ad libitum,* animals were fasted for 36 h andgrouped into eight groups with six animals each. Group 1, normalcontrol and Group II, the ulcer control animalswith 1% Tween – 80. Group III and IV animals were orally administered with KRR. While the animals of Group V and VIwere pre-treated with KRRC and the Group VII and VIII animals were prior administered with thepositive controls, ranitidine and omeprazole. Afterdrugtreatment animals from Group II- Group VIII allowed animals to swim in the glasscylinder. Then the animals were carefullyremoved from their experimental conditions and were euthanized by CO2 inhalationand the stomach tissue of each animal was excised.

**2.5Haematological parameters**

heparinised blood is used for the analysis of haematologicalparameters. Parameters are HGB, RBC, WBC) and PLT count were made byusing an haematological analyser.

## 3. RESULT AND DISCUSSION

### 3.1 Phytochemical analysis

**Table 1: Phytochemical screening of rhizomes of *K.rotunda(Ginger)*.**

| S.no | test | KRRP | KRRC | KRRB |
|---|---|---|---|---|
| 1 | Alkaloids | - | - | - |
| 2 | Saponins | - | - | - |
| 3 | Terpenoids | - | + | + |
| 4 | Flavonoids | - | + | + |
| 5 | Steroids | + | + | + |
| 6 | Coumarines | - | - | - |
| 7 | Tannins | - | - | - |

### 3.2 Ointment formulation effect on topical application of *K.rotunda*(KRRD) containing ethanolextract concentration (1 %, 3 %, and 5 % ) on excision wound model

The gross morphological changes observed in the vehicle treated control animals and the KRRD (1 %, 3 % and 5 %) and the positive control povidone-iodine treated groups were monitored from 0th day till the wounds get completely closed and was photographed and summarized. Topical treatment of wounds with KRRD at a concentration of 1 %, 3 % and5 % demonstrated an increased wound closure rate in comparison with the vehicletreated control animals. In addition, the KRRD and povidone - iodine treated animalshad less redness, swelling, and exudates. In between the 2nd and 3rd day post-surgery, a deep purple / black colouredscab tissue covering the entire surface of the open wound area appeared on thecontrol and treated wounds. As the treatment of wounds with KRRD (1 %, 3% and 5%) continued, re-epithelialization progressed under this scab tissue in the wounded region and a reduction in the surface area was observed inall the animals in comparison with the vehicle treated control animals, while treatment of wounds with 5 % KRRD showed an increased woundclosure rate and faster re-epithelialization in comparison with the control and othertreated groups. This was followed by treatment of wounds with KRRD 3 % and 1 %treatment. In between 14th and 15th post wounding day, the wounds treated with 5 %KRRD. The newly formed tissue appeared tobe thinner and paler than the surrounding tissue that was not excised. The treatmentof wounds with the povidone-iodine treated group also showed a decrease in themean wound area in comparison with the vehicle treated control animals during thisperiod, while the wounds of the vehicle treated control animals were foundto be still open and remained to be covered with the scab tissue on the surface of thewound bed during this period and it took more than 32 days for complete woundclosure.

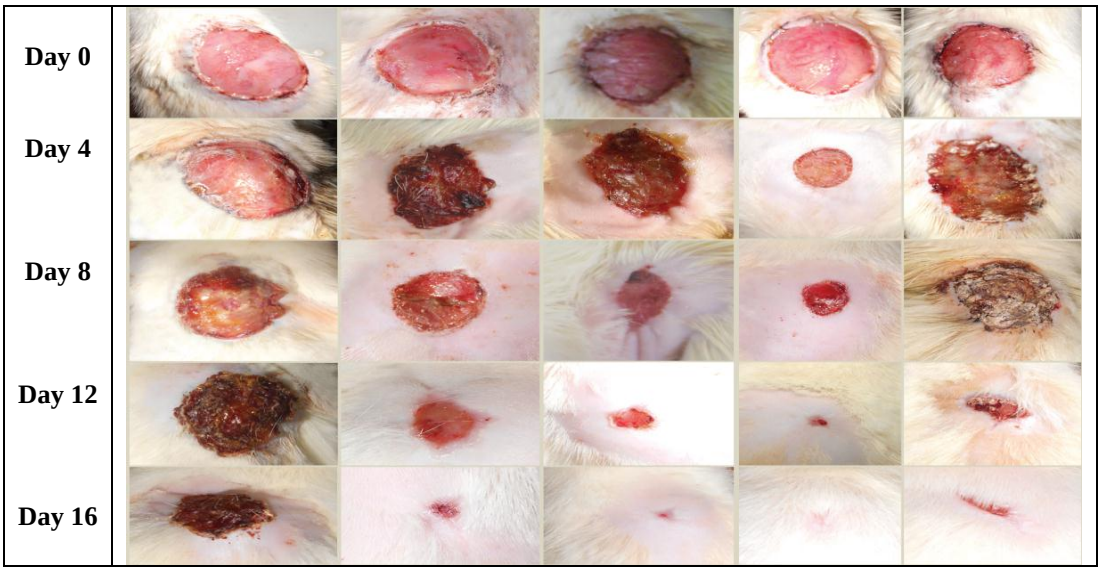


**Figure 1: Photographic representation of wound closure treated control animals, KRRD 1%, 3% and 5% and povidone-iodine 5% treated rats on $0^{th}$,$2^{nd}$,$4^{th}$,$8^{th}$, $12^{th}$ and $16^{th}$ wounding days.**

**3.3 The gross morphology of the vehicle treated control, KRTD (1 %, 3 %, and 5 %) treated wound tissue**

The gross morphological changes observed in the vehicle treated controlanimals and the KRTD (1, 3 and 5 %) and the positive control povidone-iodinetreated groups were monitored from 0th day to till the wounds get completely closedand was photographed and summarized. The gross examination of the wounded tissue showed that the topicaltreatment of animals with KRTD 1 %, 3 % and 5 % show a decreasedosedependent in comparison with the vehicle treatedcontrol groups and they were also associated with less redness, swelling, andexudates. Treatmentof wounds with povidone-iodineshow a significant decrease in mean wound area in comparison with the vehicle treated control animals.

