

# Arabica Coffee Bean Quality Test With Wet Processing (Full Wash Processing) System At "Sejahtera Bersama" Farmers Group, Panti Sub-District, Jember Regency, East Java

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**Abstract.** Coffee is one of the main commodities in Indonesia. In Indonesia, coffee plantations began to grow rapidly so that potential for the development of domestic coffee. The development of people's coffee plant required support of various factors such as availability of facilities, methods of processing and postharvest handling which suitable for the coffee plantations to produce excellent coffee beans according to Indonesian National Standard (SNI).. Coffee fruit must be handled quickly into a more stable form to be safe to store for a certain period of time. Post-harvest processing has an influence on the quality and taste of coffee. The purpose of this research is finding the relationship between a wet processing system on postharvest processing with quality and taste of coffee. Based on research, wet processing coffee can produce coffee beans with better quality, than the dry processing.

## 1. Introduction

Coffee is an important export commodity for Indonesia which is able to contribute a large amount of non-oil and gas foreign exchange. In 2017 the coffee plantation area reached 1,227,787 hectares with a production of 637,539 tons. Coffee is also one of the potential plantation crops in East Java Province. Jember Regency is the third largest coffee producing area in East Java and Panti District is a potential Arabica coffee producing sub-district in Jember Regency.

In 2015, Indonesia was able to export coffee with an export volume of 502,020,679 tons, equivalent to US \$ 1,197,735,052. The export value contributed significantly to the acquisition of foreign exchange from the non-oil and gas sector and played an important role in macroeconomic stability. The contribution of coffee export value to the total value of agricultural commodity exports is 11.35 percent. Where the composition of coffee plantation ownership in Indonesia is dominated by the People's Plantation (PR) with a portion of 96% of the total area in Indonesia, and the remaining 2% is the State Large Plantation (PBN) and 2% is the Large Private Plantation (PBS) [1].

Based on the percentage of coffee plantation land ownership in Indonesia, it can be seen that the group of coffee farmers in smallholder plantations plays a very important role in coffee success in Indonesia.

The quality of Arabica coffee produced by farmers is generally low because post-harvest processing is carried out still produces random coffee, such as coffee beans produced with relatively high methods and are still mixed with other ingredients in relatively large quantities [2]. At present, the increase in coffee production in Indonesia is still hampered by the low quality of coffee beans that are produced which affects the development of final coffee production.

The development of the community coffee plants requires the support of various factors including the availability of facilities, processing methods and postharvest handling that are suitable for smallholder coffee plantations to produce coffee beans with the quality of Indonesian National Standard (SNI). Coffee quality requirements based on SNI 01-3542-2004 consist of physical, chemical and biological properties. Physical properties include performance (smell, color, and taste), seed size, seed weight, and seed hardness. Chemical properties include proximate (water, ash, fat, protein and carbohydrate), caffeine content, metal contamination and other chemical compounds. Biological properties include contamination of microorganisms, insects, and molds [3].

Coffee must be handled quickly into a more stable form so that it is safe to store for a certain period. Seed quality criteria which include physical aspects, taste and cleanliness and aspects of uniformity and consistency are largely determined by the treatment at each stage of the production process. Therefore, the stages of the process and specifications of coffee processing equipment that guarantee quality must be clearly determined. Observations of quality changes that occur during processing must be carried out regularly so that if quality deviations occur can be corrected quickly and accurately. Efforts to improve quality must be accompanied by a quality-oriented marketing mechanism so that optimal results can be achieved.

Coffee processing is very important in determining the quality and taste of coffee [4]. One factor that influences the quality of coffee is post-harvest handling because the selected processing method will affect quality. So far, most of the coffee commodities are processed in the form of primary processed products (dried coffee beans). The community coffee processing is still a low-quality coffee (quality 5 and 6) and the water content is still relatively high (around 16%). This is due to poor processing technology. Generally, random coffee that is marketed is not sorted by farmers, so that the coffee traded still contains some ingredients that can reduce the quality of coffee [5]. . Regarding these various obstacles, there is an opportunity to develop and improve the community coffee quality, one of them is the wet coffee processing technology..

