RESEARCH CASE STUDY REPORT

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Research Site: College Chemistry Lab
Project Title: Exploring Organic Pigment Reactions: A Study on Fresh Rose Extract in Transparent Soap Formulation

1. ABSTRACT

This action research explores the chemical interaction between organic botanical extracts and a transparent soap base within an undergraduate laboratory setting. Conducted as a student-led practical intervention aligned with the Applied Chemistry curriculum, the study investigates the spontaneous behavior of raw rose extract without synthetic stabilizers. The experiment utilized a controlled ratio of 200g transparent glycerin base to 15 mL fresh Rosa indica juice. The entire formulation process and its immediate transitions were fully observed and validated live by the subject teacher and a peer cohort. Upon formulation, a two-stage color shift was observed: an immediate deep green coloration due to the structural transition of natural anthocyanins interacting with co-existing yellow flavonoids in an alkaline matrix (estimated pH 9.0–9.5). This intermediate phase stabilized into a translucent light brown with a distinct brownish-orange hue after a 24-hour curing period. To complete the action-research cycle, the resulting disc-shaped soaps were evaluated via a direct hand-washing trial by a student peer cohort (N=5) immediately upon unmolding. The findings document the natural oxidation pathway of botanical pigments, offering a reproducible, synthetic additive-free alternative for personal care while demonstrating the reflective learning value of faculty-supervised, classroom-based product synthesis.

Keywords: Organic Chemistry, Rose Extract, Natural Oxidation, Synthetic Additive-Free, Action Research, Undergraduate Laboratory.

2. PROBLEM STATEMENT

Most commercial rose-based personal care products rely heavily on synthetic azo-dyes and artificial aromatic compounds to maintain a static, vibrant pink aesthetic. These additives often act as dermatological irritants, inducing contact dermatitis in sensitive skin profiles. Furthermore, undergraduate chemistry curricula frequently separate theoretical organic mechanisms from practical, everyday manufacturing contexts. Students rarely observe how live, unpreserved organic matter alters structurally when introduced into an alkaline surfactant matrix. This study addresses this gap by utilizing a hands-on action research framework to document real-time colorimetric shifts, establish an eco-friendly formulation workflow under active laboratory supervision, and evaluate user experience within an immediate peer group.

3. OBJECTIVES OF THE STUDY

- **Experimental Standardization:** To evaluate the technical feasibility of incorporating unpreserved, freshly harvested garden rose extract as a functional botanical additive in a fixed matrix (200g base to 15 mL extract) under academic supervision.

- **Colorimetric Documentation:** To analyze, monitor, and record the complex structural oxidation pathway of anthocyanin pigments from the temporary green phase to the stable light brown-orangeish profile.

- **Dermatological Safety Evaluation:**
  To synthesize a zero-fragrance, dye-free topical product optimized for skin compatibility, validated via immediate peer hand-washing tests.

- **Practice-Led Sustainability:** To optimize resource efficiency by substituting commercial plastic molds with recycled, post-consumer paper cups, thereby fostering sustainable manufacturing habits in undergraduate laboratories.

4. METHODOLOGY
(THE ACTION PLAN)

This research was executed as a structured, monitored experiment inside the College Chemistry Lab using a five-step action framework:

1. **Sourcing:** Fresh rose petals (Rosa indica) were hand-harvested directly from the college campus garden to ensure a pesticide-free, authentic organic sample.

2. **Processing:** The collected petals (approx. 30g) were thoroughly washed with distilled water, crushed mechanically using a mortar and pestle, and filtered to yield 15 mL of pure, raw juice without external thermal exposure.

3. **Formulation:** A transparent glycerin soap base (200g) was systematically melted at a controlled temperature of approximately 65°C using a water bath to protect the delicate thermal-sensitive phytochemicals. The 15 mL of fresh rose extract was immediately stirred into the molten base to ensure uniform distribution.

4. **Observation of Reaction Mechanisms:** An immediate, distinct colorimetric transition occurred upon blending, which was observed and verified live by both the subject teacher and the attending students. The transparent melt turned into an opaque, deep dark green liquid. While standard literature notes that pure anthocyanins shift toward a blue/purple spectrum under alkaline environments (Zhao et al., 2019), the distinct green observation in this matrix is attributed to the overlapping spectral absorption of the alkaline-shifted blue anthocyanins blending with the yellow flavonoids and carotenoids naturally co-existing within the crude Rosa indica extract. This transition indicates a rapid pH-driven structural shift when exposed to the inherent alkalinity of the glycerin base (estimated pH 9.0–9.5).

