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ZingSweet: Herbal Drink Based on Ginger (*Zingiber officinale Roscoe*) and Licorice Root (*Glycyrrhiza glabra L.*) as an Anti-Inflammatory Agent and Throat Health Support

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Abstract

Background: Synthetic drugs are often used to treat upper respiratory tract inflammation, including throat irritation, but they can cause side effects. Because they are more practical and safer, herbal plants are increasingly in demand. Ginger (*Zingiber officinale Roscoe*) contains shogaol and gingerol, which act as anti-inflammatories, antioxidants, and immunomodulators. Licorice root (*Glycyrrhiza glabra L.*) contains high levels of glycyrrhizin, which acts as an antimicrobial, expectorant, and throat mucosa protector. **Objective:** This study aims to evaluate the potential of combining ginger and licorice root in ZingSweet products as functional herbal drinks. **Methods:** This study used laboratory tests. Phytochemical screening tests were conducted using qualitative methods, in vitro anti-inflammatory tests using the red blood cell (RBC) membrane stabilization method, and organoleptic tests. **Results:** ZingSweet extract screening tests were positive for alkaloids, flavonoids, saponins, triterpenoids, and quinones, which act as anti-inflammatory and antioxidant agents. Anti-inflammatory testing showed very high membrane stabilization (99.22–99.34%) at concentrations of 5–80 ppm, close to the positive control (98.83%) and far above the negative control (0%). Organoleptic testing also showed that ZingSweet was preferred by panelists in terms of taste, color, and aroma. **Conclusion:** The combination of gingerol and glycyrrhizin in ZingSweet demonstrates strong anti-inflammatory effects, supports throat health, and is well-received organoleptically. With its instant sachet formulation, this product has the potential to be developed as a practical and safe functional herbal beverage.
Keywords: ginger, licorice root, anti-inflammatory, herbal drink, ZingSweet

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INTRODUCTION

Indonesia, located at the center of a megabiodiversity region, offers a botanical treasure trove with more than 30,000 plant species, some of which have unexplored therapeutic potential. Unfortunately, only a handful have been incorporated into the health industry. This situation allows for innovations that transform natural resources into health solutions, such as the creation of herbal medicines for upper respiratory tract inflammation, including throat irritation, based on local wisdom and scientific research. (1) One of the major health problems worldwide remains upper respiratory tract infections such as coughs, pharyngitis, and throat irritation. This condition reduces the quality of life and productivity of the community. The 2019 Global Burden of Disease (GBD) report shows that upper respiratory tract diseases are the most common cause of morbidity in various age groups. (2)

Respiratory tract infections are usually treated with synthetic drugs, such as antibiotics and nonsteroidal anti-inflammatory drugs (NSAIDs). Long-term use of these drugs often causes side effects, including hepatotoxicity, gastrointestinal disorders, and the risk of antibiotic resistance. (3) Due to these limitations, the use of herbal therapy is increasing. Herbal medicines are considered safer than conventional medicines because they contain bioactive compounds with very high pharmacological activity and a lower toxicity profile. (4)

One of the most widely used herbs is ginger (*Zingiber officinale Roscoe*). Its bioactive compounds, such as gingerol and shogaol, are known to have anti-inflammatory, antioxidant, and immunomodulatory effects. Its mechanism of action involves inhibiting the production of proinflammatory cytokines (e.g., TNF-α and IL-6) and modulating the NF-κB signaling pathway. (5) Licorice (*Glycyrrhiza glabra L.)* contains the main compound glycyrrhizin, which has antimicrobial, expectorant, and respiratory tract mucosal protective activities. Recent pharmacological studies reveal that glycyrrhizin is able to suppress inflammatory mediators through a mechanism similar to natural corticosteroids. In addition,

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glycyrrhizin also plays a role in enhancing the immune response, thus having significant therapeutic potential in the management of respiratory tract diseases. (6)

The combination of ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) is believed to have a synergistic effect in suppressing the inflammatory process and supporting throat health. Based on research on phytochemical interactions, the use of a combination of several medicinal plants tends to produce more potent pharmacological activity than single use, due to complementary interactions between bioactive compounds. (7)

