



Colorado Science and Engineering Fair

2024 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: The Effects of Caffeine on Stem Cells and Skeletal Muscle Regeneration

Finalist's Name: Ashley Acton

School and City: Fairview High School, Boulder

Sponsor's Name: Paul Strode

Category: Biomedical Sciences (BMED)

Division: Senior (9th - 12th grades)

Abstract (250 words or less):

Caffeine is the most popular central nervous system stimulant, with roughly four in five US adults and high school students drinking caffeinated beverages regularly. Caffeine is also becoming popular in pre-workout powders, based on claims that caffeine enhances overall performance in workouts and helps build muscle. The current rate of consumption of caffeine and the body's constant need to repair damaged skeletal muscles highlights the need to understand what effect caffeine has on satellite cells, the stem cells responsible for rebuilding damaged skeletal muscle fibers. In this study, I used data published on public databases with information on genes and protein pathways and discovered that caffeine down-regulates several genes responsible for promoting cellular differentiation and up-regulates those responsible for inhibiting differentiation. I also found that caffeine up-regulates genes that affect skeletal muscle integrity and atrophy and those that are negative regulators of membrane dynamics and organelle identity establishment. Genes associated with lipid metabolism and cholesterol biosynthesis were also shown to be down-regulated. Similarly, I found that caffeine results in the under-expression of pathways that regulate various metabolic and biosynthetic processes. These results reveal that caffeine decreases the ability of satellite cells to differentiate, proliferate, and maintain cellular homeostasis, leading to difficulty regenerating damaged muscle fibers.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature:

Date:

3/1/24

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. A signed copy of this form must be included in your notebook.