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CHEWRASA HERBA GUMMY LOZENGES: FORMULATION, TEXTURAL STABILITY, AND CONSUMER ACCEPTANCE OF AN UNDEREXPLORED WHITE ROSELLE AND GINGER-BASED ALTERNATIVE

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Abstract:

Herbal gummy lozenges are gaining substantial attention as functional confectionery products due to their potential health benefits and improved consumer acceptability. Traditional lozenges are hard and have the unpleasant texture that is hard to swallow. They also often contain synthetic colorants, preservatives and artificial flavors which may not be appropriate for people who have sensitive tastes or are children. Furthermore, even though Red Roselle has received much attention in research, White Roselle has not been studied as much, even though it contains high amounts of antioxidants and soothing capabilities. By creating this healthier and plant-based candy alternative, this study helps achieve SDG 3 (Good Health and Well-being), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production). Thus, this study prepared functional gummy lozenges made with White Roselle and ginger extract and analyzed their consumer-perceived physical, textural, and sensory

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properties. The gummy lozenge formulation was prepared using a hot process with gelatin as the gelling agent and honey to provide sweetness. Sensory analysis was conducted on a consumer panel of 35 participants using questionnaires that rank various organoleptic properties. The results indicated that all recipes successfully achieved stable gel structures, the Red Roselle with ginger formulation (Sample B / 436) was identified as the most balanced (57.14%) and preferred (51.43%), followed by White Roselle with ginger (Sample A / 321) and Chrysanthemum with ginger (Sample C / 249). In conclusion, although White Roselle lozenges were successfully developed and evaluated, Red Roselle demonstrated higher consumer acceptance. This study highlights the potential of herbal gummy lozenges as a natural alternative to conventional products. In addition, the formulation developed has demonstrated high technical and sensory viability for functional gummy lozenges, offering a promising, clean-label therapeutic alternative for soothing throat irritation.

Keyword:

Consumer Preference, Ginger Extract, Herbal Gummy Lozenges, Sensory Evaluation, White Roselle

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Introduction

White roselle (Hibiscus sabdariffa) is a lesser-known and underexplored botanical variety of roselle that is highly valued for its mild, refreshing taste and potent bioactive potential, including rich antioxidant, anti-inflammatory, and mucilage-rich soothing properties (Almajid et al., 2023). In recent years, global market dynamics have experienced an increasing consumer demand for natural, organic, and plant-based remedies, particularly for managing minor seasonal ailments such as acute throat irritation. Sore throats, often caused by respiratory infections, environmental dry air, airborne pollutants, or vocal strain, present a significant public health discomfort that represents a high volume of over-the-counter remedy seeking. Conventional throat lozenges are widely utilized to provide temporary symptomatic relief. However, many commercial options are highly hard, difficult to swallow for pediatric or elderly cohorts and frequently contain synthetic colorants, preservatives, artificial flavour, and high levels of refined cane sugar that may not suit sensitive consumers (Chanda & Nallaguntla, 2020).

The existence of this limitation has created a demand for conducting further research to discover a safer, more natural, and more effective substitute that has pleasant taste and texture. The current project aims to bridge the gap by formulating a tasty and calming herbal lozenge, which is made of concentrated Ginger (Zingiber officinale) extract and natural White Roselle extract, and is known as ChewRasa Herba. This product utilizes the natural plant components

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that have been traditionally considered effective in producing therapeutic results. The utilization of the White Roselle extracts allows for the inclusion of a lot of vitamin C, anthocyanins, and organic acids that work in combination with gingerols, which have anti-inflammatory effects on the throat mucous membrane.

To further enhance gel formation, the gel undergoes a three-step process to obtain desired gel properties, beginning with extraction of raw materials, heating under controlled conditions, and the combination of hydrocolloids and finally using silicone molds (Almajid et al. 2023). This study, which is primarily focused on the analysis of the properties of the produced lozenges such as texture, color, taste, and plasticity through the use of structured organoleptic questionnaires filled by a group of 35 adult evaluators, is a preliminary study since no medical research, clinical trials, or long-term study or commercialization stage has been carried out to date. However, the results support the global goals of sustainability, including SDG 3 (the promotion of human health), SDG 9 (the invention of innovative approaches), and SDG 12 (the production of environmentally friendly products). The aim of this study is to achieve two major goals by following this systematic methodology. The first goal is to develop a gummy formulation that contains both ginger and White Roselle. The second goal is to evaluate the quality of the gummy products with respect to consumption experience and make a comparison among them with that of red roselle and chrysanthemum gummies.

