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Characterization and Formulation of Butterfly Pea Flower Drinks (*Clitoria ternatea* L.) Fermented by Pineapple Peel based on Organoleptic Attributes and Gen-Z Acceptance

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Abstract

Background: *Butterfly pea flowers (BPF) Clitoria ternatea were known as an antioxidant-rich functional drink ingredient at approximately 6.58 ppm. Various kinds of BPF drinks formulations had been consumed by the public, especially the older generation, due to their benefits. Meanwhile, the younger generation (Generation Z) was not familiar with these drinks and tended to enjoy soft drinks with sweet and fizzy flavors. This study formulated BPF with fermented pineapple peel (FPP) as an alternative to soft drinks.* **Methodology:** *Based on the SNI 01-2346-2006 standard, a total of 34 untrained Generation Z panelists were used to test organoleptic attributes (color, flavor, aroma, and sensation) using the Check-All-That-Apply approach and the hedonic test 5-point scale approach for panelist acceptability. Five formulations were used: BPF without sugar (A), with 10% sugar (B), (FPP + 10% sugar) (C), (BPF + FPP + 10% sugar) (D), and (BPF + FPP + 20% sugar) (E).* **Results:** *Based on Kruskal-Wallis with the Mann-Whitney further test for all organoleptic attributes, there were significant differences; the preferred color was formulation A, the aroma acceptability was neutral for all formulations, the preferred flavor was formulation E with a strong sweet and sour flavor, and for the sensation, formulation A was not preferred. The overall rating assessment showed that formulation E had the highest score due to strong sweet-sour flavor. Formulation E became the favorite drink of the panelist. This formulation could be a consideration for functional BPF drink innovation, which is the novelty of this study as an alternative to soft drinks with the Generation Z market share.*
Contribution: *This study contributes scientifically by demonstrating that the combination of antioxidant-rich butterfly pea flower and fermented pineapple peel can be formulated into a functional drink with sensory attributes acceptable to Generation Z, thus bridging traditional herbal drinks with modern consumer preferences.*

Keywords: *Clitoria ternatea; Drinks formulations; Fermentation; Generation Z; Pineapple peel*

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INTRODUCTION

Butterfly pea flower (*Clitoria ternatea* L.) is an herb that has rich benefits including antioxidants, antimicrobials, anticancer and so on (Marpaung, 2020; Zahara, 2022). According to the study of Juswardi et al., (2023), the antioxidant content of butterfly pea flower is 6.58 ppm, Lakshan et al., (2019) with IC_{50} around 242 μL/mL. Butterfly pea flower (BPF) has bioactives that have functional benefits, including flavanoids, tannins, phenolic acids, anthraquinones and alkaloid and terpenoid groups such as triterpenoids, phytosterols and others (Marpaung , 2020).

Butterfly pea plants, almost all parts of which are widely used by the community, one of which is the flower part. Butterfly pea flowers are increasingly in demand by the public, marked by the increasing demand for butterfly pea flowers in commercial butterfly pea flower cultivators (Purba, 2020). People use butterfly pea flowers for several uses, including as food additives that act as natural dyes, as health herbs, including for insomnia, fever, ulcers and so on. Butterfly pea flowers are widely used for making butterfly pea flower herbal drinks.

Butterfly pea flower-based drinks have been formulated with other ingredients as functional drinks including butterfly pea drinks with dates (Khoirunnisaa & Anwar, 2024), butterfly pea flowers with sweet leaf (*Sauropus androgynus* L.) (Rawar, 2024), butterfly pea flowers with lemongrass (Jayanti et al., 2025), butterfly pea flowers with lemon extract (Utami & Fauziah, 2024), and so on. However, the enthusiasts of this functional drink are still certain circles and mostly the age category above 45 years, while the younger generation is more interested in sweet drinks (Mustakim et al., 2024; Sosianika et al., 2024), and fizzy drinks, especially the millennial generation and generation Z (Azzahra et al., 2025). Bottled soft drinks are delicious and refreshing but there are synthetic food additives such as flavors, preservatives and sweeteners that harm the body of the consumer (Sarhan et al., 2024).

Consumption of packaged soft drinks needs to be limited because excessive consumption will have a negative impact on the body (Mubaraqin et al., 2024). Euromonitor International's 2022 data shows that sales of low-sugar soft drinks account for 9 % in Latin America, 26 % in North America, and 33 % in Western Europe, indicating Gen Z is starting to consider health benefits in drink consumption, making it important to consider healthier drink products (Mattos & Negrao, 2023). An alternative to packaged soft drinks in the form of a traditional drink from Mexico called tepache, this drink is the result of fermentation of pineapple skin (Devi et al., 2024; Hujjatusnaini et al., 2022; Najini et al., 2024). Tepache contains probiotics including *Lactobacillus*, *Leuconostoc*, *Acetobacter*, *Saccharomyces* and others that are good for gastrointestinal tract (Pérez-Armendáriz & Cardoso-Ugarte, 2020). There is no standard recipe and formula for tepache drinks (Sukriadi et al., 2022). The process of making this pineapple peel-based drink is easy and simple, namely with pineapple peel raw materials, sugar and controlled fermentation time. Unlike other fermented beverages such as kombucha, which requires about 7-10 days of fermentation (Pribadi et al., 2025), tepache only requires 2-3 days of fermentation (Martani et al., 2025). Consumption of pineapple peel fermented drinks can nourish the body because it contains probiotics that have many benefits. Water, crude fiber, carbohydrates, and protein are among the nutrients found in pineapple peel

