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CHARACTERISTICS OF THE GAYO ARABICA COFFEE WITH THE ADDITION OF GEGARANG LEAVES (*Mentha piperita L.*) AT VARIOUS ROASTING TIMES AND TEMPERATURES

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ABSTRACT

The Gayo arabica coffee is a species of coffee belonging to the *Rubiaceae* family and the genus *Coffea*. The aroma and taste of coffee are generally influenced by genetics, where it is grown, roasting time, temperature, brewing method, and the addition of other ingredients in coffee. This study aims to evaluate the characteristics of Gayo arabica coffee with the addition of gegarang leaves (*Mentha piperita L.*) during brewing. The coffee roasting was carried out at three temperatures, namely, a light roast (195°C), a medium roast (210°C), and a dark roast (220°C) for 10, 13, and 16 minutes. The taste of coffee was modified by the addition of gegarang leaves by 1, 2, and 3% (w/w%). The characteristics of the resulting coffee were analyzed in terms of moisture content, ash content, chlorogenic acid, caffeine content, and organoleptic acceptance. The results showed that the ash and water content had met the requirements of the Indonesian National Standard (SNI 01-3542-2004) with a maximum limit of 5% and 7%, respectively. Caffeine testing showed that the caffeine content in coffee decreased with the addition of gegarang leaves. Roasting temperature and time affected the chlorogenic acid content, where 50% of the chlorogenic acid content decreased as the roasting temperature increased. The results of the organoleptic test showed that the most popular coffee was the sample roasted at 210°C for 13 minutes with the addition of 1% (w/w) gegarang leaves.

Keywords: Gayo Arabica Coffee, Gegarang Leaves, Roasting, Caffeine, Chlorogenic Acid, Organoleptic

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INTRODUCTION

Coffee is one of the most widely traded agricultural products.[1] The two types of coffee most widely known in Indonesia are arabica and Robusta coffee. However, most consumers prefer arabica to Robusta because the former has better taste and is considered a more valuable commodity. It also accounts for more than 70% of world coffee production. Until now, arabica coffee has been cultivated in various countries including Brazil, Colombia, Vietnam, Ethiopia, and Indonesia.[2-4] One of the arabica coffee varieties found in Indonesia is the Gayo arabica coffee, which is grown in Aceh. The Gayo arabica coffee production currently ranges from 650-750 kg ha^{-1}.[5] According to the SCAA (Specialty Coffee Association of America), Gayo arabica coffee is included in the specialty coffee as this coffee has a distinctive aroma and complex flavor and very distinctive viscosity (body). These advantages make it a high-quality coffee and are in great demand by the coffee market in the world.[6-9] Coffee contains few nutrients and thousands of natural chemicals including carbohydrates, lipids, nitrogen compounds, vitamins, minerals, alkaloids, and phenolics.[10-12] The most recognized content of coffee is caffeine, which can also generally be found in various plants or fruits, energy drinks, chocolate, and tea.[13-16] Coffee quality is influenced by the harvesting process and postharvest treatment, including drying and roasting. The coffee roasting process is a thermal process that can change the physical and chemical properties of coffee beans by temperature and time factors.[17,18] The addition of several ingredients/compounds in coffee will make it have a variety of flavors and aromas, making it more attractive to consumers. Currently, several types of coffee have been modified, for example, by adding salak (*Salacca zalacca*) seed powder and making ginger-modified coffee bags.[19,20] Gegarang leaves are the leaves of a type of mint plant that grows in the Gayo area. Mint leaves generally contain various esters, including menthyl acetate and monoterpenes which are useful as an agent for a distinctive flavor and aroma.[21,22] The Gayo arabica coffee could have a more attractive flavor to consumers if it is modified with other natural ingredients that are also good for health, for example, the addition of peppermint leaves. Therefore, it is interesting to study the modification of the existing taste of Gayo arabica coffee with the addition of gegarang leaves (*Mentha piperita L.*). Although several studies on coffee flavor variants have been carried out, studies on the addition of gegarang leaves in Gayo arabica coffee have not yet been carried out. Therefore, this study aimed to examine the characteristics of coffee modified with gegarang leaves, which could become an innovation in the coffee industry.

EXPERIMENTAL

Dry coffee beans (semi-wash variant) obtained from Atu Lintang in the Central Aceh district were roasted using three methods, namely, light roast (195°C), a medium roast (210°C), and dark roast (220°C) for 10, 13, and 16 minutes in a roaster (William Edison Type W600). The roasted coffee beans were ground and sieved at 1200 µm to produce a coffee powder. Gegarang leaves (Mentha piperita L.) obtained from the Central Aceh district were dried, crushed, and sieved to produce gegarang leaf powder of 1200 µm fineness. The coffee powder and gegarang leaf powder were mixed with variations in the weight of 0, 1, 2, and 3% (w/w %). The mixture resulted in the gegarang leaf-flavored coffee powder. The characteristics of coffee were tested in terms of water content, ash content, chlorogenic acid, and caffeine content as well as consumer preference through the organoleptic test. The naming of the research sample codes is shown in Table-1.

