



Colorado Science and Engineering Fair

2025 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: Milk Mysteries: Understanding the Differences Between A1 and A2 Proteins

Finalist's Name: Clara Miller

School and City: Sanford Junior High School Sanford, Colorado

Sponsor's Name: Jenni Miller

Category: Micro & Molecular Biology

Division: Junior (grades 6 - 8)

Abstract (250 words or less):

Milk contains several types of protein with casein being the most common. Casein makes up about 80% of all milk protein. Beta-casein is a common type of protein found in at least 12-13 forms, with A1 and A2 being the most studied. A2 beta-casein is considered the original form, found in mammals such as humans, goats, and certain cows. Around 5,000-10,000 years ago, a random genetic mutation occurred which changed the 67th amino acid in the beta casein, from proline (A2) to histidine (A1). This mutation introduced A1 beta-casein in Northern European cattle. The amino acid histidine (A1) allows for the release of beta-casomorphin-7 (BCM-7) during digestion, which has been linked to potential health concerns, including digestive issues and chronic diseases. This study aimed to investigate whether A1 and A2 milk behave differently in chemical and physical tests. Three physical tests (frothing, boiling, freezing/melting) and three chemical tests (digestive enzyme reaction, pH, and baking) were conducted. Results indicated that while four tests showed varying differences, two presented no distinction. The results suggested that milk composition (fats, proteins, and carbohydrates) and pasteurization processes possibly impacted outcomes which lead to difficulty in deciphering A1 and A2 behavior. Although the hypothesis that A2 milk would behave differently was only partially supported, the study provided insights into the evolving research on A1 and A2 proteins. This research strives to increase awareness of the potential impact of milk protein composition on digestion and health, and emphasizes the need for further scientific exploration.

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:

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.**