

# Development a novel and comprehensive cupping protocols for wine coffee assessment using Qualitative Description Analysis

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## ABSTRACT

Diversification of coffee products and consumer demands attempt to create a new product such as wine coffee, a fermented coffee product which undergoes the coffee cherries fermentation process for up to 30 days or longer. As a new product, wine coffee does not have quality standard, which barriers the coffee trade and trust between coffee producers and buyer. This research aims to develop a novel and comprehensive cupping protocol for wine coffee using qualitative description analysis with the presence of the Specialty Coffee Association of America (SCAA) as a guideline. Qualitative Descriptive Analysis (QDA) is divided into three sections: panellist screening, training, and product evaluation. Of 20 screened panellists, 12 undergo training panellists, but only 8 panellists show consistent results, and share a similar understanding of wine coffee quality. The results showed that fragrance, aroma, flavour, body, aftertaste and acidity have different definitions than speciality coffee from SCAA cupping protocols.

**Key words:** Arabica; aftertaste; cherries; fermented; wine coffee.

## 1 INTRODUCTION

Coffee (*Coffea* sp.) is a widely cultivated plantation crop in the highland regions of Indonesia such as Gayo Highland (GH), Aceh. In GH, Arabica coffee is predominantly cultivated by farmers. Both districts, Bener Meriah and Central Aceh, are the primary regions for Gayo Arabica coffee production, which is managed and held by local farmers. These two districts encompass a plantation area of 93.316 hectares, contributing a total coffee production of 126.490 tons in Aceh in 2021, with a projected increase to 127.464 tons in 2022 (Badan Pusat Statistik, 2021)

Gayo Arabica coffee is one of Indonesian's coffee that has been certified as a geographical indication since 2010 (Abubakar et al., 2022). Based on Indonesian governmental regulation, the geographical indication is a label that signifies the specific region where a product originates (Hasni et al., 2023), which emphasises the influence of environmental factors of that region on the quality of the product, including both natural and human elements. Natural factors refer to climate conditions, soil fertility, elevation level, rainfall patterns, local cultivars and other environmental factors (Artêncio; Giraldi; De Oliveira, 2022). On the other hand, human factors encompass the technical practices farmers employ in terms of coffee post-harvest handling, processing, and many more (Andini; Muzaifa; Marlina, 2021).

In GH, farmers generally process coffee in semi-wet techniques. This processing produces speciality coffee with a distinctive sensory quality. However, according to market demand and to increase profits, Gayo farmers have begun to produce wine coffee. Wine coffee or commonly also known

as fermented coffee, refers to green beans that are processed through coffee cherries fermentation. The coffee cherries are aged or anaerobically fermented for 7-30 days; several farmers take up to 60 days, followed by drying the cherries for 3-6 weeks, pulped and hulling (Sunarharum; Farhan, 2020). Coffee cherries fermentation enables to improvement of the coffee flavour and reduces the caffeine level. The longer fermentation and drying time is believed to enhance the adherence of cherries to coffee beans, resulting in a wine-like flavour (Muzaifa et al. 2023). Due to this, wine coffee has a distinct sensory characteristic compared to common wet or semi-wet processed green bean (Croijmans; Majid, 2016). Wine coffee has a fermented aroma, distinct acidity and aftertaste, as well as a light body due to the metabolic changes caused by microorganisms such as yeast, local lactic acid and acetic acid bacteria activity during the coffee cherries fermentation (Sulaiman; Hasni, 2022; Sulaiman; Hasni; Yulia, 2023).

The coffee brew is the ultimate outcome of long and complex coffee production, including wine coffee. The quality of the coffee brew is measured by cupping quality. Nowadays cupping quality is a crucial benchmark widely employed in the global coffee trade (Bhumiratana; Adhikari; Chambers, 2011; Baqueta et al., 2020). Based on various studies conducted on the cupping quality of wine coffee, which utilized the SCAA (Specialty Coffee Association of America) cupping protocol as a reference, it has been observed that wine coffee is classified as low-grade coffee (Specialty Coffee Association of America - SCAA, 2015; Sulaiman; Irfan; Syahputra, 2022). Wine coffee brew reportedly has a fermented sour aroma, a potent astringent, mild aftertaste

and mouthfeel (Dairobbo et al., 2018; Sunarharum et al., 2014). Despite its low quality based on SCAA reference, the cupping quality of wine coffee above is preferred by consumers. Meanwhile, SCAA cupping protocol is mainly applicable to wet-processed Arabica coffee. Arabica Gayo semi-wet coffee typically exhibits a harmonious balance of acidity, flavour, body and aftertaste, which serves as a speciality coffee according to SCAA qualification (Baqueta et al., 2020). This disparity in quality criteria between semi-wash and wine coffee tends to highlight a gap in the classification of wine coffee cupping quality. Therefore, this research aims to conduct a comprehensive study and establish sensory attributes to define the wine-coffee cupping quality based on Quantitative Descriptive Analysis (QDA). This set of standard attributes and definitions will help both researchers and stakeholders in the wine coffee industry evaluate wine coffee in terms of grading, quality control, and fair price based on determined quality classification.