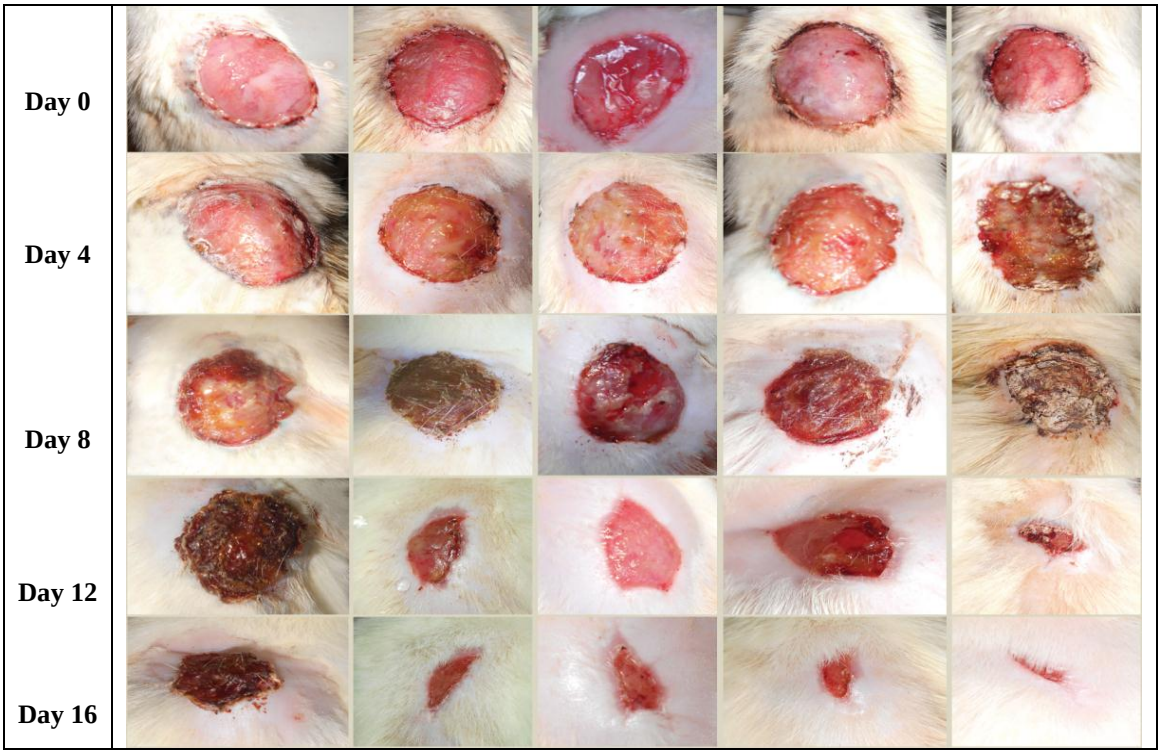


**Figure 2: Photographic representation of wound closure treated control animals, KRTD 1%, 3% and 5% and povidone-iodine 5% treated rats on 0th,2nd ,4th ,8th, 12th and 16th wounding days.**