that are increased in tepache. This is because probiotic activity increases the production of riboflavin, niacin, thiamine, vitamins B12 and B6, and other nutrients (Ramadana et al., 2025). Probiotic drinks made from fermented pineapple fruit peel produce a distinctive taste, aroma and sensation (Pratiwi et al., 2024). Testing the taste of a drinks can use sensory or organoleptic tests involving the five senses including color, aroma, texture and taste (Pribadi et al., 2025).

The combination of pineapple peel fermented drinks with butterfly pea flower will produce a unique flavor, multiple benefits, and the potential to attract the younger generation (Gen-Z). This combination offers a new experience with the attractive color of butterfly pea flowers, the distinctive aroma of fermentation, and the refreshing sensation of a soft drink, without the risk of synthetic chemicals. However, the formulation of drinks resulting from this combination has not been widely studied, especially those that target the organoleptic preferences and acceptance levels of Gen-Z consumers. The formulation of butterfly pea flower simplisia drinks has been widely researched but the formulation by combining with pineapple peel fermentation has not been widely done. Therefore, this study needs to be conducted to explore the potential of the combination of butterfly pea flower simplisia and pineapple peel fermentation as an innovative natural probiotic drink that focuses on organoleptic characteristics and the level of acceptance of Gen-Z who are starting to realize the importance of a healthy lifestyle but still provide an experience of enjoying drinks with a pleasant sensation.

METHOD

The research was conducted at the Integrated Science Laboratorium, Cipta Wacana Christian University in June 2025. The materials of this study used dried butterfly pea flowers (*Clitoria ternatea* L.) weighing 0.7 g/L (± 26 dried butterfly pea flowers) per drinks formulations referring to Mulangsri (2019) approach with modification by interviewing the local wisdom of the community, honey variety of pineapple (*Ananas comosus* L.), sugar (0 % sugar (no sugar), 10 %, and 20 %), 1 L mineral water per drinks formulations and tools in the form of glass jars sterilized with hot water, cover cloth, analytical scales, pH meter, measuring cup and stove.

Research Procedures

Making Drinks Formulation

The procedure for making pineapple peel fermented drinks refers to Martani's method with the modification of using a cloth-covered container at room temperature and normal room light, without artificial aeration or microbial starter, but spontaneous fermentation comes from local microorganisms from pineapple peel (Martani et al., 2025). Making drinks formulations using honey pineapple peel starts with pineapple fruit was cleaned and peeled. The center of the pineapple fruit and pineapple peel were weighed as much as 300 g/L per formulation. Granulated sugar was weighed according to the formulation and dissolved in 1 L of mineral water by heating and then cooling to become sugar syrup and used in drinks formulations. Drinks formulations: Butterfly pea flowers (BPF) without sugar (A), butterfly pea

flowers with 10% of sugar (B), fermented pineapple peel (FPP) with 10 % of sugar (C), fermented pineapple peel with butterfly pea flower and 10 % of sugar (D), and fermented pineapple peel with butterfly pea flower and 20 % of sugar (E). The fermentation period of fermented drinks formulations, namely C, D and E, was carried out for 2 days in room temperature (± 27 ^{o}C). While formulations A and B were made fresh (0 days).

Parameters Observation

The parameters observed pH (degree of acidity), organoleptic flavor, aroma, sensation, color and acceptability (hedonic test) of each parameters and overall rating acceptanced. The degree of acidity was measured using a calibrated pH meter portable. Organoleptic test of color by matching colors using a color diagram, aroma by smell, sensation and flavor by tasting each drinks formulations using Check-All-That-Apply (CATA) approch and panelist acceptability using 5-point scale approach (1=strongly disliked, 2= disliked, 3= Neutral, 4= liked, 5= Strongly liked). Presentation was placed in plastic cups that were given a code. Based on SNI 01-2346-2006 standard by method approaches of Kosnayani et al., (2022) and Anas et al., (2021), a total of 34 randomly selected untrained panelists were involved in this study. The panelists were university students aged between 20-25 years old who fall into the Generation Z (Gen-Z) category, most of whom are from the Sumba region of East Nusa Tenggara without exclusion criteria.

Data Analysis

Data were statistically analyzed using the Kruskal-Wallis test (Shapiro-Wilk normality test stated that the data distribution was not normal). Mann-Whitney further test was conducted for significant data.