QDA is a sensory evaluation method that utilizes a group of 8-12 extensively trained panellists. The primary objective of QDA is to objectively describe and quantify the intensity of product attributes using a pre-established and mutually understood lexicon agreed upon by the panellists. Then it continues with the statistical analysis of QDA results (Gasperi et al., 2005; Hunaefi et al., 2020). The implementation of QDA consists of four stages. It starts with panel selection, panel discussion to determine the lexicon based on panel consensus, panellist training and sample testing (Cincotta et al., 2023; Heymann, 1999).

## 2 MATERIAL AND METHODS

### 2.1 Materials and Equipments

This research was conducted in three laboratories of the Department of Agricultural Product Technology, Syiah Kuala University – Banda Aceh, Indonesia. It started from August to Oktober 2022. Coffee Teaching Industry, Product Development, Pilot Plant Laboratory, and Sensory Evaluation Laboratory are the laboratories. Equipment used include DIDATECH Italian roaster and grinder, electric water bath, and cupping utensils that follow the SCAA cupping protocol. The materials used for panellist selection were Dolphin brand table salt, sugar or sucrose Gulaku brand, quinine pills, and citric acid. The materials used during panellist training and sample testing were wine coffees with different lengths of fermentation times (8 days, 16 days and 30 days). Apart from that, unsalted crackers as neutralizers in the test, android cellphones with an internet network and Google Forms as score sheets are used for data collection tools, and SPSS statistical software 22 for statistical tools.

### 2.2 Research Procedures

#### 2.2.1 Prescreening and Screening Panelists

The planned screening panellists refers to QDA procedures from Everitt (2018). 18 participants were screened based on their interest, willingness and available time to attend the training, have high sensory sensitivity and a comprehensive understanding of coffee cupping test protocols, and are knowledgeable about the sensory quality of coffee in general (Gasperi et al., 2005). The process of selection process involved the completion of questionnaires, personal interviews and sensory testing. From the questionnaire, those participants were screened based on their knowledge related to coffee attributes. They were requested to match the common terms of coffee attributes with the provided definitions (Christofi et al., 2021). In the interview sessions, the participants were assessed on their ability to articulate their perception of one or two sensory attributes (Hunaefi et al., 2020). In the sensory test, basic taste (sweet, sour, salty and bitter) identification and their intensity threshold, aroma identification and triangle test were conducted to screen their sensory sensitivity.

#### 2.2.2 Panel Discussion & Training

Panel discussions were conducted to investigate the sensory characteristics of wine coffee. This wine coffee lexicon is based on the sensory attributes outlined in the SCAA cupping protocols (Christofi et al., 2021). Before the discussion started, panellists were asked to answer the questionnaires and do the cupping for three coffee-wine samples. The primary purpose of the training panel is to familiarize the approved lexicons as representative sensory attributes of wine coffee, to assess the perceived intensity of each attribute by panel members, and to gauge the panelist's sensitivity and consistency (Hunaefi et al., 2020). The training was conducted four times per week, each session lasting 150 minutes and consisting of individual cupping tests and FGD sessions (Muzaifa; Hasni, 2016). During training sessions, the panellists are regularly provided three wine coffee samples.

#### 2.2.3 Sample Testing and Preparation

All the brewed coffee served during the Focus Group Discussion (FGD) and sample testing was roasted and prepared in accordance with the golden cup ratio outlined in the SCAA cupping protocols. The wine coffee green bean was roasted in medium degree (Agtron Scale 65). Each cup consisted of 8.25 grams of medium size ground coffee, brewed manually using the Tobruk method with 150 ml of 93°C hot water. The coffee should be allowed to cool for 3 minutes before the assessment commenced (SCAA, 2015). Subsequently, the panellists were requested to identify the attributes of wine coffee based on the results of FGD. The cupping test took place in individual

booths equipped with controlled lights and temperature as per ISO 8589:2007. The score form was provided to panelists on their Android cellphones, enabling them to fill it out directly after testing each provided sample.