This study aims to determine whether wet coffee processing systems can improve the physical quality of beans and steeping (taste) coffee produced by the farmer group "Sejahtera Bersama" Kemiri Village, Panti Sub-District Jember Regency - East Java.. The results of this study are expected to be a material consideration and reference for coffee commodity entrepreneurs, especially coffee farmers to determine the coffee processing system that will be implemented.

## **2. Theoretical Review**

Quality is the ability to describe the inherent characteristics of a product, system or process to meet the desires of consumers or a group of people related to the product, system or process [6]. Coffee quality is generally determined by consumers as well as other food or beverage products. The characteristics attached to coffee are called attributes.

Coffee taste quality can be different for every consumer or country. According to Leroy et al. (2006), taste is included in organoleptic properties that can be measured by the senses and can be influenced by physical, chemical, and agronomic and technological factors. Assessment of organoleptic quality depends on sensory evaluation. Assessment of the quality of organoleptic coffee requires practice, especially flavor from a cup of coffee which is a combination of multi-aromatic components in coffee. The application of semi-wet processing technology in post-harvest coffee is one of the efforts to improve the quality of people's coffee. Coffee will go through a fermentation process that is believed to improve taste [7].

Post harvest processing greatly influences the physical quality, flavor and chemical composition of coffee beans [12]. Physically, the quality standards of coffee beans are determined based on

Indonesian national standards for coffee bean commodities (SNI 01-2907-2008) which state the general quality requirements of coffee beans in the form of no live insects, foul-smelling seeds and or smell of mold, maximum moisture content of 12.5 % and dirt content other than coffee beans a maximum of 0.5% [8].

There are two coffee processing methods, the dry processing / natural coffee and wet (full process) [11]. However, in Indonesia there are four coffee processing methods, namely (1) processing wet-milled dry (full wash-dry hulling), (2) wet-wet processing (full wash-wet hulling), (3) semi-wet processing wet processing or natural pulp process), and (4) dry processing.

In principle, coffee fruit processing consists of two ways, namely; wet processing (WIB) and dry processing (OIB). The difference between the two methods is; wet processing uses water for stripping and washing coffee fruit, while dry processing after the coffee fruit is harvested is immediately dried (stripping the fruit flesh, parchment and epidermis done after drying) [7]. There is a fundamental difference in the taste of coffee produced from these two processes. The wet process produces a soft cup of coffee, a stronger aroma, a lighter body, a more memorable aftertaste, and higher acidity. Coffee produced from dry processes is usually superior in the body, floral, more bitter, low acidity.

Processing wet coffee produces better quality coffee beans though it takes longer time than dry processing. Wet processing can be done for small-scale (farmer level) or medium (semi-mechanical and mechanical). In principle, coffee fruit processing consists of two ways, namely; wet processing (WIB) and dry processing (OIB). The difference between the two methods is; wet processing uses water for stripping and washing coffee fruit, while dry processing after the coffee fruit is harvested is immediately dried (stripping the fruit flesh, parchment and epidermis done after drying) (Najiyati et al., 2004). There is a fundamental difference in the taste of coffee produced from these two processes. The wet process produces a soft cup of coffee, a stronger aroma, a lighter body, a more memorable aftertaste, and higher acidity. Coffee produced from dry processes is usually superior in the body, floral, more bitter, low acidity [17].

### *2.1. Dry Coffee Processing Technology*

Dry process is often used in processing robusta coffee beans. This is due to Robusta coffee beans are not as expensive as arabica. The equipment needed for processing dry processes is simpler and the workload is less, so it can save production costs. These are the steps to process coffee beans with a dry process.

#### 1. Coffee beans selection

That's same from the wet processing, sort it immediately after harvesting. Beans that are superior to low beans as a quality marker.

#### 2. Drying coffee beans

The drying process is usually carried out around 2 weeks and will produce dried coffee beans with 15% moisture content.

#### 3. Stripping beans skin and horn skin

Stripping can be performed by pounding or using a huller machine.

#### 4. Coffee beans sortation and drying

Removing the desired product with the remaining skin, parchment, broken coffee beans and other dirt.

Coffee beans will be stable if the water content is 12%.