Along with the increasing trend of healthy lifestyles, the development of herbal products in the form of functional beverages is increasingly in demand. Products in the form of instant sachets are appreciated for their practicality, hygiene, and ease of acceptance by modern consumers. Consumer survey results show a higher preference for instant herbal drinks compared to traditional herbs, based on ease of use and consistency of taste. (8)

This study aims to evaluate the potential of combining ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) in the formulation of the instant herbal drink ZingSweet. The research focuses on phytochemical screening, anti-inflammatory testing using the erythrocyte membrane stabilization method, and organoleptic testing. This study is expected to contribute scientifically and present practical, safe, and beneficial innovations in functional herbal drinks for respiratory health. (9)

METHOD

This study used a laboratory descriptive design to evaluate the potential of ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) in the ZingSweet instant herbal drink formulation as an anti-inflammatory agent and throat health supplement. The research materials consisted of dried ginger rhizome and licorice root powder, which were formulated into instant powder with the addition of natural carriers to make them easily soluble in water.

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Qualitative phytochemical screening was conducted to identify secondary metabolites in ZingSweet combination powder, including tests for alkaloids, flavonoids, saponins, phenols, tannins, triterpenoids, and quinones using standard reagents, with interpretation of results based on color changes and precipitate formation.

In vitro anti-inflammatory testing was conducted using the red blood cell membrane stabilization assay. Human red blood cell suspensions were obtained from fresh blood, then mixed with ZingSweet solution at concentrations of 5–80 ppm, incubated, and centrifuged. The absorbance of the supernatant was measured using a UV-Vis spectrophotometer at a wavelength of 560 nm. The percentage of membrane stabilization was calculated by comparing the absorbance of the sample to the positive control (sodium diclofenac) and negative control (phosphate buffer). Erythrocyte membrane stability can be calculated using the following formula:

$$= 100 - [\frac{Abs\ test\ solution - Abs\ test\ control\ solution}{Abs\ negative\ test\ control}] \times 100\%$$

Organoleptic testing was conducted to assess consumer acceptance of ZingSweet products. Twenty-five partially trained panelists assessed color, aroma, and taste using a five-point hedonic scale, where a score of 1 indicated strong dislike and a score of 5 indicated strong liking. The organoleptic data were tabulated in the form of score distributions and interpreted descriptively to illustrate the panelists' level of acceptance of the product's sensory quality.

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RESULTS

1. Phytochemical Screening Test

Phytochemical testing was conducted to determine the secondary metabolite content in the combination of ginger and licorice root. The qualitative results of the phytochemical test are presented in Table 1.

Table 1. Phytochemical Screening Results of ZingSweet

No	Test Parameter	Result	Observed Change
1.	Alkaloid (Mayer)	+/Positive	A creamy white/yellow precipitate
2.	Alkaloid (Wagner)	+/Positive	A brown/reddish precipitate
3.	Alkaloid (Dragendorff)	+/Positive	A reddish-brown precipitate
4.	Flavonoid	+/Positive	An orange color
5.	Tannin	-/Negative	Blue - green color
6.	Triterpenoid	+/Positive	Golden yellow layer (at the bottom)
7.	Quinone	+/Positive	A green color
8.	Phenolic	-/Negative	Dark green/bluish black color
9.	Saponin	+/Positive	Persistent foam for 10 min

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The phytochemical screening results in Table 1 show that the combination sample of ginger and licorice root contains alkaloids, flavonoids, saponins, triterpenoids, and quinones.

2. In Vitro Anti-Inflammatory Test of Ginger and Licorice Root Combination

In this study, the samples used were instant powder combinations of ginger rhizome (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*), which were formulated into instant herbal drinks (ZingSweet). The powder was dissolved in water at concentrations of 5, 10, 20, 40, and 80 ppm, then tested using the red blood cell membrane stabilization assay to assess anti-inflammatory activity. Based on measurements using a UV-Vis spectrophotometer and data processing using a predetermined formula, the results of erythrocyte membrane stabilization percentages at each concentration were obtained.

