The Effect of *Rheum palmatum* L. and *Rheum undulatum* L. on Rat Thoracic Aorta and Abdominal Aorta

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**Introduction**

The dried root of *R. palmatum* and *R. undulatum* have long been used in traditional Chinese medicine. It has been reported for treatment of hypertension, lipemia, and paramenia in the oriental herbal medicines for a long time1-4).

There have been reports that *R. palmatum* root given to anesthetized dogs lowered their blood pressure. The effects of emodin, one of main components in *R. palmatum* and *R. undulatum*, on the isolated intestinal smooth muscle of guinea pigs were dose dependent5).

In this study, we focused on vasorelaxational effect of *R. palmatum* and *R. undulatum* cultivated in Korea. In order to study the vasodilation effect, we have in the present study characterized the relative relaxational response to water extract of *R. palmatum* and *R. undulatum* (root and leaf) on rat thoracic aorta and abdominal aorta.

**Materials and Methods**

1. **Plant Material**

1) Plant Origin

The dried roots (RPR) and leaves (RPL) of *R. palmatum* were collected at Pyunchangsanchesihumjang...
(in Kangwon-do, Korea), and the dried roots (RUR) and leaves (RUL) of *R. undulatum* were collected at Pukbunongupsihumjang (in Kangwon-do, Korea).

2) Preparation and Handling of *R. palmatum* and *R. undulatum*

Water extracts of *R. palmatum* and *R. undulatum* were prepared from dried roots and leaves cultivated in Korea. They were cut into small pieces and mashed with a mortar and pestle. The roots (100 g) were extracted with boiling water (50 g/L), total volume 2L. The extract of *R. palmatum* and *R. undulatum* was dissolved in 1 ml of distilled water.

2. Animals

Adult male Sprague-Dawley rats (SD, 300-350 g) were used for the present study. Animals were purchased from Semtaco Animal Care (Semtaco, Korea) and housed and cared for in accordance with the Guide for the Care and Use of Laboratory Animals.

3. Materials

NaCl, KCl, NaH2PO4, MgSO4, CaCl2, NaHCO3, glucose, 5-HT and Acetylcholine were purchased from Sigma (Sigma, USA).

4. Preparation of isolated aortic rings

Male SD rats were killed with an overdose of chloral hydrate (400 mg/kg, ip) and the thoracic aorta and mesenteric artery were removed and cleaned of adherent tissue. The aorta and mesenteric artery were mounted on a length of scoured polythene tubing and placed in a petri dish containing modified physiological salt solution (PSS) of the following composition (mM): NaCl 119.0, NaHCO3 25.0, KCl 4.7, KH2PO4 1.2, MgSO4 1.2, glucose 11.0, CaCl2 0.25. The aorta was cleared of surrounding adipose tissue and the endothelium was removed by gentle rubbing of the intimal surface with the polythene tube. Six to nine ring segments (2-3 mm length) were prepared from each aorta and were mounted between two stainless-steel wires in 5 ml organ baths, thermostatically controlled at 37 °C, containing modified PSS. The solution was bubbled with a gas mixture consisting of 95% O2 and 5% CO2 in order to keep a pH in the bath of around 7.35-7.38. Experiments were carried out after the vessel had equilibrated, usually within 1-2 h of mounting.

The tension was recorded isometrically with a Grass FT03C force-displacement transducer and registered on a Grass model 7 polygraph. The vessels were given an initial passive load of about 2 g and allowed to equilibrate for at least 90 min prior to the experiments. After the equilibrating period, vessels were stimulated with KCl (100 mM) in order to obtain a reference contraction. This contraction was defined as the maximal contraction to KCl. Vessels that did not respond or responded abnormally were not tested further. RPR, RUR, RPL, and RUL and other substances were dissolved in 0.9% NaCl and given to the baths in volumes of 5 mL. The response to the added substances (contraction or relaxation) was expressed as a percentage of the maximal KCl-induced contraction exhibited by each ring. After the resting tension became stabilized, 5-HT were administrated into the bathing buffer to induce a rapid increase of vascular tone followed by the stable vasoconstriction. Treatments groups were administered RPR, RUR, RPL, and RUL from concentrations of 10^-4 to 100 mg/ml to observe vasodilation (the decrease of tonic contraction). Concentration-relaxation curves were generated in a cumulative fashion.