#### 5. Packaging and Storage

Pack coffee beans with clean sacks and kept it away from sharp odored objects.

### *2.2. Wet Coffee Processing Technology*

Processing wet coffee produces better quality coffee beans though it takes longer time than dry processing. Wet processing can be done for small-scale (farmer level) or medium (semi-mechanical and mechanical).

#### 1. Postharvest Coffee Fruit Handling

The wet-processed coffee fruit must be ripe or red picking (95% red fruit). Coffee fruit that has just been harvested must be immediately sorted / separated between red, green, rotten / broken coffee and dirt.

#### 2. Peeling (pulping)

Pulping aims to separate coffee beans from the outer skin and mesocarp (part of the meat). The working principle is to release the exocarp and mesocarp of coffee fruit.

#### 3. Fermentation

The fermentation process aims to help release / remove the remaining mucus layer on the surface of the coffee parchment after the stripping process. Besides, fermentation also aims to reduce the bitter taste and increasing the mild impression on the steeping taste.

#### 4. Washing mucus (washing)

The washing process aims to remove the residual mucus from the fermentation which is still attached to the parchment. After peeling the skin of the coffee fruit, the washing process could be performed.

#### 5. Drying

Drying aims to reduce the water content in coffee beans which was originally 60-65% to around 20%.

#### 6. Parchment Peeling (Hulling)

Coffee beans produced from the process above are still coated with parchment, known as HS coffee. To remove the parchment on the coffee beans, the parchment peeling was performed. Peeling the parchment used a huller. By carrying out this stage the coffee beans produced are known as rice coffee.

#### 7. Drying rice coffee

The drying of rice coffee aims to obtain about 11% of coffee bean moisture content, to maintain storage stability. This is done 2-3 days under the sun by using drying area / drying floor / para-para. This stage of drying can also be done mechanically by heating at a temperature of 50-60°C for 8-12 hours to a moisture content of 11% (Indonesian Coffee and Cocoa Research Center, 2008).

#### 8. Packaging and Storage

Packaging dried coffee beans with water content of 11% (the limit of water content is safe to store) is using clean plastic or burlap sacks and keep it away from foreign odors.

### 3. Research Methods

#### 3.1. Research Design

This research is part of the research to improve the quality of ose (green coffee) coffee with a wet coffee processing system in the Sejahtera Bersama farmer group in Kemiri Village, Panti District, Jember Regency - East Java which is conducted in 2018.

The source of coffee fruit for the treatment of the research came from the Coffee Plantation owned by the farmer group "Sejahtera Bersama" which was located in Kemiri village, Panti District, Jember Regency - East Java. As a comparison, an analysis of the quality of ose (green coffee) coffee beans from dried processed arabica coffee with coffee beans from the wet processing system has been applied. Dry-processed coffee beans and wet-processed coffee beans from farmer groups in Durjo and Kemiri Villages were analyzed and compared as samples of treatment controls carried out by the people.

#### 3.2 Experiment Design

The sample used in this study, especially in water minimization treatment using double replication. On physical quality testing, the replication was carried out 2 times. The samples tested are as follow :

**Table 1.** The Types of Coffee Samples Tested

| Sample | Description |
|--------|-------------|
|--------|-------------|

|              |                                      |
|--------------|--------------------------------------|
| Durjo (Dry)  | Dry Coffee Beans from Durjo Village  |
| Durjo (Wet)  | Wet Coffee Beans from Durjo Village  |
| Kemiri (Dry) | Dry Coffee Beans from Kemiri Village |
| Kemiri (Wet) | Wet Coffee Beans from Kemiri Village |

### 3.3 Test Implementation

Analysis of the quality of coffee beans refers to SNI 01-2907-2008. A total of 300 grams of coffee beans were taken to analyze their physical character in the form of normal, single and defective bean percentages and the percentage of large and small beans [8].

