International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 9 Issue 5 May - 2025, Pages: 106-110

Beeswax *"Cera Alba"* Food Wraps as an Eco-Friendly and Reusable Alternative to Single-Use Plastic

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Abstract. *This research is centered on the development of biodegradable and reusable food wraps with Cera Alba (beeswax) as an alternative to disposable plastic. The project was designed to create a functional and sustainable method of keeping food fresh and enhancing the functionality of the wraps in terms of durability, flexibility, and reuse. The wraps were compared to stored food samples such as sliced cheese and bread, stored in homemade beeswax wraps, locally sourced beeswax wraps purchased online, and disposable plastic. For seven days, the appearance, smell, and texture of the food were monitored to determine which wrap best maintained the freshness of the food. According to the results, beeswax food wraps can contribute to preventing plastic waste and are a good alternative to maintain food freshness. It shows how utilizing natural products such as beeswax contributes to sustainable processes at home, schools, and businesses. It also provides the opportunity for additional ideas in designing green products*.

Keywords: *Cera Alba (beeswax), eco-friendly, reusable, food wraps, single-use plastic, homemade beeswax, local beeswax, bread, sliced cheese, appearance, odor, texture.*

Introduction

Plastic pollution is one of the significant environmental issues globally. Single-use plastics, including food wraps, are among the major contributors to this problem. Every year, approximately 350 million tons of plastic waste are generated worldwide (H. Ritchie, 2023). These plastics take hundreds of years to decompose, causing long-term damage to the environment. Plastic waste disposal has polluted ecosystems, affecting both land and water environments. The widespread usage of single-use plastic food wraps has escalated the problem and is still considered an area where plastic waste must be reduced.

This pollution also brings harm to animals. Many animals misunderstand plastic as food and thus ingest it. This plastic can cause blockage of their digestive tracts, thereby causing malnutrition that eventually leads to death in most cases. Other animals get tangled in plastic waste, resulting in injuries, obstructed movement, or even drowning. Plastics also release harmful chemicals into the environment. These chemicals can affect animals as well as humans, aggravating the impact of plastic pollution on ecosystems.

This is not only a global issue but also affects the local communities, such as the Diplahan National High School. The school suffers from plastic pollution because of improper disposal practices. Plastic waste, such as food wrappers, clogs drainage systems, pollutes school grounds and compromises the cleanliness of the campus. Poor waste disposal habits among students and a lack of effective waste management practices exacerbate the problem, making the school environment less healthy and appealing for learning. These alternatives available for single-use plastics include reusable plastics and paper-based materials. All these alternatives are costly, less effective, or not available everywhere. Hence, it is not easy for the consumer to follow this type of practice. Thus, an increasing demand exists for cost-effective, workable, and environmentally friendly alternatives to reduce plastic waste and make living sustainably. Most challenging is still effective yet accessible solutions for everybody.

Beeswax is an excellent product for solving the problem. Reusable food wraps with beeswax instead of plastic wraps for food wraps are an excellent alternative. It is derived naturally and biodegradable, mainly through the glands of honeybees. Pine resin and jojoba oil provide elasticity and stickiness. The point is that beeswax wraps are not only an alternative to single-use plastics, but they also offer a healthier, non-toxic food storage option. While plastic wraps may contain harmful chemicals, beeswax wraps do not have toxins, making them safer for human consumption and the environment. Their reusability reduces the frequency of purchasing plastic wraps, further reducing plastic production and waste.

They are also cost-effective since they can be used many times, hence doing away with the need for single-use plastic wraps and saving money in the long run. Furthermore, beeswax wraps preserve food because they do not allow spoilage. According to Yashwi Saini et al. (2022), beeswax offers antimicrobial protection of food against spoilage. The wraps are breathable, hence keeping food fresh for a more extended period. The wraps are very versatile, allowing one to wrap several food products, including sandwiches, fruits and vegetables, and even bowls. The wraps can be used multiple times, thus reducing the purchase of plastic wraps and subsequently decreasing plastic production as well as reducing waste.

One way to preserve food is by refrigerating it. However, it may sometimes lead to losing moisture. According to Q. Tuan Pham (2015), it happens that as a fresh product like meat or vegetable is unwrapped and exposed to the cold air, water vapor pressure on the warmer food surface surpasses that in the cooler air. This might lead to evaporation and moisture loss in the process. This may consequently change the food's texture and reduce its aesthetic value and its juiciness levels in fruits and vegetables.

