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Kiwi Fizz: Developing Naturally Carbonated Fruit Soda with Ginger Bug

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Abstract- The increasing consumer demand for healthier and naturally fermented beverages has driven the development of innovative alternatives to conventional carbonated soft drinks. This study centers on the creation of "Kiwi Fizz," a naturally carbonated fruit soda produced using a ginger bug—a symbiotic culture of beneficial bacteria and wild yeasts—as the natural fermenting agent. Kiwi fruit (Actinidia deliciosa), selected for its exceptional nutritional value and distinctive flavor, served as the primary ingredient. The fermentation process was carefully controlled and monitored to ensure optimal carbonation, maintain an appropriate pH balance, and enhance the sensory characteristics of the final product while ensuring microbial safety. Critical parameters such as sugar concentration, fermentation time, and temperature were standardized to achieve a consistent level of natural effervescence without the use of artificial carbonation or preservatives. A sensory evaluation was conducted to assess consumer acceptability based on taste, aroma, appearance, and mouthfeel. The results indicated that the final product was a refreshing, lightly carbonated beverage with a pleasant kiwi flavor profile and smooth texture. Additionally, the use of ginger bug fermentation introduced potential probiotic benefits, supporting digestive health. The study demonstrates that naturally fermented fruit sodas like Kiwi Fizz can serve as a functional and clean-label alternative to commercially available soft drinks. It highlights the feasibility of producing health-oriented beverages using traditional fermentation methods and minimal additives, thus catering to the growing consumer preference for natural, wholesome, and sustainable food and beverage options.

Indexed Terms- Fruit Soda, Ginger Bug, Gut Health, Kiwi, Naturally Carbonated, Probiotic Drink.

I. INTRODUCTION

The growing interest in healthy, natural, and functional beverages has led to significant innovation in the food and beverage industry. Consumers are increasingly seeking alternatives to artificially sweetened soft drinks, turning instead to naturally fermented products that offer not only refreshment but also potential health benefits (Singh et al., 2022). Among these emerging products, naturally carbonated fruit sodas have garnered notable attention due to their probiotic properties, clean-label ingredients, and artisanal appeal (Li & Wang, 2023). This study focuses on the development and evaluation of "Kiwi Fizz," a naturally fermented, carbonated fruit beverage created using a ginger bug starter culture.Fermentation is one of the oldest food processing techniques known to humankind, traditionally employed for preserving food, enhancing flavor, improving digestibility, and augmenting nutritional value (Zhao et al., 2021). In beverage production, fermentation not only acts as a natural preservative mechanism but also introduces carbonation and complex flavors through microbial activity. Naturally fermented sodas utilize wild yeasts and lactic acid bacteria to produce a gentle effervescence and a slightly tangy taste, distinguishing them from industrially carbonated, sugar-laden soft drinks (Mendez-Albores & Lopez-Malo, 2022). The use of a ginger bug — a symbiotic culture of wild yeast and bacteria cultivated from fresh ginger, sugar, and water — offers an accessible, chemical-free method of achieving natural carbonation (Kumar & Meena, 2023).However, the process of natural carbonation requires careful control. Over-fermentation can lead to the buildup of excessive carbon dioxide, increasing the internal pressure of sealed bottles and posing a risk of explosion (Chen et al., 2023). It is important to monitor fermentation time, temperature, sugar levels, and microbial activity to ensure safety and product consistency. Proper sanitation practices are also crucial to prevent contamination with undesirable microorganisms, which could spoil the beverage or introduce off-flavors (Patel & Sharma, 2024).The objective of this study Is to formulate and evaluate Kiwi Fizz as a naturally fermented, non-dairy probiotic beverage. The study focuses on the preparation of ginger bug, optimization of fermentation conditions, monitoring of microbial activity, pH, and carbonation levels, and the sensory and physicochemical properties of the final product. By combining the nutritional richness of kiwi with the microbial benefits of natural fermentation, this project aims to offer a sustainable and health-promoting alternative to conventional soft drinks.