### 2.2.4 Data Analysis

During the five-day training period, panellists were subjected to sample testing four times, once per day. Previously, the test was also conducted twice before and after the training, resulting in a total of eight times of sample testing. All the measured attributes were considered as parameters. The data were collected, normalized and analysed using Analysis of Variance (ANOVA). This ANOVA employed a factorial randomized design. The independent variable in this study was training time (T) and length of fermentation (F). Training time was divided into three levels: T1 (before the training), T2 (during training) and T3 (after training). Length of fermentation refers to the variation of wine coffee samples, 8 days of fermentation (F1), 16 days of fermentation (F2) and 30 days of fermentation (F3). The number of panellists involved determined the replication number, which is 12. If both independent variables or one of them and their interaction are proven to affect a cupping score of wine coffee significantly, the analysis proceeded with the Least Significant Difference (LSD). ANOVA and LSD analyses aimed to examine the changes in panellists' responses as perceptions during training. Furthermore, all the data is also presented in a spider web.

**Table 1:** Panelists Identity.

| Panelists | Gender | Age   | Coffee Intake             | Occupation    | Smoking Habits |
|-----------|--------|-------|---------------------------|---------------|----------------|
| 1         | Male   | 30-35 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 2         | Male   | 26-30 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 3         | Male   | 26-30 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 4         | Male   | 26-30 | Regular (up to 2 cup/day) | Barista       | No             |
| 5         | Male   | 21-25 | Regular (up to 2 cup/day) | Barista       | No             |
| 6         | Male   | 21-25 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 7         | Male   | 21-25 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 8         | Male   | 21-25 | Regular (up to 2 cup/day) | Coffee Cupper | No             |
| 9         | Male   | 21-25 | Regular (up to 2 cup/day) | Barista       | No             |
| 10        | Female | 21-25 | Regular (up to 2 cup/day) | Barista       | No             |
| 11        | Female | 21-25 | Regular (up to 2 cup/day) | Barista       | No             |
| 12        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 13        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 14        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 15        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 16        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 17        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |
| 18        | Female | 21-25 | Regular (up to 2 cup/day) | Students      | No             |

## 3 RESULTS

### 3.1 Screening panelists

Before the research was carried out, a selection of panellists was carried out to ensure that the data produced was uniform, with the following criteria, shown in Table 1 and the classification in Table 2.

The panelists were screened based on their ability to differentiate the coffee attributes based on triangle test, and their sensitivity from intensity threshold and basic aroma taste. The results of panelists screening could be shown in Table 3.

### 3.2 Panelists Training

#### 3.3.2 Definition of wine coffeee atributes based on FGD

During training panellists train and acknowledge the common coffee attributes and its description as stated in Table 4.

#### 3.3.3 Cupping protocols of wine coffee sensory evaluation

Based the four-day training and FGD, the cupping protocols for wine coffee is determined below:

1. Prepare samples that have been roasted at medium levels and let sit for 3 days, then grind to a coarse size.

**Table 2:** Characteristics respondents for screening panellists.

| Characteristics    |                                         | Percentage (%) |
|--------------------|-----------------------------------------|----------------|
| Gender             | Male                                    | 50%            |
|                    | Female                                  | 50%            |
| Age                | 21-25 years old                         | 83.3%          |
|                    | 26-30 years old                         | 11.1%          |
|                    | 30-35 years old                         | 5.6%           |
| Coffee Consumption | Occasional consumer (2-4 cups a week)   | 0%             |
|                    | Regular consumer (up to 2 cups a day)   | 100%           |
|                    | Heavy consumer (more than 3 cups a day) | 0%             |
| Occupation         | Training as cupper                      | 30%            |
|                    | Training as barista                     | 35%            |
|                    | Students of Coffee Technology Courses   | 35%            |
| Smoking Habit      | No, no smoking habit                    | 100%           |

