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ORIGINAL ARTICLE

Effect of Carrots (*Daucus carota L.*) on Gastric Histopathology of Piroxicam-Induced Mice as a Peptic Ulcer Prevention

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A B S T R A C T

Introduction: Non-steroidal anti-inflammatory drugs (NSAIDs) consumption contributes significantly to gastrointestinal morbidity, including peptic ulcers. NSAIDs cause gastric mucosal damage by inhibiting PGE2 and PGI2 secretion, increasing HCl secretion, and also causing local irritation and neutrophil adhesion. Flavonoids and chlorogenic acid are gastroprotective agents found in carrots (*Daucus carota L.*). Therefore, this study aimed to validate the effect of carrots on gastric histopathology of piroxicam-induced mice.

Methods: This was an experimental study using a post-test-only control group design. 35 mice were divided into 5 groups and were allowed to adapt for 1 week. The negative control group received 0.25 mL aqua dest, while the positive control group received 0.104 mg famotidine. Group A, B, and C received carrot extract with each dosage was 200 mg/kgBW, 300 mg/kgBW, and 400 mg/kgBW. The mice were induced 2 hours later with 0.052 mg piroxicam. The treatments lasted 14 days. Each stomach was taken and examined on the 15th day. Afterward, histopathological preparations were made.

Results: The results of the histopathological signs of inflammation using the Kruskal-Wallis method showed p = 0.000, indicating that there was an effect of the carrot extract in preventing inflammation on the gastric histopathology ($p < 0.05$).

Conclusion: In conclusion, this study confirmed that carrot extract is more effective in avoiding peptic ulcers due to NSAID consumption.

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Introduction

Non-steroidal anti-inflammatory drugs (NSAID) have common side effects that damage the digestive tract mucosa through inhibition of cyclooxygenase-1 (COX-1) enzyme which can reduce the secretion of gastric mucosal cytoprotective materials, especially PGE2 and PGI2, through local irritation due to direct contact with gastric mucosa,[1] through inhibition of cyclooxygenase-2 (COX-2) enzyme which can increase neutrophil adhesion,[2] through reactive oxygen species (ROS) production,[3,4] and also through its prominent acidic nature.[4] Based on 2013 Basic Health Research in Indonesia, there were 24,496 NSAIDs stored by 20,516 households purchased without a prescription. One of them is piroxicam which has side effects of peptic ulcers and gastrointestinal bleeding up to 9.5 times higher than others.[5,6]

Peptic ulcers are ulceration of the gastric or duodenum mucosa.[7] The best therapy is proton pump inhibitor (PPI). However, PPI is an acid-labile drug and only works after being absorbed in the intestine,[5] thus the H2 receptor antagonist (H2RA) was the drug used in this study because it directly inhibits the H2 receptor. Famotidine, for example, was effective in preventing peptic ulcers in indomethacin-induced rats by reduction of gastric degenerative changes, gastric acidity, and ROS production.[8] However, PPI and H2RA have side effects such as diarrhea and headache.[5] Therefore, carrots (*Daucus carota L.*) which contain anti-inflammatory substances, known as phenolic substances, can be used as an alternative to prevent peptic ulcers.[8] The most dominant phenolic compound in carrots is chlorogenic acid which can reduce the release of inflammatory mediators, especially TNF-α.[9,10] Carrots also contain flavonoids that inhibit acid secretion, reduce pepsin level and activity, and also increase gastric mucous and bicarbonate secretion. Flavonoids also have antioxidative, anti-inflammatory, and cytoprotective effect.[11,12] Therefore, this study aimed to prove the effect of carrot extract as a peptic ulcer prevention on piroxicam-induced mice using histopathological signs of inflammation as the measurement.

Methods

This study used an experimental method with a post-test-only control group design that randomized mice into groups consisting of 2 control groups and 3 experimental groups.

Drugs

The dosage of the piroxicam used in this study was 20 mg x 0.0026 = 0.052 mg/treatment/mice (2 tablets of piroxicam were crushed). 25.48 mg of piroxicam were taken and dissolved in 122.5 ml aqua dest. The dosage of the famotidine used in this study was 40 mg x 0.026 = 0.052 mg/treatment/mice (1 tablet of famotidine was crushed). 10.192 mg of famotidine were taken and dissolved in 24.5 ml aqua dest. 0.0026 was the constant surface-area ratio from man to mouse.[13]

Carrot Extract

Fresh carrots were pureed with methanol using a blender. Then the juice was put in a place to be macerated for 3 days. Afterward, the juice was filtered to separate the pulp and the filtrate. The filtrate was evaporated using a rotary evaporator to evaporate the methanol. Carrot extract was dissolved in aqua dest.

