

A SENSORY EVALUATION OF ARABICA GAYO COFFEE FLAVOUR BASED ON VARIETIES AND PROCESSING TECHNIQUES

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Post-harvest handling of coffee is one of the main factors in producing a high-quality coffee, including its processing techniques. This study aimed to conduct a sensory evaluation of arabica Gayo coffee flavour in various varieties and processing techniques. There were four selected coffee varieties in this study, namely Bor-bor, Tim Tim Aceh, Bergendal and Ateng Super, which were obtained from the garden of farmers in Gayo Highlands, Province of Aceh, Indonesia. The coffee processing methods used in this study were both dry and wet processing techniques. The sensory assessment of arabica Gayo coffee flavour was carried out by ten panelists by evaluating the acceptance of the product based on the level of preference. The sensory assessment of flavour included fragrance, flavour, after-taste, acidity, balance, body, and overall based on the panelist decision values using the exponential comparison method (ECM/MPE). Results showed that the wet processing technique was the most suitable technique for arabica Gayo coffee based on the preference of panelists compared to the dry processing technique. Arabica Gayo coffee varieties that have the highest acceptance value by panelists in sequence were Bor-bor varieties (1st choice), Tim Tim Aceh (2nd choice), Ateng Super (3rd choice), and Bergendal (4th choice). Therefore, the Bor-bor variety was the most important coffee variety recommended to be developed by the farmers compared to other coffee varieties.

Keywords: Gayo Highland, product acceptance, decision criteria, processing technique.

INTRODUCTION

Indonesia is one of the best coffee producers in the world. Besides having very diverse types of coffee based on the place or location of cultivation, such as Gayo, Java, Sidikalang, Mandailing, Toraja, Bali, Flores, and Kintamani, Indonesia also has many planted coffee varieties. Generally, the most widely cultivated coffee in Indonesia are arabica and robusta. In the Province of Aceh, arabica coffee is the most dominant type of coffee cultivated, reaching 80% of the planted area. Gayo coffee is one of the most expensive brands in the world, due to its flavour, which is highly favoured by the international community (SCAA 2005;

Herdyanti, 2013). Moreover, Gayo coffee has a distinctive aroma with complex flavour and body, which makes Gayo coffee a high-quality product that is in high demand in the world coffee market (ICCRI, 2008; Putri *et al.*, 2013). The specificity of the taste of Gayo coffee has caused the government to register it as an arabica specialty product that has obtained its own geographical index (GI) (Fadhil *et al.*, 2018a).

The name of Gayo coffee shows the location where the coffee plant is located, namely in Gayo highlands, Province of Aceh, Indonesia, which includes Aceh Tengah Regency, Bener Meriah Regency and Gayo Lues Regency (Fadhil *et*

al., 2017). This area is located in a mountainous region with temperatures ranging from 15–25 °C. The coffee plants have been cultivated by the communities in the region since 1908 and up to now have reached about 97 796 hectares of coffee plantations planted at an altitude of 1000–1600 meters above sea level (Fadhil *et al.*, 2018b). The most widely cultivated varieties of coffee plants are Bor-bor, Tim Tim Aceh, Bergendal, and Ateng Super.

Most of the Gayo coffee production (80%) has been marketed to the world market, including America, Germany, Japan, and other European countries (Almqvist, 2011; Disperindagkop Aceh, 2012; Walker, 2015). Most of the coffee export companies from the Province of Aceh (87%) already have received organic and fair-trade certificates in the marketing of arabica Gayo coffee (AEKI, 2013; Herdyanti, 2013). Development of coffee industrialisation in Indonesia is very prospective for both arabica and robusta coffee. Besides the domestic market, the potential of the international market is still open. The world coffee demand continues to show an increasing trend (ICO, 2011; Sudjarmoko, 2013). According to a report from the Ministry of Agriculture of the Republic of Indonesia (2019), the increase in coffee demand is around 10% per year.