**Table 3:** Panellist attempt based on triangle test, intensity threshold and basic aroma score

| Panellists | Score         |                     |                  | Total Score | Notes        |
|------------|---------------|---------------------|------------------|-------------|--------------|
|            | Triangle Test | Intensity Threshold | Basic Aroma Test |             |              |
| 1          | 275           | 250                 | 190              | 715         | Qualified    |
| 2          | 275           | 225                 | 180              | 680         | Qualified    |
| 3          | 285           | 225                 | 180              | 690         | Qualified    |
| 4          | 290           | 225                 | 185              | 700         | Qualified    |
| 5          | 285           | 225                 | 180              | 690         | Qualified    |
| 6          | 300           | 225                 | 180              | 705         | Qualified    |
| 7          | 300           | 200                 | 70               | 570         | Disqualified |
| 8          | 300           | 225                 | 235              | 760         | Qualified    |
| 9          | 255           | 225                 | 300              | 780         | Qualified    |
| 10         | 300           | 250                 | 295              | 845         | Qualified    |
| 11         | 270           | 225                 | 290              | 785         | Qualified    |
| 12         | 260           | 150                 | 35               | 445         | Disqualified |
| 13         | 300           | 175                 | 140              | 615         | Disqualified |
| 14         | 255           | 175                 | 80               | 510         | Disqualified |
| 15         | 275           | 175                 | 70               | 520         | Disqualified |
| 16         | 300           | 225                 | 80               | 605         | Disqualified |
| 17         | 300           | 225                 | 180              | 705         | Qualified    |
| 18         | 300           | 225                 | 180              | 705         | Qualified    |

2. Prepare 5 cupping cups for each type of sample, cupping spoons, disposing cups, water, unsalted crackers and warm-wipe cotton for neutralizers, and hot water with a temperature of 93°C for brewing.

3. Furthermore, coffee grounds are weighed as much as 8.25 grams for each cup, then the aroma of dry coffee powder is assessed before brewing. Then pour hot water directly into the bottom of the cup by pouring it from the edge of the cup evenly to the middle of the cup so that the brewed water is

evenly mixed into all coffee grounds. Then let it sit for 3-5 minutes so that all the flavor of the coffee comes out.

4. Then an assessment of the aroma attribute of coffee after brewing is carried out to get a score from the aroma attribute. Then when the sample has cooled to 71°C or after letting it sit for 8-10 minutes at room temperature, move the coffee grounds left on the surface of the cup using a cupping spoon so as not to interfere with the coffee tasting. Then a coffee tasting was carried out to assess the attributes of flavor,

aftertaste, acidity, body, balance and overall with the meaning of the attributes used in accordance with the attributes that have been agreed upon for wine coffee in Table 4. Assessment points are awarded in their entirety from all cups. Then an assessment of sweetness, uniformity and clean cup attributes is carried out. For this attribute, assessment points are carried out for each cup, namely by giving 2 points per cup from each attribute so that a maximum score of 10 points is obtained for 5 cups.

5. After assessing all attributes, then the total score of all attributes is calculated to get the final score of each sample.

6. The scoring template start from 6.00 (good) to 10.00 with interval 0.25. Cupping score is a sum of all scores (total score) reduce by defect if any.

### 3.3.4 Measurement of panelists responses

The effect of time training on panelists responses during coffee wine sensory assessment could be seen in Figure 1.

Figure 2 shows the standar deviations of cupping score given by 12 panelists before, during and after training of QDA.

### 3.3 Sensory evaluation of wine coffeee

The influence of length fermentation on cupping score of coffee wine as shown in Figure 3.

The differences of obtained cupping score of 16 days fermentation of coffee wine given by 12 panelists before, during and after training as shown in Figure 4.

The cupping notes of wine coffeee as an outcome of panellists QDA training and FGD discussion could be seen in Table 5.

## 4 DISCUSSION

### 4.1 Screening panellists

Based on these screening stages, 10 respondents were chosen and asked to sign the agreement letter to join and support this research until all the stages are done, with the characteristics in Table 1. They were selected from other respondents who had lower total scores (less than 450), and lower standard deviations

