Front Porch CHOCOLATE

Summer/24

MTP2 Final Presentation

Employer : Greg and T

Interns: Anna Binion & Katie Elliott

P2 Advisor: Dr. Wan-Yuan Kuo

Anna Binion

- Major: Dietetics
- Career Interests: Dietician
- Intern Role: Innovative recipe development
- Why P2: Find creative ways with project based learning to prevent food waste, and overall pollution

Katie Elliott

- Major: Nutrition and Dietetics
- Career Goal: Registered Dietitian
- Intern Role: Chemical Analyst
- Why P2: Passionate about people being nourished in sustainable and safe ways

Front Porch Chocolate

Single Origin Chocolate

- Sierra Leone, Dominican Republic, Blend
  - Sipping Chocolate
  - Chocolate ice cream shell

Meet Greg and T :)

- Evolved from making chocolate for fun to creating a profitable business
- Expanding their brand by selling their products in more local stores, businesses, and markets

Interest in P2

- Innovating with cocoa shell recipes to maximize flavor and sustainability
- Conducting rigorous heavy metal testing to ensure product safety and quality

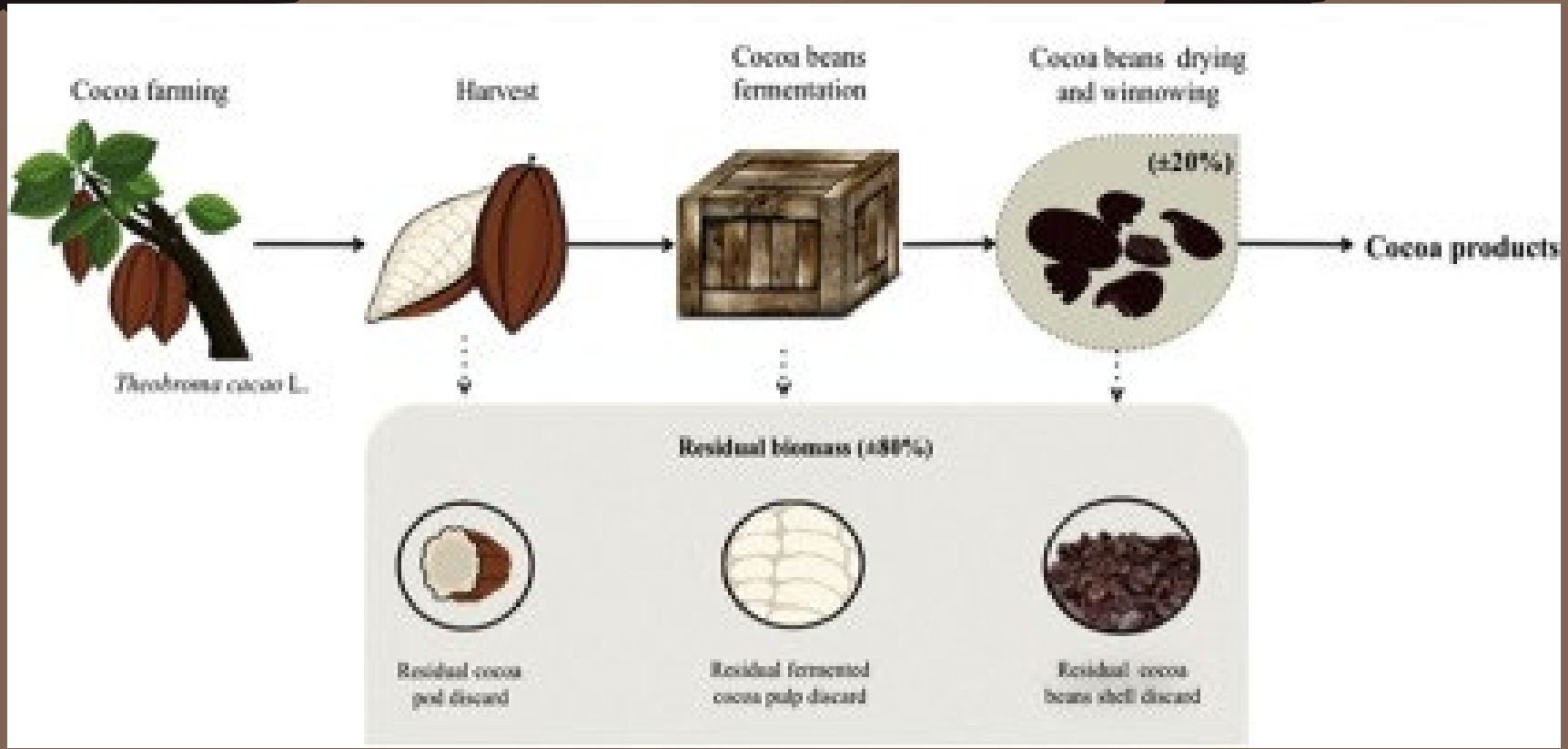
Significance

Industry