5. Statistical analysis

Analysis of data from the two groups was performed using Student’s *t*-test. Data from several groups were examined using analysis of variance (ANOVA), using the computer
program GraphPad Prism (GraphPad Software, San Diego, CA). Significance levels were set as follows: $p=0.05(*)$, $p=0.01(**)$, $p=0.001(***)$.

**Results**

1. Effect of 5-HT induced contraction
5-HT ($10^{-10}$ to $10^{-4}$ M) produced a concentration-dependent and dose-dependent contraction of the thoracic aorta. At $10^{-4}$ M 5-HT, the maximal contractile response were $93.5 \pm 3.3\%$ of the maximum KCl-response, and EC$_{50}$ was $0.81 \times 10^{-5}$ M(Fig. 1).

2. Inhibition Effect of RPR, RUR, RPL, and RUL on 5-HT induced contraction
Thoracic aorta segments responded to 5-HT with a dose-dependent vasoconstriction. At 10 mg/ml RPR, RPL, RUR, and RUL, the relaxational response were $86.4 \pm 3.9\%$, $37.6 \pm 2.3\%$, $62.1 \pm 1.3\%$ and $24.5 \pm 4.6\%$ of the maximum 5-HT induced contraction and EC$_{50}$ of ERP-R and ERU-R were 5.22 mg/ml and 8.77 mg/ml (Fig. 2, Table 1).

3. Effect of RPR and RUR on 5-HT induced contraction in rat thoracic aorta with and without endothelium
Inhibitional effect of RPR and RUR on 5-HT induced contraction was dose-independent. At $10^{-4}$ M 5-HT, the relaxational response of RPR and RUR with and without endothelium were $86.4 \%$, $83.2 \%$, $85.8 \%$, and $62.1 \%$ of the maximum KCl-response (Fig. 3).

**Discussion**
Rhizoma Rhei originated from *R. palmatum* L., *R. tanguticum* Maxim. et Reg., *R. officinale* Baill. *R. undulatum* L. is also used as Rhizoma Rhei in Korea. Rhizoma Rhei was described at the first phytology text, Divine Husbandman’s Classic of the Materia Medica. Its properties are bitter and cold. Its channel enters the
stomach, large intestine and liver. Its function is mainly
to drain heat and move stool. One of the important
functions is to clear heat obstructing the blood level.
The other function is to invigorate the blood and break
up congealed blood. It has drain-heat and move-stool
functions and is used for high fever, profuse sweating,
thirst, constipation, abdominal distension and pain,
delirium, yellow tongue moss, and a full pulse1-4).

In pharmacological and clinical research, cardio-
vascular effects include infusions and tinctures of Rhi-
zoma Rhei given to anesthetized dogs which lowered
their blood pressure5).

Extract of Rhizoma Rhei can suppress the production
of tumor necrosis factor and interleukin-1 by macro-
phages as well as interleukin-6 by human mesangial
cells. It is reported that emodin possesses antibiotic and
antineoplastic functions. It has an effect on the
pathogenicity of trichomonas vaginalis in mice6-14). The
effect of emodin action on the isolated intestinal smooth
muscle of guinea pigs was dose dependent5).

Small doses stimulated frog’s hearts, while larger
doses inhibited them.

The present results indicate that the water extract of
the roots of R. palmatum and R. tanguticum does
possess relaxation effects in rat thoracic aorta and
abdominal aorta.

A number of agents have been shown to relax
vascular smooth muscle through release from the
endothelium of a labile relaxing factor. This indirect
relaxation is generally detected by comparing responses
of intact and endothelium-denuded isolated vascular
preparations. Water extract of the roots of R. palmatum
and R. tanguticum inhibited 5-HT induced contractions
in thoracic and abdominal aortic rings with and without
endothelium, suggesting an effect exerted directly on
smooth muscle.

In conclusion, our result showed that R. palmatum
and R. tanguticum induced dose-dependent vasore-
lation on rat thoracic aorta and abdominal aorta and
that the roots of R. palmatum and R. tanguticum have
more potent effect than the leaves.

References

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