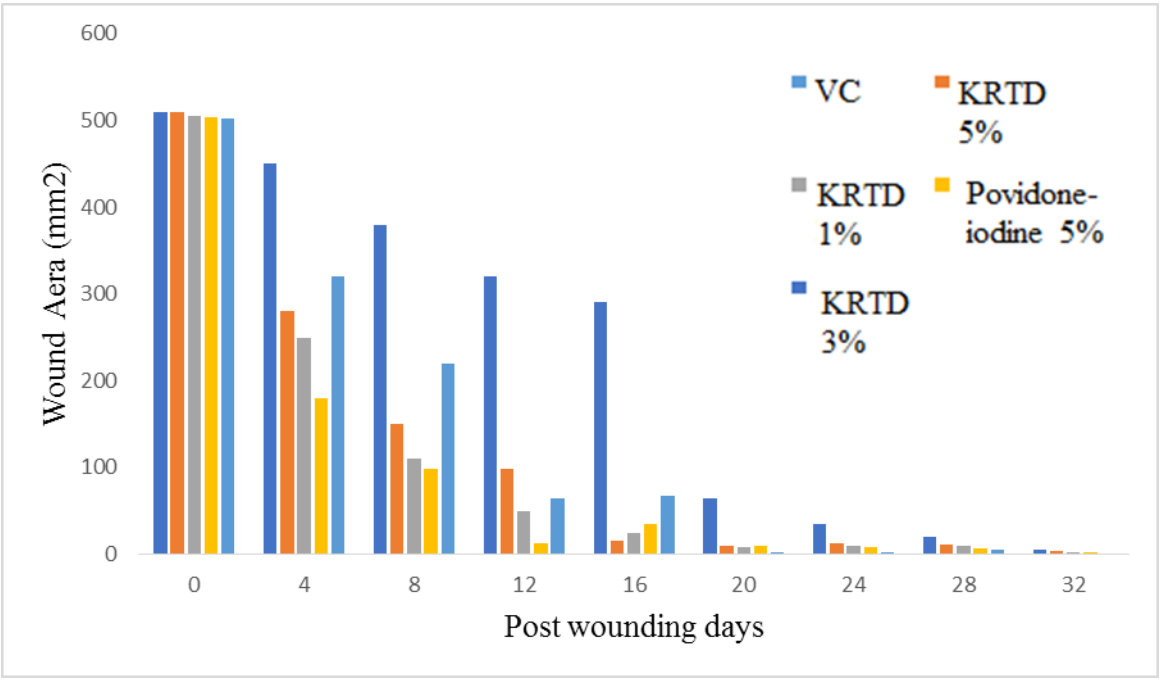


**Figure 3: Ointment formulation effect of *Kaempferia rotunda (Ginger)*tuber(KRTD) on wound contraction.**

### 3.4 Oral toxicity studies (repeated 28 day) of ethanol extract of the rhizome (KRR), tuber (KRT) of *K.rotunda*

No treatment-related toxicity signs and mortality observed in both sexes of rats orally for 28 days. There were no changes in eye, fur, skin, respiratory system and behavioural pattern.

**Table 2: Haematological parameters of oral administration (28days) of ethanol extract of rhizome (KRR) and tuber (KRT) of *K.rotunda(Ginger)*in male rats.**

| Treatment | RBC ($10^6$/µl) | WBC ($10^3$/µl) | PLT ($10^3$/µl) | HGB (g/dl) |
|---|---|---|---|---|
| **Control** | 8.68±0.65 | 14.85±1.56 | 840.18±65.48 | 15.89±1.85 |
| **Vehicle control** | 7.58±0.59 | 13.75±1.38 | 845.58±59.90 | 15.31±1.85 |
| **KRR (250mg/kg)** | 8.10±0.65 | 13.67±1.63 | 803.20±58.45 | 17.19±1.45 |
| **KRR (500mg/kg)** | 9.01±0.97 | 17.09±0.98 | 810.00±40.19 | 17.12±1.98 |
| **KRR (1000mg/kg)** | 6.89±0.86 | 15.18±1.98 | 899.02±55.98 | 18.78±1.94 |
| **KRT (250mg/kg)** | 7.12±0.58 | 15.98±0.89 | 890.98±33.98 | 15.26±1.09 |
| **KRT (500mg/kg)** | 8.09±1.08 | 15.98±1.03 | 835.00±56.04 | 17.89±1.04 |
| **KRT (1000mg/kg)** | 9.07±0.55 | 17.98±1.07 | 846.08±67.98 | 18.09±1.08 |

**Table 3: Clinical haematological parameters of oral administration (28day) of ethanol extract of rhizome (KRR) and tuber (KRT) of K.rotunda in female rats.**

| Treatment | RBC ($10^6$/µl) | WBC ($10^3$/µl) | PLT ($10^3$/µl) | HGB (g/dl) |
|---|---|---|---|---|
| **Control** | 7.90±1.09 | 15.98±0.98 | 820±78.09 | 15.98±0.98 |
| **Vehicle control** | 6.98±1.02 | 10.98±1.09 | 813±67.98 | 15.09±1.02 |
| **KRR (250mg/kg)** | 7.98±0.98 | 8.90±1.26 | 850±88.09 | 17.09±0.98 |
| **KRR (500mg/kg)** | 6.90±1.34 | 12.90±1.40 | 872±89.90 | 18.90±1.90 |
| **KRR (1000mg/kg)** | 7.80±0.89 | 15.90±0.89 | 890±88.90 | 16.89±1.88 |
| **KRT (250mg/kg)** | 7.89±0.90 | 13.89±1.89 | 769±89.89 | 15.90±1.89 |
| **KRT (500mg/kg)** | 6.66±0.89 | 15.89±1.70 | 888±69.80 | 17.89±1.66 |
| **KRT (1000mg/kg)** | 7.80±1.89 | 14.26±1.77 | 890±77.89 | 16.90±1.77 |

