Effect of brewing technique and particle size of the ground coffee on sensory profiling of brewed Dampit robusta coffee

K Fibrianto, Y R Febryana and E S Wulandari

Food Sensory Research Group, Department of Agricultural Product Technology, Universitas Brawijaya, Malang, Indonesia

Email: kiki.fibrianto@ub.ac.id

Abstract. This study aimed to assess the effect of different brewing techniques with the use of appropriate particle size standard of Apresio coffee cafe (Category 1) compared to the difference brewing techniques with the use of the same particle size (coarse) (Category 2) of the sensory attributes Dampit robusta coffee. Rate-All-That-Apply (RATA) method was applied in this study, and the data was analysed by ANOVA General Linier Model (GLM) on Minitab-16. The influence of brewing techniques (tubruk, French-press, drips, syphon) and type of particle size ground coffee (fine, medium, coarse) were sensorially observed. The result showed that only two attributes, including bitter taste, and astringent/rough-mouth-feel were affected by brewing techniques (p-value <0.05) as observed for brewed coarse coffee powder.

1. Introduction

Robusta coffee is one of the most widely cultivated types of coffee in Indonesia. According to [1] the southern part of Malang, precisely in Dampit area, is the largest producer of Robusta coffee in East Java with an area of ± 12,000 ha, with total production of ± 48,000 tons per year. To date, investigation on Dampit Robusta coffee is limited, in which they mostly focus on the comparison of composition [2]. Since the sensory profiling is important to identify consumer segmentation, the profiling of Dampit Robusta is required.

Meanwhile, it has been reported that coffee preparation techniques as one factor which influences the amount of some compounds in the beverages [3]. Similar study was also reported as they only focuses on aroma, flavor and aftertaste of Arabica coffee from Colombia with different method of electric brewing (coffee maker, infusion, espresso, and cupping) [4]. Different preparation techniques involve different polyphenols extraction, caffeine content, antioxidant activity level, total solid content and volatile profile [5]. Each brewing techniques applies different water and ground coffee ratio, water temperature and extraction time, and different water pressure and final volumes the beverage [6]. One of cafes in Malang region area that apply manual brewing techniques of Dampit Robusta coffee is Apresiocoffee. Therefore, this cafe was chosen as point of interest for investigating the influence of manual brewing techniques (tubruk, drip, French-press, and siphon) and particle size (fine, medium, and coarse) on sensory profiles of Dampit Robusta coffee.

This current study aims to know the effect of different brewing method using particle size according to the standard of Apresiocoffee (Category 1) compared to the different brewing method
using the same particle size (Category 2) of Dampit robusta coffee sensory attributes. Benefit of this research output can be used as a reference and practical guidance for barista to brew Dampit robusta.

2. Materials and Methods
2.1. Tools and Materials
The tools were used in this study consist of syphon, drips, french press, and tubruk glass. Other supporting tools were thermometer, gas stove, glass, digital scale, grinder, teapot, spatula and digital timer.

The materials were used in this study consist of Dampit robusta coffee and mineral water as palate cleanser according to the recommendation from [7] that mineral water can clean the palate for various products. The purpose of using palate cleanser was to avoid carry-over effects and adaption to sensory stimuli.

2.2. Methods
The method used in this study was RATA (Rate-All-That-Apply) method. RATA (Rate-All-That-Apply) method was a method used to determine the intensity of sensory attributes using untrained panelists or consumer panelists with minimum number panelist 70 people [8] 50-100 people [9]. In this study used consumer panelist (104 people) who consumed Dampit robusta coffee at the Apresiocoffee.

The data was analyzed using ANOVA General Linear Model (GLM) in Minitab 16 software with 95% confidence interval with 2 factors, brewing technique (tubruk, french press, drips, syphon) and the type of particle coffee powder (fine, medium, coarse). The meaning of Category 1 and Category 2 and the use of particle size in this study can be seen in the Table 1 and Table 2. The particle size of coffee powder (micron) was tested 3 times replication in Chemical Laboratory of Brawijaya University.