Table-1: Research Sample Description

Sample Codes	Roasting temperature (°C)	Roasting time (minute)	Gegarang leaves (%)	Sample Codes	Roasting temperature (°C)	Roasting time (minute)	Gegarang leaves (%)	Sample Codes	Roasting temperature (°C)	Roasting time (minute)	Gegarang leaves (%)
A1	195	10	0	A13	210	10	0	A25	220	10	0
A2	195	10	1	A14	210	10	1	A26	220	10	1
A3	195	10	2	A15	210	10	2	A27	220	10	2
A4	195	10	3	A16	210	10	3	A28	220	10	3
A5	195	13	0	A17	210	13	0	A29	220	13	0
A6	195	13	1	A18	210	13	1	A30	220	13	1
A7	195	13	2	A19	210	13	2	A31	220	13	2
A8	195	13	3	A20	210	13	3	A32	220	13	3
A9	195	16	0	A21	210	16	0	A33	220	16	0
A10	195	16	1	A22	210	16	1	A34	220	16	1
A11	195	16	2	A23	210	16	2	A35	220	16	2
A12	195	16	3	A24	210	16	3	A36	220	16	3

Organoleptic Test

The organoleptic test of Gayo arabica coffee with gegarang leaf variations was carried out involving 20 panelists from Takengon, Bener Meriah, and students at Universitas Syiah Kuala. The treatment of coffee influenced the panelists' preference for the aroma, taste, and texture of the coffee produced. Organoleptic tests can determine the coffee with the preferred quality and taste. The panelists' preference scale is divided into 5 levels, namely, 1 = very dissatisfied; 2 = dissatisfied; 3 = quite satisfied; 4= satisfied; 5 = very satisfied. Aside from the assessment category, the following five testing variables were determined: coffee taste (bitter, sour, minty), coffee fullness perceived in the mouth, coffee texture, coffee aroma before brewing, and coffee aroma after brewing (wet).

RESULTS AND DISCUSSION

Ash Content

Ash content is one of the tests used to determine the amount of material contained in a foodstuff. The material content in coffee is strongly influenced by the material contained in the environment where the coffee grows.[23]

In Table-2, the highest ash content in the arabica Gayo coffee with the addition of gegarang leaves was found in sample A36 (4.97%). In addition, the results of the ash content test also showed that all samples met the Indonesian National Standard (SNI) 01-3542-2004,[24] which determines the maximum ash content limit of 5%. The longer the roasting time and the higher the temperature, the greater the ash content will be because the roasting process decreases the mineral content in the coffee samples. The amount of ash content also depends on how much mineral content is in the coffee beans.[19]

Table-2: Laboratory Test Results for Ash Content in the Coffee

Sample Codes	% Ash Content	Sample Codes	% Ash Content	Sample Codes	% Ash Content
A1	4.46	A13	4.45	A25	4.52
A2	4.53	A14	4.55	A26	4.74
A3	4.6	A15	4.53	A27	4.78
A4	4.74	A16	4.6	A28	4.8
A5	4.48	A17	4.58	A29	4.74
A6	4.55	A18	4.61	A30	4.76
A7	4.65	A19	4.7	A31	4.79
A8	4.82	A20	4.75	A32	4.84
A9	4.32	A21	4.41	A33	4.73
A10	4.46	A22	4.56	A34	4.82
A11	4.62	A23	4.64	A35	4.91
A12	4.68	A24	4.79	A36	4.97

This can be seen in the comparison between the roasting temperatures of 195°C, 210°C, and 220°C in samples A1, A13, and A25, where the higher the roasting temperature, the higher the ash content is. In the previous studies, the resulting coffee powder also has increasing ash content along with the addition of salak seed powder. This is because coffee powder and salak seed powder have different concentrations, where the higher the concentration of salak seed powder, the greater the ash content will be. In that study, the highest ash content was 4.96%,[25] which is not much different from the ash content in the arabica coffee with modified gegarang leaves (4.97%), and both are still by the standard.

Water Content

High water content in dry food products, such as ground coffee, affects the shelf life of the product. High water content in ground coffee shortens the product's shelf life.

