

NATURE'S HUES IN PRODUCT DESIGN: UNVEILING VIBRANT TONES FROM FRUITS AND VEGETABLES

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ABSTRACT

*This study compares the efficiency of watermelon (*Citrullus lanatus*) and ridge gourd (*Luffa acutangula*) peels as sources of pigment extraction. The peels are prepared using a standard process that includes cleaning, drying, and grinding into a powder before solvent extraction is applied under optimal conditions. Colorimetric analysis gives information about the hue and intensity of the extracted colors, while spectrophotometric analysis is used to measure the concentration of extracted pigments. A comparative analysis identifies apparent differences in color extraction effectiveness between the two peels, which are related to variations in pigment concentration and composition. The results highlight the significance of sustainable use of natural resources while also revealing the potential of these agricultural by-products for color extraction. The paper also highlights the value of reusing agricultural waste for value-added uses by discussing possible uses of the recovered colors in a variety of industries, including food, cosmetics, and textiles. Overall, this study advances ongoing initiatives to maximize agricultural by-product usage, supporting both economic viability and environmental sustainability. It also contains antioxidants, such as lycopene and flavonoids, which cause the damage caused by free radicals, potentially reducing the risk of developing chronic diseases. The pigments obtained from the color extraction of watermelon and ridge gourd peels can be used in a sauce created from the white parts of the ridge gourd. This sauce can be used to enhance a variety of dishes with flavor and nutrition. Rich in natural colorants and minerals, the peels' pigments can improve the sauce's appearance and nutritional value. The sauce gives the dish a distinctive flavor profile and bright color, and it can be used as a marinade, condiment, or dip. By using the entire ridge gourd, this creative method not only minimizes food waste but also optimizes the nutritious value of the skins and the remaining fruit.*

Keywords: Reuse waste, Peels, Color extraction, Comparative, Sauce

1. INTRODUCTION

The utilization of agro-waste materials for extracting natural pigments like chlorophyll from ridge gourd and watermelon peels is a significant advancement in sustainable practices. This innovative approach not only reduces food waste but also meets the increasing demand for natural colorants in the food and cosmetics industries. Chlorophyll, apart from its green color, offers health benefits and aligns with consumer preferences for natural and health-promoting ingredients. While natural colorants have advantages such as perceived health benefits and environmental friendliness, they also come with challenges like variability, stability issues, and higher costs compared to synthetic colors. Therefore, a careful evaluation of trade-offs is necessary when choosing between natural and synthetic colorants to meet market demands effectively. Watermelon peels, often overlooked, offer

significant health benefits and can contribute to waste reduction, supporting environmental sustainability. Rich in vitamins C and B6, potassium, magnesium, and fiber, the peel aid's immune function, nerve health, blood pressure regulation, muscle strength, digestion, and blood sugar control. Citrulline, abundant in the rind, improves circulation, lowers blood pressure, enhances athletic performance, and may benefit cardiovascular health. Antioxidants like lycopene and flavonoids in the peel combat free radicals, reducing chronic disease risks. Utilizing watermelon rind in various culinary ways not only enhances nutrient intake but also minimizes food waste and opens up new flavorful possibilities, aligning with personal health and environmental goals.

1.1 Objectives

The project aims to extract natural colors from fruits and vegetables to incorporate them into a new food product. This process will harness the vibrant hues found in nature to enhance the visual appeal and nutritional value of the final food item. By utilizing these extracted colors, the project seeks to create a more natural and wholesome product that appeals to consumers looking for healthier food options.

- To extract the color from Ridge gourd peels and Watermelon peels.
- To study the characterization of the extracted colors of Ridge gourd peels and Watermelon peels.
- To develop a food product by infusing the extracted colors of Ridge gourd peels and Watermelon peels.
- To study the characterization of the developed Food products.