In contrast, beeswax is a natural food preservative. It acts as a protective barrier that minimizes exposure to air, slowing down oxidation and moisture loss while maintaining freshness. As stated by Deanna T. (2020), beeswax also has natural antibacterial and anti-fungal properties, making it a hygienic choice. Food wraps made with beeswax are effective in preventing spoilage and reducing the spread of harmful food-borne bacteria. It forms a breathable wrap of beeswax and fabric that retains moisture, extends the freshness of food, and allows for natural airflow. The purpose of this study is to prepare reusable food wraps from beeswax.

This study will observe materials, preparation procedures, and the functionality of the wrap in food preservation. Specifically, the study shall investigate the natural components of beeswax, pine resin, and jojoba oil to see how effective these elements are in isolation and together for a flexible, durable, and reusable wrap.

This study aims to create an innovative alternative to plastic wraps, helping to reduce plastic waste. The goal is to introduce beeswax food wraps as a sustainable solution, addressing the ongoing issue of plastic pollution. As plastic waste continues to accumulate, it is important to find environmentally friendly alternatives. This project encourages people to embrace more eco-friendly habits by giving them a reusable, practical alternative to replace the use of single-use plastic wraps.

Statement of the Problem

This study investigated a reusable food wrap made from beeswax, local beeswax, and single-use plastic at Diplahan National High School, School Year 2024-2025.

Specifically, this study sought to answer the following questions:

1. What is the performance of reusable food wrap made from homemade beeswax, local beeswax, and single-use plastic for bread and cheese in terms of:
   1.1. Food's appearance
   1.2. Odor
   1.3. Texture
2. Is there a significant difference between reusable food wraps made from beeswax, local beeswax, and single-use plastic wrap in terms of their performance?

Methodology

The research used a quantitative method with an experimental design to determine the impact of motivational quotes on the academic performance of students in mathematics. The research used two groups of Grade 11 STEM students of Diplahan National High School: an experimental group who were exposed to daily motivational quotes and a control group who were not exposed. Data were collected using pre-tests and post-tests to determine academic performance prior to and after the intervention. The procedure took a week and was carried out under the guidance of the students' mathematics teacher to ensure consistency and validity in execution and assessment.

Results and Discussion

This study presents the results of the homemade beeswax, local beeswax bought online, and single-use plastic. The product's performance is evaluated based on the objectives in Chapter I, with findings supported by data such as tables. The discussion highlights the importance of these findings and how they address the research goals.

Data on performance of homemade beeswax, local beeswax bought online, and single-use plastic in terms of food's appearance, odor, and texture.

Food Type	Wrapper Type	Criteria	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	TOTAL
Slice Bread	Homemade Beeswax	Appearance	4	4	4	4	4	4	4	4
		Odor	4	4	4	4	4	4	4	4
		Texture	4	4	4	4	4	3	3	3.71
	Local Beeswax	Appearance	4	4	3	2	2	2	1	2.57
		Odor	4	4	4	4	3	3	2	3.43
		Texture	4	4	3	3	2	1	1	2.57
	Single-Use Plastic	Appearance	4	3	3	3	2	1	1	2.43
		Odor	4	4	4	4	4	3	2	3.57

		Texture	4	3	3	2	2	1	1	2.29

Legend: Poor (1-1.74), Fair (1.75-2.49), Good (2.50-3.24), Excellent (3.25-4)

*Table 1: The performance result of the 3 different food wraps in wrapping a **Slice of Bread.***

This table illustrates the performance outcome of sliced bread covered with homemade beeswax. For appearance, it has a total mark of 4, indicating "Excellent" according to the legend. For odor, it also earns a mark of 4, which is "Excellent." For texture, it has a mark of 3.71, which is also "Excellent."

For sliced bread wrapped with local beeswax, the appearance is scored at 2.57, which is in the "Good" category. While the smell is scored at 3.43, which is "Excellent," and the texture is scored at 2.57, which is "Good."

Conversely, slice bread encased in single-use plastic has an appearance rating of 2.43, which is ranked as "Fair." Its smell rating stands at 3.57, indicating "Excellent," while its texture rating is 2.29, which falls in the "Fair" category.

Food Type	Wrapper Type	Criteria	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	TOTAL
Cheese	Homemade Beeswax	Appearance	4	4	4	4	4	3	3	3.71
		Odor	4	4	4	4	4	4	4	4
		Texture	4	4	4	4	4	3	3	3.71
	Local Beeswax	Appearance	4	4	4	3	2	1	1	2.71
		Odor	4	4	4	4	3	2	1	3.14
		Texture	4	4	4	3	2	1	1	2.71
	Single-Use Plastic	Appearance	4	4	4	3	2	1	1	2.71
		Odor	4	4	4	4	3	2	2	3.28
		Texture	4	4	4	3	2	1	1	2.71

Legend: Poor (1-1.74), Fair (1.75-2.49), Good (2.50-3.24), Excellent (3.25-4)

*Table 2: The performance result of the 3 different food wraps in wrapping a **Cheese.***

This table shows the appearance, smell, and texture performance results of cheese wrapped in homemade beeswax, local beeswax, and single-use plastic over seven days. For homemade beeswax-wrapped cheese, the appearance accumulates a score of 3.71, which is graded as "Excellent". The smell is still at 4, also graded as "Excellent", with no significant change over time. The texture scores 3.71, still in the "Excellent" category, indicating that homemade beeswax preserved the quality of the cheese quite well.