Table-3: Laboratory Test Results for Water Content in the Coffee

Sample Codes	% Water Content	Sample Codes	% Water Content	Sample Codes	% Water Content
A1	2.0	A13	1.0	A25	6.0
A2	3.0	A14	3.0	A26	4.0
A3	1.0	A15	3.0	A27	2.0
A4	4.0	A16	1.0	A28	1.0
A5	2.0	A17	1.0	A29	1.0
A6	3.0	A18	4.0	A30	1.0
A7	6.0	A19	4.0	A31	2.0
A8	4.0	A20	1.0	A32	2.0
A9	3.0	A21	5.0	A33	2.0
A10	2.0	A22	2.0	A34	3.0
A11	4.0	A23	3.0	A35	3.0
A12	4.0	A24	5.0	A36	7.0

Table-3 presents the results of the water content test on the arabica Gayo coffee with the addition of gegarang leaves. The highest water content was found in sample A36, which was 7%. At such water content, the coffee is suitable for consumption because it still meets the SNI standard 01-3542-2004 which determines the maximum water content of 7%. The results of water content testing in the other ground coffee samples, such as samples A1, A13, and A25, showed that the water content for each treatment is different, which was caused by the roasting temperature and time. In previous studies, roasting temperature and time affected the level of water content, where the longer the roasting time and the higher the temperature, the lower the water content in the ground coffee.[26] This was due to the temperature differences between the roasting medium and the foodstuff. The higher the temperature is, the faster the transfer of heat to the food will be, making the water evaporation from the foodstuff faster. The water content also affects the taste and aroma of the coffee, where the higher the water content in the gegarang leaf-modified coffee powder, the weaker the aroma of the coffee produced and the poorer the taste will be. Water is an important component in food products because water affects the texture and taste of food.[27]

Caffeine Content Analysis

Caffeine is the main component that can cause the bitter taste in coffee. The taste of coffee can be obtained after a roasting process that causes changes in the composition during the chemical reaction.[28]

Table-4: The Caffeine Content in the Arabica Gayo Coffee with Gegarang Leaves Variations

Sample Codes	Caffeine Content (%)	Sample Codes	Caffeine Content (%)	Sample Codes	Caffeine Content (%)
A1	1.496	A13	1.574	A25	1.459
A2	1.443	A14	1.288	A26	1.346
A3	1.182	A15	1.068	A27	1.343
A4	1.114	A16	1.026	A28	0.914
A5	1.668	A17	1.195	A29	1.427
A6	1.182	A18	1.130	A30	1.335
A7	1.004	A19	0.970	A31	0.886
A8	0.805	A20	0.967	A32	0.817
A9	1.065	A21	1.421	A33	1.348
A10	1.014	A22	1.342	A34	1.340
A11	0.976	A23	1.116	A35	1.314
A12	0.937	A24	1.085	A36	1.183

Table-4 shows the results of the caffeine content test in the arabica Gayo coffee with the addition of gegarang leaves, which ranged from 0.81 to 1.66% in samples A32 and A5 respectively. The standard for caffeine content in ground coffee as regulated in the SNI No. 01-3542-2004 ranges from 0.45 to 2.00% and Gayo arabica coffee with the addition of gegarang leaves still met the standard. The results of this analysis are not much different from that reported by previous studies, that the caffeine content in Arabica coffee is around 0.9 - 1.5%.[29] In other words, the arabica coffee with the gegarang leaves variety in this study had a lower caffeine content than coffee in general. In line with the results of other studies,[19] the higher the concentration of the additional foodstuffs (i.e., powdered salak seeds) added to arabica coffee, the less intense the bitter taste in the coffee produced will be.

Analysis of the Chlorogenic Acid Content

Table-5 presents the chlorogenic acid content in the coffee samples with variations in gegarang leaves, temperature, and roasting time. The chlorogenic acid content in samples A1–A36 ranged from 0.46% to 2.79%. The highest chlorogenic acid was found in samples produced with a roasting temperature of 195°C while the lowest was found in samples roasted at 220°C.

Table-5: The Chlorogenic Acid Content in the Arabica Gayo Coffee with Gegarang Leaves Variations

Sample Codes	Chlorogenic Acid Content (%)	Sample Codes	Chlorogenic Acid Content (%)	Sample Codes	Chlorogenic Acid Content (%)
A1	2.793	A13	2.271	A25	0.601
A2	2.946	A14	2.319	A26	0.643
A3	2.979	A15	2.329	A27	0.703
A4	2.852	A16	2.424	A28	0.735
A5	2.533	A17	2.021	A29	0.596
A6	2.579	A18	1.883	A30	0.607
A7	2.763	A19	1.889	A31	0.700
A8	2.813	A20	1.187	A32	0.710
A9	2.511	A21	0.463	A33	0.727

A10	2.529	A22	0.508	A34	0.756
A11	2.588	A23	0.581	A35	0.820
A12	2.718	A24	0.728	A36	0.982

The addition of gegarang leaves could increase the acid content in the samples as seen in the addition of 0, 1, 2, and 3% of gegarang leaves in samples A1, A2, A3, and A4. In addition, during the roasting process, 50% of the chlorogenic acid content was reduced so that the higher chlorogenic acid was found in samples roasted at lower temperatures.[30] A comparison of the chlorogenic acid content by roasting temperature can be seen in samples A1, A13, and A25 roasted at 195°C, 210°C, and 220°C with a chlorogenic acid content of 2.793; 2.271; and 0.601 respectively. As reported by Belay and Gholap[31] in their study on Western Ethiopian coffee, the higher the roasting temperature, the lower the chlorogenic acid content in the coffee beans was.