1.2 Scope of the project

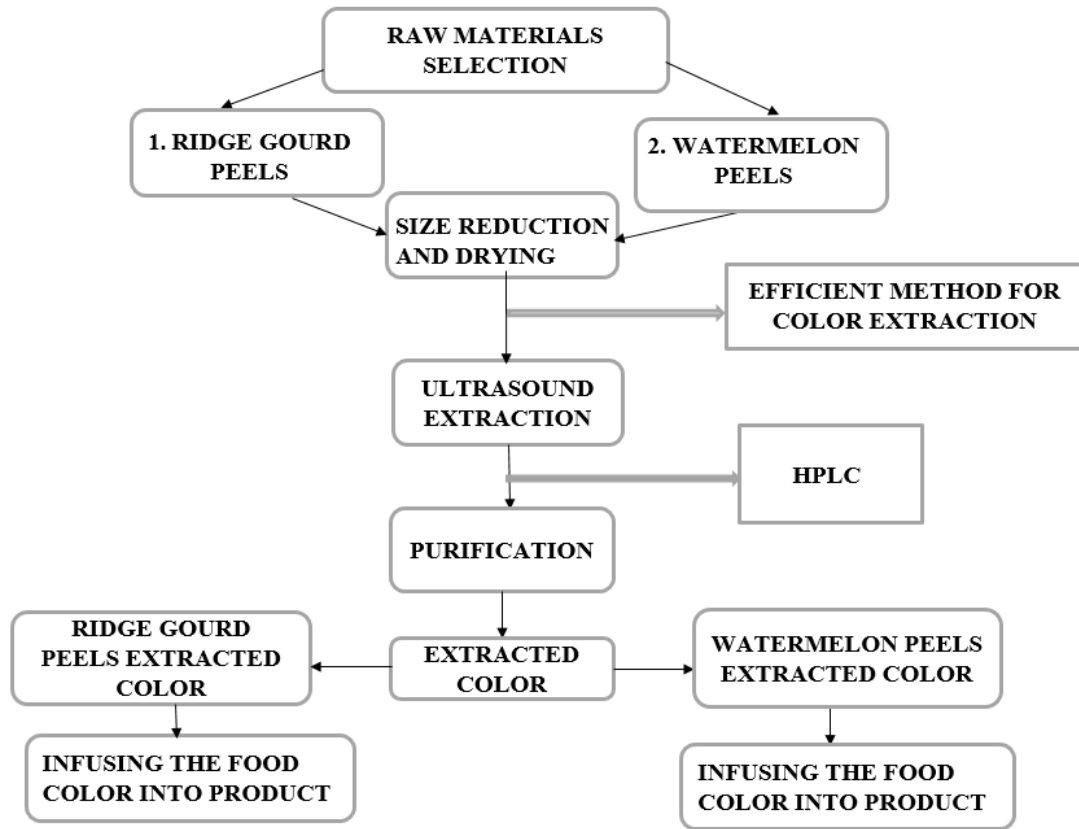
The scope of the project involves exploring innovative methods for extracting chlorophyll from food industry by-products like watermelon peels and ridge gourd peels. This process aligns with sustainable practices by utilizing waste materials and contributes to the circular economy. The project aims to develop efficient extraction techniques that minimize environmental impact while maximizing chlorophyll yield and purity. Analytical methods such as spectrophotometry or chromatography will be employed to assess the quality and concentration of the extracted chlorophyll. Additionally, the project will evaluate the potential applications of the extracted chlorophyll as a natural colorant in the food and cosmetics industries. Considerations for scalability and industrial applications will also be explored to determine the feasibility of large-scale chlorophyll extraction from food by-products.

- Developing scalable and cost-effective extraction methods.
- Investigating potential health benefits of extracted chlorophyll.
- Exploring innovative uses for chlorophyll extract beyond coloring.

2. MATERIALS AND METHODOLOGY

Ridge gourd and watermelon peels can be used to create a color extraction process by first choosing ripe, clean peels, then washing and sorting them to remove impurities, carefully separating the outer layers to extract pure peels, drying them if necessary to reduce moisture, and storing them properly for later pigment extraction.