Uniquely, several coffee flavours in the world are also found in this Gayo land. For example, the unique taste of Kintamani coffee from Sulawesi island, Indonesia, even the Colombia and Kenya coffee taste, can be found in the Gayo land. The biggest problem that is still being discovered is that the arabica Gayo coffee often has an unstable flavour. Nevertheless, the flavour rating score is always above the average of other coffee varieties. This challenge requires deeper studies of Gayo coffee, because it is difficult to define the coffee taste. Moreover, coffee flavour is greatly influenced by various conditions such as varieties, processing methods, the height of planting location, post-harvest handling, etc.

Post-harvest processing is one of the key contributing factors in producing high-quality coffee — the main methods are full wash (wet), semi-wash, and dry method (Duarte *et al.*, 2010; Joet *et al.*, 2010; Arruda *et al.*, 2012). Fermentation and roasting processes also contribute to the flavour of coffee produced, including the handling in storage and stowage (Pimenta *et al.*, 2009; Salla, 2009; Budryn *et al.*, 2011; Wang, 2012).

Considering that research on the flavour of Gayo coffee is still very limited, more research should be done in this context. This study aimed to carry out sensory evaluation of various types of arabica Gayo coffee flavours and their processing methods. The chosen varieties were the varieties that are most cultivated in the area with two processing methods, i.e. dry and wet processing. Product acceptance was evaluated based on the consumer preferences that provide an assessment of flavour sensory parameters, including fragrance, flavour, after-taste, acidity, balance, body, and preference.

MATERIALS AND METHODS

This research was conducted at the Post Harvest Technology Laboratory, Faculty of Agriculture, Syiah Kuala University. A total of four coffee varieties (Bor-bor, Tim Tim Aceh, Bergendal, and Ateng Super) were selected, which were obtained from the Gayo Highlands, Province of Aceh, Indonesia. Each of these varieties of coffee was processed through the dry and wet process. The dry process technique of coffee processing includes fruit sorting, wet coffee fruit drying, grinding, hulling, coffee bean sorting, packaging, and storing, while the wet process technique is carried out through seven stages — fruit sorting, pulping, coffee fruit milling, fermentation, washing, wet coffee bean drying, hulling, packaging, and storing (Winston *et al.* 2005).

Sensory assessment of arabica Gayo coffee flavour was carried out by ten panelists meeting the following criteria:

- a) have a basic knowledge of coffee,
- b) understand the sensory taste of coffee,
- c) are accustomed in consuming arabica Gayo coffee,
- d) the health condition is not in a state of illness (such as colds, coughs, sprue, etc.) that can interfere with the sensory testing process,
- e) are not colour blind.

The sensory evaluation used in this research uses the preference level for the coffee-brewed product being tested. It means one product and another are assessed based on the highest acceptance (most preferred).

Procedure of coffee processing. Each coffee variety was processed through the dry and wet process, and then the coffee beans were placed in closed containers (a plastic bucket) at a temperature of 25–27 °C. Coffee beans were roasted at the medium level (230 °C) for 16 minutes roasting time to produce a medium brown colour, then ground to a fine size. Further, the coffee was brewed using a semi-manual brewing machine — Delonghi 35.31, made in China.

Data processing of coffee flavour sensory assessment. Flavour sensory evaluation of arabica Gayo coffee was done using the exponential comparison method. This method is a tool for individuals in making a decision by quantifying the opinion of one or more person on a certain scale. The use of this method has been widely carried out by researchers, especially in determining the choice of decision from a number of alternatives to be chosen.

The stages in using the exponential comparison method are as follows:

1. Determination of alternative decisions. An alternative decision consisted of four varieties of arabica Gayo coffee and two types of processing methods.

2. Development of decision criteria. The decision criteria were made based on the opinion of the panelists, which had been determined previously.
3. Determination of the weight of each criteria by panelists. The criteria used in determining the importance weight of each sensory attribute on a scale is shown in Table 1.
4. Sensory assessment of arabica Gayo coffee flavour by the panelists. This assessment was conducted based on the preference score as in Table 1.
5. The calculation of values for each alternative decision was done using the exponential comparison method (ECM) formula, locally called the Metode Perbandingan Eksponensial (MPE):

$$\text{Total value } \sum_{j=1}^M (TN_i) = \sum (RK_{ij})^{TKK_j}$$

Explanation:

TN_i = total alternative value number-i

RK_{ij} = degree of importance of relative criteria number-j in decision choice number-i

TKK_j = degree of importance of decision criteria number-j; $TKK_j > 0$; round

n = number of decision choices

m = number of decision criteria

6. Ranking of the best alternative decisions according to the panelist preferences for the sensory flavour of arabica Gayo coffee of various varieties and processing techniques.