Table 2. In-Vitro Anti-Inflammatory Test Results of ZingSweet

No	Sample Concentration (ppm)	Means Absorbance	% Stability
1.	5 ppm	0,0324	99,34 %
2.	10 ppm	0,0376	99,27 %
3.	20 ppm	0,0398	99,30 %
4.	40 ppm	0,0489	99,34 %
5.	80 ppm	0,0762	99,22 %
6.	C (+)	0,0399	98,83 %
7.	C (-)	0,0000	00,00%

Based on Table 2, the results of anti-inflammatory activity testing using the red blood cell membrane stabilization method show that the combination of ginger and licorice root at concentrations ranging from 5 to 80 ppm has very high anti-inflammatory activity. The percentage of stability at a concentration of 5 ppm was 99.34%, 10 ppm 99.27%, 20 ppm 99.30%, 40 ppm 99.34%, and 80 ppm 99.22%. All concentrations provided nearly equivalent membrane stabilization

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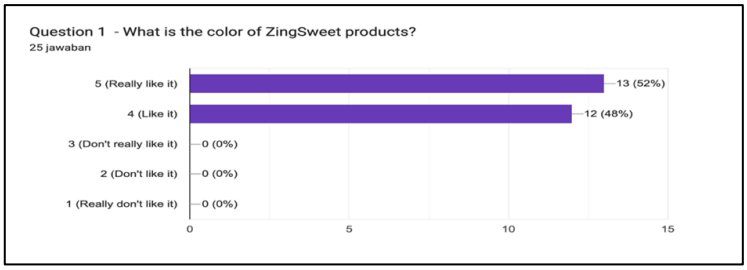
effects, with the best activity at concentrations of 5 ppm and 40 ppm, both reaching 99.34%, even higher than the positive control of sodium diclofenac at 98.83%.

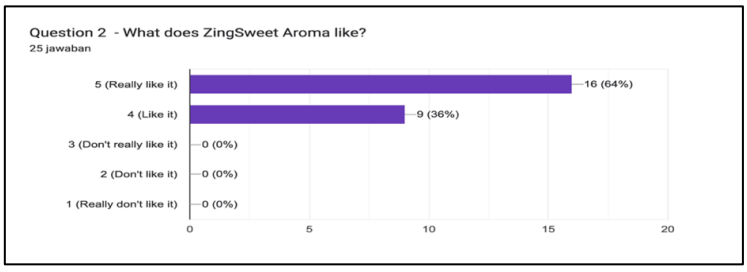
3. ZingSweet Organoleptic Test

Figures 1–3 show the results of organoleptic tests that evaluated consumer acceptance of ZingSweet products. Twenty-five partially trained panelists assessed color, aroma, and taste using a five-point hedonic scale (1 = strongly dislike, 5 = strongly like). The data were summarized in a score distribution and analyzed descriptively to illustrate the panelists' level of preference for each sensory attribute.

Picture 1. Organoleptic Color Test Result of ZingSweet



Picture 2. Organoleptic Aroma Test Result of ZingSweet



Picture 3. Organoleptic Taste Test Result of ZingSweet

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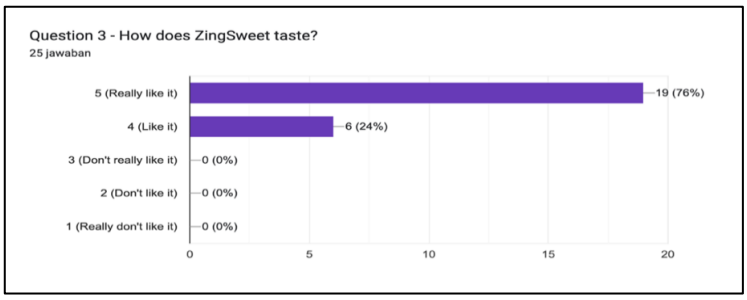

