

The Effect of Dietary Nitrate and Anthocyanins on Anaerobic Exercise Performance



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Introduction

Beetroot (*Beta vulgaris*) and tart cherry (*Prunus cerasus L*) contain high levels of anthocyanins that possess potent antioxidant and anti-inflammatory properties. These reddish-purple pigments can blunt secondary muscle damage associated with a local inflammatory response in damaged muscle. Beetroots are a natural source of nitrates, which get converted to nitric oxide in the body. Nitric oxide is a vasodilator, and as a result allows increased blood flow in the body. Hence, ingesting both dietary nitrates and anthocyanins may yield benefits during exercise performance.

Purpose

To examine the effect of dietary nitrate and anthocyanins on anaerobic exercise performance among healthy individuals.

Methods

A double-blind, randomized crossover study conducted at the Physical Therapy laboratory of Loma Linda University.

Participants (N=28, 19-35 y/o) were recruited from Loma Linda University and surrounding cities (**Table 1**).

- **Inclusion:** Healthy, able to exercise on a stationary bike, willing to abstain from: caffeine, mouthwash, and high antioxidant foods.
- **Exclusion:** Orthopedic injuries, taking NSAIDs, known allergy to tart cherry and/or beetroot, pregnant or breastfeeding.
- Randomization of participants and supplementation after baseline:
 - Treatment A: 5.05g (3.62 mmol) of beetroot powder and placebo.
 - Treatment B: 5.05g (3.62 mmol) of beetroot powder and 480 mg of a tart cherry capsule.
 - 7-days run-in, 7-days of supplementation with either treatment A or B, followed by 7-days washout, then participants switched treatments.
- Modified Wingate Anaerobic Protocol on Monark 928E testing bike.
 - Resistance equivalent to 10% of participant's body weight.
 - Begin: 3-minute warm-up
 - Test: 30-second sprint
 - End: 2-minute cool down
- Study measurements:
 - Systolic Blood pressure (SBP), diastolic blood pressure (DBP), heart rate, serum lactate and allantoin, power (watts), speed (RPM), distance (m), rate of perceived exertion (RPE).
- Statistical analysis:
 - Linear mixed models, adjusted for baseline subject characteristics, treatment sequence (A-B, B-A), energy (kcal), sleep (hours), and workload (watts).

Table 1. Participant characteristics at baseline *

	Treatment A	Treatment B
Gender – no. (%)		
Female	9 (64.3)	13 (92.9)
Male	5 (35.7)	1 (7.1)
Age (years)	24.2 ± 2.5	24 ± 2.3
Height (cm)	169.5 ± 12.2	158.0 ± 4.4
Weight (kg)	67.6 ± 14.3	59.1 ± 10.7
BMI (kg/m ²)	23.5 ± 3.8	23.7 ± 4.3
Fat (%)	25.8 ± 9.9	30.4 ± 8.1
Free Fat Mass (kg)	50.1 ± 12.5	40.6 ± 5.3