**Table 4:** Description of coffee attributes based on SCAA and FGD.

| No | Atribut                                                                             | Definition of Coffee Attributes                                                                                                                                                                                                                                            |                                                                                                                                                                          |
|----|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |                                                                                     | SCAA                                                                                                                                                                                                                                                                       | FGD Results for wine coffeee                                                                                                                                             |
| 1  | Fragrance/aroma                                                                     | The aromatic aspects of dry coffee ground and coffee brew.                                                                                                                                                                                                                 | Winey aroma, with fresh sweet fruity notes, dark choco and spicy cinnamon.                                                                                               |
| 2  | Flavor                                                                              | Coffee principal character, as a combined impression of all taste bud sensations, and all netro nasal aromas that go from mouth to nose by slurping the brew.                                                                                                              | A good flavour of wine coffeee have a balance combination between acidity and sweetness which consider as soft fermented fruity acid such as berry fruit and grape fruit |
| 3  | Aftertaste                                                                          | The length of positive flavor (combination of aroma and taste) when the liquor is swallowed and recognized by the back of palate and remain after it is swallowed                                                                                                          | Aroma and taste blend well with a slight bitter taste at the back of palate after swallowing                                                                             |
| 4  | Body                                                                                | Perception based on the tactile feeling of the liquid in the mouth, especially the sensation perceived when the brew passed the tongue and roof of the mouth. Good quality coffee expected to have a high body, even the lighter body could be consider as a pleasant one. | A good quality of wine coffeee have medium body, pleasant to drink and pass through from tongue to roof of mouth.                                                        |
| 4  | Acidity                                                                             | A favorable brightness of coffee brew which has sweet and fresh fruit characters.                                                                                                                                                                                          | A comfortable acid with sweet fermented fresh from fresh tropical fruits and berries, without sharp bitter sour or tangerine taste.                                      |
| 5  | Balance                                                                             | The length of positive flavor remains in the back of the plaate after the brew is swallowed                                                                                                                                                                                | Comfortable aftertaste, have a good balance between the body and acidity, medium aftertaste with slightly bitterness.                                                    |
| 6  | Sweetness, clean cup, uniformity                                                    | Similar description, a medium uniform sweetness as an impact of caramelisation process such as brown sugar, caramel, sugar palm and milk chocolate.                                                                                                                        |                                                                                                                                                                          |
| 7  | Defect                                                                              | A negative taste which reduce coffee quality, this inadequate quality is presence in aftertaste such as grassy and hew flavor.                                                                                                                                             |                                                                                                                                                                          |
| 8  | Is there any difference of acidity in arabica coffee between acidity in wine coffee | Yes, Arabica coffee is known to have fresh acidity coming up from the fresh fruit. Meanwhile wine coffee has complex fruity taste, varied from fresh acidity of tropical fruits mango or orange juice, and sweet cinnamon flavour in aftertaste perception.                |                                                                                                                                                                          |

on these three sensory tests. Panelists should be able to perform score 80% for basic taste and intensity threshold, and 60% right answers for triangle test and aroma identification. Furthermore, in knowledge about coffee attributes and cupping protocols, they should tend to have high matching attributes and definition scores, and could explain their perceptions profoundly. The scores of each panelist were presented in Table 2.

Sensitivity of basic tastes which is sour, salty, sweet and bitter are evaluated by triangle test. Panelists were given 3 sets of samples, where 1 sample consists of two identical samples

and a different sample. Meanwhile, intensity is assessed by threshold test, panelists' sensitivity of basic taste is evaluated by comparing the lowest and highest intensity. Therefore, for four basic tastes, five levels of taste intensity are used as can be seen in Table 6. In aroma identification, the candidate panelists were asked to smell 20 types of common coffee aroma; defect such as rubber, smoke, medicinal, cooked beef; spicy aroma such as clove-like, pepper, sweet caramel aroma such as toast, dark chocolate, roast coffee, liquorice, caramel; fruity and flower-like aroma such as coffee pulp, lemon, tea-