RESULT AND DISCUSSION

Color

Drinks formulations had a significant effect on color organoleptic (sig. value of 0.00 <0.05) in the Kruskal Wallis test (Table 1). Drinks formulations A, B, C, D and E had different color variations, including formulation A had a blue color, formulation B had a greenish-blue color, formulation C had a pastel yellow color, formulation D and E had a purplish yellow (pastel) color (Figure 1). This color variation was influenced by several factors including the composition of the ingredients, the variation of pH in each drinks formulation. According to Angriani (2019), butterfly pea flowers had anthocyanin content which had various color conditions depending on pH, butterfly pea flower extract had a red color with pH 1, purple color at pH 4-5 conditions, blue color pH 7, and green color at pH 10. The color that appeared in drinks formulation A tended to be blue where the pH measurement results showed a neutral pH, this result was in line with the results of Angriani's research that pH 7 butterfly pea flowers were blue (Angriani, 2019).

According to Aprilliani et al., (2022), changes in pH would affect the color of anthocyanins from butterfly pea flowers where pH 1-3 would produce a pink to purple

color, pH 4-10 from purple gradation to blue. The color of drink formulation B occurred from mixing the natural blue color of butterfly pea flowers combined with the yellow color of the 10 % sugar solution which produced a blue-green color. The green color appeared due to the combination of blue with yellowish brown (Khoirunnisaa & Anwar, 2024). The effect of the interaction of sugar and butterfly pea flower extract and the heating process of sugar would affect the color of the final product (Novitasari et al., 2023).

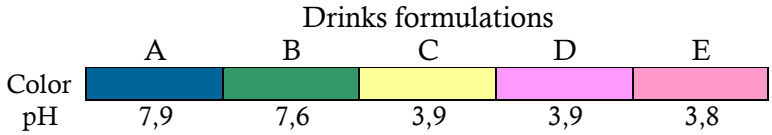

Figure 1. Color and pH of drinks formulations

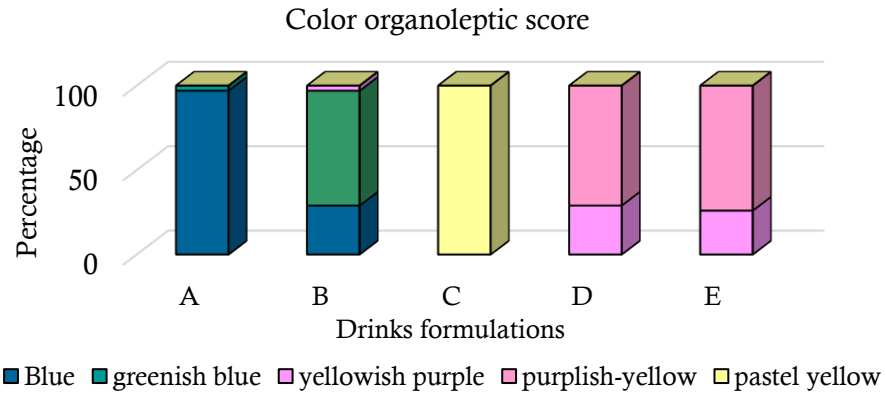

Figure 2. Distribution of the results of panelists' perceptions in the color organoleptic test conducted on the butterfly pea flower drinks formulations

Table 1. Color organoleptic test and acceptability

Drinks formulation	Color Organoleptic		Color Acceptability	
	Score	Interpretation	Score	Interpretation
A	1[a]	Blue	3,62[a]	Liked
B	1[b]	Greenish blue	3,18[b]	Neutral
C	5[c]	Pastel yellow	2,74[b]	Neutral
D	4[d]	purplish yellow (pastel)	2,97[b]	Neutral
E	4[d]	purplish yellow (pastel)	2,97[b]	Neutral

Annotations: The same letter in the same column indicated insignificant differences in the Mann-Whitney test. **Color organoleptic score:** 1= Blue, 2= greenish blue, 3= yellowish purple (pastel), 4= purplish yellow (pastel), 5= pastel yellow. **Color acceptability score:** 1=strongly disliked, 2= disliked, 3= Neutral, 4= liked, 5= Strongly liked

Color created the first impression of the assessment of a product, an attractive color would influence consumers to try food or drinks (Nofitasari et al., 2024; Rosyidah et al., 2024). The color hedonic test of Gen-Z panelists on drinks formulations A, B, C, D and E had a significant effect (sig. value of 0.028 <0.05) in the Kruskal Wallis test (Table 1). The test results showed that Gen-Z panelists

predominantly preferred the color of drinks formulation A, which was blue, rather than the color of drinks formulations B, C, D and E, where in general Gen-Z panelists showed neutral responses to the color of drinks formulations B, C, D and E, namely neither hating nor liking. This blue color was obtained from the anthocyanin color of butterfly pea flowers at neutral pH (Angriani, 2019).