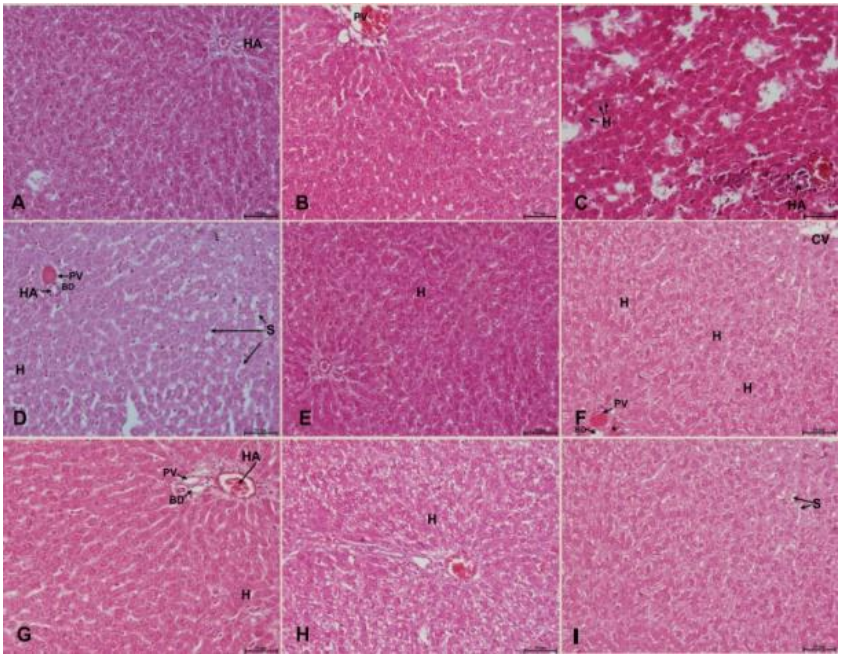


**Figure 4: Photomicrographs of the rat liver sections stained with hematoxylin and eosin after a 28-day repeated oral administration of test drug. The strained sections of liver from KRR, KRT (1000mg/kg) treated animal.**

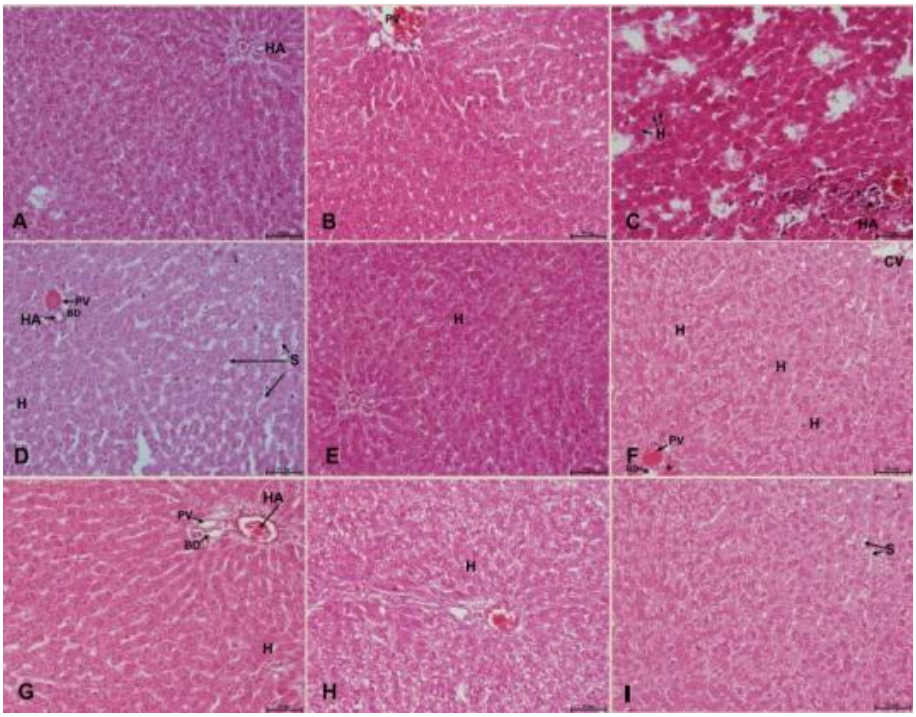


**Figure 5: Photomicrographs of the rat spleenfrom normal control showing normal granular hemosiderin pigment with macrophages in the red pulp. The stained sections of spleen from vehicle treated control (1% Tween 80). The strained sections of liver from KRR, KRT (1000mg/kg) treated animal.**

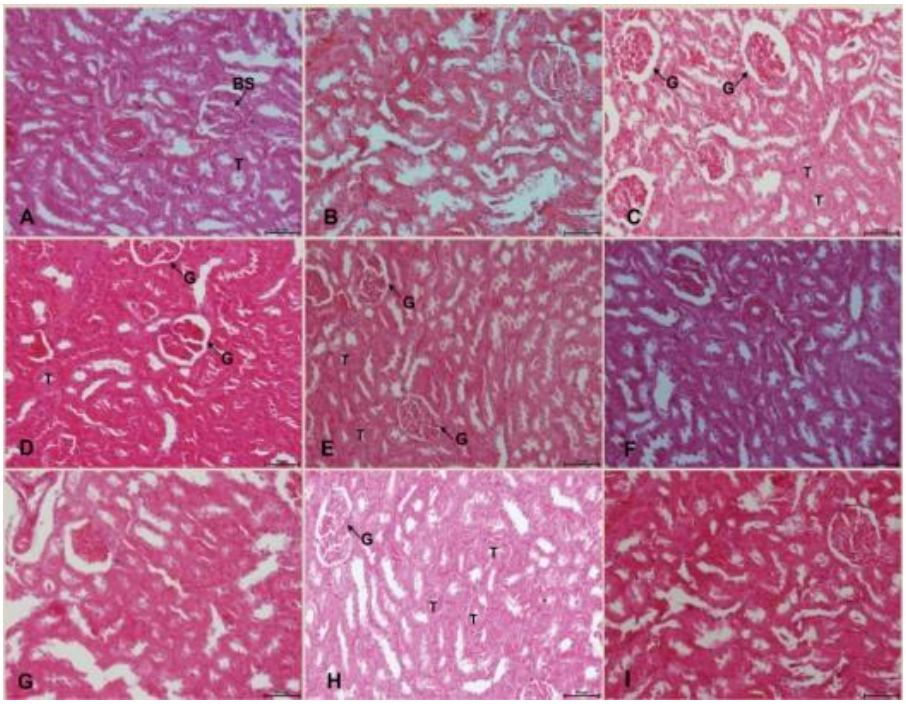


**Figure 6: Photomicrographs of the rat kidneyfrom normal control showing normal size of glomeruli with normal tubules. The stained sections of kidney from vehicle treated control (1% Tween 80) animals showing normal size of glomeruli with normal tubules. The strained sections of liver from KRR, KRT (1000mg/kg) treated animal.**