- Chocolate industry
  - Specializes in single-origin, small-batch chocolate made from ethically sourced, high-quality beans

Impact

- ~3.8 million tons of cocoa beans produced worldwide in 2022/23
  - 20-30%is shells that are discarded in the winnowing process
  - 760,000 and 1,140,000 metric tons of shells worldwide


Cocoa farming
Harvest
Cocoa beans fermentation
Cocoa beans drying and winnowing
(±20%)
Cocoa products
Theobroma cacao L.
Residual biomass (±80%)
Residual cocoa pod discard
Residual fermented cocoa pulp discard
Residual cocoa beans shell discard

Cocoa Shell Waste

- Approximately 22% of the product received consists of cocoa shells, often considered waste
- These edible shells are rich in nutrients
- Developing creative recipes to repurpose them, such as chocolate cookies, spice mixes, and tea blends

P2 Area of Focus

- Cocoa products tend to bind heavy metals due to negatively charged components.
- Testing cocoa shells for heavy metal contaminants.
- Making recommendations based on findings as needed.

Chemical Testing

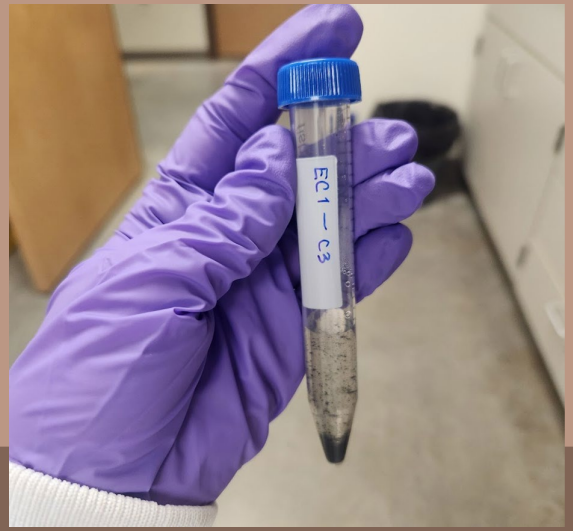
- Cocoa Shells
- Store Bought Cacao Nibs