Aroma

Aroma was an important factor to determine the quality of the drink without tasting it (Nofitasari et al., 2024). The aroma generated by the drinks formulations was significantly different (sig. value of 0.00 <0.05) in Kruskal Wallis, drinks formulation A had no aroma compared to drinks formulation B which tended to have a pungent sweet aroma, while according to Gen-Z panelists drinks formulations C, D and E had aromas that were not significantly different, namely pungent sweet and sour. According to A'yuni et al., (2023); Rahayu et al., (2021), this sharp aroma was caused by the aroma of pineapple peel that had undergone fermentation by LAB and would get stronger as the duration of fermentation increased. During the fermentation process *Saccharomyces cerevisiae* converted the saccharide sugar sucrose into monosaccharides with the help of the enzyme invertase, then the monosaccharide sugars glucose and fructose were converted into ethanol with the enzyme zymase, this process resulted in a decrease in sugar content and an increase in ethanol which had an impact on the organoleptic pungent aroma (Najini et al., 2024). In general, Gen-Z panelists neither hated nor liked drinks formulations A, B, C, D and E (Table 2). Aroma preference in these drinks formulations did not significantly affect the acceptance of Gen-Z panelists (sig. value of 0.573 > 0.05) in the Kruskal Wallis test, so that in these drinks formulations aroma did not affect the acceptance of Gen-Z panelists.

Table 2. Aroma Organoleptic Test and Acceptability

Drinks formulations	Aroma Organoleptic		Aroma Acceptability	
	Score	Interpretation	Score	Interpretation
A	1a	Unscented	2,65	Neutral
B	3b	Pungent sweet	2,97	Neutral
C	4c	Pungent sweet-sour	3,12	Neutral
D	4c	Pungent sweet-sour	2,94	Neutral
E	4c	Pungent sweet-sour	3,09	Neutral

Annotations : Different letters in the same column indicated significant differences in the Mann-Whitney test. **Aroma organoleptic score:** 1= Unscented, 2= Pungent sour, 3= Pungent sweet, 4= Pungent sweet-sour**. Color acceptability score:** 1=strongly disliked, 2= disliked, 3= Neutral, 4= liked, 5= Strongly liked

Flavor

Flavor affected a person's acceptance of food and could be influenced by the basic ingredients (Nofitasari et al., 2024). Drinks formulations A, B, C, D and E had a significant effect on the main organoleptic flavor (sig. value of 0.00 <0.05) in the Kruskal Wallis test. Drinks formulations between B and E were not significantly different from the main sweet flavor, Drinks formulations C and D were not significantly different from the main flavor perceived by Gen-Z panelists which was sour flavor, and drinks formulation A was bland (Table 3). According to

Syafah et al., (2025), butterfly pea flowers in drinks did not provide flavor so it was necessary to provide flavorings. The sour flavor in drinks formulations C, D, and E was caused by the product of the fermentation process, namely an increase in lactic acid content. The fermentation process of pineapple peel involved microorganisms both fungi and bacteria, the group of bacteria involved was a group of lactic acid bacteria (LAB) including: *Lactobacillus*, *Lactococcus, Leuconostoc* and *Acetobacter* (Najini et al., 2024).

The organoleptic flavor of the combination also showed a significant difference (sig. value of 0.00 <0.05) in the Kruskal Wallis test. Gen-Z panelists had the perception that drink formulations A and B both had no combination of flavors, while drinks C, D and E had a combination of flavors, where the perception of Gen-Z panelists on drink formulation E was different from C and D, namely the combination of sweet and sour was equally strong compared to C and D which were more dominant sour than sweet. Drink formulation E had a sugar composition that was 2 x higher than other fermented drinks so that the sour flavor caused was balanced by a higher sweetness. The flavor of pineapple skin fermented drink was influenced by the basis and composition of its constituents (A'yuni et al., 2023; Kusuma et al., 2019). The lower of the sugar concentration in pineapple peel fermented drinks was, the more sour the flavor was due to an increase in lactic acid levels (Najini et al., 2024).

Table 3. Main and Combination Flavor Organoleptic Test and Flavor Acceptability

Drinks formulations	Main flavor organoleptic		Combination flavor organoleptic		Flavor acceptability	
	Score	Interpretation	Score	Interpretation	Score	Interpretation
A	1[a]	Bland	1[a]	No combination	1,88[a]	Disliked
B	5[b]	Sweet	1[a]	No combination	3,15[b]	Neutral
C	4[c]	Sour	3[b]	Predominantly sour rather than sweet	2,88[b]	Neutral
D	4[c]	Sour	3[b]	Predominantly sour rather than sweet	3,21[bc]	Netural
E	5[b]	Sweet	5[c]	Strong sweet-sour	3,62[c]	Liked

Annotations: The same letter in the same column indicated non-significant difference in Mann-Whitney test. **Main flavor organoleptic scores:** 1= Bland, 2= Bitter, 3= Savory, 4= Sour, 5= Sweet. **Combination flavor organoleptic score:** 1= No combination, 2= Moderately sweet-moderately sour, 3= Predominantly sour rather than sweet, 4= Predominantly sweet rather than sour, 5= Strong sweet-sour. **Flavor acceptability score:** 1=strongly disliked, 2= disliked, 3= Neutral, 4= liked, 5= Strongly liked

Flavor acceptability of drinks formulations to Gen-Z was significantly different, where Gen-Z generally disliked drink formulation A which was bland and had no combination of flavors, but liked drink formulation E, while for drinks formulations B, C and D on average Gen-Z panelists were neutral. This showed that sweetness was the main flavor preferred by Gen-Z over other flavors, but the balanced combination

of acids made drink formulation E more preferred than sweet without combination (drink formulation B). According to Najini et al., (2024), sugar concentration was one factor that affected the level of acceptance of a drink, a balanced flavor between sweet and sour was more preferred than sour.