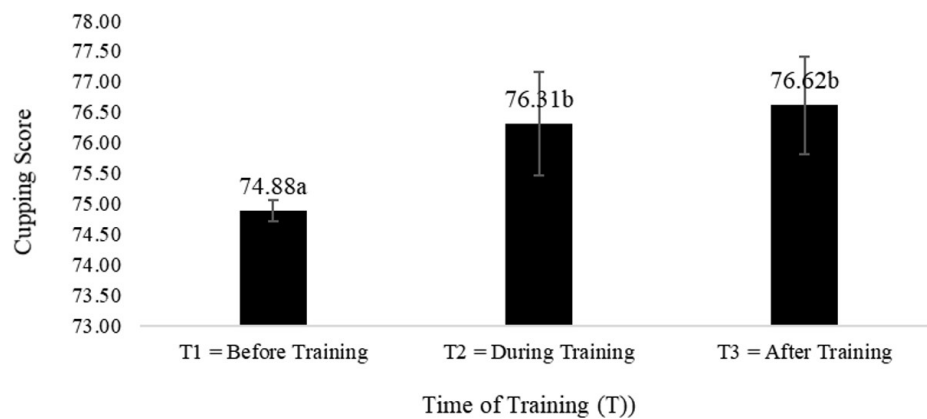


**Figure 1:** The effect of time of training on cupping score of wine coffee (n=12).

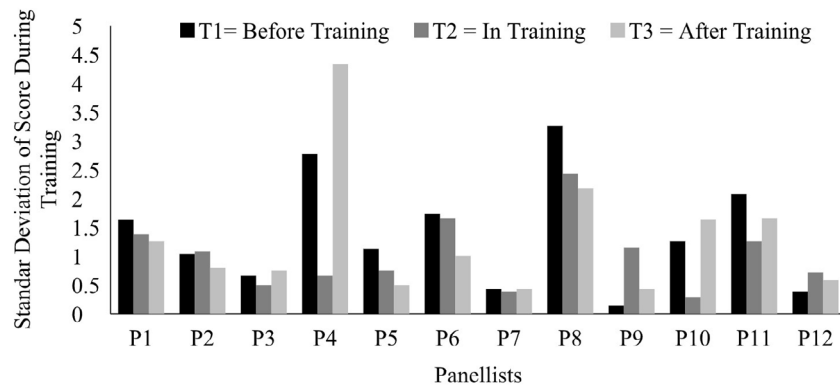


**Figure 2:** Standard deviations of cupping test scores of 12 panelists during five training days and when QDA test.

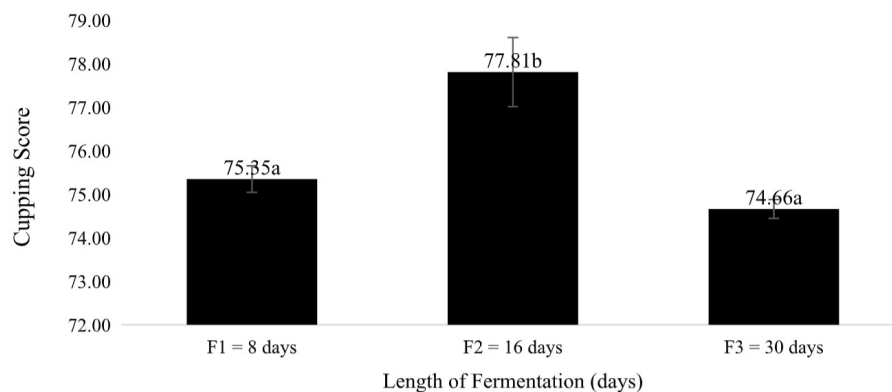


**Figure 3:** The effect of coffee length of fermentation (days) on the cupping score of wine coffee (n=12).

rose, apple, coffee blossom and vanilla. According Meilgaard et al. (2020), passing criteria for candidate of QDA panelists are those who have 60% correct responses for basic and aroma taste, and 80% for threshold test.

## 4.2 Panelists Training

### 4.2.1 Definition of wine coffeee atributes based on FGD

Panelists who pass the initial selection stage will participate in a three-day training programme to develop vocabulary for coffee and wine attributes. The training aims to facilitate the recognition, differentiation, description and

quantification of sensory attributes through a consensus-based process using an agreed-upon flavour language. Before training throughout the FGD in an open round table, the panellists are given three samples of wine coffee again to recall and emphasize the perception based on the given stimulus. Before the cupping test starts, the panel leader will introduce the attribute once at a time and what conclusions are expected for this attribute, such as their opinion about the lexicons and description. This step is regularly repeated for all ten attributes. The coffee evaluation started with sniffing the dry and wet aroma for as much as needed, then continued to assess the flavour, body, acidity and aftertaste by sipping the coffee through retronasal. This step could be repeated as much as it takes with appropriate rinsing,

