



Effects of Hawthorn and Epicatechin on Blood Pressure, Heart Rate, and Metabolic Rate in *Graptemys pseudogeographica kohni*

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Introduction

Hawthorn (*Crataegus* spp.) is a small, flowering shrub found in the temperate climates of Asia and Europe. Hawthorn extract has been used in homeopathic medicine for hundreds of years and is advertised to treat cardiovascular disease by lowering blood pressure, metabolic rate, and heart rate.

Scientists have hypothesized that hawthorn can increase the strength of heart contractions and decrease heart rate through the release of nitric oxide to increase vasodilation (Figure 1) and improve oxygen diffusion to the muscles by causing the walls of smooth muscles in blood vessels to relax (Shefer et al., 2024). The oligomeric procyanidins within hawthorn have been associated with the release of nitric oxide and the lowering of blood pressure caused by hawthorn is thought to be linked to nitric oxide-mediated vasodilation (Nie et al., 2023).

Of the procyanidins in hawthorn, one of the suspected active compounds is epicatechin. Epicatechin also functions as a building block for procyanidins and is characterized as an antioxidant. Studies have revealed that it may prevent cardiac disease through the dilation of the endothelium in the arteries (Shu et al., 2023). (Figure 1)

Materials and Methods

Nine juvenile Mississippi map turtles (*Graptemys pseudogeographica kohni*) were randomly assigned to an injection group: physiological saline, hawthorn extract [500 mg/kg] (Du et al., 2022), and epicatechin solution [32.58 mg/kg]. Injections in the muscle between the neck and forelimb were given every other day for 4 weeks. Metabolic rate was obtained through open respirometry. Heart rate was obtained using electrodes on both hind limbs and the left forelimb to produce an electrocardiogram [ECG] (Hammond et al., 2024). A pulse transducer on the right forelimb produced a photoplethysmograph [PPG]. The change in time between the peak on the ECG and the peak on the PPG provided the data necessary to estimate blood pressure (Choi et al., 2023). Data was collected from both a relaxed and stressed state (flipped upside down) at the end of two and four weeks of exposure.

Discussion

Metabolic rate, average stressed heart rate, and average stressed blood pressure yielded no statistically significant differences between exposure groups (Figures 2, 3, & 4) using a two-tailed Student's t-test assuming equal variance. Percent change in stressed heart rate from week two to week four yielded no statistically significant differences either (Figure 5). Looking at the graphs, there could be a trend of increasing heart rate and blood pressure between the hawthorn and epicatechin groups (Figures 3 & 4). Statistical analysis produces p-values in the range of 0.09-0.10 ($\alpha=0.05$) for these groups. These numbers suggest that with higher numbers of replicates, a significant difference might be obtained. It also suggests that the effects of hawthorn were very minimal despite a high dosage. Even with a larger sample size, only a subtle difference would be expected. Due to the nature of this data, it cannot be concluded that epicatechin is the compound in hawthorn responsible for the nitric oxide mediated vasodilation.