Literature Review

The presence of strong theoretical knowledge is necessary for understanding natural content as well as physical properties of ChewRasa Herba ingredient. For this reason, the present section presents information regarding active compounds from the composition of ingredients as well as gelling network structure in order to demonstrate the manner in which gummy lozenges may serve as a method of oral delivery.

Phytochemical and Therapeutic Profile of White Roselle

Hibiscus sabdariffa is well-known for containing high levels of organic acids (such as citric, malic, and tartaric acids), vitamin C, and active polyphenols. While the red-calyx variety has received the most attention due to its color, White Roselle is still an underexplored ingredient in food science (Chew et al., 2024). Phytochemical analyses indicate that White Roselle offers equivalent or superior antioxidant concentrations and anti-inflammatory properties compared to its red counterpart (Hamrita, B. et al., 2022). Importantly, White Roselle calyces are rich in mucilage, a natural demulcent. When consumed as a gummy lozenge, this mucilage hydrates to coat and protect the irritated throat lining, instantly soothing tickly throat sensations and dry coughs (Cid-Ortega & Guerrero-Beltrán, 2015)

Synergistic Bioactivity of Ginger Extract

Ginger (Zingiber officinale) has been trusted for thousands of years in traditional medicine for its warming and infection-fighting abilities. Its signature pungent taste comes from key active compounds: gingerols, shogaols, and zingerone (Mao, Q. Q. et al., 2019). These compounds help calm sore throats and reduce localized swelling by blocking the body's cyclooxygenase (COX) and lipoxygenase (LOX) inflammatory pathways. In addition, ginger extract targets the actual oral germs that cause sore throats (Prasad, S. et al., 2015) and provides crucial anti-inflammatory and antioxidant defense (Adhao, V. et al., 2026). When formulated with White

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Roselle, the heat from the gingerols beautifully balances the sour, acidic flavor of the roselle, resulting in an appealing and highly soothing taste profile.

Hydrocolloid Gel Networks in Confectionery Delivery Systems

The employment of honey in the formulation provides a plethora of benefits. It aids in retaining the moisture of the lozenge and thus prevents it from drying and turning into a solid product while being stored. Moreover, honey is known to possess certain natural characteristics which help with fighting infections and easing of the throat in the process, thus making it a wonderful ingredient in the combination with other formulation components (Yahtya et al. 2023). However, sustaining the ratios between gelatin and the liquid components involved in the combination can be extremely challenging. In case the proportion is incorrect, the finished product can either be a watery jelly (syneresis) or extremely hard to eat (Renaldi et al. 2022).

Methodology

The experiment had to be conducted in three stages allowing to maintain hygiene, ensure that a formulation can be produced, and get trustworthy feedback during the tests carried out by consumers as in Figure 1. This series of three stages consisted of the following operations: the collection of the plant raw materials, their heat processing, and sensory assessment of their properties. While that organized process seems ideal in theory, in reality, it can be tricky to get all the conditions the same every time the procedure is replicated, especially because of the complications arising from the use of natural plant extracts. However, while this method may not always be practical it provides tripartite structure for monitoring the properties of the ingredients up to the point of obtaining the gel.