Dry Ashing

Removes all organic carbon

Chemical Treatment

Dissolve ash in strong acid

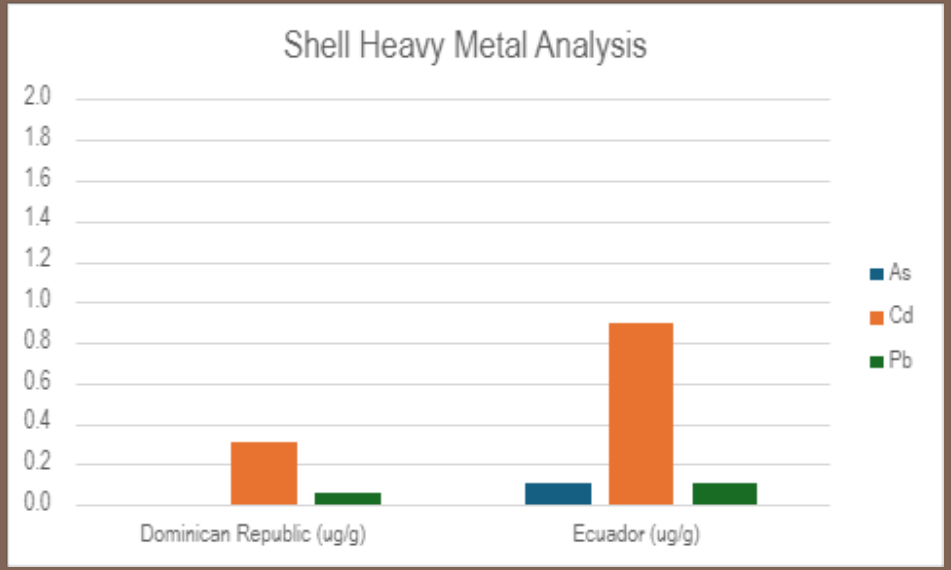


ICP-MS

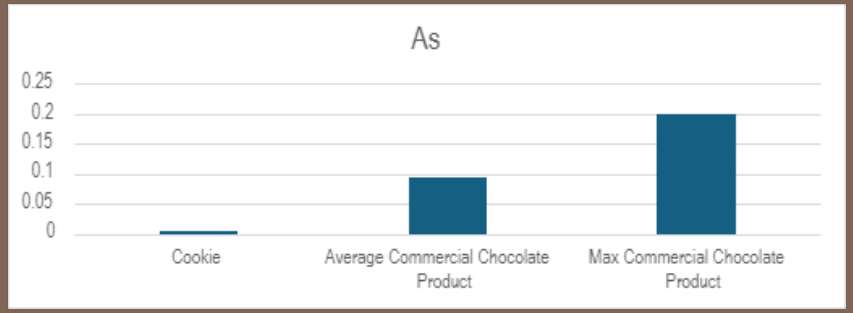
Inject into argon plasma

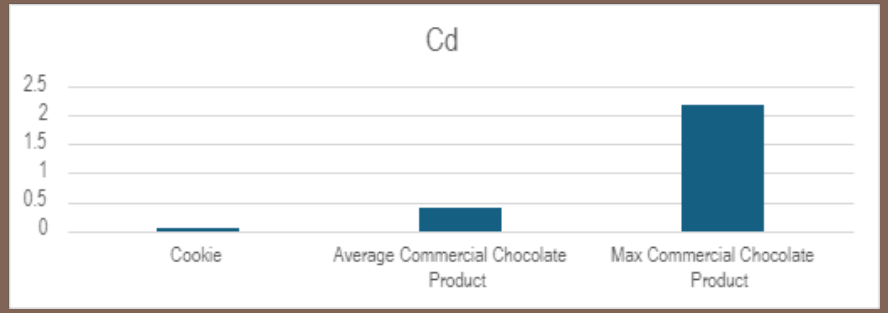
Results

- Heavy metal content determined.
- Differences discovered between the two source regions.
- Significantly below the CA standards for each
  - As = 10 ug/ svg
  - Cd = 4.1 ug/ svg
  - Pb = 0.5 ug/ svg