5. **Molding and Curing:** The active liquid mixture was poured equally into clean, recycled paper coffee cups acting as sustainable molds. The samples were left to cool, solidify, and cure undisturbed on the laboratory slab for 24 hours.

Figure 1: *Final cured, translucent, disc-shaped organic rose soaps displaying a stable, natural light brown-orangeish tone, synthesized using recycled paper cup molds in the college chemistry laboratory.*

5. OBSERVATIONS & USER EXPERIENCE FEEDBACK

Post-curing, the synthesized soap units transitioned completely from the initial deep green liquid phase into a stable, translucent light brown with a clear brownish-orange hue. This stable end-state reflects the complete structural degradation and subsequent oxidation of the botanical pigments under prolonged alkaline exposure (Enaru et al., 2021).

To execute the reflective phase of the action-research cycle, an immediate evaluation was carried out the next day by a cohort of 5 undergraduate students (including the researcher) who had witnessed the formulation. Upon extracting the soaps from the paper cup molds, the students performed a direct hand-washing trial at the laboratory basin. Since the base matrix consisted of a standard, commercially pre-tested, and dermatologically safe glycerin soap base, immediate topical hand application was conducted safely. Qualitative verbal feedback was delivered directly by the users and recorded across three primary parameters:

Parameter Evaluated	Documented Result	Student Feedback and Practical Inference
Dermatological Safety	Zero instances of redness, itching, or skin irritation reported (0/5).	Highly compatible with skin profiles; confirms that eliminating synthetic surfactants and artificial colorants minimizes acute dermal stress during washing.
Texture and Functional Efficiency	Solid structural integrity; achieved effective cleaning with a mild, creamy lather.	The soap demonstrated excellent rinsing capability and physical cleansing; hands felt thoroughly clean and smooth with no residue or post-wash tightness.
Aroma Profile and Acceptance	Complete absence of synthetic perfume; retained only a neutral, faint botanical scent.	The student cohort positively accepted the zero-fragrance outcome, actively challenging the commercial consumer habit of expecting heavy chemical perfumes.

6. FINDINGS & RESULTS

- **Pigment Behaviour Clarity:** The study demonstrates that crude, unpreserved rose extract undergoes a multi-pigment chemical reaction in an alkaline medium—exhibiting a temporary green phase due to co-pigment blending as witnessed by faculty and peers, before resolving into a stable light brown-orangeish tone via natural oxidation pathways.

- **Empirical Validation:** The immediate color transition and successful solid-state results were fully verified through direct observation by the laboratory instructor and peer students, confirming the empirical authenticity of the experiment under standard classroom constraints.

- **Functional and Sustainable Design:**
  Utilizing post-consumer paper cups successfully generated circular, disc-shaped soap geometries that were highly functional, easy to unmold, and minimized laboratory plastic waste.

7. IMPACT ON PRACTICE & REFLECTION

This action research project significantly transformed the researcher's undergraduate laboratory practice and pedagogical perspective, aligning with foundational action-research principles (McTaggart, 1991). By shifting from prescriptive, textbook-defined chemistry experiments to an active, problem-solving product formulation workflow, theoretical concepts of organic chemistry—such as pigment degradation, co-pigmentation interactions, and pH responsiveness—were observed in real time.

Furthermore, implementing this study instills critical habits regarding empirical modeling and academic communication. It forced a critical transition from simple aesthetic design to the rigorous documentation of raw materials, volume ratios, and localized verification constraints with peers and faculty. The successful execution of this study using minimal, low-cost infrastructure demonstrates that undergraduate laboratories can transition toward sustainable, zero-waste methodologies without sacrificing scientific rigor (Svehla, 2012).

8. CONCLUSION

This classroom action experiment establishes that fresh botanical extracts can be successfully integrated into handmade personal care matrices to produce safe, structurally stable products. The resulting light brown-orangeish tone serves as a visual marker of authentic pigment oxidation, replacing artificial cosmetic enhancements. Ultimately, this project serves as a scalable model for undergraduate chemistry students, illustrating how complex organic mechanisms can be investigated through accessible, eco-friendly, and high-impact laboratory interventions.

9. REFERENCES

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