To explain the stages of the study, a business communication diagram was built using the Sybase-Power Designer 16.6 software (Sybase, 2013). The use of the business communication diagram was very helpful in understanding the role of each element in the system. This study described the role and function of researchers, data and information collection, as well as the panelists who gave the preference scores in determining the decisions on sensory evaluation of arabica Gayo coffee (Fig. 1).

Table 1. Scale of importance weight and preference score

Scale	Importance weight	Preference score
1	The least important	Like very much
2	Very unimportant	Dislike moderately
3	Unimportant	Dislike slightly
4	Neutral	Neither like nor dislike
5	Important	Like slightly
6	Very important	Like moderately
7	The most important	Like very much

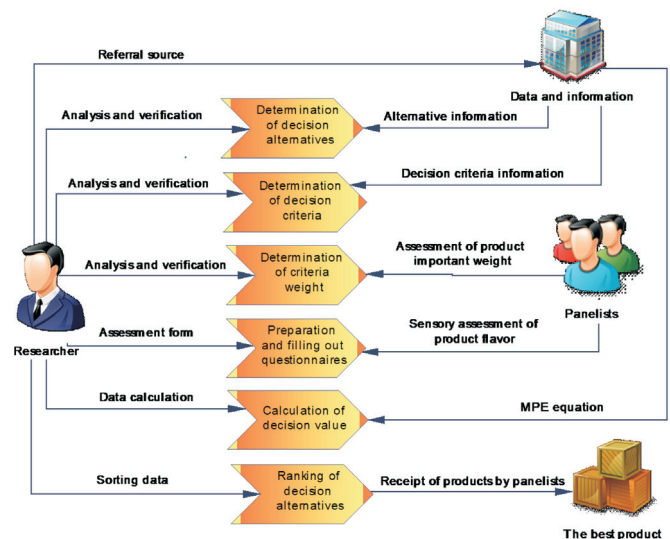


Fig. 1. Diagram business communication of sensory evaluation of Arabica Gayo coffee.

RESULTS

Results of flavour sensory assessment (sensory of coffee cupping quality) of dry and wet processing techniques on several varieties of arabica Gayo coffee were described in the form of flavour attributes based on the interpretation of acceptance levels, which included the aroma of the coffee (fragrance), flavour, after-taste, acidity, body, balance, and preference. Based on the panelist assessments of each coffee variety with each attribute of the criteria, the weight and decision values were obtained as shown in Table 2.

Table 2. Assessment of flavour sensory values of Arabica Gayo coffee in various varieties and processing techniques

Varieties	Processing	Sensory of cup quality of coffee							Decision value of ECM/MPE	The best decision
		fragrance	flavor	after-taste	acidity	balance	body	preference		
Bor-bor	Dry	5.6	5.2	5.1	4.6	4.9	5.0	5.2	398 473	5
	Wet	6.9	6.8	6.9	6.6	6.3	6.5	6.7	2 105 171	1
Tim Tim Aceh	Dry	5.4	4.9	4.9	3.9	4.4	4.7	4.7	261 589	6
	Wet	6.6	6.8	6.5	5.8	6.8	6.2	6.5	1 960 898	2
Bergendal	Dry	3.8	3.9	4.0	2.7	3.1	3.8	3.8	40 771	8
	Wet	4.9	6.0	4.8	4.8	5.1	4.7	5.8	528 427	4
Ateng Super	Dry	4.7	4.4	4.5	3.5	3.9	4.3	4.5	125 198	7
	Wet	5.4	6.1	5.3	5.5	5.5	5.0	6.2	759 096	3
Weight of importance criteria		6.9	6.9	5.7	5.9	6.8	6.5	6.7		

Generally, the best choices (number 1 to 4) for arabica Gayo coffee varieties were obtained after wet processing techniques. The four best sequences were for wet processing, shown by the decision value using the exponential comparison method (ECM/MPE): variety Bor-bor (1st choice), Tim Tim Aceh (2nd choice), Ateng Super (3rd choice), and Bergendal (4th choice). The next ranked choices were for dry processing in the same exact sequence as in the wet processing: variety Bor-bor (option number 5), Tim Tim Aceh (option number 6), Ateng Super (option number 7), and Bergendal (option number 8).

