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Phytochemical Analysis on Matcha Product Content in Gorontalo City

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ABSTRACT

Matcha is known to have a high content of bioactive compounds compared to regular green tea. This is because matcha is consumed in the form of a whole powder, so that all the compounds in tea leaves are also consumed. In Gorontalo City, matcha drinks are becoming more and more popular so KL, NK, and RHU were chosen as the sampling locations because they offer a variety of matcha products. The formulation of the problem in this study is what are the ingredients contained in matcha products in Gorontalo City. This study aims to identify and analyze the content contained in matcha products. This study uses a quantitative descriptive design to determine the content of matcha through phytochemical analysis. The study population included matcha drinks from 25 coffee shops and 8 street coffees in Gorontalo City, with samples taken from KL, RHU, and NK. The results showed that the RHU sample had the highest total phenol content of 209.34 mg GAE/g, followed by NK 184.64 mg GAE/g, and KL 149.30 mg GAE/g. The mean value of IC_{50} showed that the antioxidant activity of RHU was very strong (34.87 ppm), strong NK (52.41 ppm), and moderate KL (109.32 ppm). In conclusion, KL, NK, and RHU matcha samples in Gorontalo City are still safe to consume based on their phenol content. The antioxidant activity of the KL sample is moderate, NK is strong, and RHU is very strong, it is recommended to consume matcha wisely and business actors need to pay attention to the quality of raw materials and processing processes to maintain the content of active compounds of the product.

INTRODUCTION

Matcha is known to have a high content of bioactive compounds compared to regular green tea. This is because matcha is consumed in the form of a whole powder, so that all the compounds in tea leaves are also consumed. The main compounds contained in matcha are polyphenols, especially catechins such as epigallocatechin gallate (EGCG), epigallocatechin (EGC), and epicatechin (EC), which act as powerful antioxidants. The high content of polyphenols provides greater ability to ward off free radicals than vitamin C alone (Kochman dkk., 2021).

Based on a YouGov report cited by Campaign Asia-Pacific, the majority of people in the three Southeast Asian markets drink tea, coffee, or both; in Singapore 74%, in Indonesia 64%, and in Thailand 53%. In the tea drinkers' group, green tea including matcha was the top choice in Thailand (68%) and Singapore (67%), and was in second place in Indonesia (43%) (Campaign Indonesia, 2025).

Based on a national survey in 2025, around 43% of Indonesians like green tea, which includes matcha, and around 53% of respondents stated that they are familiar with matcha-based products (Databoks, 2025). However, until now in Gorontalo City there has been no official data that records the exact number of matcha drinkers in Gorontalo City and Province respectively.

Based on initial observations, NK, RHU, and KL were chosen as the research sites because the three places did sell matcha drinks. In addition, many buyers order matcha drinks there and the matcha menu available is quite diverse and includes drinks that are often ordered by customers. The visitors also came from various circles, such as students, students, and workers. Therefore, these three places are considered suitable and representative to be used as samples in research on matcha drinks.

This research needs to be carried out regarding phytochemical analysis on the content of matcha products in the city of Gorontalo, because there is no specific research in Indonesia that analyzes the content of products in matcha in the city of Gorontalo.

RESEARCH METHODS

This study uses a quantitative descriptive design. The sampling location was carried out at three matcha sales places in Gorontalo City, namely KL, NK, and RHU, while laboratory analysis was carried out at the BPPMDPHP Laboratory. The research will be carried out in March-April 2026.

RESULTS

Table 1 Phenol Content Test Results on KL Matcha Samples

Sample Code	Detestation	KTFe (mgGAE/g)	Average KTFe (mgGAE/g)	Phenol Standard
KL	1	148.822	149.30	Safe to consume: ±100mg-300mg
	2	149.267		
	3	149.822		

Based on table 1, it is shown that the total phenol content in the KL sample has an average value of 149.30 mg GAE/g, with relatively close interrepeat values of 148.822 mg GAE/g, 149.267 mg GAE/g, and 149.822 mg GAE/g, thus showing consistent measurement results. This value is still in the safe range for consumption (±100–300 mg GAE/g).

Table 2 Phenol Content Test Results on NK Matcha Samples

Sample Code	Detestation	KTFe (mgGAE/g)	Average KTFe (mgGAE/g)	Phenol Standard
NK	1	182.600	184.64	Safe to consume: ±100mg-300mg
	2	185.933		
	3	185.378		

Based on table 2, it is shown that the total phenol content in the NK sample has an average value of 184.64 mg GAE/g, with relatively close inter-repeat values of 182.600 mg GAE/g, 185.933 mg GAE/g, and 185.378 mg GAE/g, thus showing consistent measurement results. This value is still in the safe range for consumption (±100–300 mg GAE/g).