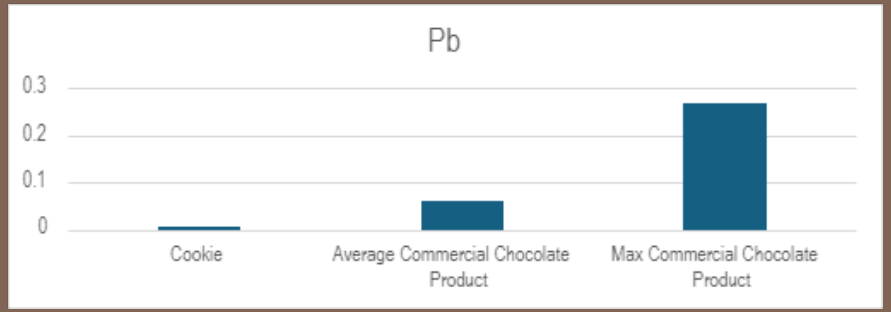


Implications for Recipe Development



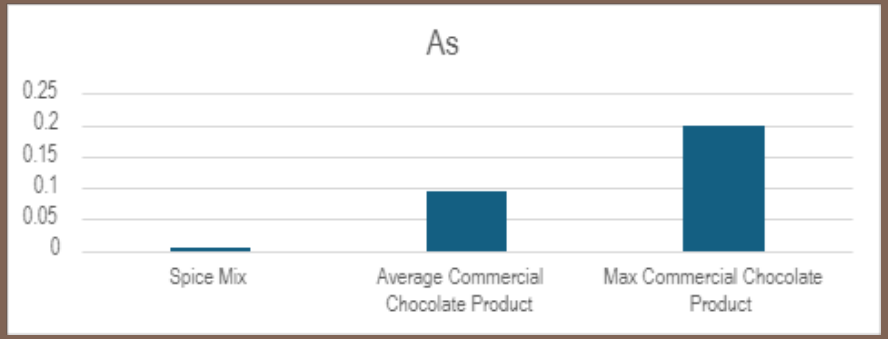


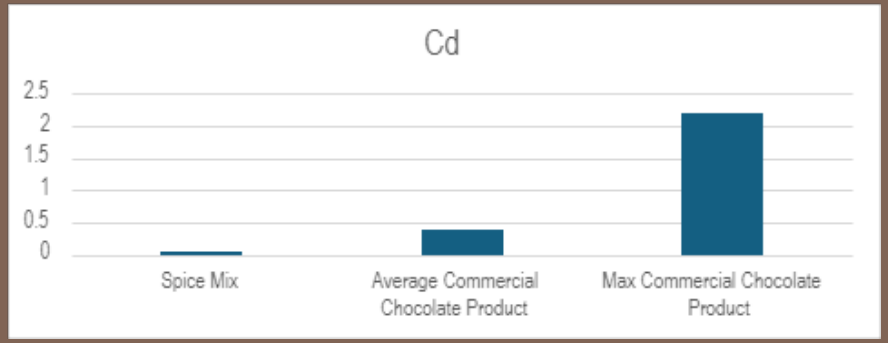
Using cocoa shells in the cookie recipe is well within safe levels of consumption.



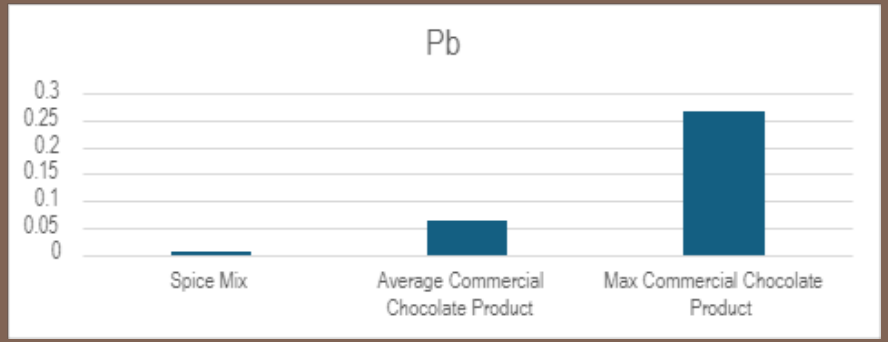
https://www.frontiersin.org/journals/nutrition/articles/10.3389/fnut.2024.1366231/full

Implications for Recipe Development





Using cocoa shells in the spice mix recipe is well within safe levels of consumption.