Sensation

Drinks formulations A, B, C, D and E had a significant effect on organoleptic sensation (sig. value of 0.00 <0.05) in the Kruskal Wallis test (Table 4). Drink formulation A in the perception of Gen-Z panelists had a sensation that was not fizzy and more dilute than drink formulation B which tended to be more concentrated even though both were not fizzy, while drinks formulations between C, D and E were not significantly different and had a lot of fizzy sensation. The concentration that occured in drink formulation B occured due to the presence of 10% sugar content compared to drink formulation A, but the sugar content that occured in drinks formulations C, D and E was due to the fermentation process that would break down sugar into pyruvic acid which was continued into lactic acid products that made the drink thicker. According to Najini et al., (2024), the fermentation process would change the viscosity of pineapple peel fermented drinks. The fermentation process of lactic acid bacteria could go through heterofermentative or homofermentative processes. The homofermentative process would produce lactic acid and ATP as its main products while heterofermentative would produce lactic acid, ethanol, carbon dioxide, acetic acid and other aroma compounds (Ramadana et al., 2025). The fizzy sensation occurred due to the presence of carbon dioxide during the fermentation process by *Saccharomyces cerevisiae* which converted sugar into ethanol and carbon dioxide products and by lactic acid bacteria. The longer the fermentation process was, the more carbon dioxide formation increased, which was characterized by more foam (Amalia et al., 2024).

Table 4. Sensation Organoleptic Test and Acceptability

Drinks formulations	Sensation organoleptic		Sensation acceptability	
	Score	Interpretation	Score	Interpretation
A	1[a]	Dilute - not fizzy	2,26[a]	Disliked
B	2[b]	Not fizzy	2,88[b]	Neutral
C	4[c]	A lot of fizzy	2,79[b]	Neutral
D	4[c]	A lot of fizzy	3,35[b]	Neutral
E	4[c]	A lot of fizzy	3,41[b]	Neutral

Annotations : Different letters in the same column indicated significant differences in the Mann-Whitney test. **Sensation organoleptic score:** 1= Dilute - not fizzy, 2= Not fizzy, 3= Moderately fizzy, 4= A lot of fizzy, 5= Very much fizzy. **Sensation acceptability score:** 1=strongly disliked, 2= disliked, 3= Neutral, 4= liked, 5= Strongly liked

Gen-Z panelists predominantly disliked the sensation of drink formulation A compared to other drinks formulations (sig. value 0.01 <0.05) in the Kruskal Wallis test, while for other drinks, namely drinks formulations B, C, D, and E in general Gen-Z were neutral, namely neither hated nor liked the sensation of the fizzy drink

formulation. The sensation of fizzy or carbonation was a sensation that tickled or bit in the mouth (Suryani et al., 2025).

Overall Rating Acceptability

In general, drinks formulations A, B, C, D and E had a significant effect on the liking (rating) acceptance of Gen-Z panelists (sig value of 0.01 <0.05) in the Kruskal Wallis test. The drink formulation that had no sugar (A) had the lowest acceptance score of 3, drinks formulations B and C had an acceptance score of 5 which was sufficient or medium, where these formulations both had a sweet flavor, drinks formulations B and C were not significantly different in acceptance where these drinks formulations had the same flavor, namely sweet and sour but different in color appearance, however, Gen-Z preferred drink formulation D over drink formulation B with a score of 6. The best acceptance of the five drinks formulations was owned by drink formulation E, where this drink had a sweet and sour flavor that was equally strong, this happened because the composition of sugar was better at compensating for the sour flavor that was formed during the fermentation process. This was in line with the research of Najini et al., (2024), that panelist preferred sweet and sour drinks that were balanced rather than dominantly sour or very sweet.

Table 5. Overall Rating Acceptance

Drinks formulations	Annotations	Over all acceptance	
		Score	Acceptance score
A	Butterfly pea flower without sugar	3.24[a]	3
B	Butterfly pea flower + 10% sugar	4.59[b]	5
C	Fermented pineapple peel + 10% sugar	5.44[bc]	5
D	Fermented pineapple peel + Butterfly pea flower + 10% sugar	6.38[c]	6
E	Fermented pineapple peel + Butterfly pea flower + 20% sugar	7.91[d]	8

Annotations : Different letters in the same column indicated significant differences in the Mann-Whitney test. **Acceptance score:** the closer to a score of 1, the worse the panelists' acceptance, and the closer to a score of 10, the better the panelists' acceptance.