## 4. Results and Discussion

Indonesia is one of the world's coffee-producing countries, the same as some European countries such as Brazil, Colombia and other Asian countries such as Vietnam. Most of coffee plants in Indonesia (90%) are cultivated by farmers with a relatively low level of productivity, which is only around 500 kg/ha. While private and state plantations are able to achieve productivity of 1000 kg/ha. Considered from the aspect of quality, the coffee produced is still quite alarming since most of them are included as medium grade (Grades 3 and 4). With such quality, the selling price of farmers' coffee in the market is certainly still low and this is what causes the level of coffee farmers' income is also low.

The principle of processing coffee fruit consists of two ways, namely; wet processing and dry processing [9]. The difference between the two methods is; wet processing using water for stripping and fruit washing coffee, while dry processing after the coffee fruit is harvested is dried immediately (stripping the fruit flesh, parchment and epidermis is done after drying) [7].

**Tabel 2.** Comparison of Physical Tests on Non-Processing Coffee (Dry Sports) and Processing Coffee (Wet)

| No                      | Defect Type            | Defect Total Value |              |             |              |
|-------------------------|------------------------|--------------------|--------------|-------------|--------------|
|                         |                        | Durjo (Dry)        | Kemiri (Dry) | Durjo (Wet) | Kemiri (Wet) |
| 1                       | Blackened Beans        | 8                  | 10           | 0           | 1            |
| 2                       | Partly-Blackened Beans | 2                  | 0            | 4           | 3            |
| 3                       | Brown-coloured Beans   | 6,25               | 7            | 0           | 0,25         |
| 4                       | Medium-Sized Cuticle   | 1,4                | 0            | 0           | 0,4          |
| 5                       | Small-sized Cuticle    | 3,8                | 0            | 0,2         | 0            |
| 6                       | Broken Beans           | 32                 | 36,6         | 9,8         | 2,4          |
| 7                       | Medium-sized Branch    | 2                  | 0            | 0           | 2            |
| 8                       | Small-sized Branch     | 8                  | 0            | 0           | 0            |
| <b>Total Value</b>      |                        | 63,45              | 53,6         | 14,25       | 9,05         |
| <b>Quality Category</b> |                        | <b>4b</b>          | <b>4a</b>    | <b>2</b>    | <b>1</b>     |

Source : Primary Data, 2018

Processing wet coffee produces better quality coffee beans, which takes longer time than dry processing. Wet processing can be done for small-scale (farmer level) or medium (semi-mechanical

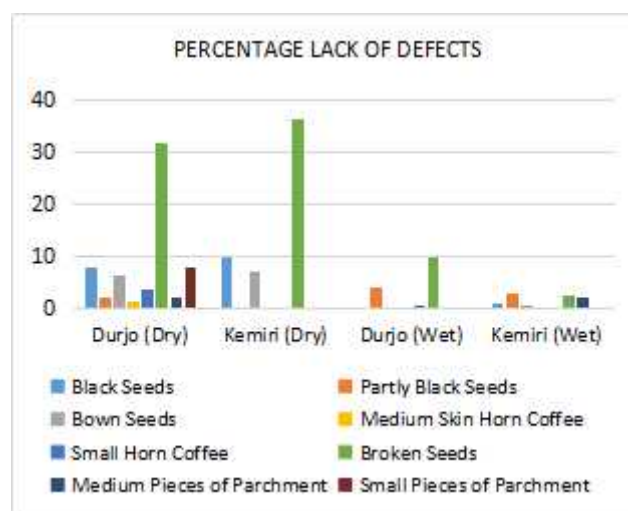
and mechanical). The results of the analysis of the physical quality of the coffee beans above are carried out based on SNI No. 01- 2907-2008 is presented in Table 2. Based on ISO 10470: 2004 standards, the classification of coffee defects includes; (a) the presence of foreign objects that do not come from coffee, (b) the presence of foreign objects not coffee beans, such as coffee bark, (c) abnormal seed shape in terms of unity (integrity), (d) abnormal seeds from visualization such as black seeds and (e) abnormal seeds that cause flavor defects after roasting and brewing [10].

Based on the table of quality test results above there are differences in the quality or grade of coffee produced. The coffee which is not treated with processing (dry) has lower quality than coffee with wet processing. Dry coffee quality ranges between 4 a and 4 b, while coffee with wet processing is included as quality 1 for wet-processed coffee from kemiri village and quality 2 for wet coffee from durjo village.