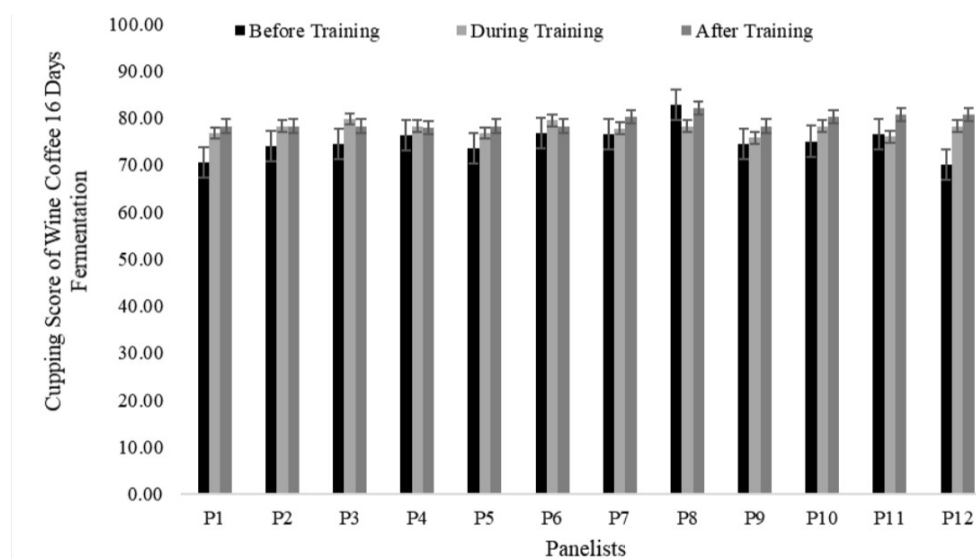


**Figure 4:** The cupping score of wine coffee 16 days fermentation before, during and after training (n=12).

**Table 5:** Cupping notes wine coffeee.

| Length of Fermentation | Cupping notes                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 8 Days                 | Dark chocolate, caramel, sugar palm, nutty, fruity, clove cinnamon, floral like a tea, banana, tamarin, smoky                              |
| 16 Days                | Dark chocolate, smoky, brown sugar, nutty, cinnamon, fruity, tobacco, grape, berries, orange, clover, like a black tea, like a mango juice |
| 30 Days                | Fruity, nutty, chocolate, cengkeh, caramel, like a black teea, cinnamon powder, baggy, phenolic, fermented                                 |

**Table 6:** Concentration of four basic taste for threshold test.

| Intensity Level | Tastant Concentration (g/L) |       |      |        |
|-----------------|-----------------------------|-------|------|--------|
|                 | Citric Acid                 | Sugar | Salt | Kafein |
| 1st Level       | 0.10                        | 5.00  | 0.40 | 0.15   |
| 2nd Level       | 0.20                        | 10.00 | 0.80 | 0.30   |
| 3rd Level       | 0.40                        | 20.00 | 1.60 | 0.60   |
| 4th Level       | 0.80                        | 40.00 | 3.20 | 1.20   |
| 5th Level       | 1.60                        | 80.00 | 6.40 | 2.40   |

Source : (Fibrianto; Ramanda, 2018).

but at least panellists should swallow the brewed once. Then, the evaluation continues with an assessment of sweetness, cleanup and overall. This step is repeated for all three samples. Panelists must rinse their mouths with water, clean up their palate's unsalted crackers, and take deep breaths through warm-cotton to clean their nasal passages.

When all the sample is evaluated, the panel leader assists the panellists in reaching a consensus on the chosen lexicons and their descriptions. Each day, the discussion lasted approximately 150 minutes. On the first training day, panellists should deliberate about the agreed lexicons for coffee-wine sensory attributes. The panelists came to a unanimous decision without the panel leader interfering. Panellists agreed that the lexicon "winey" should be used to describe a fresh, fermented, fruity aroma with a slightly soft sweetness. Table 4 shows the description of coffee attributes defined by panelists during FGD discussion compared with those defined by SCAA. The definition of coffee attributes from this FGD will be proposed to be used as standard definition of wine coffeee attributes.

#### 4.2.2 Cupping protocols of wine coffee sensory evaluation

The panelists of the FGD also agreed that SCAA coffee attributes should be used but that the description should differ, and wine coffee cupping tests use a similar scale and description to SCAA. However, the description of cupping score is not determined in this research. Further research should be applied by using high variety of wine coffeee sample. Since there is no standard quality process of wine coffeee, farmers and coffee producers still looking for the best practice which produce the constant quality of wine coffeee such as the variety, technical pratices of fermentation process or length fermentation it self (Muzaifa et al., 2023).

#### 4.2.3 Measurement of panelists responses

Furthermore, panelists repeatedly performed the cupping test used the lexicons and descriptions above during training. Anova indicates that time of training has a very significant influence ( $P \leq 0.01$ ) on the cupping score. According to  $LSD_{0.05}$  as shown in Figure 1, there is a significant difference between the cupping score before and after training. In contrast, there is no significant difference in cupping scores during and after training. Apparently, the panellists share a common perception and understanding of all sensory characteristics and lexicon descriptions after training. The data collection is divided into pre-training, training and post-training phases, consisting of scores obtained from cupping tests using the ten SCAA attributes. This approach ensures assessment consistency among panellists. The panellist training takes place from 09.00 to 11.30 WIB when panellists are most alert and able to concentrate effectively. It

is generally recommended to allocate one up to three hours per day of training (Lee; Chambers, 2006). The training should be well-structured with specific goals and involve continuous evaluation of previous results before proceeding.