*Plus-minus values are means ± SD

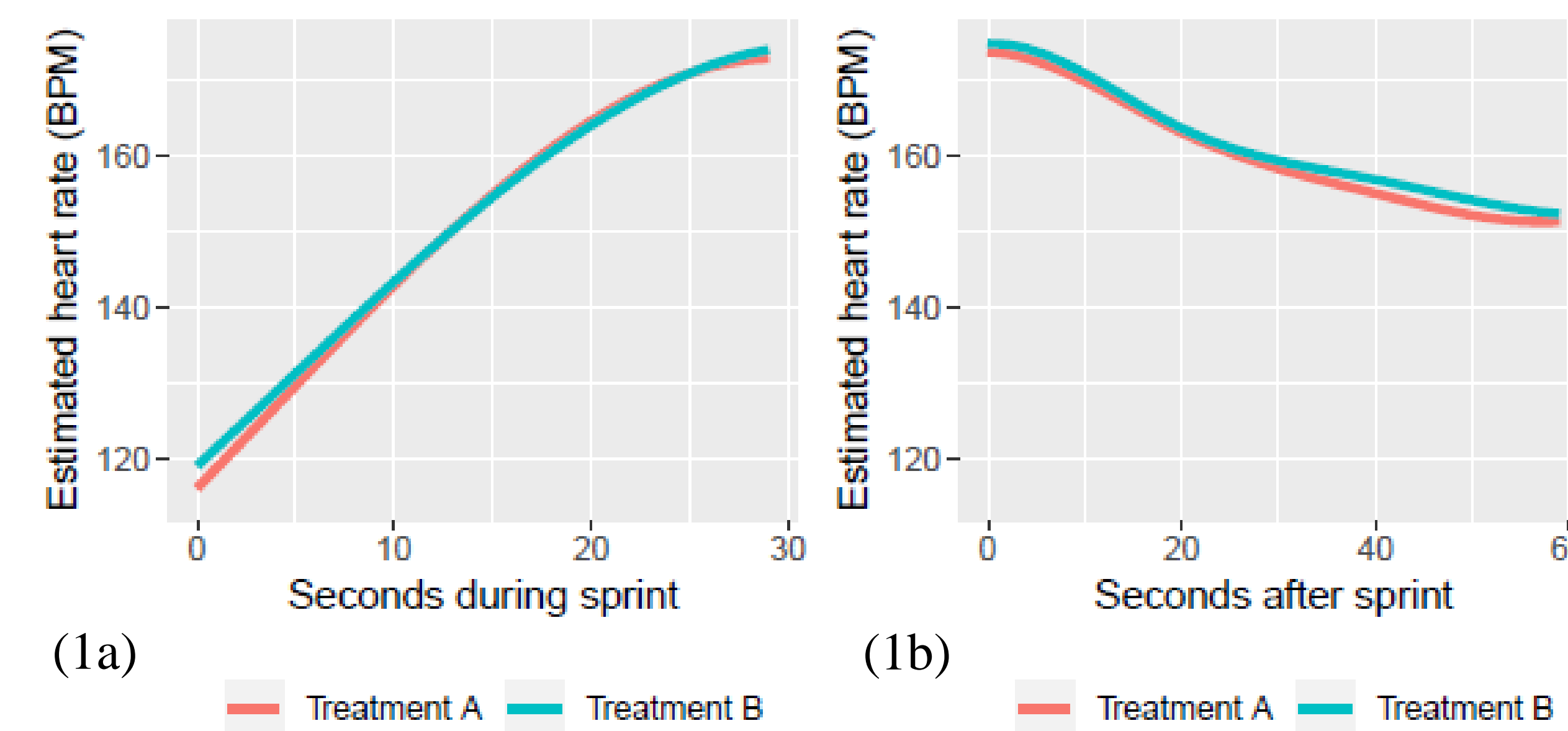


Figure 1a. Average heart rate during 30-second sprint

Figure 1b. Average heart rate after 30-second sprint

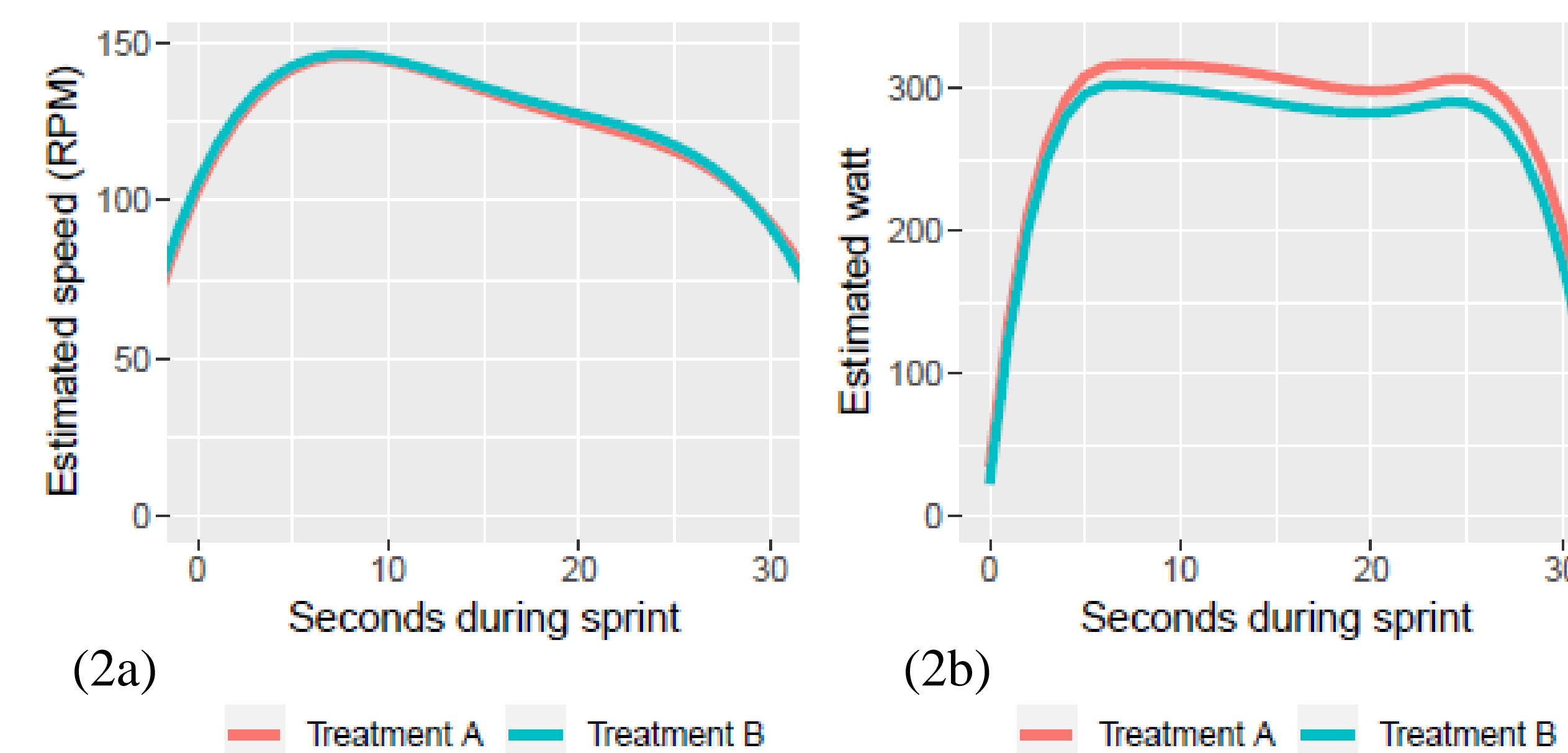


Figure 2a. Average speed during 30-second sprint

Figure 2b. Average power during 30-second sprint

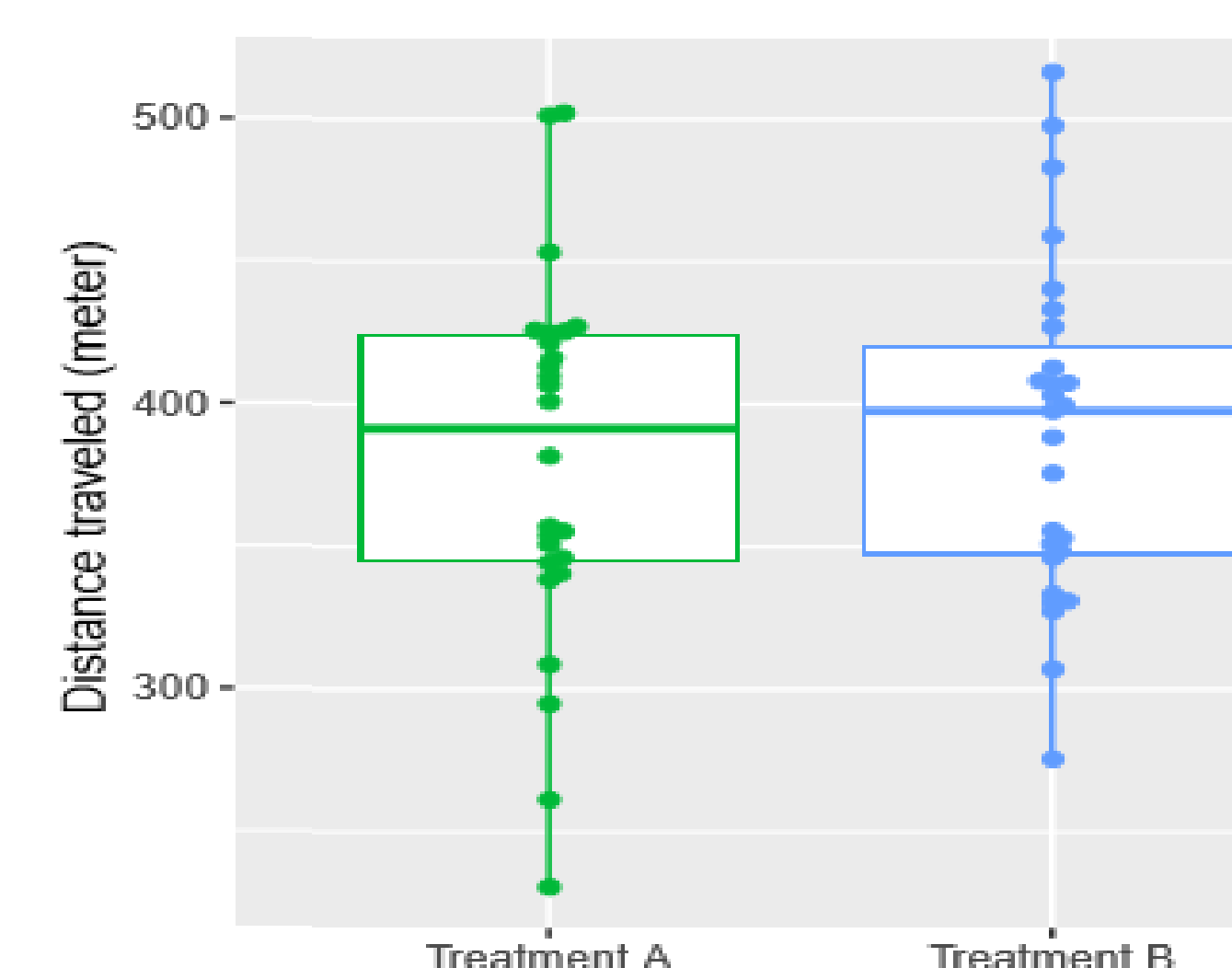


Figure 3. Boxplot of distance traveled (meters) by treatment.

Table 2. Mean distance traveled (meters) and percent change

Treatment	Distance (m)	% Change	p-value
A	383	1.3	0.247
B	388		

Table 3. Means and percent change in blood pressure, heart rate, RPE, lactate and serum allantoin before and after the bike test.

	Treatment	Pre	Post	% Change	p-value
SBP	A	107.8	112.4	4.60	0.129