Animals

The sample population of this study was male mice (*Mus musculus*) with an average weight of 25 grams, aged 2-3 months, and healthy. Samples that died during the trial period were excluded. The animals were provided by Department of Anatomy, Histology, and Pharmacology Faculty of Medicine Universitas Airlangga Surabaya. The animals were housed in standard cages and supplemented with food and water ad libitum. After 7 days of adaptation, the mice were randomly divided into 5 groups and were treated as follows: (negative control) aqua dest 0.25 ml; (positive control) famotidine 0.104 mg; (A) 200 mg/kg BW carrot extract; (B) 300 mg/kg BW carrot extract; and (C) 400 mg/kg BW carrot extract. 2 hours later, all mice received 0.052 mg piroxicam. All treatments were administered orally. The treatments were given for 14 days. On the 15th day, the mice were examined and the stomachs were removed. All procedures were approved by the ethics committee of Faculty of Medicine Universitas Airlangga Surabaya

Histology Preparation

The stomach was opened along the greater curvature. Then, the part that had rugae (corpus to antrum) was given 10% formalin solution, dehydrated through increasing the grades of alcohol, printed into a paraffin block, and stored in the refrigerator. Paraffin blocks were cut to a thickness of 5 µm. The pieces floated in warm water with a temperature of 60°C for 24 hours. The preparation was then removed and stained with hematoxylin-eosin (HE) solution.

Determination of Histopathological Signs of Inflammation

Each preparation was viewed in 3 fields per specimen (400x).
Score 0: normal gastric mucosa
Score 1: signs of inflammation of the gastric mucosa, such as hyperemia and edema, accompanied by neutrophils on the basement membrane, but the epithelial surface was still intact and there were no lymphocytes or plasma cells in the lamina propria
Score 2: erosion or bleeding on the mucosal surface
Score 3: erosions that penetrate the mucosa or transmural bleeding
Score 4: necrotic tissue in the basal lamina formed by granulation tissue[14]

Statistical Analysis

For histopathology the inflammatory sign, this study used the Kruskal-Wallis method because the data measurement scale was an ordinal. The results were displayed in tables.

Results

Table 1. Mean value and the Kruskal-Wallis test result of histopathological score

Group	Histopathological Score	*Asymp. sig.* (*p*)
Negative Control	1.95 ± 0.26	0.000
Positive Control	1.67 ± 0.29	
A	0.84 ± 0.07	
B	0.50 ± 0.14	
C	0.39 ± 0.10	

Table 1 shows that the severity of the inflammation decreased as the dosage increasing. There was an effect of treatment given on the histopathological score of inflammation signs. Similarly, this study used post hoc Mann-Whitney test to know which groups were significantly different. The results showed that group A and group B were not significantly different, the same with group B and group C.

Below are some pictures from the histopathological score of inflammation signs measurement:

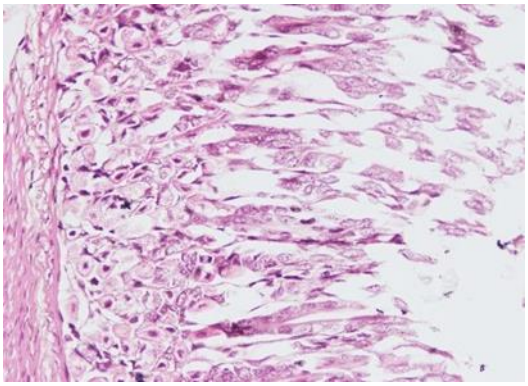

Figure 1. Negative Control (Score 3)

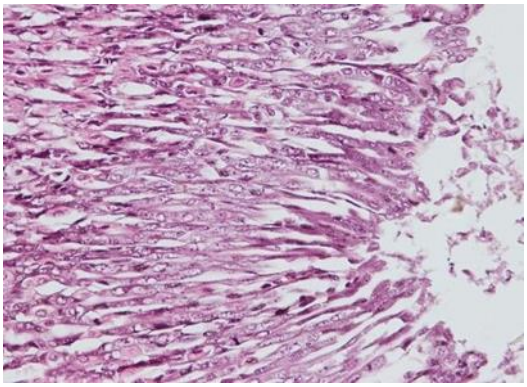

Figure 2. Positive Control (Score 2)