Quality Standards for Coffee Beans have been promoted since 1978 through the Minister of Trade Decree No. 108 / Kp / VII / 78 dated July 1, 1978. The quality standard of coffee beans used is the TRIASE SYSTEM. However, from October 1 1983, to determine the quality of coffee, Indonesia uses the Defects Value System according to the decision of the ICO (International Coffee Organization). In this flawed system, the more the defect value, the lower the quality of the coffee and vice versa, the smaller the defect value, the better the quality of the coffee. Based on the policy of quality standards applied in Indonesia, there are 6 coffee quality classifications from beans defect systems, namely: Grade 1 with a defect value of 0-11, Grade 2 with a defect value of 12-25, Grade 3 with a defect value of 26-44, Grade 4a with a defect value of 45-60, Grade 4b with a defect value of 61-80, Grade 5 with a defect value of 81-150, Grade 6 with a defect value of 151-225.

Blackened beans that occur due to coffee fruit disease are considered the most severe defects because the aroma of black seeds is very unpleasant and tastes like rotten wood. Black seed defects include black seed defects, partial black seeds, and broken black seeds. Broken black seeds occur due to processing. The largest percentage of black seed defects came from coffee beans without dry processing.

According to Wibowo [14] the type of defect or damage referred to in this study was divided into (1) damage from the garden, (2) damage during processing and (3) contamination of foreign objects that were not coffee beans. The type of damage that started in the garden was a type of perforated seed defects, black seeds and young seeds. The percentage of black bean defect values in each sample has been presented in Figure 2.



**Figure 1.** Percentage of Black Bean Defects in Dry and Wet Seeds

Blackened beans defects can also come from young coffee fruit. The young fruit with a certain level of maturity, if it is processed, will produce black wrinkled coffee beans, while the older one will produce smooth green beans. Perforated beans defects are mainly caused by insect attacks, namely coffee beans borer pests (coffee beans powder pests) (*Hypothenemus hampei* Ferr). Coffee fruit that is attacked by powder pests will dry on the stalk or fall to the ground and perforate. The coffee beans will be pale reddish yellow like ripe coffee beans so that after processing it becomes blackened beans defects. Perforated beans can cause chemical quality damage.

The broken beans and beans with parchment defects can occur during complex skin stripping, that is, if the huller did not work perfectly. Beans with parchment are coffee beans which are still wrapped by parchment that wrap the seeds intact or equal to or greater than the whole parchment. While broken seeds are coffee beans that are not intact with the same or less than  $\frac{3}{4}$  of the whole seed. Broken seed defects can also occur during the process of peeling coffee fruit peels (pulping).

Another foreign body contamination is due to the presence of large, medium and small coffee skins. Based on SNI, large coffee skin is a compound skin (pericarp) of spindle coffee with or without skin (silver skin) and the cuticle (parchment) inside which is larger than  $\frac{3}{4}$  of the whole pericarp. While the skin is considered as medium if the size is between  $\frac{1}{2}$  to  $\frac{3}{4}$  of the whole pericarp. Small coffee skin size is less than  $\frac{1}{2}$  of the whole pericarp.

Foreign matter in the form of large, medium, and small twigs, soil, and stones were included as foreign contamination. Twigs, soil, stones are categorized as large if they have a length or diameter of more than 10 mm. Twigs, soil, stones are considered as medium and small size if they have a length or diameter of 5 mm - 10 mm and less than 5 mm. Coffee samples without processing (dry coffee) have a percentage of defects in the content of foreign matter twigs, soil and stones greater than coffee samples with half-wet processing. The content of twigs in coffee beans is possible because in dry processing there is no sorting treatment before drying. Soil and stones contamination can occur during the drying process which generally uses tarpaulin as a base on the ground.

#### 4.1 Testing of Arabica Coffee Beans Taste

The taste test in this study was conducted by expert and trained panelists from the Coffee and Cocoa Research Center, Jember. Standardized arabica coffee taste tests include fragrance / aroma testing, flavor, aftertaste, acidity, body, uniformity, balance, clean cup, sweetness, and overall. Fragrance is the aroma of roasted coffee before adding water. The scent was assessed after hot coffee was added to the roasted coffee in the cup. Coffee beans are the main ingredient of coffee brewing. The complete results of Arabica coffee bean taste test were presented in the following table.