Results

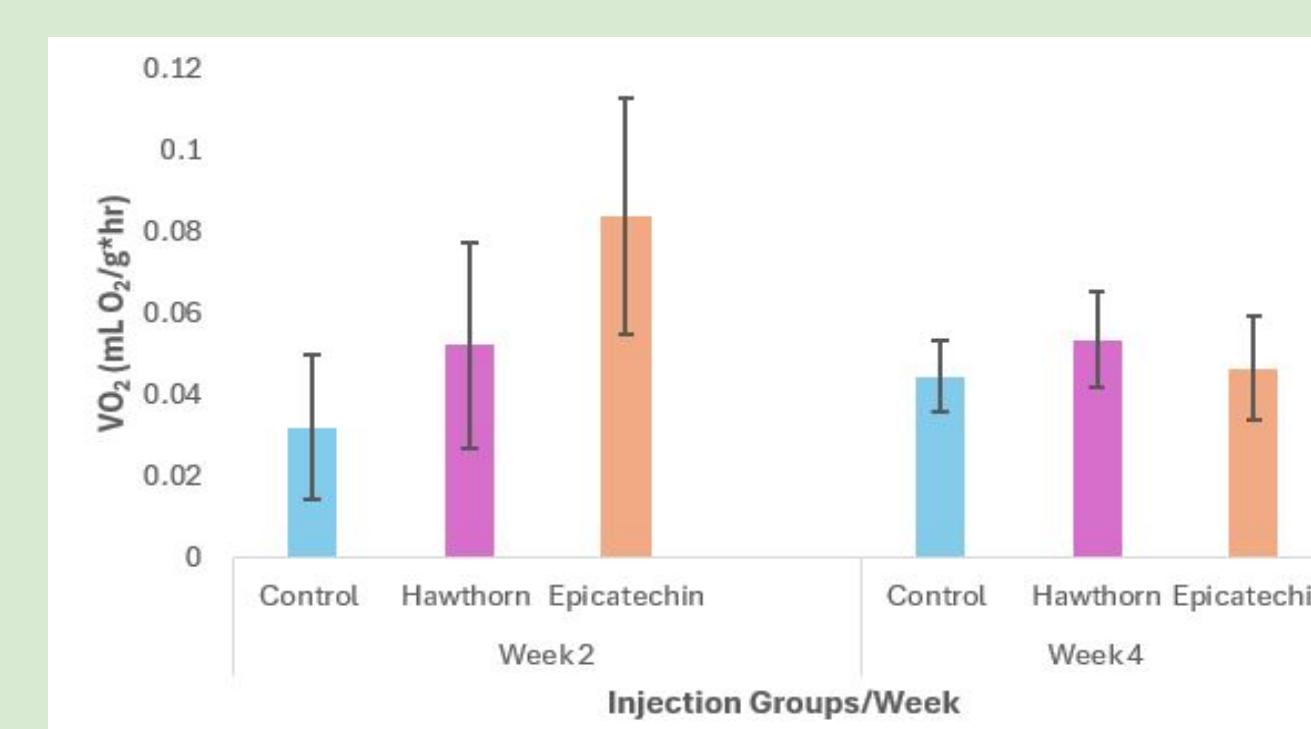


Figure 2. Average metabolic rate (VO_2) for each group at two and four weeks after exposure. Values are mean \pm standard error. No statistically significant difference was found between groups.