II. MATERIALS AND METHODS

Raw materials: Some of the raw materials required for development of kiwi soda are Ginger, Brown sugar, Kiwi, Water, Lemon. The procurement of raw materials like Ginger, Kiwi ,Lemon and Brown sugar is from nearby local market of Anantapuramu .

Preparation Of Ginger Bug:
A ginger bug is a naturally fermented mixture of ginger, sugar, and water used to ferment homemade sodas, particularly ginger Bug . Grate about 2 tablespoons of fresh ginger. You can leave the peel on, as it contains natural yeasts that will help with fermentation.In your clean jar, add the grated ginger and sugar. Pour in about 2 cups of room temperature filtered water. Stir until the sugar dissolves completely. Cover the jar with a cloth or a loose lid (to allow airflow while keeping dust out). Leave it at room temperature for 2-3 days. Every 24 hours, add 1 tablespoon of grated ginger and 1 tablespoon of sugar to the jar, stirring well. This “feeding” helps the fermentation process. You’ll notice bubbles start forming, which means the fermentation is happening. After 5-7 days, your ginger bug should be ready for use when it’s bubbly and has a slightly tangy taste. You can use it to ferment drinks.

Preparation of Kiwi Juice:
Choose ripe and firm kiwifruits with no signs of spoilage. Wash the kiwi fruits thoroughly to remove any dirt or pesticides. Remove the fuzzy skin from the kiwifruit using a peeler or knife. Cut the kiwifruit into slices or pieces and blend it by adding water lemon juice. After blending extraction of juice is done.

Mixing of ginger bug and kiwi juice:
Kiwi soda is prepared by mixing ginger bug with kiwi juice and a teaspoon of brown sugar is added for the fermentation. Mix the ginger bug and kiwi juice in tightly sealed glass bottle and keep it for fermentation for 2days at room temperature. Once you observe bubbles it means carbonation is generated and place the bottle in refrigerator and serve it cool.

Flow Chart of Kiwi Soda:

Procurement of raw material (kiwi, ginger, brown sugar etc.)
↓
Preparation of ginger bug by mixing fresh ginger, brown sugar and water
↓
Undergoes fermentation for 4-5days.
↓
Peeling, bleeding and extraction of kiwi juice.
↓
Mixing of ginger bug and kiwi juice
↓
Packaged in a sterilized glass bottle
↓
Again, undergoes fermentation for 2 days
↓
Development of carbonation and storage.

Formulations:

Table:1 formulation

INGREDIENTS	Variation 1	Variation 2	Variation 3
Kiwi	100g	110g	125g
Brown Sugar	50g	55g	60g
Water	500ml	500ml	500ml
Ginger Bug	15ml	18ml	20ml

Lemon Juice	7ml	10ml	12ml

III. METHODS

Determination of pH: Calibrate the pH meter using pH 7.0 and pH 4.0 buffer solutions then rinse the electrode with distilled water and blot dry, now immerse the electrode in the soda sample and wait for the reading to stabilize and record the ph.

Determination of Titratable Acidity: Pipette 10 mL of the sample into a conical flask and add ~50 mL distilled water sequentially adds 2–3 drops of phenolphthalein indicator and titrate with 0.1 N NaOH until a faint pink colour persists for 30Seconds note the titre value.

$$\text{Formula: Acidity} = \frac{\text{Titrate value} \times \text{equivalent weight of NaOH} \times \text{normality of NaOH}}{\text{weight of the sample}}$$

Determination of Total Soluble Solids (Brix): Calibrate the refractometer using distilled water (should read 0 °Brix), then mix the soda sample thoroughly place 1-2 drops of the sample on the refractometer prism and close the cover and wait for a stable reading read and record the value as °Brix.

Formula:
TSS (%) = Brix reading × conversion factor

Total Plate Count (TPC): The TPC of the soda was calculated using the pour plate technique and Plate Count Agar. One millilitre of the adequately diluted material was added to sterile Petri dishes, followed by molten agar. Plates were incubated at 35 ± 2°C for 48 h. Following incubation, all visible colonies were enumerated and reported as cfu/mL to determine the overall microbial load in the product.