DISCUSSION

1. Phytochemical Screening Test of ZingSweet

Combined phytochemical screening test of ginger and licorice root showed positive results for flavonoids, saponins, triterpenoids, quinones, and alkaloids (using Mayer's, Wagner's, and Dragendorff's reagents). Conversely negative results were obtained for phenolic compounds and tannins.

a. **Flavonoids:** Screening of flavonoids from ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) identified compounds with anti-inflammatory activity through suppression of the NF-κB, COX-2, and proinflammatory cytokine pathways (Egorova et al., 2022; Wahab et al., 2021). The presence of flavonoids was confirmed by Mg-HCl and H_2SO_4 reactions, which produced characteristic color changes (Nurjannah et al., 2022; Sabdoningrum et al., 2021), thereby supporting bioactive fractionation and extract standardization.

b. **Saponins:** The foam test is used to detect the presence of saponins. The formation of stable foam for more than ten minutes after the extract is shaken in water and heated indicates the natural surfactant properties of saponins as complex glycosides capable of reducing surface tension (Humbare et al., 2022; Nurjannah et al., 2022).

c. **Triterpenoids:** Triterpenoid testing shows anti-inflammatory potential because compounds such as oleanolic acid and ursolic acid are able to suppress COX-2, iNOS, and proinflammatory cytokines through NF-κB and

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MAPK modulation (Mantiniotou et al., 2025; Miranda et al., 2022). The presence of triterpenoids was confirmed using the Salkowski test with a golden yellow layer (Sabdoningrum et al., 2021).

d. **Quinones:** Compounds such as plumbagin, lawsone, and thymoquinone exert anti-inflammatory effects by inhibiting NF-κB, suppressing COX-2/iNOS, and reducing proinflammatory cytokines. Detection of these compounds in combinations of ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) supports bioactive fractionation and standardization of extracts for anti-inflammatory activity (Adam et al., 2022; Sattar et al., 2023; Wang et al., 2016).

e. **Alkaloids:** Alkaloid testing with Mayer, Wagner, and Dragendorff reagents produces characteristic precipitates that confirm the presence of alkaloids (Putri & Lubis, n.d.). This compound contributes to anti-inflammatory activity by inhibiting NF-κB, COX-2, iNOS, and reducing TNF-α and IL-6, thereby supporting the bioactive fractionation and standardization of combined extracts of ginger (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) (Li et al., 2020; Wang et al., 2016).

2. In Vitro Anti-Inflammatory Test of Ginger and Licorice Root Combination

The results of erythrocyte membrane stabilization tests show that a combination of ginger extract (*Zingiber officinale Roscoe*) and licorice root (*Glycyrrhiza glabra L.*) at concentrations of 5–80 ppm provides very high anti-inflammatory activity, with stabilization percentages ranging from 99.22% to 99.34%. The optimal effect at concentrations of 5 ppm and 40 ppm, which reached 99.34%, even exceeded the positive control of sodium diclofenac (98.83%), indicating the synergistic potential of the two extracts in protecting erythrocyte membranes from damage caused by oxidative stress and inflammation.

The effectiveness of erythrocyte membrane stabilization is an important indicator of anti-inflammatory activity because these membranes are like lysosomal

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membranes, which, if damaged, can trigger the release of hydrolytic enzymes that cause tissue inflammation. Agents that stabilize erythrocyte membranes are believed to prevent the release of inflammatory mediators, thereby reducing tissue damage. Therefore, these data not only demonstrate protection at the cellular level but are also pathophysiologically relevant in the inflammatory process.

From a mechanism perspective, ginger contains phenolic compounds such as gingerol, shogaol, and paradol, which have been shown to inhibit inflammatory pathways through suppression of NF-κB and Akt activation and reduction of proinflammatory cytokine expression (TNF-α, IL-1β, IL-6) and inflammatory enzymes COX-2 and iNOS. Meanwhile, glycyrrhizin in licorice root has anti-inflammatory effects like corticosteroids through the suppression of inflammatory mediators and NF-κB activity, as well as providing protection to the respiratory tract mucosa.