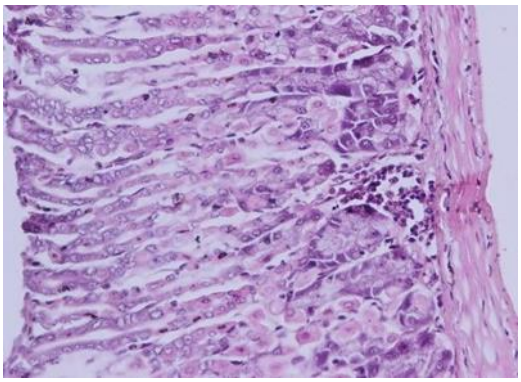

Figure 3. Group A (Score 1)

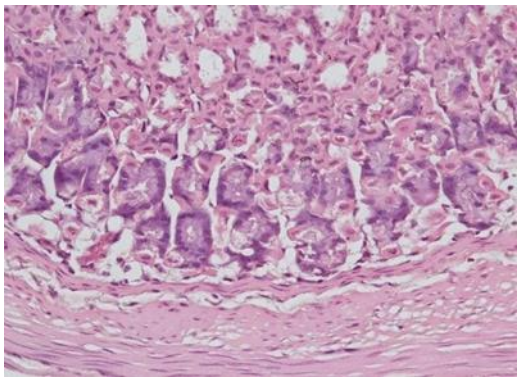

Figure 4. Group B (Score 1)

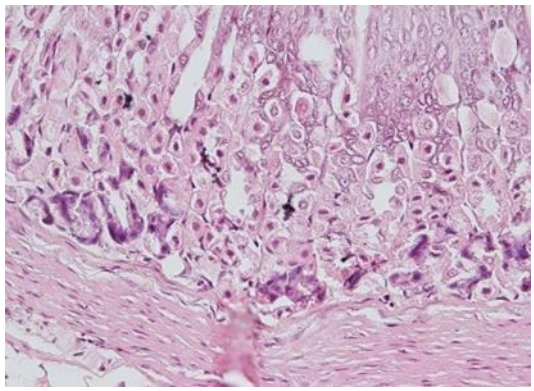

Figure 5. Group C (Score 0)

Discussion

On the histopathological signs of inflammation, all doses of carrot extract were more effective than famotidine. However, the difference in histopathological scores between group A and B and group B and C was less significant because of the close difference in dosage. The dosage used in the previous study were 150 mg/kg BW and 300 mg/kg BW, the results showed that ulcer index and

curative ratio percentage were significantly different.[15] Therefore, carrot extract is more effective at preventing peptic ulcers than famotidine. This is caused by the antioxidant and gastroprotection compounds found in carrots such as flavonoids and chlorogenic acid.[8,16]

Flavonoids can increase gastric prostaglandins, reduce H+ secretion, reduce free radicals, and regulate both pro and anti-inflammatory cytokines.[12,16,17] One of the flavonoids in carrots is flavonols. There are several substances that are included in the flavonol class, one of which is quercetin. Quercetin can inhibit gastric acid secretion and lipid peroxidation. It also can increase mucous bicarbonate secretion.[18].

On the other hand, chlorogenic acid can also reduce gastric tissue lesions through several ways. First, it can decrease neutrophil migration and infiltration to the lesion area. Neutrophils are the first leukocytes to enter the area of inflammation and secrete chemicals to destroy the damaging agent. Thus, it can damage the host tissue.[10,19] Second, it can decrease local secretion of pro-inflammatory mediators by modulating the key transcription factors.[10,20] Lastly, it can decrease free radicals production. It can restore enzyme function and glutathione levels that can be reduced during inflammation.[10]

In comparison to carrot extract, famotidine is the most potent H2RA. In previous studies, famotidine could reduce the side effect of NSAID consumption.[5,8] However, the results showed that it was not as effective as carrot extract due to its only mechanism of action that reduce aggressive factors but does not increase defensive factors.[8,21] If the use of NSAIDs should be continued, then PPI is a better choice than H2RA.[6]

Conclusion

Carrot extract at a dose of 200 mg/kg, 300 mg/kg, and 400 mg/kg of body weight can prevent inflammation better than famotidine 0.104 mg for the histopathological signs of inflammation. In conclusion, carrot extract is more effective in preventing peptic ulcers due to NSAIDs consumption than famotidine.

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Conflict of Interest

The authors declared there is no conflict of interest.

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