### Table 1. Brewing techniques using particle size appropriate with Apresiocoffee standards (Category 1).

| Brewing Techniques | Particle size of coffee powder (micron) |
|--------------------|----------------------------------------|
| Tubruk             | Fine (454.94 µm)                       |
| French press       | Coarse (1,751.56 µm)                   |
| Drips              | Medium (762.006 µm)                    |
| Syphon             | Medium (762.006 µm)                    |

### Table 2. Brewing techniques using same particle size of coffee powder (Category 2).

| Brewing Techniques | Particle size of coffee powder (micron) |
|--------------------|----------------------------------------|
| Tubruk             | Coarse (1,751.56 µm)                   |
| Drips              | Coarse (1,751.56 µm)                   |
| French press       | Coarse (1,751.56 µm)                   |
| Syphon             | Coarse (1,751.56 µm)                   |

3. Results And Discussion
3.1. Panelists response to significantly different attributes to Apresiocoffee standards (Category 1)
The determination of significantly different attributes was made using the General Linear Model (GLM) in Minitab 16 software with 95% confidence interval. The meaning of significantly different was the value of p-value less than 0.05 and denoted by different notation. These significantly different attributes can be interpreted as the panelists can detect the difference in the intensity of the sensory attributes of the difference brewing techniques and the use of particle size. The following attributes were significantly different in Category 1 and Category 2 can be seen in Table 3.
Table 3. The influence brewing techniques and particle size on sensory attributes of Dampit Robusta

| Attributes          | Techniques | Particle Size | Mean      | Grouping |
|---------------------|------------|---------------|-----------|----------|
| Brown Aroma         | F. Press   | coarse        | 3.808±0.2583 | A        |
|                     | Drips      | medium        | 3.288±0.2583 | A B      |
|                     | Tubruk     | fine          | 3.125±0.2583 | A B      |
|                     | Syphon     | medium        | 2.615±0.2583 | B        |
| Bitter Taste        | Drips      | medium        | 6.048±0.2287 | A        |
|                     | Tubruk     | fine          | 5.990±0.2287 | A B      |
|                     | F. Press   | coarse        | 5.327±0.2287 | A B      |
|                     | Syphon     | medium        | 5.173±0.2287 | B        |
| Acid Afterslime     | Syphon     | medium        | 2.567±0.2373 | A        |
|                     | F. Press   | coarse        | 1.894±0.2373 | A B      |
|                     | Tubruk     | fine          | 1.712±0.2373 | A B      |
|                     | Drips      | medium        | 1.404±0.2373 | B        |
| Thick Mouth-feel    | Drips      | medium        | 3.154±0.2378 | A        |
|                     | Syphon     | medium        | 2.827±0.2378 | A        |
|                     | Tubruk     | fine          | 2.471±0.2378 | A B      |
|                     | F. Press   | coarse        | 1.952±0.2378 | B        |
| Astringent Mouth-feel| Drips     | medium        | 3.106±0.2602 | A        |
|                     | F. Press   | coarse        | 2.500±0.2602 | A B      |
|                     | Tubruk     | fine          | 2.337±0.2602 | A B      |
|                     | Syphon     | medium        | 2.125±0.2602 | B        |

Based on Table 3, it can be seen that there were 5 sensory attributes that significantly different (p-value, 0.05), they were brown aroma, bitter taste, acid aftertaste, thick mouth-feel, and astringent mouth-feel. Based on mean values, the drips techniques had the highest intensity in bitter taste, thick mouth-feel, and astringent mouth-feel attributes. Bitter taste in coffee due to in coffee beans contain between 0.8-2.8% caffeine and it contributes to 10 to 30% of the bitter taste of the coffee brews. The caffeine content in Robusta coffee is about two times that of Arabica coffee [10]. Meanwhile, thick mouth-feel attributes associated with density and viscosity in coffee. This attribute is caused by the presence of lipids and dissolved polysaccharides in coffee brew [11].

While the brown aroma attribute, French Press technique had higher intensity than the others. It was allegedly due the coffee brewing left in the french press tool considered as the brewing time (ideally, the coarse particle size accordingly brewing time required for 5,5-8 minutes [3]. It was caused over-extraction of coffee brewing using a french press tool that caused the brown aroma. According to [12], the extraction of some compounds in coffee was dependent upon the time of brewing.

In the acid aftertaste attribute, the Syphon technique had the highest intensity. It was allegedly due the syphon process using principal of water vapor pressure. Chlorogenic acids confer astringency, bitterness, and acidity to the coffee brew [13]. According to the literature said that the differences in coffee brewing techniques, especially techniques using pressure would have an impact on the concentration of caffeoylquinic acids (CQAs) in coffee extraction. This acid would be responsible for astringent mouth-feel, bitter flavor, and bitter aftertaste in coffee [14]. It has been suggested that medium particle size have a large surface, allowing chlorogenic acid more extracted [15].