The combination of these two extracts produces a synergistic effect, whereby gingerol targets the NF-κB/Akt pathway while glycyrrhizin also suppresses TLR4 and NF-κB, strengthening the membrane stabilization mechanism and suppressing inflammation more significantly than either extract alone. Interestingly, optimal effectiveness is achieved at low concentrations (5 ppm), which is likely due to receptor saturation or competition between active compounds at higher concentrations, meaning that excessive doses can reduce effectiveness.

Overall, the results of this study provide strong evidence that the ZingSweet formulation with a combination of ginger and licorice root can provide significant anti-inflammatory activity through the mechanism of erythrocyte membrane stabilization. Its effectiveness, which exceeds that of sodium diclofenac as a positive control, indicates the potential of ZingSweet as a safe and effective natural anti-inflammatory agent, making it highly relevant for development as a functional herbal beverage for the management of inflammation, particularly in the upper respiratory tract.

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3. Organoleptic Test of ZingSweet

Organoleptic test results show that ZingSweet received very high acceptance from panelists in terms of color, aroma, and taste. A total of 52% of panelists gave a score of 5 (love it) and 48% gave a score of 4 (like it) for the product's color, confirming that the visual appearance of ZingSweet is attractive and consistent, where visual aspects play an important role in increasing consumer preference for herbal drinks (Gai et al., 2023). In terms of aroma, 64% of panelists chose a score of 5 and 36% chose a score of 4, indicating a distinctive aroma of ginger and licorice that provides a soothing and refreshing sensation.

This finding is consistent with reports that the aroma of traditional spices plays a strong role in triggering sensory preferences because it is associated with memories and experiences of consuming herbal medicines or local herbal drinks (Estiasih et al., 2025). The taste assessment showed the most dominant results, with 76% of panelists liking it very much and 24% liking it, with no negative responses. The combination of spicy-warm ginger and mildly sweet licorice root produced a widely accepted harmony of flavors, as found in herbal tea studies showing that a balance of sweetness and spice aroma influences panelist acceptance (Novita et al., 2023; Sabdoningrum et al., 2021).

Overall, these results support the hypothesis that ZingSweet is not only effective as an anti-inflammatory agent but also has sensory qualities that are preferred by consumers. High hedonic scores across all parameters indicate the formulation's success in overcoming a common challenge for herbal products, which typically have a bitter taste or pungent aroma (Putri & Lubis, n.d.). With this potential, ZingSweet deserves to be developed as a modern functional herbal drink that is practical, effective, and globally accepted, while also supporting the competitiveness of Indonesian herbal drinks in the international market.

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CONCLUSION(S)

Based on the results of research on the ZingSweet formulation (a combination of ginger and licorice extract), several conclusions can be drawn as follows:

1. Phytochemical screening identified flavonoids, saponins, triterpenoids, quinones, and alkaloids as the main bioactive compounds in ZingSweet, while phenols and tannins were not detected.
2. The ZingSweet formulation (ginger and licorice root extract) demonstrated potent anti-inflammatory activity through erythrocyte membrane stabilization, with a stabilization percentage of 99.22–99.34% that exceeded the positive control of sodium diclofenac.
3. The synergy of active compounds in ginger (gingerol, shogaol) and licorice root (glycyrrhizin) strengthens anti-inflammatory pathways (NF-κB, COX-2, iNOS, TLR4), supporting the potential of ZingSweet as a safe and effective functional herbal drink to help heal inflammation, especially in the upper respiratory tract.

SUGGESTIONS

1. For further research, it is recommended that a quantitative analysis of the main bioactive compounds in ZingSweet be conducted. In addition, additional phytochemical screening parameters such as steroids, organic acids, vitamin C, and terpenoids should be included to expand the characterization of phytochemical content.
2. To ensure the safety and effectiveness of ZingSweet in more complex biological systems, anti-inflammatory testing should be expanded to include in vivo methods and clinical trials.
3. Given the synergistic potential of the active compounds in ZingSweet, further research could lead to the investigation of other pharmacological activities such as

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antioxidants and immunomodulators. This approach would support the development of ZingSweet as a safe and effective multifunctional herbal beverage.

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