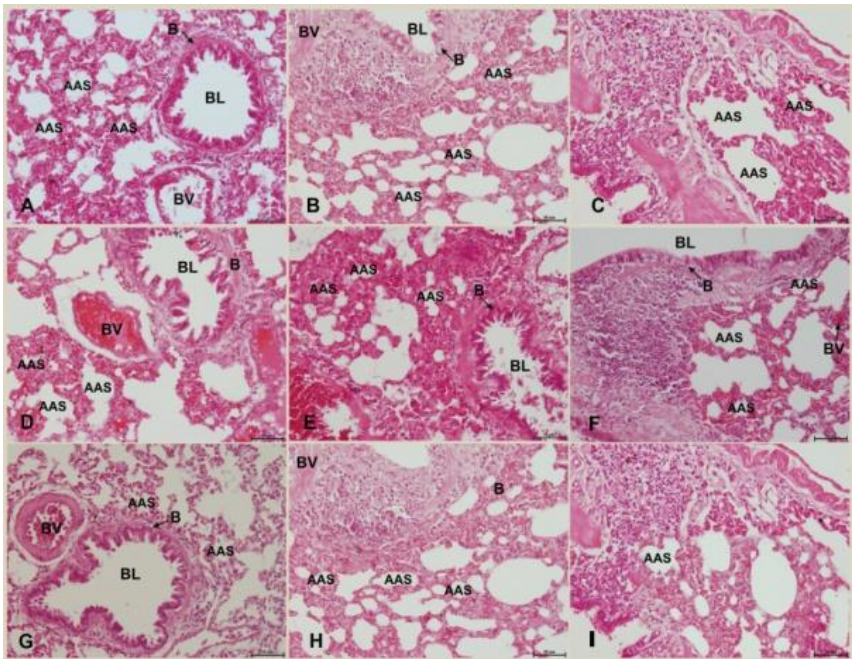


**Figure 7: Photomicrographs of the rat lung from normal control showing normal lung architecture illustrating. The stained sections of lung from vehicle treated control (1% Tween 80) animals showing normal size of glomeruli with normal tubules. The strained sections of liver from KRR, KRT (1000mg/kg) treated animal.**

**3.5 The anti-ulcerogenic activity of the ethanol extract of rhizomes of *Kaempferia rotunda L.*(Ginger) on experimentally induced gastric ulcers in rats**

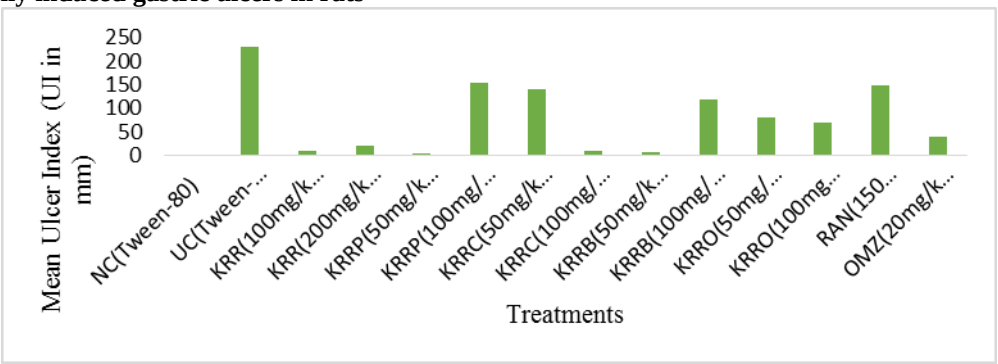


**Figure 8: Effect of ethanol extract from rhizomes of Kaempferia rotunda (KRR, KRRP, KRRC, KRRB and KRRO) on ethanol (EtOH)-induced gastric ulcer in rats.**

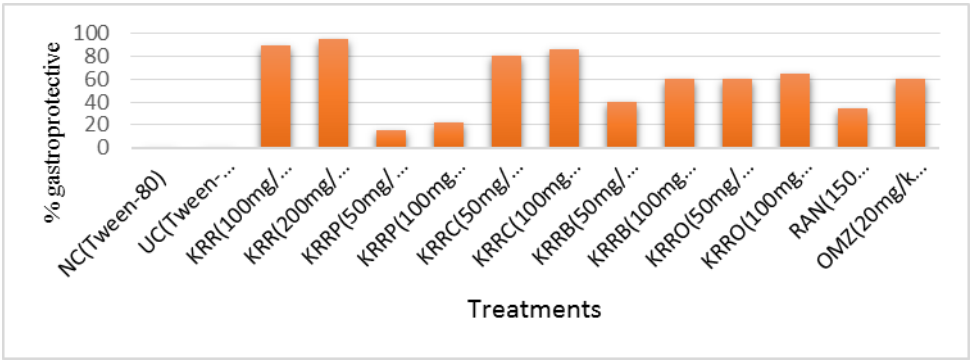


**Figure 9: Effect of ethanol extract from rhizomes of Kaempferia rotunda (KRR, KRRP, KRRC, KRRB and KRRO) on degree of protection against ethanol (EtOH) – induced gastric ulcer in rats.**

