

Quercetin Accelerated Hypoxia Inducible Factor-1 α Expression in Tooth Sockets Wistar Rats

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Abstract

All or part of an organ's function is lost, as is the sympathetic response to stress, bleeding, and blood coagulation, bacterial infection, and cell death are some of the consequences of a wound.

There will be a regeneration process that involves the soft tissue and hard tissue of the oral cavity in the wound caused by tooth extraction. Quercetin is a flavonoid found in plants that has anti-oxidant and anti-inflammatory activities. It can lessen the symptoms of inflammation and improve the healing of wounds. All samples were randomly categorized into 4 groups (8 rats for each). Group 1 (quercetin 20mg/kg body weight for two days), Group 2 (control group for two days), Group 3 (quercetin 20mg/kg body weight for five days) and Group 4 (control group for five days).

The outcomes on the 2nd and 5th days, while inspected using a light beam conducted to the tissue and magnified 450 times, indicate that the group received quercetin has much more HIF-1 expressing cells than the control group. Conclusion: Quercetin can potentially level up the rise of HIF-1 expression in the Wistar Rat after tooth extraction.

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Introduction

Wounds occur when a portion of the body's tissues is lost or destroyed. Sharp or no sharp injuries, Temperature fluctuations, acids, fires, electric shocks and tooth extraction can all contribute to this scenario. All or part of an organ's function is lost, as is the sympathetic response to stress, bleeding, and blood coagulation, bacterial infection, and cell death are some of the consequences of a wound. There are some regeneration process that involves the soft tissue and hard tissue from the oral cavity in the wound caused by tooth extraction. The gingiva and periodontal ligament are soft tissue, while the alveolar bone is hard tissue.^{1,2}

HIF is organized into 3 members: HIF-1, HIF-2, and HIF-3. The subunits are the same in all three, but the units are different. When oxygen levels are disrupted, HIF plays a critical function

in gene regulation. Endothelial cells, osteoblast lining cells, mesenchymal cells, fibroblasts, and macrophages all release HIF-1. HIF-1 is a transcription factor that has a role in the control of angiogenesis and the creation of bone healing, especially on tooth extraction sockets.³

Quercetin is a flavonoid found in plants that has anti-oxidant and anti-inflammatory activities. It can lessen the symptoms of inflammation and improve the healing of wounds. Maceration extraction is a common method of obtaining quercetin from medicinal herbs. Maceration is a simple extraction method that involves shaking a solvent at room temperature/room temperature numerous times. This approach has the advantage of being able to attract nutrients from plants that are not heat resistant. The simplicia powder is macerated by soaking it in a liquid filter. The filtered fluid will pierce the cell wall and enter the active substance-containing cell cavity; the concentrated solution will be forced out due to the concentration difference between the active substance solution inside the cell and outside the cell.⁴

Bone healing is a complex process that requires stability, revascularization, osteogenesis, osteoinduction, and osteoconduction. Osteoinduction is the process of stimulating

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undifferentiated, pluripotent cells to grow into the bone-forming progenitor cells. HIF has a vital role in the early stages of injury to allow the osteoinduction and osteoconduction processes to take place in the alveolar bone.^{5,6}

The goal of this study was to see how Quercetin increased HIF-1a expression in wistar rats' incisive sockets.

Materials and methods

All samples were randomly categorized into 4 groups (8 rats for each). Group 1 (quercetin 20mg/kg body weight for two days), Group 2 (control group for two days), Group 3 (quercetin 20mg/kg body weight for five days) and Group 4 (control Group five days). The Post-Test Only Control Group Design was used in this analysis, and it's an experimental laboratory study. We used 32 female Wistar Rats that measured between 150 and 200 grams and were 3 months old. Have excellent health, consume plenty of food, and drink plenty of water. The Committee of Animal Care at the University of Airlangga Surabaya approved all animal experiments. Though tooth extraction is easier on Wistar Rats with a deep enough socket extraction wound for administering quercetin, this animal was chosen. On the lower left incisor, a tooth extraction is being performed. The lower front teeth is chosen because of Rat's teeth's morphology and anatomic form, which enables for extraction.