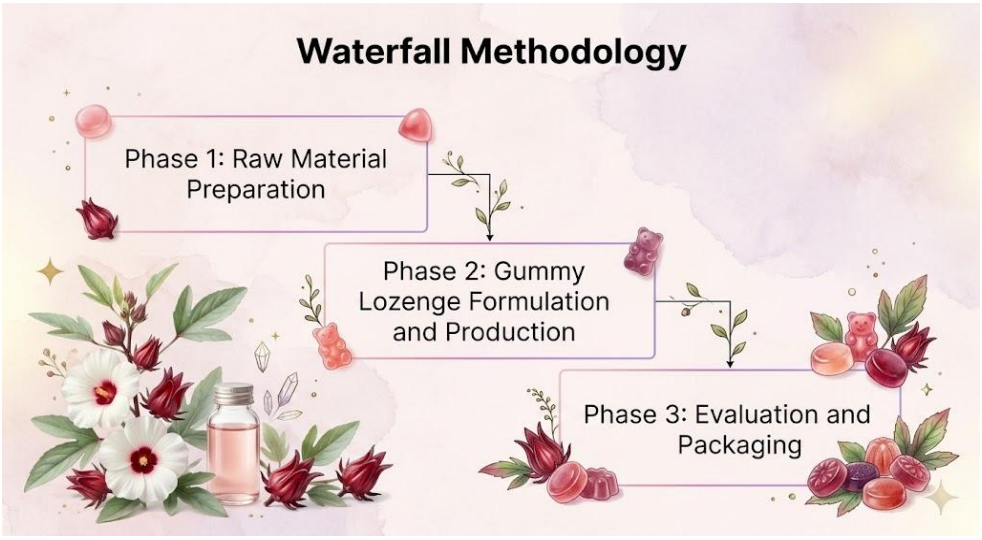


Figure 1: Waterfall Methodology Flowchart Representing the Three-Phase Development Process of ChewRasa Herba

Phase 1: Raw Material Preparation

For the preparation of the mixture, the process used the flower buds of high-quality Roselle and what is even more complex, the root of ginger. Both ingredients were rinsed and sorted

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before they were used in the process. Halal bovine gelatin as the main hydrocolloid was used in the formulation and deionized water as a solvent, whereas pure raw honey was used as the sweetening agent. The extraction method included boiling 50g of dried flower buds and 50g of fresh ginger in about 200mL of deionized water for 20 minutes. After boiling, the extracts were filtered with the help of a mesh strainer and paper filter. The heat was raised to 70°C and kept there for 15 minutes. This temperature is generally sufficient to melt the gelatin without damaging it.

Phase 2: Gummy Lozenge Formulation and Production

After ensuring that there were no lumps, the Roselle extract was added to the system. This was done in a very gentle way using a stirrer at a rate of 100 rpm since air might get into the mixture which will make the lozenges fallible. The final appearance of the lozenge is going to be cloudy due to air bubbles. After adding all the ingredients to the mixture, heating process was stopped and warm honey was added to the mixture.

The mixture was then poured into silicone molds and left at room temperature (around 25°C for about 30 minutes) until the gelatin was set. Afterwards, the molds were put into the refrigerator at a temperature of 4°C for 3 hours to achieve desirable hardness of the lozenges. After being set up in all respects, lozenges were removed from their molds. Since hydrocolloid gels tend to absorb moisture if left alone, the samples were immediately placed into air-tight containers. Every grouping of lozenges was labeled by ingredients and direction for storage (keep them in the cold 4°C). Some nutritional information was also provided.

Phase 3: Quality Evaluation and Packaging

To evaluate the final outcome of lozenges, the testing involved two steps: evaluating the physical properties of lozenges and conducting a consumer evaluation. In the consumer evaluation, 35 adult participants tried three different types of plant combinations. The plant combinations were Sample A (White Roselle and Ginger), Sample B (Red Roselle and Ginger), Sample C (Chrysanthemum and Ginger). After each type of lozenge, participants cleansed their palate with a cracker and water so that the different flavors would not interfere with one another's taste recollection.

Participants were instructed to rate lozenges on look, color, aroma, texture, sweetness, flavor, aftertaste, and acceptance rate using a standard 1-7 scale where 1 means “Disliked It Very Much” and 7 means “Liked It Very Much”. The data were processed with a One-Way ANOVA using p-value of 0.05.