CONCLUSION

The best formulation most favored by Gen-Z panelists was the butterfly pea flower drink formulation enriched with pineapple peel with 20% sugar content (E) compared to other drink formulations. The factor that most influenced Gen Z acceptance was flavor. A strong and balanced combination of sweet and sour flavors is one of Gen Z's preferences in enjoying drinks made from fermented pineapple peels with butterfly pea flowers. The innovation of butterfly pea flower by combining pineapple peel fermentation can be a consideration for the development of butterfly pea flower-based functional drink products. For further research, it is recommended to conduct food analysis related to the nutritional content and bioactive compounds of the drink formula and increase the category and number of panelists with diverse backgrounds. So that the formulation and innovation of functional butterfly pea

flower-based drinks can be beneficial for maintaining public health in general and Gen Z in particular.

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REFERENCES

Amalia, E. Y., Maulana, A., Astuti, F. I., & Anindita, N. S. (2024). Tepache, a probiotic drink made from pineapple skin. *Prosiding Seminar Nasional Penelitian dan Pengabdian Kepada Masyarakat*, *2*, 524–529. https://proceeding.unisayogya.ac.id/index.php/prosemnaslppm/article/view/759/287 **[*In Indonesian language*]**

Anas, D. F., Jaya, I., & Nurjanah. (2021). Design and implementation of fish freshness detection algorithm using deep learning. *IOP Conference Series: Earth and Environmental Science*, *944*(1), 1–12. https://doi.org/10.1088/1755-1315/944/1/012007

Angriani, L. (2019). The Potential of Extract Butterfly Pea Flower (*Clitoria ternatea* L.) as a Local Natural Dye for Various Food Industry. *Canrea Journal: Food Technology, Nutrition, and Culinary Journal*, *2*(1), 32–37. https://doi.org/10.20956/canrea.v2i1.120 **[*In Indonesian language*]**

Aprilliani, F., Ayuningtyas, L. P., & Lestari, H. A. (2022). Butterfly Pea Flower (Clitoria ternatea L.) as a pH Indicator in Smart Packaging Systems. *Agroteknika*, *5*(2), 87–97. https://doi.org/10.55043/agroteknika.v5i2.133 **[*In Indonesian language*]**

A'yuni, Q., Sabira, N., & Suryani, T. (2023). Glucose Levels and Organoleptic Quality Probiotic Tepache of Pineapple Peel on Variation of Sugar and Fermentation Duration. *International Conference on Biology Education, Natural Science, and Technology*, *1*(1),348–355.

Azzahra, R. D., Harto, B., & Dwijayanti, A. (2025). Modern Lifestyle Trends and Their Influence on Sprite Consumption Among Millennials and Gen Z. *ATRABIS Jurnal Administrasi Bisnis (e-Journal)*, *11*(1), 1–9. https://doi.org/10.38204/atrabis.v11i1.2190 **[*In Indonesian language*]**

Devi, S. N. K., Renanda, J. D., Laili, V. C., & Herawati, E. (2024). Organoleptic and Hedonic Testing of Tepache Made from Kelud Pineapple Peels from Kediri Regency. *Seinkesjar*, *4*(1), 1111–1122. https://doi.org/10.29407/6baefm06 **[*In Indonesian language*]**

Hujjatusnaini, N., Amin, A. M., Perditson, H. F. A., Robiyansyah, M., Guri, W. A., Husna, N., Annisa, N., & Ramlan, C. (2022). Innovation of Tepache Drink Made from Pineapple Peel (Ananas comosus (L.) Merr.) Supplemented with

Lactobacillus casei Probiotics. *Jurnal Teknologi Pangan Dan Gizi*, *21*(1), 47–54. https://doi.org/10.33508/jtpg.v21i1.3568 **[*In Indonesian language*]**

Jayanti, M., Prabowo, S., Candra, K. P., & Emmawati, A. (2025). Optimisation of the Antioxidant Activity of Herbal Tea Bags Made from Butterfly Pea Flowers and Lemongrass. *Jurnal Mutu Pangan : Indonesian Journal of Food Quality*, *12*(1), 1–13. https://doi.org/10.29244/jmpi.2025.12.1.1 **[*In Indonesian language*]**

Juswardi, J., Yuliana, R., Tanzerina, N., Harmida, H., & Aminasih, N. (2023). Anthocyanin, Antioxidant and Metabolite Content of Butterfly Pea Flower (*Clitoria ternatea* L.) Based on Flowering Phase. *Jurnal Pembelajaran Dan Biologi Nukleus*, *9*(2), 349–360. https://doi.org/10.36987/jpbn.v9i2.4064

Khoirunnisaa, T., & Anwar, K. (2024). Sensory Analysis and Polyphenol Content of Functional Beverages Made from Butterfly Pea Flower Tea (Clitoria ternatea L.) and Date Tea (Phoenix dactylifera L). *Jurnal Ilmu Gizi Dan Dietetik*, *3*(2), 120–127. https://doi.org/10.25182/jigd.2024.3.2.120-127 **[*In Indonesian language*]**