	B	112.6	113.0	0.4	
DBP	A	72.0	71.6	-0.4	0.531
	B	71.7	69.9	-1.8	
Heart Rate	A	68.8	93.9	25.3	0.613
	B	65.6	93.5	27	
RPE	A	11.3	15.5	5.2	0.589
	B	11.5	15.5	4	
Lactate	A	1.6	11	9.5	0.652
	B	1.5	11.2	9.7	
Allantoin	A	18.7	14.2	-24.10	0.274
	B	15.5	9.6	-8.50	

Results

- 25 participants (22 female) completed the study.
- Treatment B had meaningful increase in distance traveled.
 - Mean distance of 5 meters (p = 0.25) further than Treatment A (**Figure 3**).
- Significant increase in power (watts) output in Treatment B compared to treatment A (p < 0.05).
 - Estimated differences ranged from 15.3 to 19 watts (**Figure 2b**).
- No significant difference between treatments in speed (RPM) (**Figure 2a**)
- Treatment B had significantly higher heart rate (p < .05) than treatment A during the first 5 seconds of the sprint (**Figure 1a**).
 - The differences ranged from 1.6 to 2.7 bpm
- Treatment B had a significantly higher heart rate than Treatment A, 30 to 55 seconds post sprint (p < 0.05).
 - The difference ranged from 0.94 to 2.4 bpm (**Figure 1b**).

Conclusion

- Supplementation with beetroot powder and tart cherry for 7 days may synergistically improve anaerobic exercise performance by maximizing potential heart rate and energy output.
- Further research should be conducted to determine if a higher dose of beetroot and tart cherry has greater effect on anaerobic exercise performance.

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References available upon request.