- Wash and dry ridge gourd, watermelon rinds.
- Grind dried peels into fine powder, store separately.
- Make 80% ethanol solution.
- Mix 10g chosen powder with 100ml ethanol solution.
- Sonicate for 10 minutes, filter to get colored extract.
- Concentrate extract using rotary evaporator (below 40°C, 50 rpm).
- Wash, peel, deseed, and blend ridge gourd into pulp.
- Boil pulp for 20 minutes (optional, for softer sauce).
- Grind/blend boiled or raw pulp.
- Sauté pulp in oil, add vinegar, simmer 10-15 minutes.
- Season with salt.
- Add desired amount of ridge gourd or watermelon color extract to the sauce.
- Cool sauce to room temperature.
- Store in sterilized jar/bottle in refrigerator.



Ridge gourd

Ridge gourd powder

Extracted color

Sauce

Ridge gourd color sauce

RIDGE GOURD COLOR INFUSED SAUCE



Watermelon

powder

Extracted color

Sauce

watermelon color sauce

WATERMELON PEELS COLOR INFUSED SAUCE

3. RESULT AND DISSCUSION

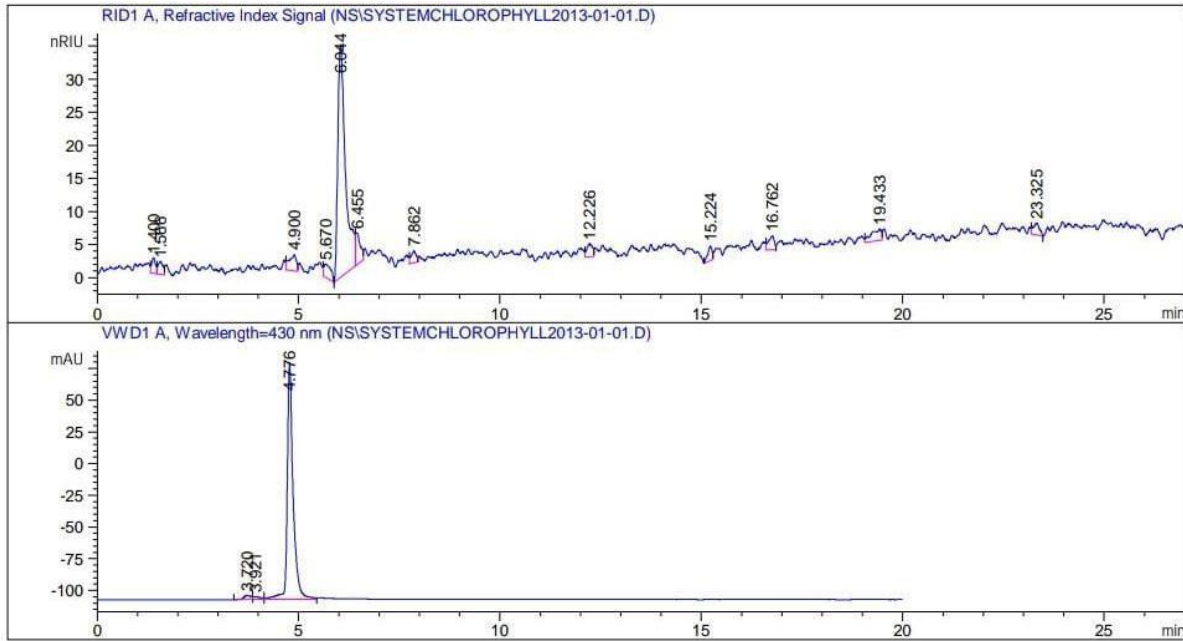
The nutritional properties of prepared ridge gourd peels powder are revealed by chemical analysis. This powder moisture content is 8.71%, pH is 7.33 which is slightly basic, color of the powder done in colorimeter – $L^*=51.95$ (white), $a^*=-6.39$ (green), $b^*=33.86$ (yellow), water activity is 0.567% prevent microbial growth and allow for a longer shelf life. Additionally, the 0.1g ash content indicates that important minerals are present. Together, these results suggest that ridge gourd peels powder may find use in a range of food products due to its nutritional properties, visual appealing color and storage stability.