Kosnayani, A. S., Yunianto, A. E., & Rizal, M. E. A. (2022). The effect brewing methods on the hedonic value and antioxidant activity of Meniran (*Phyllanthus niruri* Linn.). *AcTion: Aceh Nutrition Journal*, *7*(1), 1. https://doi.org/10.30867/action.v7i1.459

Kusuma, A. P., Chuzaemi, S., & Mashudi. (2019). The Effect of Fermentation Time of Pineapple Waste (Ananas comosus L. Merr) on Physical Quality and Nutrient Content Using Aspergillus niger. *Jurnal Nutrisi Ternak Tropis*, *2*(1), 1–9. https://doi.org/10.21776/ub.jnt.2019.002.01.1 **[*In Indonesian language*]**

Lakshan, S. A. T., Jayanath, N. Y., Abeysekera, W. P. K. M., & Abeysekera, W. K. S. M. (2019). A commercial potential blue pea (*Clitoria ternatea* L.) flower extract incorporated beverage having functional properties. *Evidence-Based Complementary and Alternative Medicine*, *2019*(1), 1–13. https://doi.org/10.1155/2019/2916914

Marpaung, A. M. (2020). Review of the benefits of butterfly pea flower (Clitoria ternatea L.) for human health. *Journal of Functional Food and Nutraceutical*, *1*(2), 47–69. https://doi.org/10.33555/jffn.v1i2.30 **[*In Indonesian language*]**

Martani, N. S., Hanasia, Turnip, O. N., Halik, H., & Adnyana, I. G. H. E. (2025). Isolation and characterization of acetic acid bacteria from pineapple peel fermentation (*Ananas comosus*). *Biodiversitas*, *26*(2), 789–798. https://doi.org/10.13057/biodiv/d260227

Mattos, R., & Negrao, C. (2023, May 22). *Soft Drinks in the Americas: How Gen Z is Investing in Health*. Euromonitor.Com. https://www.euromonitor.com/article/soft-drinks-in-the-americas-how-gen-z-is-investing-in-health. Retrieved September 7, 2025.

Mubaraqin, N. H., Rosalina, E., & Hatussaadah, S. F. (2024). The Relationship between Knowledge of Negative Effects and Beverage Consumption Behaviour

among Adolescents. *Jurnal Akademika Baiturrahim Jambi*, *13*(2), 208–214. https://doi.org/10.36565/jab.v13i2.782 **[*In Indonesian language*]**

Mulangsri, D. A. K. (2019). Teaching the Children at the Baiti Jannati Orphanage How to Make Dried Butterfly Pea Flowers for Tea. *Abdimas Unwahas*, *4*(2), 93–96. https://doi.org/10.31942/abd.v4i2.3010 **[*In Indonesian language*]**

Mustakim, A'yunin, E. N., Handari, S. R. T., & Aprillia, T. (2024). Consumption Behaviour of Sugar Sweetened Beverages (SSB) and Social Media Activity among Urban Students. *Media Publikasi Promosi Kesehatan Indonesia*, *7*(1), 237–243. https://doi.org/10.56338/mppki.v7i1.4647 **[*In Indonesian language*]**

Najini, R., Purwanti, N. U., Rosidatul Mufida, A., Kurniawan, A., Alghifary, M. H. H., Syalsabila, R. R., Nuraini, R., & Safitri, W. (2024). Probiotic Tepache Drink from Fermented Pineapple Peel (Ananas comosus L.) Using Different Types and Concentrations of Sugar. *Journal Pharmacy of Tanjungpura*, *1*(2), 74–79. https://jurnal.untan.ac.id/index.php/JPOP **[*In Indonesian language*]**

Nofitasari, R. S., Saputri, R. K., NIsak, S. K., & Basith, A. (2024). Testing the Antioxidant Activity of Bunga Telang Herbal Tea with Different Sweeteners as an Alternative Treatment for Hypertension. *Jurnal Penelitian Dan Pengabdian Kepada Masyarakat UNSIQ*, *11*(3), 191–199. https://doi.org/10.32699/ppkm.v11i3.7832 **[*In Indonesian language*]**

Novitasari, T. A. D., Sukardi, & Husna, A. (2023). The Effect of Adding Butterfly Pea Flower Extract (Clitoria ternatea) on the Physicochemical and Organoleptic Characteristics of Cow's Milk Caramel Sweets. *Food Technology and Halal Science Journal*, *6*(2), 176–188. https://doi.org/10.22219/fths.v6i2.28346 **[*In Indonesian language*]**

Pérez-Armendáriz, B., & Cardoso-Ugarte, G. A. (2020). Traditional fermented beverages in Mexico: Biotechnological, nutritional, and functional approaches. *Food Research International*, *136*(109307), 1–28. https://doi.org/10.1016/j.foodres.2020.109307

Pratiwi, C., Saufani, I. A., & Nurfaziah, L. R. (2024). Identification of the Ideal Sensory Profile of Fermented Pineapple Fruit Skin (Ananas comosus L.). *Amerta Nutrition*, *8*(3), 344–352. https://doi.org/10.20473/amnt.v8i3SP.2024.344-352 **[*In Indonesian language*]**

