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### Fuel Your Fitness

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Fuel Your Fitness

Payton Carpenter

KIN4502

## Fuel Your Fitness

Caffeinated beverages are incredibly popular for improving mental acuity and exercise performance, and their ergogenic effects have been thoroughly studied. For our research project, we wanted to study the effects of caffeine, specifically caffeinated energy drinks, on muscular endurance. There are hundreds of energy drinks on the market with varying ingredients in addition to caffeine that claim to have substantial physiological benefits, so when choosing energy drinks for the study, we chose Alani Nu and Celsius because of the similarities in marketing strategies, ingredients, and serving size. We asked this questions: is there a significant difference in muscular endurance when an Alani Nu is consumed prior to exercise compared to a Celsius? Our hypothesis was that there would be a significant improvement in muscular endurance when caffeine was consumed via Alani Nu an hour before exercise when compared to consuming Celsius prior an hour before exercise.

We decided to test caffeine's effect on muscular endurance via Alani Nu and Celsius for a few reasons. Their marketing strategies are very similar; they are widely advertised on social media, and they're marketed toward younger populations looking for an energy boost for varying activities. Second, the ingredient lists are very similar, both including taurine, B vitamins, 200 mg of caffeine, zero sugar, as well as very few calories (*Dragonfruit-Lime...*,2020; P-Themes, 2023). Celsius claims to have only natural ingredients in their drinks, and the caffeine comes from green tea leaf extract (*Dragonfruit-Lime...*,2020). Alani Nu has an ingredient list that more closely resembles a pre-workout than Celsius' ingredient list, containing L-Theanine and L-Carnitine Tartrate (P-themes, 2023). L-Theanine has been shown to improve focus (Anas Sohail, A. et al, 2021), and L-Carnitine Tartrate helps with muscular recovery (Stefan, M. et al, 2021). Because of the presence of L-Theanine and L-Carnitine Tartrate in Alani Nu, we hypothesized

muscular performance would be better after Alani Nu rather than Celsius because they should help mitigate the side effects of caffeine.

While caffeine's ergogenic effects are well documented when aerobic exercise and high intensity exercise are tested, few studies have been conducted on caffeine's effect on muscular endurance specifically. There has been a correlation between muscular endurance and caffeine, and researchers found that roughly 250 milligrams of caffeine were needed to produce ergogenic effects (Barcelos et al, 2020). 250 mg of caffeine would affect people of different weights differently, so we had to establish a dose of caffeine that could be adjusted for each participant. According to the Committee on Military Nutrition Research, 2.5-4 mg per kg body weight was enough to cause ergogenic effects. When caffeine is ingested via liquid form, it should be consumed 1 hour before testing in order to allow for optimal blood saturation (Institute of Medicine (US), 2001). Lastly, a protocol to test for muscular endurance had to be chosen; the YMCA bench press protocol was chosen because it has been validated for testing endurance as well as predicting 1RM. To complete the YMCA bench press protocol, women bench a 35 lb barbell and men an 80 lb barbell to the beat of 60 bpm until failure to complete repetitions on beat (Ronai, 2020).

The participants included 6 men and 6 women between the ages of 18 and 25 years old. This sample size was chosen from a population of Lipscomb University students, and the population was chosen based on convenience as well as it being part of the demographic that Alani Nu and Celsius are marketed toward. They fell into the category of untrained individuals (participating in planned exercise < 3 days per week), as well as infrequent energy drink consumers. 3 trials were completed over the course of 3 weeks. The first week the participants' treatment was a placebo (non-caffeinated, colored water flavoring), the second week's treatment

was Alani Nu, and the third week's treatment was Celsius. The participants were unaware of the types of energy drinks they were taking, as well as the presence of a placebo, making this study a blind study.

After the participants signed an informed consent, their weights were measured in kg, and the dose of energy drinks were calculated. 3 mg caffeine per kg body weight was chosen as the dose of caffeine, so equations were created to properly measure the amount of powdered energy drink each participant needed to drink in order to get 3 mg of caffeine per kg of their body weight. The calculation to determine mg of caffeine per gram of powdered Alani Nu is as follows:  $200 \text{ (mg caffeine)} / 5.8 \text{ (g solute)} = 34.5 \text{ mg/kg}$ . To calculate the amount of solute per participant:  $(\text{body weight in kg} \times 3 \text{ mg (caffeine)}) / 34.5 \text{ mg/g} = \underline{\hspace{2cm}}$ . The calculation to determine mg of caffeine per gram of powdered Celsius is as follows:  $200 \text{ (mg caffeine)} / 5.9 \text{ (g solute)} = 33.9 \text{ mg/kg}$ . To calculate the amount of solute per participant:  $(\text{body weight in kg} \times 3 \text{ mg (caffeine)}) / 33.9 \text{ mg/g} = \underline{\hspace{2cm}}$ .

The participants drank a solution with their dose of energy drinks or placebo mixed into water 1 hour before reporting to the lab for testing. They completed a 5 minute guided upper body warmup before completing the YMCA bench press test protocol. The women used a 35 lb barbell while the men used an 80 lb barbell. With a metronome playing at 60 bpm, participants would complete the upward and downward phases on the beat until failure. Their scores were recorded to be analyzed once all testing was completed.

The results were analyzed using repeated measures ANOVA on JMP in order to compare the scores of the YMCA bench press after each treatment. There was not a significant difference in muscular endurance among any of the three conditions ( $F = .4995, p = .61$ ), so the null hypothesis could not be rejected.

It is important to note that there are a few factors that could have influenced the results. Many participants reported feeling jittery, even displaying hyperactive behavior, after drinking the energy drinks. Though most participants were regular caffeine users, none of the participants were used to drinking such a concentrated amount of caffeine in such a short period of time. These side effects of the treatments could have had detrimental effects on the performance during the tests. Due to scheduling difficulties, there were typically more than a few participants in the lab at the same time, though testing happened one at a time. Our female participants reported feeling anxious, specifically because of the audience in the room. On the other hand, the male participants were clearly enjoying the experiment, taking the time to encourage their friends and push themselves to perform to the best of their ability. This was reflected in scores of the males, as their scores after Alani Nu were significantly higher than that of the placebo treatment. Generally speaking, the men were also less caffeine trained, so the treatments could have been more effective for them than for the females. It is also possible that the placebo effect played into the results. After completing all three trials, each participant was asked if they believed that there was a placebo treatment, and if so, could they identify it; only half of the participants could correctly identify the placebo treatment. Since the participants believed they were being aided by an energy drink, they performed as if they had the help of caffeine.

There is most definitely room for more studies to be done on caffeine's effects on muscular endurance. If we were to do this experiment again, there would need to be some changes made to the procedures. First, we would test a larger sample size to give more power to the results. Second, we would like to mitigate performance anxiety and encouragement by only having one participant in the lab at a time. Third, we would like to regulate the participants' diets leading up to the tests; on one test a participant may have come to the lab after eating a big

lunch, and the next after eating nothing at all that day. Overall, the results of this study gave a good jumping off point for further research to be done with energy drinks and the effects of their caffeine content.

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