3.1ANALYSIS FOR POWDER

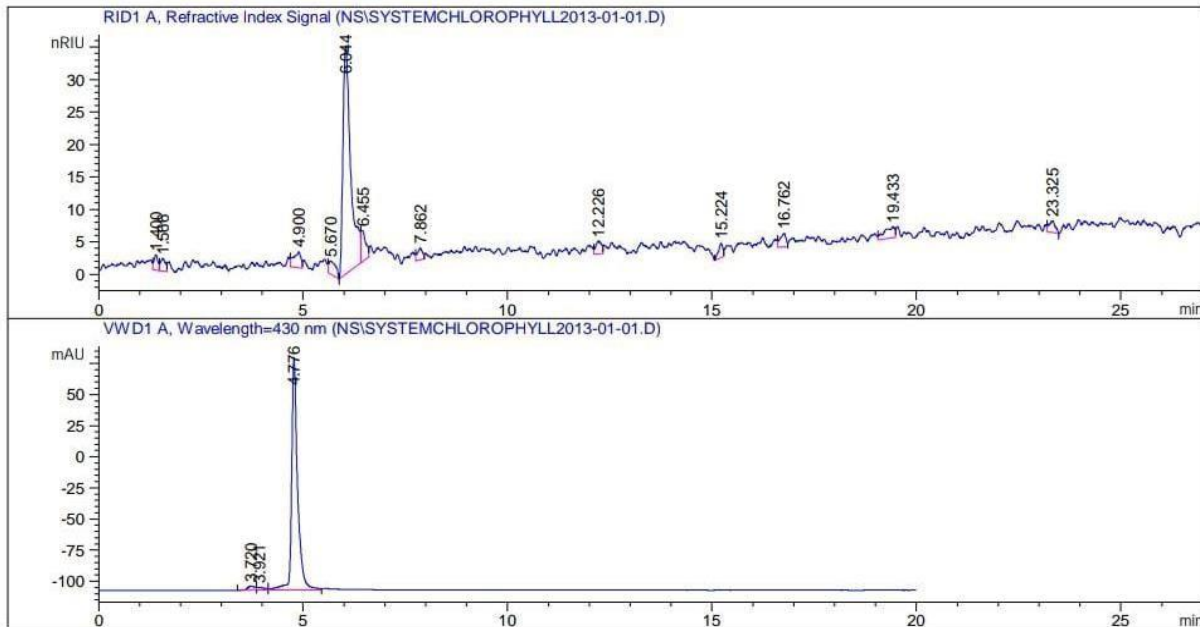
S.NO	ANALYSIS	RIDGE GOURD PEEL POWDER	WATERMELON PEEL POWDER	INFERENCE
1	Colorimeter	$L^* = 51.95$ $a^* = -6.39$ $b^* = 33.86$	$L^* = 52.14$ $a^* = -3.05$ $b^* = 25.80$	Ridge gourd peels powder have high color compared to watermelon peels powder. (Ridge gourd efficient for extraction)
2	pH	pH = 7.33	pH = 7.32	Ridge gourd peels powder have high pH compared to watermelon peels powder.
3	Water activity	aw = 0.567 at 30.2 °C	aw = 0.522 at 32.3 °C	aw of ridge gourd peels is more. So, it can easily be affected by microbes
4	Moisture content	MC = 8.71%	MC = 8.33%	Moisture content of ridge gourd peels is more. So, it can easily be affected by microbes
5	Ash content	Ash content = 0.1 g	Ash content = 0.107 g	The Ridge gourd peel powder and Watermelon peel powder both contain same mineral contents

3.2 ANALYSIS FOR COLOR

1. HPLC – HIGH PERFORMANCE LIQUID CHROMATOGRAPHY



Graph for watermelon peel color



Graph for Ridge gourd peel color

The HPLC analysis successfully separated the two target compounds Ridge gourd peels:

- With retention times of 6.044 minutes, absorbance at a wavelength of 430 nm, the graph peak indicates the presence of carotenoid compounds in the samples.
- With retention times of 4.900 and 5.670 minutes, absorbance at a wavelength of 430 nm, the graph peak indicates the presence of chlorophyll compounds in the sample.