3.2. Analysis of acceptance test in Category 1
Analysis of Acceptance Test was conducted using 1-Proportion Test on Minitab 16 software. The acceptance results can be seen in Table 4. Table 4 shows the level of acceptance of Dampit robusta coffee sample with drips technique and using medium particle size (78 people) was higher than the level of acceptance of Dampit robusta coffee with tubruk technique and using fine particle size (69 people). It was due to some of the attributes extracted on Dampit robusta coffee using drips technique more extracted and had high intensity (bitter taste, thick mouth-feel, and astringent mouth-feel) compared with tubruk technique (roasted aroma). This can be reviewed from the GLM results described above.
Table 4. Mean Value of Acceptance Test in Category 1 (p-value 0.000).

| Brewing techniques | Particle | Consumers answered Yes (people) | Number of Panelists |
|--------------------|----------|---------------------------------|---------------------|
| Tubruk             | Fine     | 69                              | 104                 |
| French Press       | Coarse   | 70                              | 104                 |
| Drips              | Medium   | 78                              | 104                 |
| Syphon             | Medium   | 75                              | 104                 |

3.3 Analysis of Hedonic Test in Category 1

The hedonic test analysis was done using Friedman Test on Minitab 16 software which consist of 5 scale, that is scale 1 = very dislike, scale 2= dislike, scale 3= rather like, scale 4= like, scale 5= very like. The hedonic test results can be seen in Table 5.

Table 5. Median value of Hedonic test analysis in Category 1 (p-value 0.032).

| Brewing techniques | Particle | Panelist (people) | Median |
|--------------------|----------|-------------------|--------|
| Tubruk             | Fine     | 104               | 3.000  |
| French press       | Coarse   | 104               | 3.000  |
| Drips              | Medium   | 104               | 3.000  |
| Syphon             | Medium   | 104               | 3.000  |

Table 5 shows the whole panelist gave the same value, 3. The “3” value can be interpreted that all panelists had a “rather like” preference for all four techniques and the use of particle size according to Apresicioffee (Category 1) standard presented. It was due to some panelists assume there were some preferred attributes, but there were some attributes that are rather liked by the panelists, so that the panelists gave a “rather like” rating to Dampit robusta coffee.

3.4. Panelists response of significantly different attributes to the same of particle size of coffee powder (Category 2)

The determination of significantly different attributes was made using the General Linear Model (GLM) in Minitab 16 software with 95% confidence interval. These significantly different attributes can be interpreted as the panelists can detect the difference in the intensity of the sensory attributes of the difference brewing techniques and the use of the same particle size of coffee powder. The following attributes that were significantly different in Category 2 can be seen in Table 6.

Based on Table 6, It can be seen that there were 4 significantly different of sensory attributes (p-values<0.05). They were roasted, nutty, bitter, and rough mouth-feel attributes. Pyrazines and guaiacol, correlated with higher processing temperature, have been described in literature with sensory notes of smoky, nutty, hazelnut-like and roasty notes [16]. It is also suggested that caffeine caused bitter taste in coffee [17]. The bitterness of coffee depends on the concentration of caffeine. While rough mouth-feel attribute was caused by astringent component and food particle size [19]. Based on mean values, drips technique also had the highest intensity on the nutty flavor and bitter taste.

While the roasted aroma attribute, Syphon technique had higher intensity than the tubruk technique. [5]. It said that coffee extraction depends on the particle size of ground coffee. The larger surface area, the higher compounds in ground coffee will be extracted. When the particle size of ground coffee smaller than ideally, it will result over-extraction or under-extraction. Based on current study, the use of the syphon technique with coarse particle size and brewing time requires 4 minutes (ideally, coarse particle size accordingly brewing time required for 5.5-8 minutes [3]. The extraction of some compounds in coffee was dependent upon the time of brewing [12]. The longer brewing time, the higher compounds will be extracted [18]. It also showed that the longer brewing time implies longer contact time between the coffee and water, allowing the higher extraction of some compounds.
Table 6. The influence brewing techniques on sensory attributes of coarse Dampit Robusta