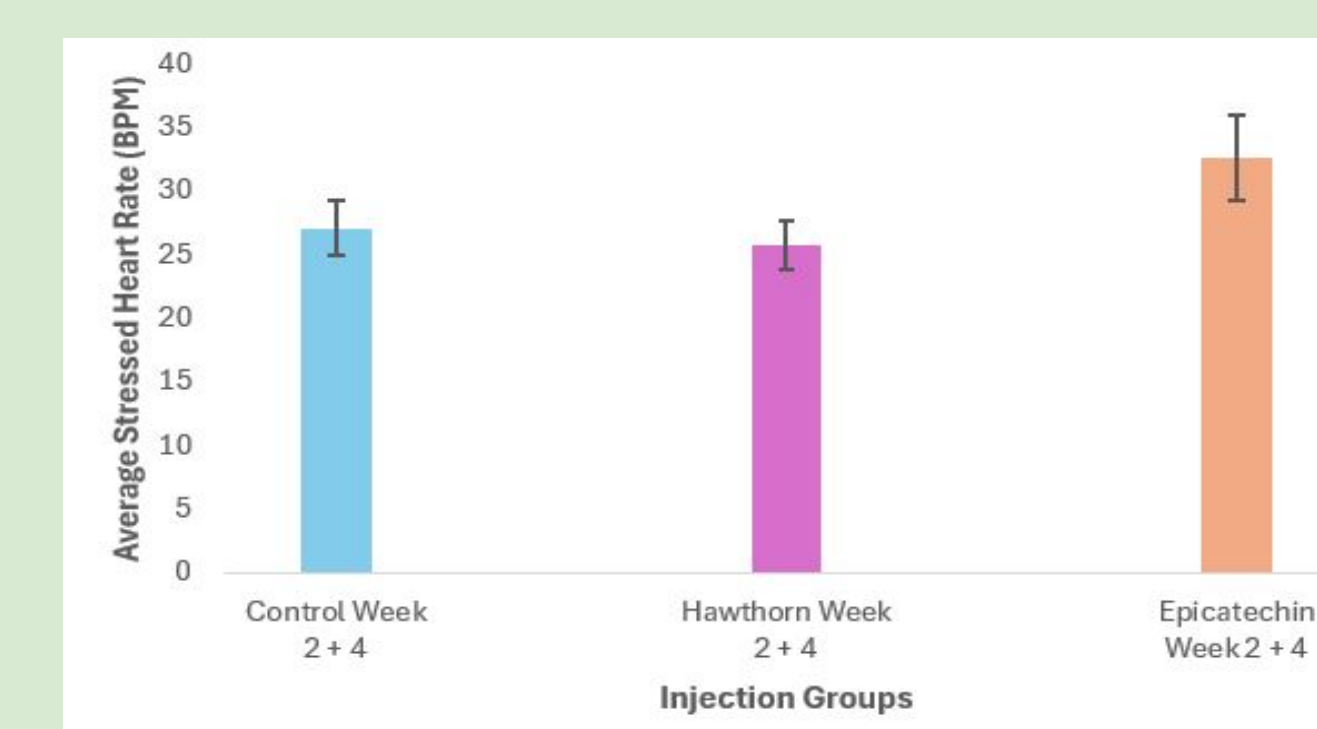


Figure 3. Average stressed heart rate for each group at two and four weeks after exposure. Values are mean \pm standard error. No statistically significant difference was found between groups.