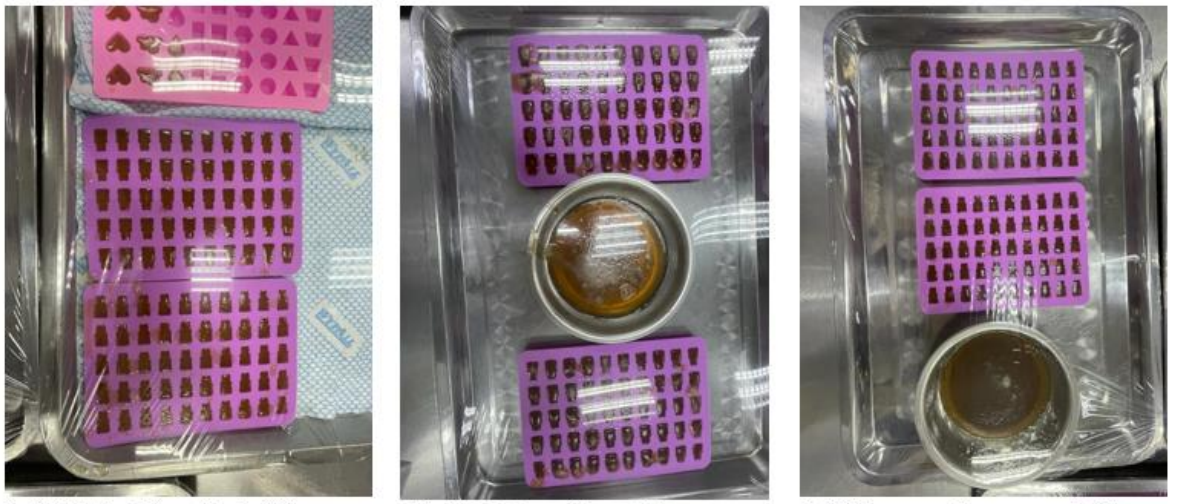
Results and Discussion

This study demonstrates that the underexplored White Roselle variety is a highly viable candidate for formulating structurally stable and sensory-acceptable herbal gummy lozenges. Both the physical testing and consumer sensory feedback confirm that this functional confectionery has strong commercial potential.

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All three botanical versions of ChewRasa Herba successfully formed stable, self-supporting gel structures that popped out of the silicone molds cleanly. Every sample was uniform in shape, smooth on the surface, and highly elastic, showing that the gelatin concentration and cooking steps were ideal. Crucially, the formulations had no issues with weeping, stickiness, or splitting. This stability indicates that heating the formula at 70°C for 15 minutes was ideal to hydrate the gelatin so it could reform into a strong, continuous network during cooling (Kaewpetch et al., 2024). Furthermore, adding honey and natural acids from the roselle calyces did not interfere with the gel's structure, demonstrating excellent ingredient compatibility.

There were minor differences in the color and transparency of the formulations. Sample A (White Roselle) had a subtle, see-through pale-pink tint, while Sample B (Red Roselle) displayed a vivid, deep ruby-red shade, and Sample C (Chrysanthemum) was a light, amber yellow. Rather than processing errors, these visual differences are due to natural botanical pigments, including monomeric anthocyanins in red roselle and carotenoids/flavonoids in chrysanthemum. Keeping these natural colors intact proves that the extraction and gentle, low-bubble mixing methods effectively shielded the pigments from heat damage, maintain the product's appealing, clean-label look intact (Roudbari et al., 2024).



(a) White Roselle + Ginger (b) Red Roselle + Ginger (c) Chrysanthemum+ Ginger

Figure 2: Visual Comparison of the Three Formulated Soothing Gummy Lozenges Under Evaluation

Sensory Acceptability and Statistical Organoleptic Profiling

The consumer panel thoroughly evaluated the sensory qualities of the three lozenge formulations, and their average scores are detailed in Table 1. Sensory profiling of the three herbal lozenges revealed consistently positive feedback, with average scores for all eight attributes ranging from 4.80 to 5.63 on a 7-point scale. According to a One-Way ANOVA, there were no statistically significant differences ($p>0.05$) among the formulations. Because of this highly scored, it is clear that our standardized gel base of gelatin, ginger, and honey provides a highly uniform taste and texture regardless of which botanical extract is used (Renaldi et al., 2022). Although the Red Roselle formulation (Sample B) received slightly higher average scores for color (5.63±0.69) and overall acceptability (5.43±0.70), ANOVA confirmed these

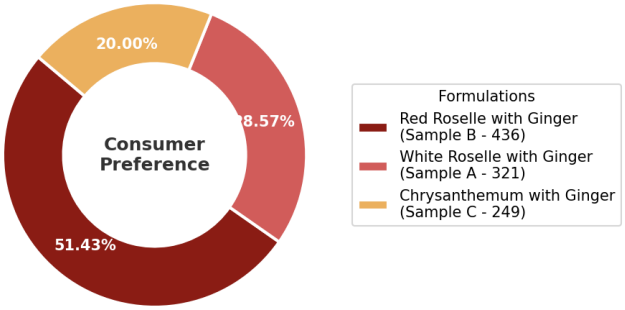
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differences were not statistically meaningful. All formulations shared the same superscript ([a]) and yielded p-values between 0.345 and 0.913, demonstrating that ginger paired with white roselle, red roselle, or chrysanthemum is equally appealing to consumers.