QDA shows positive feedback when all the panellists can recognize the sensory attributes in a similar scores or less standard deviation. QDA has the advantage of developing attributes in a shorter period of time than profiling techniques. There is also no requirement to calibrate the assessor on intensity in this method. Apart from that, the QDA method does not require comprehensive reference related to attribute development and its intensity scale, even if it is available as a positive point. Therefore, the attribute development can be more widely, and the data obtained is stronger because it uses good discrimination replication. The language used in developing attributes is also easier to understand because it uses the language of consumers of the product (Muñoz et al., 2018). The development of food product attributes using the QDA test has been widely carried out in any kind of food range, such as coffee or hot-served products (Albert et al., 2011; Hunaefi et al., 2020). QDA enable the mapping of the quality of the product and presents the details of the sensory profile of the tested product. Figure 2 shows that except for 4th, 8th and 11th panellists, there is a tendency for a lower standard deviation of the given score before and after training. Therefore the results of those 3 panellists consider as outliers.

#### 4.3 Sensory evaluation of wine coffeee

Figure 3 shows that  $LSD_{0.05}$  indicates that 16 days of fermentation proceed wine coffee with better quality or higher cupping score, and this level is significantly difference from other treatments. The whole coffee cherries were fermented anaerobically during the production of wine coffee. Because of this, the microbial type and activities are distinct and require more time than common coffee fermentation. A major role of this fermentation is played by yeast, lactic acid bacteria and acetic acid bacteria (Sulaiman; Hasni, 2022). The fermentation of wine coffee occurred spontaneously due to no starter was provided. As fermentation progressed, yeast began to degrade the pectinous sugar in coffee fruits and convert it into alcohol, as evidenced by rising temperatures. A steady population of yeast is reported in the first week. By mid-fermentation, these types of yeast decline and die off, and are replaced by *Saccharomyces cerevisiae*, which continues the fermentation until it is finished (Sulaiman; Hasni, 2022). Since yeast produces alcohol, which inhibits its own growth but encourages Lactic Acid Bacteria (LAB) and then acetic acid bacteria (AAB). Compared to the declined number of yeast in 10-14 days of fermentatiin, LAB and AAB numbers were reported to have a first peak. LAB hand-in hand with AAB break down the fructose and destroys the cell walls. This phenomenon is supported by increasing water presents in plastic bags. Cell walls degradation and LAB

activities release the aromatic compounds. *Lactobacillus* is reported to have a great influence in aromatic formation during fermentation stages. The constant given score from panelists in Figure 4, especially during and after training also indicates that panelists share similar agreement and perception on quality of wine coffeee from 16 days fermentation. As panelists are used to the product and aware of each attribute include their good characterists, the response should be objective and sharing common perception which could be shown from the given score and standard deviation within each panelist (Baqueta et al., 2020; Gasperi et al., 2005)

Higher cupping scores are also represented in cupping notes. Table 5 indicates that wine coffeee with 16 days of fermentation has a more complex aroma, such as caramel-sweet and sweet fresh fruity aroma. The fresh, fruity fermented aroma from 16 days of fermentation is far more intense but still recognised as a pleasant flavour than 8 days of fermentation. 8 days of fermentation, wine coffee is considered to have less winey aroma, and in 30 days of fermentation, it claims to have over fermented winey aroma (Sulaiman; Hasni; Yulia, 2023; Sulaiman; Irfan; Syahputra, 2022). This might be occured due to as fermentation progress, the complex interaction between yeast-yeast or yeast with acid bacteria might occur. As fruit walls degrades and releases water, coffee cherries comes into contact and absorb the water with complex fermented aroma compounds, which considers as fermented wine aroma by panellists.

## 5 CONCLUSION

Taking all the resulted data into consideration, it can be concluded that QDA enable to increase panellists' sensitivity to differentiate quality profile of coffee wine. ANOVA also presents that both training time and length of fermentation have significant effects on cupping score. In training, the panelists became more knowledgeable and demonstrated a uniform understanding of their perceptions regarding the sensory quality attributes of coffee. QDA can define wine coffeee sensory properties. QDA indicates that in wine coffee, fragrance, aroma, flavour, aftertaste, body, balance, acidity and sweetness are defined differently than in speciality coffee. Quality assessment procedure of wine coffee including the roasting, grinding and brewing preparation procedure is suggested to follow SCAA procedures, but the diefinition of wine coffee attributes should follow the recommendation of this research.

## 6 AUTHOR CONTRIBUTION

Conceptual Idea: Hasni, D.; Sulaiman, I.; Methodology Design: Hasni, D.; Data Collection: Nazira, M.M.; Data Analysis and Interpretation: Hasni, D.; Sulaiman, I.; Nazira MM and Writing and Editing: Hasni, D.; Sulaiman, I.

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