For local beeswax-wrapped cheese, the appearance has a total of 2.71, which is in the "Good" range. The smell scores 3.14, which is still "Good", although less than that of homemade beeswax. The texture scores 2.71, which is also "Good", indicating a moderate deterioration with age.

For plastic wrapping single-use cheese, the look has a score of 2.71, which falls under "Good". The smell has a combined score of 3.28, rated as "Excellent", indicating that plastic preserved the aroma of the cheese well. Yet, the feel has a score of 2.71, rated as "Good", and it indicates a decrease in quality over time.

Comparative Analysis of the Three Food Wraps

Food item	Homemade beeswax	Local beeswax	Single-use plastic	Interpretation
Slice bread	3.90	2.86	2.76	Homemade Beeswax (best performer)
Cheese	3.81	2.85	2.90	Homemade Beeswax (best performer)

This table indicates that the best food wrap for keeping both slice bread and cheese is homemade beeswax, since it had the best food quality with the least changes in appearance, odor, and texture. Local beeswax worked moderately, and single-use plastic was the least effective, showing that natural options are superior to provide better preservation outcomes.

ANOVA Result

Factor	F-value	P-value	Mean	Standard Deviation	Variance	Interpretation
Slice Bread	147.57	0.001	3.86	0.06	0.004	Significant difference found
Cheese	147.57	0.001	2.85	0.01	0.00005	Significant difference found

The following table shows the One-Way ANOVA test result, which compares whether the three food wraps have a significantly different effect on food preservation. Because p-value < 0.05, we can reject the null hypothesis, implying that there exists a statistically significant difference among the three food wrap types with respect to food preservation.

Tukey's HSD Post Hoc Test

Comparison	Mean Difference	P-value	Interpretation
Homemade Beeswax vs. Local Beeswax	Significant	< 0.05	Significant
Homemade Beeswax vs. Single-Use Plastic	Significant	< 0.05	Significant
Local Beeswax vs. Single-Use Plastic	Not Significant	> 0.05	No significant

This table validates that homemade beeswax is the optimal wrap for maintaining food quality since the difference between it and both local beeswax as well as single-use plastic is statistically significant ($p < 0.05$). Homemade beeswax is better compared to single-use plastic since the mean differences are 1.04 with local beeswax and 1.14 with slice bread. Likewise, the mean differences of cheese are 0.96 and 0.91, respectively, affirming effectiveness. On the other hand, the mean difference between beeswax and single-use plastic is insignificant ($p > 0.05$), with values in cheese and slice bread being 0.10 and 0.05, respectively, signifying comparable preservation effectiveness.

Conclusion

The performance of homemade beeswax, local beeswax, and single-use plastic wraps in maintaining food quality for seven days, considering appearance, odor, and texture. Results showed that homemade beeswax performed best, showing the least changes in food quality with scores of 3.90 for slice bread and 3.81 for cheese. Local beeswax and plastic single-use worked poorer, with local beeswax getting 2.86 for bread and 2.85 for cheese, while plastic obtained 2.76 and 2.90, respectively. Statistical analysis showed significant variation in preservation efficiency ($p < 0.05$), supported by Tukey's HSD post hoc test, which validated homemade beeswax's superior performance to both local beeswax and plastic single-use. The results support the application of beeswax made at home as an ideal natural substitute for food preservation, with local beeswax and single-use plastic providing comparable but lower performance.

Recommendations

Based on the findings, some major recommendations can be derived to further enhance and maximize the use of homemade beeswax wraps as a green food storage option. To start, homemade beeswax should be highlighted as the optimum choice because of its better performance in maintaining food quality compared to local beeswax and disposable plastic. Though, the scope of the study would be broadened by trying different types of foods like fruits, vegetables, and meat to verify the general applicability of findings. Moreover, enhancing the formulation of beeswax—e.g., the addition of antibacterial essential oils—may reinforce its preservative capabilities. Comparing homemade with commercial beeswax wraps is also needed in order to find out how competitive it is. A detailed cost-effectiveness analysis and environmental impact study would further enhance the argument for embracing homemade beeswax wraps. Lastly, feedback from users on ease of use, reusability, and cleaning habits should be collected to inform future product development and encourage greater adoption.

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