The lower incisive of Wistar rats was extracted after being given quercetin for 2 and 5 days. Midline cutting was used to decapitate the specimen, that was then fixed in a 10% buffered formaldehyde solution. ninety percent Ethanol was utilized as a solvent to extract the water out from the sample fragment. The subsequent stage is dehydration with either a graded series of alcohol, accompanied by cleaning with xylene. The following phase entails embedding tissue in paraffin and sectioning it into 5 μ , proceeded by mounting and to make the biomaterial components visible, anti-HIF-1 antibodies (Novusbio, USA) were used to stain the tissue. After all of the histology, specimens had been completed, all samples were examined under a 450x magnification light microscope.⁷

Results

Table 1 and 2 indicate the mean and standard deviation of HIF-1a expression after extraction in Wistar Rats. To determine the normality of the distribution, the data were subjected to a Kolmogorof Smirnov test. As all of the test groups' results were $p > 0.05$, the data exhibited a normal distribution, As a result, a T-test with a 5% significant data was performed.

The outcomes on the 2nd and 5th days, while inspected using a light microscope that is conducted via the tissue and magnified 450 times, indicate that the group received quercetin has much more HIF-1 expressing cells than the control group. The results indicate that each group treatment has a significant data $p < 0.05$ ($p = 0.001$). Figure 1: Data represent the number of HIF-1a per 450 field in control and treated groups for 2 & 5 days.

Group	X \pm SD Day 2	X \pm SD Day 5
Quercetin	23.00 ^a \pm 2.61	16.87 ^a \pm 3.09
K	13.50 ^b \pm 2.20	12.12 ^b \pm 1.88

Table 1. Shows the mean HIF-1a expression in the treatment and control groups. Note that the varied superscripts revealed a significant difference (0.05).

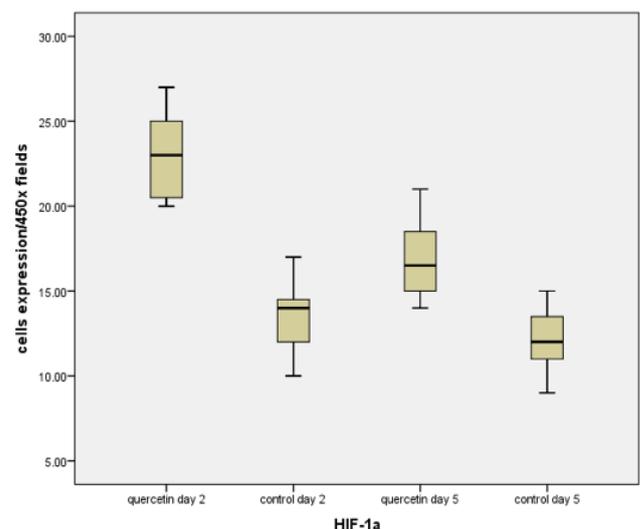


Figure 1. Data showing the number of HIF-1a per 450 field in in control and treated groups for 2 & 5 days.

Discussion

It is essential in mucous and connective tissue repair and must be kept during the beginning day of repair because it shows the way for starting a new surface. The clot is easily digested when the epithelial surface is repaired since it's no longer required. The repairing of the mucous epithelium is reliant on the repair of the lamina propria connective tissue. A clot forms in the area as a result of blood products after a trauma to the oral mucosa or socket upon extraction, and the leukocyte cells in the region cause the inflammatory reaction. Tissue repair can proceed within a few days if the source of injury is eliminated. Epithelial cells at the injury's periphery will migrate after losing their desmosomal intercellular connection beneath the clot to construct a new epithelial barrier on the surface.^{8,9}

Quercetin has the ability to increase the activity of generating new blood vessels as well as speed up the synthesis of fibroblasts and collagen. The collagen network appears blue on the mallory azan staining when examined under a microscope. In animals, collagen tissue appears as fine threads related to one another with a diameter of 75 nanometers. Collagen networks converge in several areas of the body to produce collagen bundles. Collagen is essential in wound healing because it has the capacity to form and reconstruct wounds back to their original shape. The synthesis of collagen throughout the wound healing process helps to increase the wounded tissue's tensile strength. An increase in the number of fibroblasts will have an effect on collagen production, which will result in a faster wound healing process.^{10,11}

The presence of Quercetin's substance causes a substantial increase in HIF-1 expression when it is used (Table 1 & Figure 1). Quercetin has an anti-inflammatory activity that helps the body avoiding infection, fever, and other bacterial diseases. Quercetin promotes type I collagen synthesis by constructing polypeptide chains on polyribosomes attached endoplasmic reticulum in the cytoplasm and releasing procollagen molecules into the cisternae. Collagens are the most common proteins in the body, and they play a key role in wound healing. Quercetin was found to be a better modulator of tissue recovery, particularly in the extraction socket.^{12,13,14}

Conclusions

Quercetin can potentially level up the rise of HIF-1 expression in the Wistar Rat after tooth extraction.

Declaration of Interest

There are no conflicts of interest reported by the author, and all the article wasn't financed by any research grant.

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