Table 3 Phenol Content Test Results in RHU Matcha Samples

Sample Code	Detestation	KTFe (mgGAE/g)	Average KTFe (mgGAE/g)	Phenol Standard
RHU	1	210.600	209.34	Safe to consume: ±100mg-300mg
	2	209.267		
	3	208.156		

Based on table 3, it shows that the total phenol content in the RHU sample has an average value of 209.34 mg GAE/g, with relatively close interrepeat values of 210.600 mg GAE/g, 209.267 mg GAE/g, and 208.156 mg GAE/g, thus showing consistent measurement results. This value is still in the safe range for consumption (±100–300 mg GAE/g).

Table 4 Antioxidant Content Test Results on KL Matcha Samples

Blanko	AT 1 AM			
	Concentration	Sample Absorbance	% Inhibisi	IC 50 (ppm)
0.874	50	0.135	84.55	112.93
	25	0.132	84.90	

	12.5	0.129	85.24	
	6.25	0.126	85.58	
	3.12	0.124	85.81	
Blanko	**AT 2 PM**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.132	84.90	106.67
	25	0.129	85.24	
	12.5	0.126	85.58	
	6.25	0.123	85.93	
	3.12	0.120	86.27	
Blanko	**AT 3 AM**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.137	84.32	108.38
	25	0.135	84.55	
	12.5	0.131	85.01	
	6.25	0.128	85.35	
	3.12	0.126	85.58	
Mean CI 50 (ppm)= 109.32				**Category** Medium: 100-150 ppm

Based on Table 4, the average IC_{50} value obtained was 109.32 ppm. Based on the category of antioxidant activity, these values fall into the moderate category (100–150 ppm).

Table 5 Antioxidant Content Test Results on NK Matcha Samples

Blanko	**NK 1**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.233	73.34	51.36
	25	0.229	73.80	
	12.5	0.224	74.37	
	6.25	0.219	74.94	
	3.12	0.216	75.29	
Blanko	**NK 2**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.236	73.00	51.84
	25	0.231	73.57	
	12.5	0.227	74.03	
	6.25	0.222	74.60	
	3.12	0.219	74.94	
Blanko	**NK 3**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.221	74.71	54.05
	25	0.217	75.17	
	12.5	0.213	75.63	
	6.25	0.207	76.32	
	3.12	0.204	76.66	
Mean CI 50 (ppm)= 52.41				**Category** Strong: 50-100 ppm

Based on Table 5, the average IC_{50} value obtained was 52.41 ppm. Based on the category of antioxidant activity, it falls into the strong category (50–100 ppm).

Table 6 Antioxidant Content Test Results on RHU Matcha Samples

Blanko	RHU 1			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.328	62.47	32.90
	25	0.324	62.93	
	12.5	0.321	63.27	
	6.25	0.317	63.73	
	3.12	0.312	64.30	
Blanko	**RHU 2**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.310	64.53	38.32
	25	0.307	64.87	
	12.5	0.303	65.33	
	6.25	0.299	65.79	
	3.12	0.295	66.25	
Blanko	**RHU 3**			
	Concentration	**Sample Absorbance**	**% Inhibisi**	**IC 50 (ppm)**
0.874	50	0.326	62.70	33.41
	25	0.332	63.16	
	12.5	0.319	63.50	
	6.25	0.315	63.96	
	3.12	0.310	64.53	
Mean CI 50 (ppm)= 34.87				**Category** Very powerful: <50 ppm

Based on Table 6, the average IC_{50} value obtained was 34.87 ppm. Based on the category of antioxidant activity, it falls into the category of very strong (<50 ppm).

DISCUSSION

Phenol Content in Matcha Samples in Gorontalo City

Sample Matcha KL

Based on the results of the total phenol content test on the KL matcha sample, the average value of the total phenol content (KTFe) was obtained of 149.30 mg GAE/g. This value is in the standard range of phenols that are safe to consume, which is around ±100–300 mg GAE/g, so it can be said that the KL matcha sample is still safe for consumption in terms of its phenolic compound content.

The phenol content within this safe limit shows that the bioactive compounds contained in matcha still provide benefits as antioxidants without causing potential negative effects due to excessive consumption. Phenolic compounds are known to have an important role in warding off free radicals, but in too high amounts they also have the potential to have the opposite effect of antioxidants. Therefore, values that are in the moderate range such as in this sample indicate a good balance between benefits and safety.