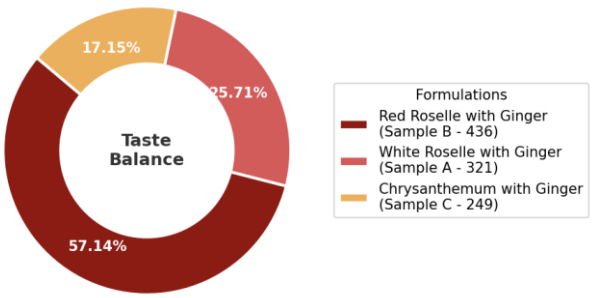
Table 1: Overall Sensory Properties of Soothing Lozenges

Sensory Attribute	Sample A (White Roselle + Ginger)	Sample B (Red Roselle + Ginger)	Sample C (Chrysanthemum + Ginger)	p-value
Appearance	5.23 ± 0.81[a]	5.46 ± 0.72[a]	5.11 ± 0.90[a]	0.621
Color	5.14 ± 0.88[a]	5.63 ± 0.69[a]	5.09 ± 0.94[a]	0.345
Aroma	5.06 ± 0.91[a]	5.20 ± 0.85[a]	5.11 ± 0.83[a]	0.892
Texture	5.29 ± 0.77[a]	5.37 ± 0.73[a]	5.23 ± 0.80[a]	0.784
Sweetness	4.97 ± 0.95[a]	5.11 ± 0.88[a]	5.00 ± 0.91[a]	0.913
Taste	5.09 ± 0.86[a]	5.31 ± 0.78[a]	4.94 ± 0.87[a]	0.552
Aftertaste	4.86 ± 1.01[a]	5.03 ± 0.94[a]	4.80 ± 0.98[a]	0.614
Overall Acceptability	5.17 ± 0.79[a]	5.43 ± 0.70[a]	5.03 ± 0.82[a]	0.489

Note: Data values are expressed as mean ± standard deviation of 35 replicates (n=35). Values with identical superscript letters ([a]) within a row are not significantly different at p > 0.05 according to One-Way ANOVA.



(a)



(b)

Figure 3: Pie Charts Displaying (a) Consumer Preference and (b) Taste Balance Assessment (n=35)

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Even though the ANOVA showed no statistically significant differences, analyzing the percentage of consumer choices revealed clear trends. As shown in the preference distribution in Figure 3(a), over half of the respondents (51.43%) preferred the Red Roselle with Ginger lozenge (Sample B/436). This was followed by Sample 321 (White Roselle with Ginger, Sample A) at 28.57%, and Sample 249 (Chrysanthemum with Ginger, Sample C) at 20.00%. Similarly, Figure 3 (b) shows that Sample 436 was identified as the most flavor-balanced formulation by 57.14% of the panel, with Sample A at 25.71% and Sample C at 17.15%. The slightly higher preference and balance rating for the Red Roselle variant can be explained by its higher acidity and stronger naturally occurring pigment density, which enhances the visual expectation of flavor intensity and sweetness (Kaewpetch et al., 2024). Regardless, Sample A (White Roselle with Ginger) performed exceptionally well with consumers, achieving a high overall liking score of 5.17 ± 0.79. These findings show that White Roselle is a highly practical and market-friendly ingredient for functional sweets.

Conclusion

To summarize, the study managed to produce and evaluate herbal lozenges containing White Roselle and Ginger extracts known as ChewRasa Herba. The gummies performed well in terms of being stable and aesthetic gummies, showing no liquid seepage or stickiness. In terms of flavor, the Red Roselle sample came out as the most liked one. However, the White Roselle lozenge was appealing in terms of taste and appearance. Overall, it can be concluded that White Roselle can be included in functional food products with ease. For future development, we have some alternative ideas to improve the product such as using high-quality low-sugar sweeteners. As for the strong's stability in hot weather, we could try to combine different stabilizing agents like gelatin and carrageenan or pectin. More tasting test on larger sample is also known to be useful if done after some time.

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Ethics Statement: The study adhered to rigorous ethical principles as all human subject trials were sanctioned by the STEM Foundation Centre Research Committee. We secured informed consent from the subjects before conducting the tests so that their participation was voluntary and anonymous. The data collected through surveys was purposed only for academic research.

Author Contribution Statement: All authors have a vital role in contributing to the completion of this manuscript. Nur Syahida Abdul Rahim has played a key role in supervising the study by designing the study and coordinating resources. Aisyah Humaira Zainui'ariffin performed formulation development, extraction of raw materials and writing the methodology section. Auni Nurdini Mohd Zulkifli did sensory panel operation, data collection and data analysis. Nur Adlin Abd Wahab conducted literature review, analyzed the structural-mechanical properties of the lozenge and drafted the results. Nina Marlini Ahmad has suggested the edits and given the final approval for publication of the manuscript. All authors have reviewed and approved the final version of the manuscript.

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