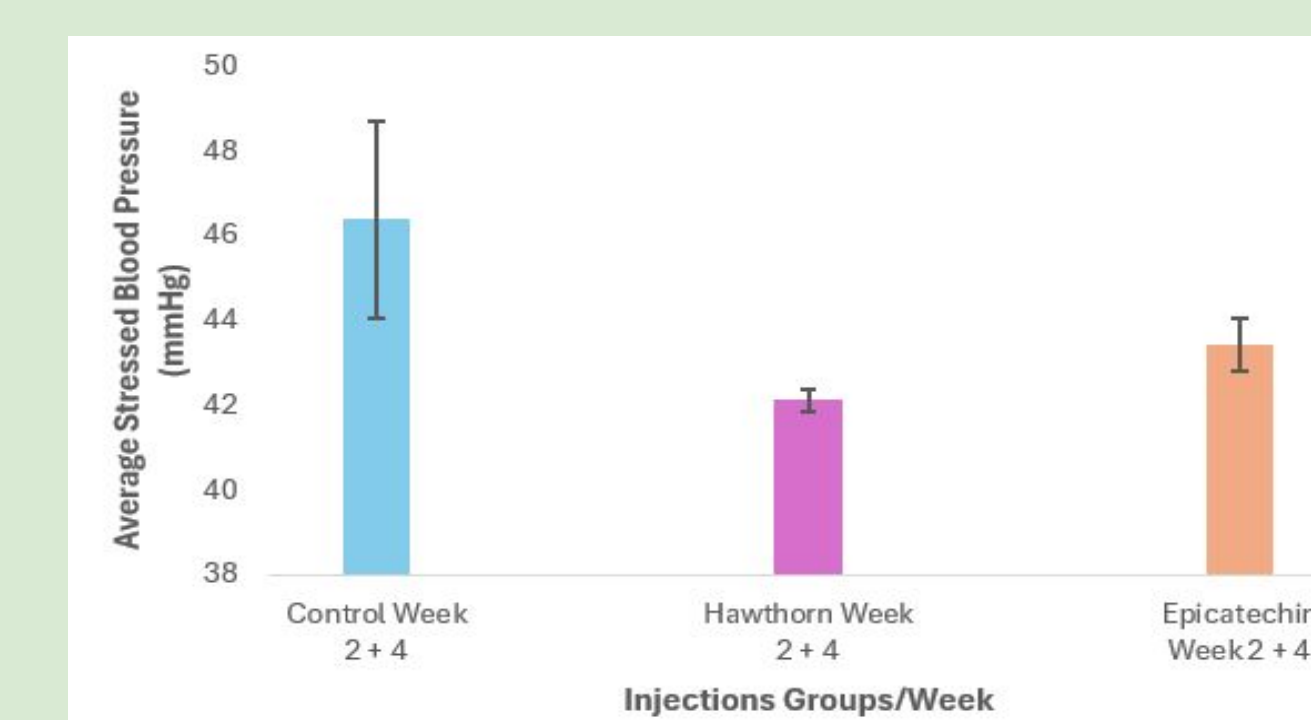


Figure 4. Average stressed blood pressure for each group at two and four weeks after exposure. Values are mean \pm standard error. No statistically significant difference was found between groups.

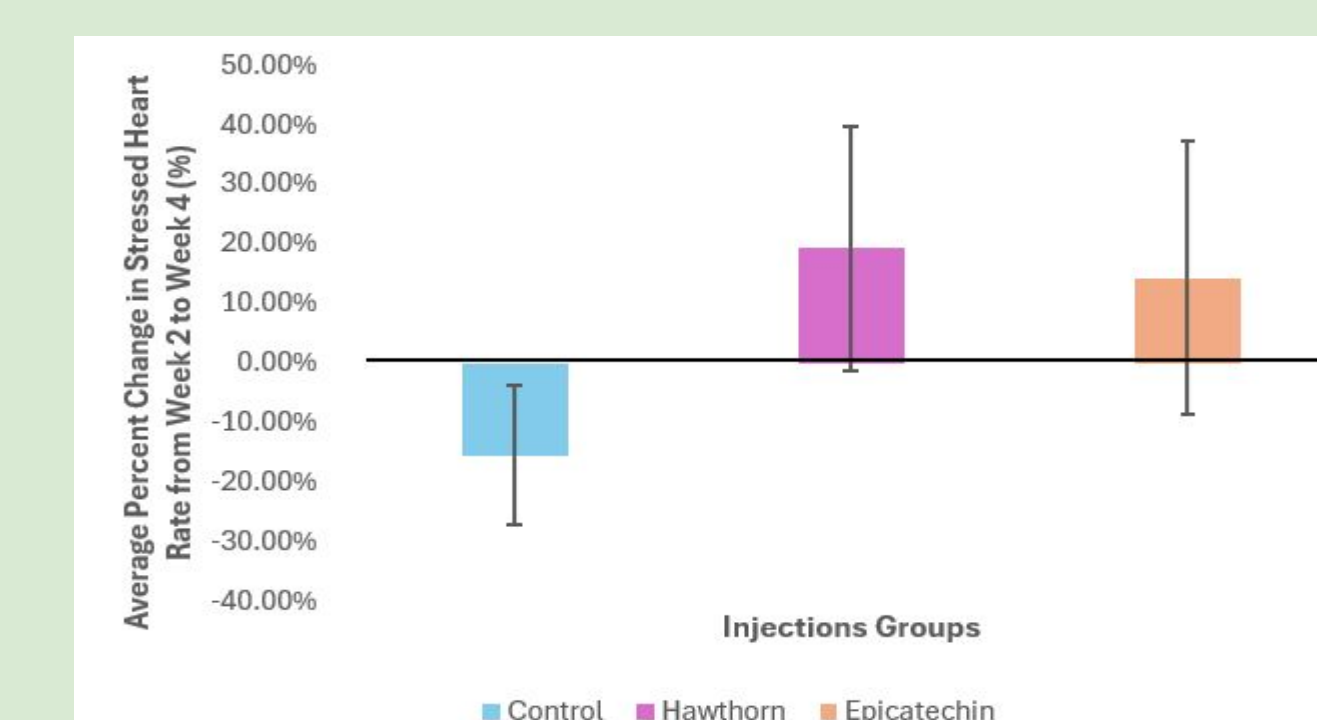


Figure 5. Average percent change of the stressed heart rate for each group at two and four week after exposure. Values are mean \pm standard error. No statistically significant difference was found between groups.