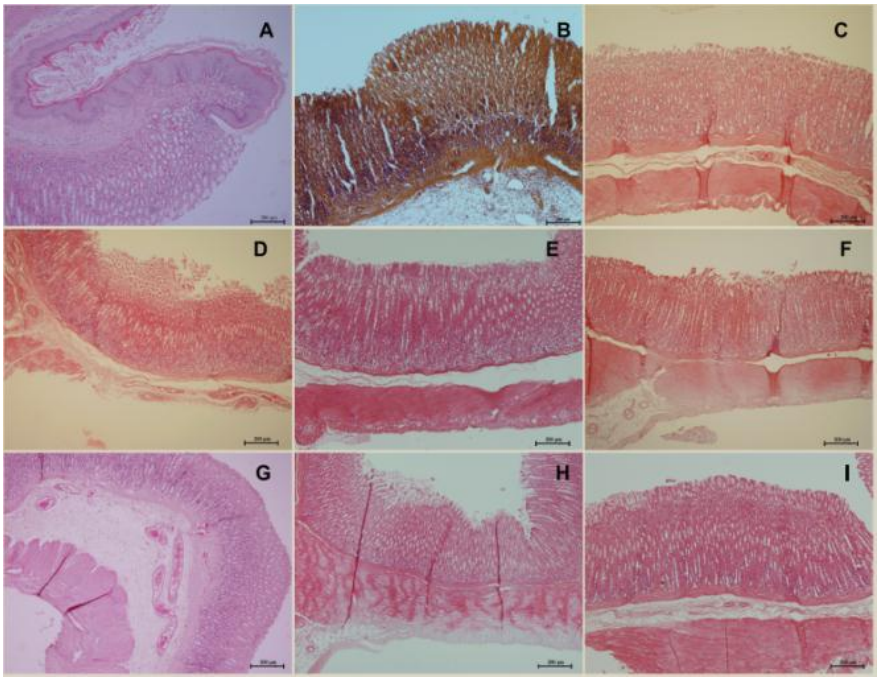


**Figure 10: Histological evaluation of hematoxylin and eosin-stained sections of glandular stomach tissue from normal, ulcer control, KKR,KRRP, KRRC,KRRB, KRRO,RAN and OMZ pre-treated rats showing their effect on ethanol induced gastric lesions.**

### 3.6 Effect of KRR and KRRC on NSAIDS induced gastric ulcer in Wistar rats

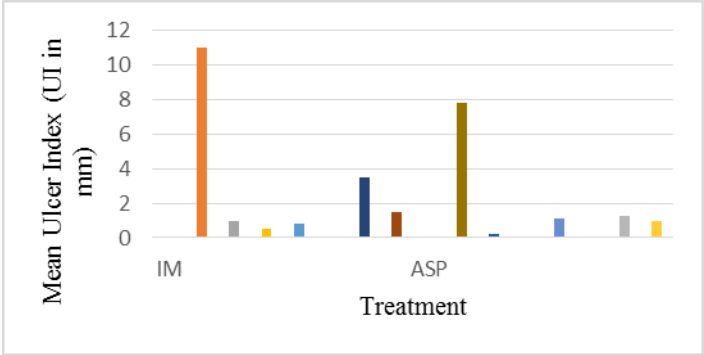


**Figure 11: Effect of ethanol extract and chloroform fraction of the rhizomes of*Kaempferia rotunda* (KRR and KRRC respectively) on gastric lesions inducedby NSAIDs (indomethacin (IM) and aspirin (ASP).**

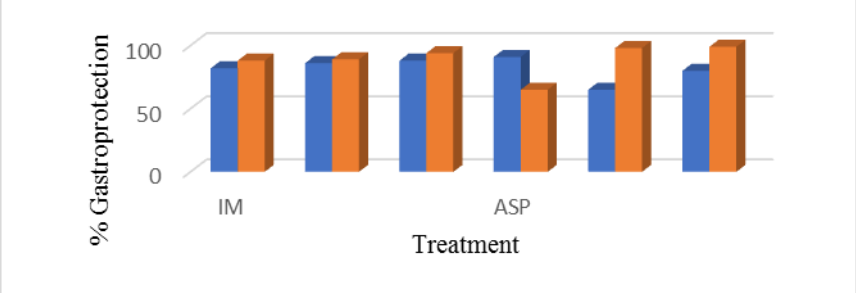


**Figure 12: Effect of ethanol extract and chloroform fraction of the rhizomes of*Kaempferia rotunda* (KRR and KRRC respectively) on degree of protectionagainst NSAIDs (indomethacin (IM) and aspirin (ASP)) induced gastriculceration in rats.**