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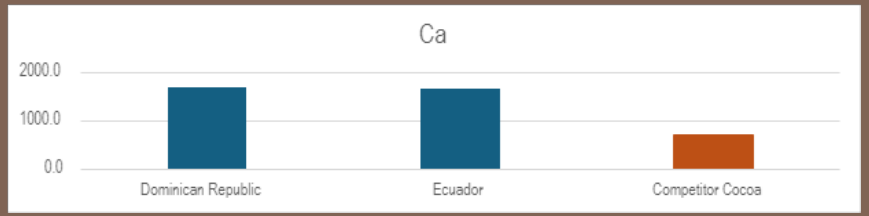
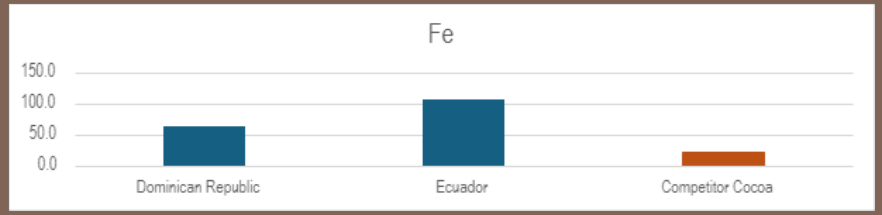
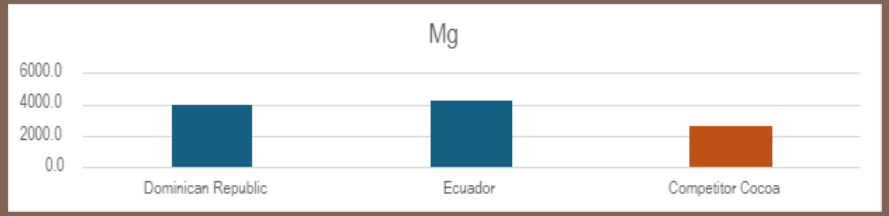
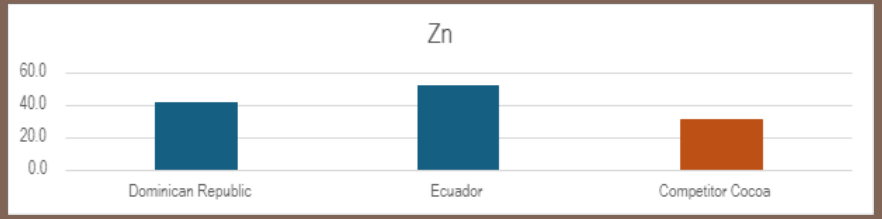
Mineral Content









P2 Area of Focus

- Utilizing cocoa shells in innovative ways to reduce waste and increase profit
  - Creating trail cookie dry mixes with Montana-sourced ingredients
  - Developing unique spice mixes to further repurpose cocoa shells

Recipe Trials

Chocolate Trail Cookie:

- Testing cocoa shell upper limit
- All purpose flour alternatives
- Montana based ingredients

Spice Mix and Sweet Tea:

- Testing cocoa shell upper limit
- Deperminging which recipe to showcase at the farmers market

P2 Outcomes

One-time Cost to Implement ($)	Savings from P2 Action ($)	Reductions in					
		Hazardous Material input (lbs)	Food waste (lbs)	Air emissions (lbs)	Water pollution (lbs)	$MTCO_2e$ emissions (tons)	Water use (gal.)
		n/a	242.5 lbs	*Based on food waste	n/a	~0.0444 tons for front porch ~304,000-456,000 metric tons worldwide	n/a

Reflections & Recommendations

Moving Forward:

- Farmer's Market
- Further chemical testing
- Marketing research
- Recommendations for future interns

Acknowledgements

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“Montana State University is located upon the homelands of indigenous peoples: people with proud heritage, a vibrant present, and a bright future. We acknowledge the Assiniboine, Blackfeet, Chippewa Cree, Crow, Gros Ventre, Kootenai, Little Shell, Northern Cheyenne, Pend d’Oreille, Plains Cree, Salish, Sioux, Hidatsa, Mandan, Arikara, and the other indigenous nations of this region in the past, present, and future. We recognize that this rich human tapestry is central to our institutional mission of learning, discovery, and engagement.”