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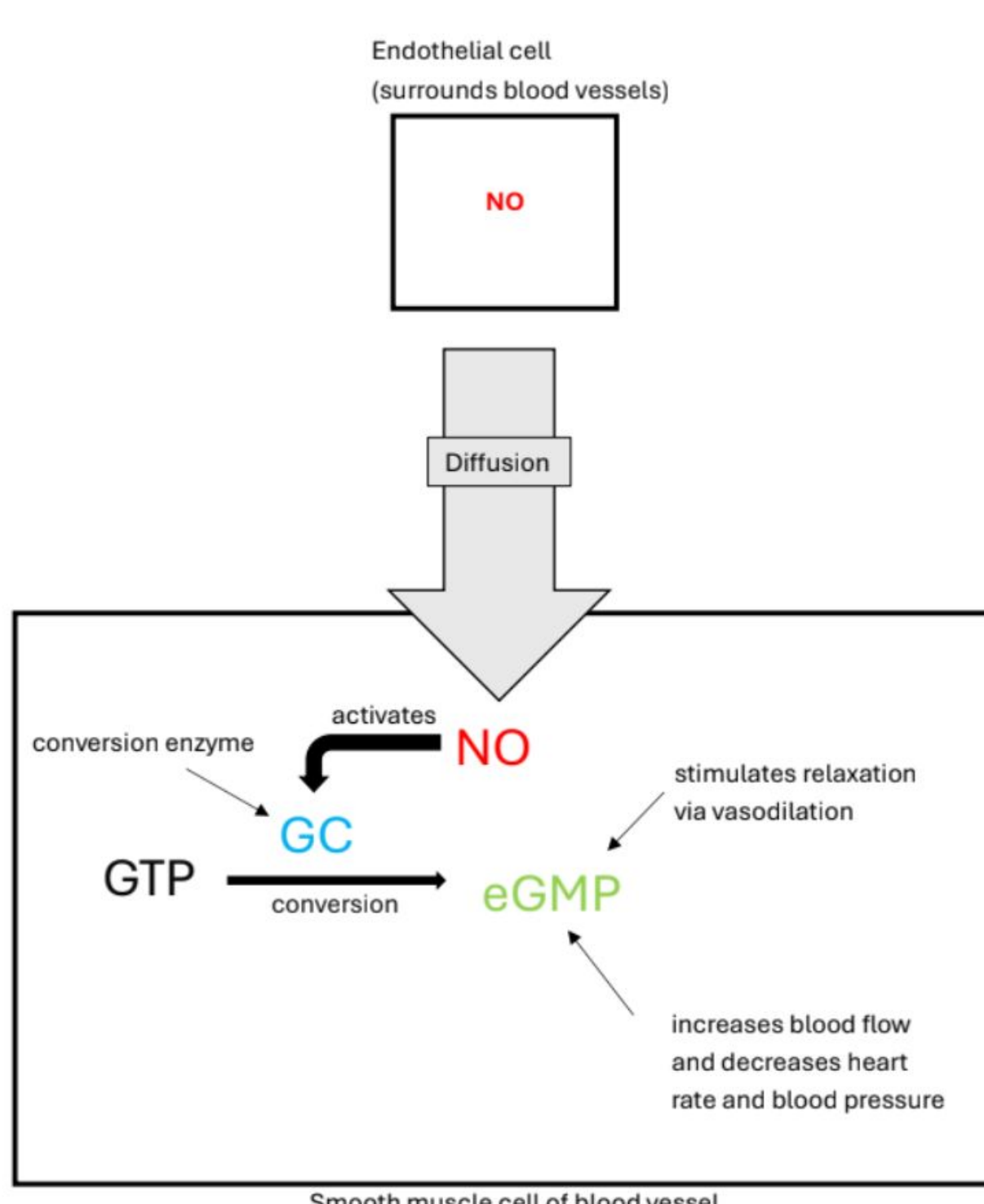


Figure 1. (Ahmad et al., 2018). Mechanism of nitric oxide mediated vasodilation. NO = nitric oxide, GC = guanylyl cyclase, GTP = guanosine triphosphate, cGMP = cyclic guanosine monophosphate.