In terms of field conditions, the analyzed matcha samples were not pure matcha, but had been subjected to the addition of other ingredients such as sugar, milk, and other mixed components. The addition of these ingredients may cause a dilution of the concentration of phenolic compounds, so that the total phenol content value obtained is not as high as pure matcha.

Based on this, it can be assumed that the phenol content in matcha KL is influenced by the formulation of beverage products, where the addition of sugar and milk decreases the relative concentration of phenolic compounds per unit weight. In addition, the interaction between milk proteins and phenolic compounds can also reduce the availability of measurable phenols, due to the formation of protein-polyphenol complexes. This is supported by the theory that phenolic compounds can interact with proteins through hydrogen bonds and hydrophobic interactions, thereby lowering the number of free phenols measured in the analysis (Piyasen & Priyadarshini, 2025). In addition, dilution by additives also contributes to a decrease in the concentration of bioactive compounds in food products.

The above findings are in line with research by Ziyatdinova dkk. (2020) It shows that the addition of milk to tea drinks can reduce antioxidant activity due to the interaction between casein and polyphenols.

Sampel Matcha NK

Based on the results of the total phenol content test on the NK matcha sample, the average value of the total phenol content (KTFe) was 184.64 mg GAE/g. This value is still within the standard range of phenol that is safe

for consumption, which is around ±100–300 mg GAE/g, thus indicating that the NK matcha sample is safe in terms of phenolic compound content.

The high content of this phenol indicates that the sample has good antioxidant activity potential. Phenolic compounds act as electron donors in neutralizing free radicals, but in too high concentrations can also trigger oxidation reactions. Therefore, values within this range reflect the conditions that are still favorable between biological benefits and consumption safety aspects.

Based on field conditions, the NK matcha samples used in this study are not pure matcha products, but have been subjected to the addition of other ingredients such as sugar, milk, and other additional components. The presence of these ingredients can lead to a decrease in relative phenol levels due to the dilution effect in the beverage system.

In addition to the dilution factor, the composition of the drink also plays a role in influencing the measurement results. The addition of milk, in particular, can trigger interactions between proteins and phenolic compounds, potentially lowering the number of detectable free phenols. This interaction occurs through the formation of complexes that affect the availability of phenolic compounds in the solution. This phenomenon is in line with the theory that the interaction between polyphenols and food proteins can affect the stability and availability of bioactive compounds in the food system (Ozdal dkk., 2013).

Research in line with Jakobek (2021) It shows that tea-based beverage formulations, including the addition of milk and the processing process, can affect the bioaccessibility as well as antioxidant activity of phenolic compounds.

Sampel Matcha RHU

Based on the results of the total phenol content test in the RHU matcha sample, the average value of the total phenol content (KTFe) was obtained of 209.34 mg GAE/g. This value is in the standard range of phenol that is safe for consumption, which is around ±100–300 mg GAE/g, thus indicating that the RHU matcha sample is safe for consumption in terms of phenolic compound content.

This relatively high phenol content value indicates that the sample has good antioxidant activity potential. Phenolic compounds play an important role in dampening free radicals through the electron donation mechanism, thus contributing to the protection of cells from oxidative damage. However, levels that are too high can also trigger oxidation reactions, so the values obtained in this range are still optimal.

Judging from the conditions in the field, the RHU matcha samples analyzed were not pure matcha, but had been mixed with other ingredients such as sugar, milk, and other additional components. The addition of these ingredients can cause changes in the chemical composition of the beverage, including a decrease in the relative concentration of phenolic compounds due to the dilution process.

In addition, the presence of milk in beverage formulations also has the potential to affect the measurement results. Proteins in milk can interact with phenolic compounds and form complexes, resulting in a reduced amount of free phenols detected. This interaction can affect the availability of phenolic compounds in the beverage system. This is in accordance with the theory that the interaction between polyphenols and food proteins can affect the stability and bioaccessibility of phenolic compounds in the food system (Bourassa dkk., 2018).

Relevant research by Guo et al. (2022) It shows that the addition of milk and processing processes in tea-based drinks can significantly affect antioxidant activity and total phenol content.

Antioxidant Content in Matcha Samples in Gorontalo City

Sample Matcha KL

Based on the results of the antioxidant activity test on the KL matcha sample, an average IC_{50} value of 109.32 ppm was obtained. These values indicate that the concentration needed to inhibit 50% of free radicals is at a moderate level. Based on the category of antioxidant activity, the IC_{50} value is included in the moderate category (100–150 ppm).