Pribadi, T., Zakiyyah, Z., Anisa, N., Wijayadi, I., Masitah, M., Sari, E. R. A., Hadi, I. R. C., & Rahmawati, A. I. (2025). Organoleptic Evaluation and Consumer Preferences for Singkil Tea and Kombucha Products (*Premna corymbose* Rottl. Et Willd). *Jurnal Pembelajaran Dan Biologi Nukleus*, *11*(2), 594–610. https://doi.org/10.36987/jpbn.v11i2.7120

Purba, E. C. (2020). Butterfly Pea (Clitoria ternatea L.): Utilisation and Bioactivity. *Jurnal EduMatSains*, *4*(2), 111–124. https://doi.org/10.33541/edumatsains.v4i2 **[*In Indonesian language*]**

Rahayu, W., Albaar, N., & Saleh, E. R. M. (2021). Making Probiotic Drinks Based Bogor Pineapple Skin Using *Lactobacillus casei* with Different Fermentation

Time. *Jurnal Agribisnis Perikanan*, *14*(1), 172–183. https://doi.org/10.29239/j.agrikan.14.1.172-183 **[*In Indonesian language*]**

Ramadana, M. M., Laila, I., Halim, M. G., Ubaedilah, N. A., & Supriyatna, A. (2025). The Effect of Sugar Concentration and Type on Fermented Pineapple Skin Drink (Tepache). *Algoritma : Jurnal Matematika, Ilmu Pengetahuan Alam, Kebumian Dan Angkasa*, *3*(1), 142–151. https://doi.org/10.62383/algoritma.v3i1.362 **[*In Indonesian language*]**

Rawar, E. A. (2024). Formulation and Physical Testing of Instant Drink Powder Combining Katuk Leaves and Butterfly Pea Flowers. *Jurnal Cahaya Mandalika*, *5*(1), 323–329. https://doi.org/10.36312/jcm.v5i1.2795 **[*In Indonesian language*]**

Rosyidah, D., Prayitno, S. A., & Rahma, A. (2024). Sensory and Chemical Quality of Functional Beverages Based on Melinjo Leaves with the Addition of Mint and Lemon Leaves. *Journal of Food Safety and Processing Technology (JFSPT)*, *2*(1), 92–106. https://doi.org/10.30587/jfspt.v2i1.8374 **[*In Indonesian language*]**

Sarhan, M. M., Aljohani, S. A., Alnazzawi, Y. A., Alharbi, N. A., Alotaibi, S. E., Alhujaili, A. S., & Alwadi, M. A. M. (2024). Individuals' perceptions of the factors linked to everyday soft drink consumption among university students: qualitative study. *Frontiers in Nutrition*, *11*(1388918), 1–8. https://doi.org/10.3389/fnut.2024.1388918

Sosianika, A., Kania, R., & Amalia, F. A. (2024). Value Proposition Canvas Modelling for Functional Beverages for Generation Z and Y Consumer Segments. *Jurnal Bisnis & Kewirausahaan*, *20*(1), 15–26. https://doi.org/10.31940/jbk.v20i1.16-27 **[*In Indonesian language*]**

Sukriadi, E. H., Rustomo, W. T., & Astiana, R. (2022). Pineapple Skin Tepache as a Beverage Ingredient. *Jurnal Pariwisata Indonesia*, *18*(1), 28–37. https://doi.org/10.53691/jpi.v18i1.267 **[*In Indonesian language*]**

Suryani, S. D., Rosyanawari, M., Lestari, E. Y., Utami, F. C. R., Muflihati, I., & Suhendriani, S. (2025). The Effect of Different Types of Sugar on the Sensory Quality Characteristics of Wedang Uwuh Carbonated Beverages. *Journal of Innovative Food Technology and Agricultural Product*, *3*(1), 13–20. https://doi.org/10.31316/jitap.v3i1.7916 **[*In Indonesian language*]**

Syafah, L., Saputri, A. R., Sari, E. P., Kurnianingsih, I. N., Ahmalia, S., & Khalila, U. (2025). Study of the Formulation, Characteristics and Antioxidant Activity of Butterfly Pea Flower Syrup (Clitoria ternatea L.). *Hexagon (Jurnal Teknik Dan Sains)*, *2*, 93–102. https://doi.org/10.36761/hexagon.v6i2.6030 **[*In Indonesian language*]**

Utami, C. R., & Fauziah, S. H. (2024). The Effect of Adding Lemon Extract (Citrus limon) on the Characteristics of Butterfly Pea Flower (Clitoria ternatea) Drink. *Insologi: Jurnal Sains Dan Teknologi*, *3*(5), 553–566. https://doi.org/10.55123/insologi.v3i5.4209 **[*In Indonesian language*]**

Zahara, M. (2022). Brief Review: Description of *Clitoria ternatea* L. and its Benefits. *Jurnal Jeumpa*, *9*(2), 719–728. https://doi.org/10.33059/jj.v9i2.6509

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