DISCUSSION

This analysis showed two interesting phenomena at once. Firstly, arabica Gayo coffee processing techniques greatly affected the taste of coffee. In a previous study (Subedi 2011), wet processing was also found to be a far better technique in producing coffee quality than the dry processing. Therefore, the wet processing method is highly recommended to produce the best quality arabica coffee flavour and is most preferred by the consumers (in this study represented by respondents). Factors that cause the differences for the wet processing technique is due to the fermentation process. A previous study (Avallone *et al.*, 2002) also reported that coffee flavour is strongly influenced by the way of processing, namely the fermentation and roasting process. The fermentation process in coffee will also reduce pH and glucose, while Ethanol and Lactic Acid will increase pH (Jackels and Jackels, 2005). The statement of Jackels and Jackels (2005) in their research entitled characterisation of the coffee mucilage fermentation process using chemical indicators: a field study in Nicaragua explains how the fermentation process affects various substances and minerals in coffee beans, which at the same time affects the taste produced.

Other studies also explained that the reduction of glucose and fructose content in wet processing is related to the water washing in the fermentation process (Knopp *et al.*, 2006), and the pH value of arabica coffee with wet processing is lower (5.3 to 5.4) compared to the dry processed (5.4 to 5.7), which means that the arabica coffee with wet processing is more acidic than with dry processing (Abubakar *et al.*, 2011). For this type of arabica coffee, the sour taste is more sought after by the coffee lover than the bitter taste sensation that is usually present in robusta coffee.

In addition, the importance of wet processing in robusta coffee testing can reduce the risk of green bean defects during the coffee grading stage (Sulistyaningtyas, 2017). Even from a financial perspective, the added value of arabica coffee in wet processing was greater than that in dry processing, meaning that wet coffee processing is more profitable for farmers (Choiron, 2010).

Secondly, of the four arabica Gayo coffee varieties that were evaluated based on sensory flavour, Bor-bor was the best variety, followed by Tim Tim Aceh, Ateng Super, and

Bergendal. This study found that Bor-bor was the most preferred variety by panelists. This finding is almost similar to the statement of Abubakar *et al.* (2011), who studied the caffeine content in the Bor-bor variety, which is higher than the other varieties, both in wet processing and dry processing. A study on the physical quality of various types of arabica Gayo coffee (Qadry *et al.*, 2017) showed that the Bor-bor variety produces the largest percentage of large seeds and also has the smallest percentage of small seed size, compared to other varieties. Therefore, the sensory evaluation of arabica Gayo coffee flavour in this study, as well as the caffeine content research (Abubakar *et al.*, 2011) and physical qualities (Qadry *et al.*, 2017) all show that the Bor-bor variety is the most important variety to be developed by farmers in the future, compared to the other varieties.

CONCLUSIONS

Processing techniques of arabica Gayo coffee greatly affected the resulting flavour. Wet processing was the most suitable processing technique for arabica Gayo coffee compared to the dry processing technique based on the sensory evaluation of flavour according to the preference of panelists. Varieties of arabica Gayo coffee that had the highest acceptance values were Bor-bor (1st choice), Tim Tim Aceh (2nd choice), Ateng Super (3rd choice) and Bergendal (4th choice). Based on this analysis, it was highly recommended to develop the Bor-bor variety coffee over the other existing varieties.

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ARABICA GAYO KAFIJAS, GATAVOTAS NO DAŽĀDĀM ŠĶIRNĒM UN AR ATŠĶIRĪGĀM PAGATAVOŠANAS METODĒM, AROMĀTA ORGANOLEPTISKĀ TESTĒŠANA

Tika testēti aromāti kafijai, pagatavoti no četrām kafijas šķirnēm ar atšķirīgām pagatavošanas metodēm. Atrasta veiksmīgākā šķirnes un metodes kombinācija, kas rekomendēta tālākai praktiskai izmantošanai.