| Attributes         | Techniques | Particle size | Mean (±SD)         | Grouping |
|--------------------|------------|---------------|--------------------|----------|
| Roasted Aroma      | Syphon     | coarse        | 4.231 (±0.2496)    | A        |
|                    | Drips      | coarse        | 4.000 (±0.2496)    | A B      |
|                    | F. Press   | coarse        | 3.673 (±0.2496)    | A B      |
|                    | Tubruk     | coarse        | 3.115 (±0.2496)    | B        |
| Nutty Aroma        | Drips      | coarse        | 2.067 (±0.2084)    | A        |
|                    | Syphon     | coarse        | 1.423 (±0.2084)    | A B      |
|                    | F. Press   | coarse        | 1.346 (±0.2084)    | A B      |
|                    | Tubruk     | coarse        | 1.202 (±0.2084)    | B        |
| Bitter Taste       | Drips      | coarse        | 6.327 (±0.1994)    | A        |
|                    | Syphon     | coarse        | 5.933 (±0.1994)    | A B      |
|                    | F. Press   | coarse        | 5.567 (±0.1994)    | B        |
|                    | Tubruk     | coarse        | 5.510 (±0.1994)    | B        |
| Rough mouth-feel   | Tubruk     | coarse        | 1.8173 (±0.2043)   | A        |
|                    | Drips      | coarse        | 1.7404 (±0.2043)   | A        |
|                    | F. Press   | coarse        | 1.1058 (±0.2043)   | A B      |
|                    | Syphon     | coarse        | 0.9327 (±0.2043)   | B        |

So from the literature can be concluded that the coffee extraction from this syphon technique in the category of under-extraction. However, the panelists can feel the difference the higher intensity of roasted aroma attribute using the syphon technique rather than tubruk technique. It was allegedly due to the use of brewing time on the tubruk technique only 1 minute, lower than the use of brewing time on the syphon technique (4 minutes). So, that causes panelists tend to give response of roasted aroma attribute lower than the syphon technique. As it said before, the extraction of some compounds in coffee was dependent upon the time of brewing [12]. The lower of brewing time, the lower compounds will be extracted.

In the rough mouth-feel attribute, the tubruk technique had higher intensity than the others. It was allegedly due to the principle of tubruk technique without using any filter. It means that the coffee powder directly contacted with hot water. Therefore, the possibility of the granule of coffee powder was being brought to the consumer when the study progressed. Thus, the panelists tend to give higher intensity of the rough mouth-feel attribute on the tubruk technique.

3.5 Analysis of Acceptance Test in Category 2

Analysis of Acceptance Test was conducted using 1-Proportion Test on Minitab 16 software. The acceptance test results can be seen in Table 7. Table 7 shows the level of acceptance of Dampit robusta coffee using drips technique and the use of coarse particle size was higher (81 people) than the level of acceptance of Dampit robusta coffee using French press technique and coarse particle size (71 people). It was due to some of the attributes extracted on Dampit robusta coffee using drips technique more extracted and had high intensity (nutty aroma and bitter taste) rather than French press technique.

Table 7. Mean Value of Acceptance Test Analysis in Category 2 (p-value 0.000)

| Brewing techniques | Particle | Consumers Answered Yes (people) | Number of Panelists |
|--------------------|----------|---------------------------------|---------------------|
| Tubruk             | Coarse   | 73                              | 104                 |
| F. Press           | Coarse   | 71                              | 104                 |
| Drips              | Coarse   | 81                              | 104                 |
| Syphon             | Coarse   | 79                              | 104                 |
Analysis of Hedonic Test was done using Friedman Test on Minitab 16 software, which consist of 5 scale, scale 1= very dislike, scale 2= dislike, scale 3= rather like, scale 4= like, scale 5= very like. The hedonic test results can be seen in Table 8.

Table 8. Median value of Hedonic test analysis in Category 2 (p-value 0.791).

| Brewing techniques | Particle | Panelists (people) | Median |
|--------------------|----------|--------------------|--------|
| Tubruk             | Coarse   | 104                | 3.000  |
| French press       | Coarse   | 104                | 3.000  |
| Drips              | Coarse   | 104                | 3.000  |
| Syphon             | Coarse   | 104                | 3.000  |

Table 8 shows that the whole panelists gave the same value, 3. The “3” can be interpreted that all panelists had a “rather like” preference for all four techniques and the use of same particle size (Category 2). It was due to some panelists assume that there were some preferred attributes.

4. Conclusion
Sensory attributes generated on Dampit robusta coffee Category 1 (difference of brewing technique with the use of particle size according to the Apresicoffee standard) were brown aroma, bitter taste, acid aftertaste, thick mouth-feel, and astringent mouth-feel. While sensory attributes generated in Category 2 (difference of brewing technique with the use of same particle size (coarse)) were roasted aroma, nutty aroma, bitter taste, and rough mouth-feel. The acceptance test for Category 1 (especially drips technique with the use of medium particle size) was lower than the level of acceptance Dampit robusta coffee in Category 2 (especially drips technique with the use of same particle size). The level of panelist preferences of Category 1 tended to be the same as all panelists said “rather like” to both categories.

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