The IC_{50} value in the medium category indicates that the KL matcha sample has a fairly good antioxidant ability, although it is not optimal. The smaller the IC_{50} value, the stronger the antioxidant activity of a sample. Thus, the values obtained indicate that the effectiveness of the sample in warding off free radicals is still at an intermediate level.

Based on conditions in the field, the KL matcha samples analyzed were not pure matcha, but had been subjected to the addition of other ingredients such as sugar, milk, and other additional components. The addition of these ingredients can cause a decrease in antioxidant activity due to dilution effects and interactions between components that affect the availability of active compounds.

Based on this, it can be assumed that the antioxidant activity in the matcha KL sample is influenced by the formulation of the beverage product, where the addition of sugar and milk leads to a decrease in the concentration of active compounds as well as a decrease in the effectiveness of free radical capture. This is in line with the theory that the antioxidant activity in food is greatly influenced by the presence of phenolic compounds and their interactions with other components, such as proteins and sugars, which can reduce the effectiveness of antioxidants (Shahidi & Ambigaipalan, 2018).

Relevant research by Corrochano dkk. (2019) It shows that the addition of milk to tea-based drinks can affect antioxidant activity due to the interaction between milk proteins and polyphenol compounds, thereby lowering the ability of measurable antioxidants.

Sampel Matcha NK

Based on the results of the antioxidant activity test on the NK matcha sample, an average IC_{50} value of 52.41 ppm was obtained. This value indicates that the concentration needed to inhibit 50% of free radicals is relatively low. Based on the category of antioxidant activity, the IC_{50} value is included in the strong category (50–100 ppm).

The low IC_{50} value indicates that the NK matcha sample has a high antioxidant ability. The smaller the IC_{50} value, the more effective a sample is in warding off free radicals. Thus, the results obtained indicate that NK matcha samples have good effectiveness in suppressing free radical activity.

Judging from the conditions in the field, the sample used was not entirely pure matcha, but had gone through a mixing process with other ingredients such as sugar and milk. Although the addition of additional ingredients has the potential to decrease antioxidant activity, the results obtained show that the antioxidant ability of the sample is still high.

It can be assumed that the high antioxidant activity in the NK matcha sample is influenced by the content of phenolic compounds that are still dominant, so that the decreasing effect due to the addition of other ingredients is not too significant. This is in accordance with the theory that antioxidant activity is strongly correlated with the content of polyphenols that act as electron donors in neutralizing free radicals (Shahidi & Ambigaipalan, 2019).

This is in line with research by Castro dkk. (2018) It shows that tea-based drinks are still able to maintain antioxidant activity despite processing and adding ingredients, as long as their polyphenol content does not decrease significantly.

Sampel Matcha RHU

Testing of antioxidant activity on RHU matcha samples showed an average IC_{50} value of 34.87 ppm. This value indicates that the concentration needed to inhibit 50% of free radicals is very low. Based on the classification of antioxidant activity, the value falls into the category of very strong (<50 ppm).

This very strong antioxidant activity suggests that the sample has a very effective ability to ward off free radicals. Low IC_{50} values are generally related to the high content of bioactive compounds, especially polyphenols, which act as free radical scavengers.

Based on conditions in the field, the RHU matcha samples analyzed were not pure matcha, but had been mixed with other ingredients such as sugar, milk, and other additional components. Nonetheless, the very strong value of antioxidant activity suggests that the content of active compounds in the sample is still very dominant.

It can be assumed that the high antioxidant activity in the RHU matcha sample is influenced by the higher content of phenolic compounds compared to other samples, so that the ability to neutralize free radicals remains optimal even after the addition of other ingredients. This is in line with the theory that the antioxidant activity in food products is greatly influenced by the composition of bioactive compounds, especially polyphenols, as well as their chemical structure that determines the ability to donate electrons (Fraga dkk., 2021).

Research by Granato dkk. (2024) It shows that variations in composition and processing processes in tea-based products can affect antioxidant capacity, where samples with higher polyphenol content show stronger antioxidant activity.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the study, all matcha samples in Gorontalo City have good phenol content and antioxidant activity. RHU samples showed the best results with the highest phenol levels and the strongest antioxidant activity. The higher the phenol content in matcha, the stronger its antioxidant activity. Therefore, business actors are advised to maintain the quality of raw materials, people consume matcha wisely, and researchers can then conduct a more in-depth analysis of other compounds.

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