The HPLC analysis successfully separated the two target compounds watermelon peels powder:

- With retention times of 4.776 minutes, absorbance at a wavelength of 430 nm, the graph peak indicates the presence of carotenoid compounds in the samples.
- With retention times of 3.720 and 3.921 minutes, absorbance at a wavelength of 430 nm, the graph peak indicates the presence of chlorophyll compounds in the sample.

3.3 ANALYSIS FOR SAUCE

S.NO	ANALYSIS	RIDGE GOURD PEEL COLOR	WATERMELON PEEL COLOR	BOTH	INFERENCE
1.	COLORIMETER	L* = 39.54 a* = 2.34 b* = 26.10	L* = 42.18 a* = 2.88 b* = 29.00	L* = 41.81 a* = 2.78 b* = 28.13	Ridge gourd peel color have high color intensity compared to others in sauce.
2.	pH	pH = 4.88	pH = 5.07	pH = 4.73	pH for mixed colors is acidic compared to others.
3	MOISTURE	MC = 13.86%	MC = 16.63%	MC= 6.07%	Moisture content for mixed colors is low.so it is efficient than others.
4	WATER ACTIVITY	0.580 aw	0.609 aw	0.535 aw	Water activity for mixed colors is low.so it is efficient than others.
5	ASH CONTENT	0.84 g	1.08 g	0.14 g	Mineral content is high for mixed colors compared to others.

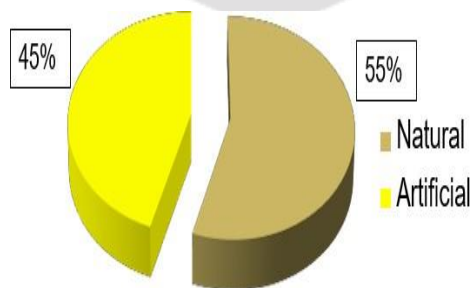
VISCOSITY ANALYSIS FOR SAUCE

- The Thin nature of the ridge gourd sauce, watermelon sauce and mixed color sauce, the use of a cylindrical probe at 20 RPM, and the temperature of 33.6 °C all suggest a shear thinning property.
- It comes under the non-Newtonian category, for all three sauces viscosity decreases as the applied shear rate increases.
- Non-Newtonian: This is the more common category for sauces. They exhibit shear thinning or shear thickening behavior.
- Shear thinning: Most food sauces fall into this category. Their viscosity decreases as the applied shear rate increases. In simpler terms, they become thinner and flow more easily under pressure.



4. CONCLUSIONS

In order to explore the possibility of watermelon and ridge gourd peels as environmentally friendly substitutes, we extracted natural colors from the peels. This research showed that these agricultural wastes have a strong pigment content that could be effectively recovered using simple methods like solvent extraction and maceration. It believes that this research provides a solution to reduce environmental impact and repurpose agricultural waste, which aligns with the global shift towards sustainability. In addition, the colors that were extracted showed exceptional durability when exposed to different pH values and amounts of light, indicating that they might be used in textiles, food, and cosmetic products. Overall, findings highlight the promising role of agricultural by-products in sustainable color production, paving the way for a greener future through innovation and resourcefulness. This shift towards natural colorants helps reduce the use of synthetic dyes, which may have adverse health effects. Embracing natural colors from ridge gourd peels and watermelon peels not only enriches the sensory experience but also safeguards human health and the environment. Within the last 10-15 years, there has been a distinct shift towards use of natural colors than that of artificial colors in global market. The global natural food color market represented 54.9% of the total food color market in 2015 and is expected to account for nearly 60% of the overall market by 2020.



5. REFERENCES

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