Yeast and Mold Count: Yeast and Mold were counted on Potato Dextrose Agar (PDA) that was acidified to pH 3.5 using tartaric acid. Dilution sample one millilitre was plated by applying the pour plate technique and incubated at 25 ± 2°C for 120 hours. During incubation, yeasts in the form of wet creamy colonies and Molds as dry filamentous colonies, result being stated as cfu/ml.

Carbonation: It is perform to check the amount of carbon dioxide produced during natural fermentation. It is done by pressure measurement method. It measures pressure buildup due to CO_2 inside the sealed bottle.

Sensory Analysis: the sensory analysis is done according to hedonic scale rating (table 2). The formulations are exposed to sensory analysis along with control. Different panelist gave the rating for sensory attributes like color, flavor, taste, appearance, taste and overall acceptability. The mean score is the overall acceptability.

Table: 2 Hedonic Scale

OPINION	RATING
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

IV. RESULTS AND DISCUSSION

Sensory Analysis: According to sensory analysis the variation 3 that is 125g of kiwi,60g of Brown Sugar, 500ml of water, 20ml of ginger bug and 12ml of lemon juice is the best among the 3 as it has highest rating due it is better in taste, appearance and texture. The overall acceptability for the variation 1 is 8, variation 2 is 8,variation 3 is 9.

Table:3 Sensory analysis

Sensorial Attributes	Control	Variation 1	Variation 2	Variation 3
Color	9	8	8	9

Taste	9	8	8	9
Appearance	9	8	9	9
Flavour	9	8.5	8	9
Texture	9	8	8	9
Overall Acceptability	9	8	8	9

Physico Chemical Analysis

The table 4 reflects the physicochemical properties of the end drink against standard ranges. The end sample Measures 8.2°Brix, 0.55% acidity, 2.5pH, all of which are within standards. This Improves mouthfeel as well as customer acceptability through having flow able texture suitable for packaging as well as consumption. Overall, physicochemical testing was done so that the designed Soda retains such important quality attributes as functional fruit-based beverages should. All the Parameters are consumer acceptable values, and therefore it is found to be consumer acceptable as well as Display shelf stability. These measures reflect a balanced composition with even consistency and flavour.

Table:4 Physicochemical Analysis

PARAMETERS	Control	Optimised Variation
Ph	3.5	2.5
Acidity(%)	0.30	0.55
TSS(°Brix)	10.5	8.2
Total plate count(CFU/ML)	1.2×10^3	<10 CFU/mL
Yeast and mold count(CFU/ML)	2.8×10^2	<10 CFU/mL

Comparison of kiwi Soda with commercial Soda

The table 5 compares Kiwi Soda with Commercial Soda. Kiwi Soda is naturally carbonated and does not contain any added preservatives. It has a natural fruit flavor but a shorter shelf life. In contrast, Commercial Soda is carbonated by the injection of carbon dioxide and contains chemical preservatives along with artificial flavorings, giving it a longer shelf life.

Table:5 Comparison of Kiwi soda with commercial soda

Kiwi Soda	Commercial Soda
Naturally carbonated	Injection of carbon dioxide
No added preservatives	Contains chemical preservatives
Natural fruit flavour	Artificial flavorings
Shorter Shelf life	Longer Shelf life

CONCLUSION

By the above results it may conclude that the soda is naturally carbonated without any chemical preservatives hence it is acceptable. The Kiwi soda is the blend of Ginger bug and kiwi juice is an innovative product that meets the modern consumer's needs for health, convenience, and taste. A convenience beverage product gives benefit good gut health and can be served a ready to drink beverage product.The product can be stored in refrigerator upto 2 weeks.It successfully combines traditional culinary appeal with enhanced nutritional value, creating a balanced, functional beverage solution.

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