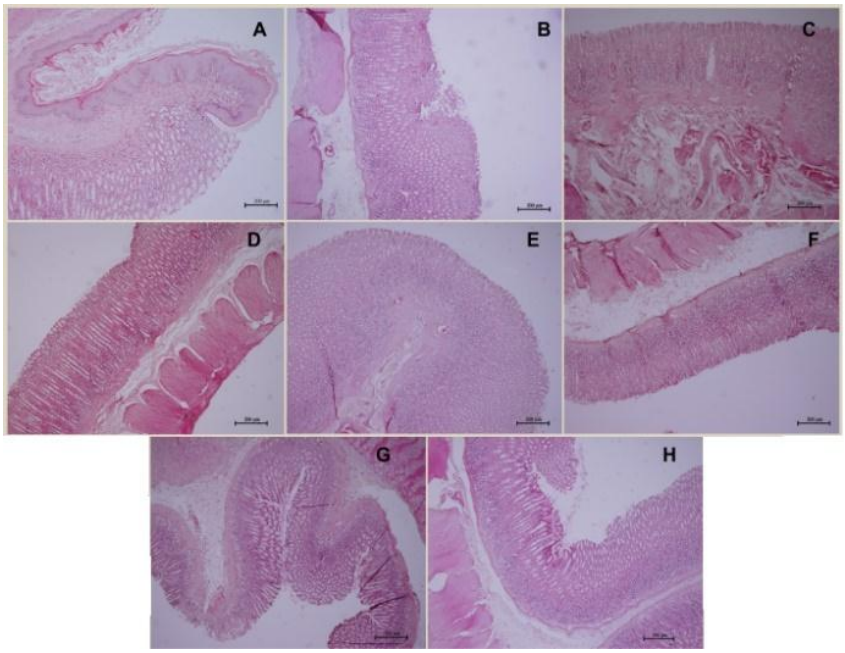


**Figure *13*: Histological evaluation of hematoxylin and eosin-stained sections of glandular stomach tissue from normal, ulcer control, KRR, KRRC, RAN and OMZ pre-treated rat.**

**3.7 Effect of KRR and KRRC on water immersion stress - induced gastric ulcer**

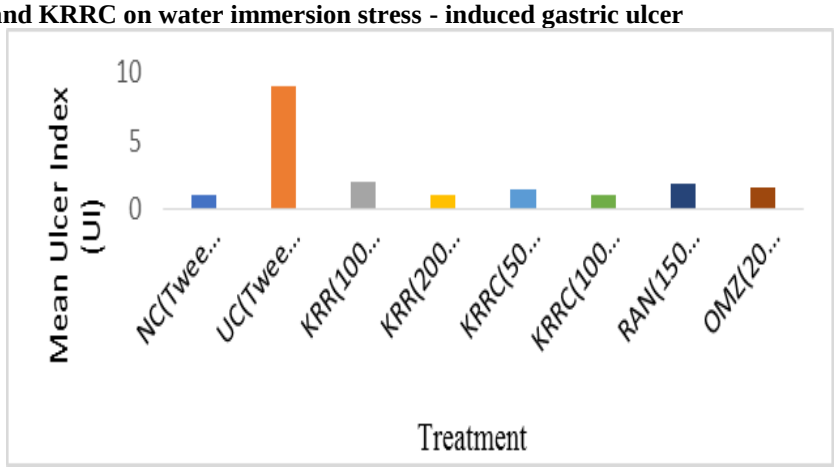


**Figure 14: Effect of ethanol extract and chloroform fraction of the rhizomes of *Kaempferia rotunda* (KRR and KRRC respectively) in rats.**

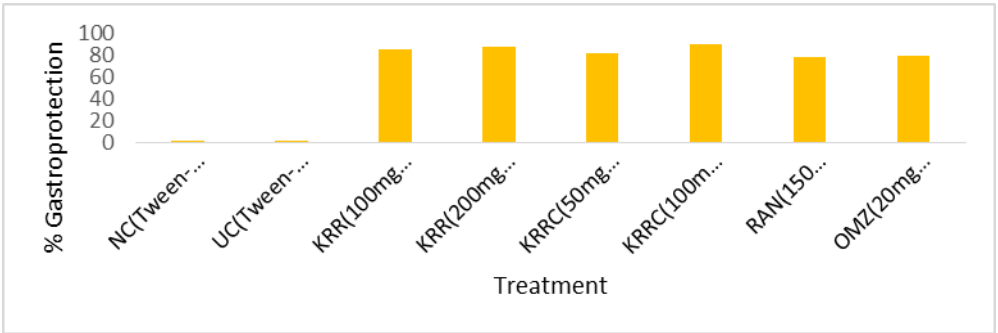


**Figure 15: Effect of ethanol extract and chloroform fraction of the rhizomes of*Kaempferia rotunda* (KRR and KRRC respectively) in rats.**