Organoleptic Test Results

Table-6 shows the results of organoleptic tests carried out on samples of Gayo arabica coffee modified by gegarang leaves. The absence or addition of gegarang leaves to the coffee sample affected the panelists' preferences. However, the test results also showed that the higher the addition of gegarang leaves, the lower the panelists' preference was. This is seen from the comparison between samples A2 and A3, where sample A2 is preferred over sample A3. The same is true for the other samples which were varied with roasting time and temperature and the addition of gegarang leaves.

Table-6: Organoleptic Test Results of the Gayo Arabica Coffee Modified with Gegarang Leaves

Sample Codes	Testing Variables				
	Coffee taste (bitter, sour, minty)	Coffee fullness in the mouth	Coffee texture	Coffee aroma before brewing	Coffee aroma after brewing (wet)
A1	3.45	3.24	3.67	3.24	3.29
A2	3.34	2.75	3.62	2.86	2.86
A3	2.97	2.67	3.08	2.75	2.78
A4	2.94	2.59	3.02	2.70	2.70
A5	3.32	3.21	4.13	3.21	3.29
A6	3.33	3.02	4.29	3.02	3.02
A7	2.83	2.83	2.78	2.89	2.89
A8	2.94	2.45	2.43	2.54	2.54
A9	3.42	3.18	3.56	3.18	3.24
A10	3.35	3.56	3.24	3.05	3.05
A11	2.59	2.83	2.83	2.83	2.83
A12	2.27	2.18	2.24	2.18	2.28
A13	3.45	3.00	3.51	3.08	3.02
A14	3.55	3.14	3.51	3.08	3.02
A15	2.7	2.24	3.40	2.97	2.97
A16	2.24	2.08	3.27	2.59	2.78
A17	4.13	3.53	3.75	3.16	3.67
A18	4.18	3.83	3.59	3.81	3.78
A19	4.67	3.13	3.45	3.18	3.62
A20	2.32	2.37	3.35	2.81	3.08
A21	3.45	3.29	3.59	3.7	3.10
A22	3.13	2.45	3.45	3.56	3.02
A23	2.72	2.48	3.13	3.45	2.83
A24	2.13	2.40	2.75	3.32	2.27
A25	2.94	2.78	3.43	3.56	3.16
A26	2.24	2.83	3.00	3.24	2.81
A27	2.62	2.45	3.37	2.83	2.70
A28	2.56	2.29	3.35	2.24	2.62
A29	2.45	2.45	3.32	3.64	3.13

A30	2.43	2.40	3.37	3.51	2.97
A31	2.51	2.45	3.40	3.40	2.83
A32	2.18	2.29	3.45	3.27	2.45
A33	2.13	2.16	3.35	3.48	3.13
A34	2.27	2.13	3.24	3.16	2.97
A35	2.21	2.10	3.29	2.75	2.75
A36	2.09	2.16	3.32	2.16	2.18

The best coffee for the panelists was found in sample A19 which was roasted at 210°C for 13 minutes with a 1% addition of gegarang leaves. The sample got a preference level of 4.18 ("like extremely") for the taste of coffee (bitter, sour, sweet, and minty). For the fullness of coffee in the mouth, the preference level was 3.83 ("like somewhat") and the coffee texture obtained a preference level of 3.59 ("like somewhat"). In terms of coffee aroma before brewing, the sample had a preference level of 3.81 ("like somewhat") while the coffee aroma after brewing got a preference level of 3.78 ("like somewhat"). An organoleptic test usually looks at the texture, color, and aroma contained in the coffee which is considered to have good quality.[32,33]

CONCLUSION

The results showed that the ash content and water content of coffee samples with variations of gegarang leaves had met the SNI standard with a maximum limit of 5% and 7%, respectively. Caffeine content testing showed that as the addition of gegarang leaves increased, the caffeine content in coffee decreased. Roasting temperature and roasting time could affect the chlorogenic acid content, where the chlorogenic acid content decreased by 50% along with the roasting process. In addition, the organoleptic test showed that the panelists' most preferable coffee was the coffee roasted at 210°C for 13 minutes with a 1% (w/w) gegarang leaves variation.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors contributed significantly to this manuscript, participated in reviewing/editing, and approved the final draft for publication. The research profile of the authors can be verified from their ORCID ids, given below:

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