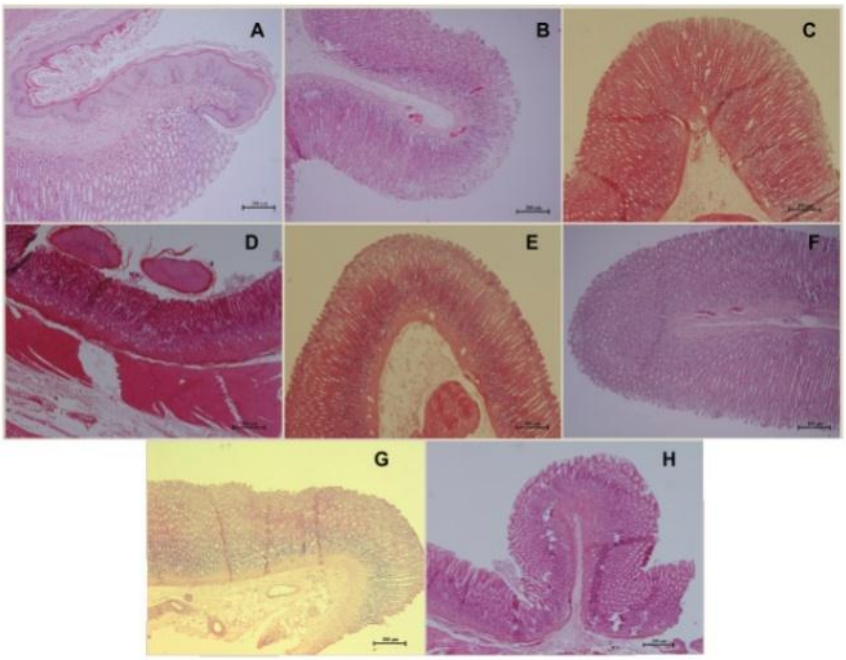


**Figure16: Histological evaluation of hematoxylin and eosin-stained sections of the glandularstomach issue from normal, ulcer control, KRR, KRRC, RAN and OMZ pre-treated rats.**

## 4. SUMMARY AND CONCLUSION

The present study was thus undertaken to evaluatethe wound healing potential of the rhizomes and tubers of *K.rotunda*in Wistar albinorats. In the excision wound model, the wound healing potential of ethanolicextract of the rhizome (KRR), tuber (KRT) were tested *in vivo*. The periodicassessment of wound area showed that the topical treatment of wounds with theointment formulation containing ethanol extract of the rhizome and tuber (KRRDand KRTD respectively), the essential oil isolated from the rhizome and tuber(KRROD and KRTOD) and the oral administration of animals withethanol extract of the rhizome and tuber (KRR and KRT) of *K.rotunda*significantly increased the wound contraction, collagen deposition and decreased themean period of re-epithelialization dose dependently in comparison with theirrespective vehicle treated control animals. The wounds treated with KRRD showedmore prominent healing with a faster wound contraction, re-epithelialization andexcellent collagen deposition than the vehicle treated control, KRROD, KRR,KRTOD, KRTD, KRT and the positive controls povidone-iodine and novamoxtreated groups. The histological and histomorphometric evaluation carried out alsosupported the increased wound healing potential of KRRD.

Anti-ulcerogenic effect of ethanol extract of therhizome (KRR), rhizome fractions (KRRP, KRRC and KRRB) and isolated from the rhizomes (KRRO) of *K.rotunda*was evaluated against ethanol -induced gastric ulcers in Wistar albino rats and the study demonstrated severehaemorrhagic lesions in the gastric mucosa of the ethanol administered ulcer controlanimals with decreased defensive factors such as gastric wall mucus and NP-SHcontent in association with ROS accumulation as evidenced by increased lipidperoxidation with concomitant depletion of endogenous GSH level in the gastricmucosa. Treatment of animals with KRR, KRRO, KRRP, KRRC and KRRB showeda dose dependent significant increase in the mucosal defensive factors and offered adose dependent significant protection to the adhered gastric mucosa. Treatment with KRR and KRRC was found to possess morepprominent gastroprotective effect by inhibiting the loss of gastric mucosal integrity endogenous GSH content and by decreasingthe membrane lipid peroxidation in comparison with the ulcer control, the fractions(KRRP and KRRB) and the essential oil formulation (KRRO) of the rhizomes of*K.rotunda*and the positive controls (RAN and OMZ) pre-treated groups. Thegastroprotective effect of the treated group were also supported by the histologicalevidences obtained from the study. However at 100 mg/kg, KRRC exhibited agreater degree of gastroprotection than all the treated groups indicating its increasedcytoprotective effect against necrotising agent (ethanol)- induced gastric lesions.

## 5. REFERENCES

1. Huffman MA. Animal self-medication and ethno-medicine: exploration and exploitation of the medicinal properties of plants. Proc Nutr Soc, 2003; 62(2): 371–81.
2. Girish Dwivedi, Shridhar Dwivedi. History of Medicine: Sushruta – the Clinician – Teacher par Excellence. National Informatics Centre, 2007; 224-225.
3. Ernst E. Herbal medicines: balancing benefits and risks. Novartis Found. Symp, 2007; 282: 154–67; 167–72, 212–8.

4. Schilling. Wound Healing. Phys. Rev., 1968; 48(2): 374.
5. L.M.Wahl, S.M.Wahl: Inflammation, in I.K.Cohen, R.F.Diegelman, W.J. Lindblad (eds): Wound Healing: Biochemical and Clinical Aspects, Philadelphia, PA, W.B. Saunders, 1992; 40-62.
6. Kerstein MD. Overview of wound healing in a moist environment.Am.J.Surg, 1994; 167(1A): 2S-6S.
7. Linder R.Effect of dressing materials on wound healing. Langenbecks Arch Chir SupplKongressbd, 1998; 115: 694-7.
8. Bolognia J.L. Jorizzo R.P. Rapini. Dermatology, 2008; 2(2): 2147–2158.
9. Khullar R, Saini S, Sethi N, Rana AC. Emulgel: A surrogate approach for topically used hydrophobic drugs. Int J Pharm Biol Sci., 2011; 117-128.
10. Mohamed MI. Topical emulsion gel composition comprising diclofenac sodium. AAPS J, 2004; 6(3): 26.
11. Baibhav, Rana AC, Seema S, Vikas S. Emulgel: a comprehensive review on the recent advances in topical drug delivery. International Research Journal of Pharmacy, 2011; 2(11): 66-70.
12. Mohamad MI, Optimization of chlorphenesinemulgel formulation. AAPS J, 2004; 6(3): 1-5.