**Table 3.** The Results for the Taste of Dry and Wet Prosesrd Coffee in Kemiri Village,

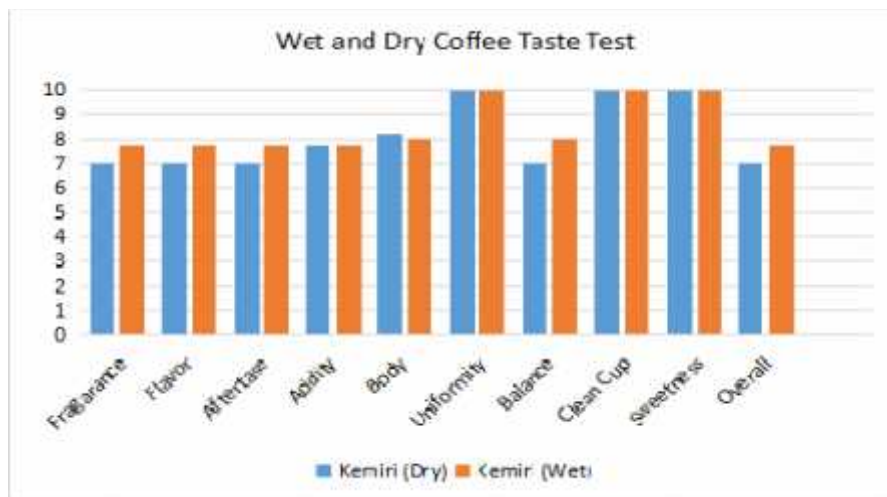
| No | Characteristics   | Kemiri (Dry<br>Prosesing<br>Coffee) | Kemiri (Wet<br>Prossing<br>Coffee) |
|----|-------------------|-------------------------------------|------------------------------------|
| 1  | <i>Fragarance</i> | 7,00                                | 7,75                               |
| 2  | <i>Flavor</i>     | 7,00                                | 7,75                               |
| 3  | <i>Aftertase</i>  | 7,00                                | 7,75                               |
| 4  | <i>Acidity</i>    | 7,75                                | 7,75                               |
| 5  | <i>Body</i>       | 8,25                                | 8,00                               |
| 6  | <i>Uniformity</i> | 10,00                               | 10,00                              |
| 7  | <i>Balance</i>    | 7,00                                | 8,00                               |
| 8  | <i>Clean Cup</i>  | 10,00                               | 10,00                              |
| 9  | <i>Sweetness</i>  | 10,00                               | 10,00                              |
| 10 | <i>Overall</i>    | 7,00                                | 7,75                               |

|              |              |              |
|--------------|--------------|--------------|
| <b>Score</b> | <b>81,00</b> | <b>84,75</b> |
|--------------|--------------|--------------|

Arabica coffee fragrance or aroma tends to increase due to the treatment of wet processing on the coffee. Treatment of water use shows an increase in fragrance intensity and aroma of coffee compared to non-processed (dry) coffee. Steeping test results for flavor and body show a similar pattern from the fragrance and aroma test. The quality and intensity of flavor, aftertaste, acidity and body values tend to increase in coffee with wet processing, although the difference is not significant. According to Sulistyowati [15] arabica coffee has a lower body even though the aroma and its flavor are higher than robusta coffee.

The wet processing coffee contains higher trigonellin, 4,5-dicaffeoylquinic acid and clogenic acid, but the sucrose content is lower than the results of dry processing. There is no significant difference in caffeine content and profile of the distribution of chlorogenic acids in coffee produced from wet processing and the results of dry processing [13]. The composition of 5-CQA and trigonellin compounds can be used to separate good quality coffee from low quality [11]. Total sugar content, body and titrated acid can be used to distinguish between dry and wet processing coffee [11].

Dry-processed coffee generally produces coffee beans with inconsistent quality. The taste will be better if before drying beans are broken down first (Sulistyowati, 2001), as most farmers in East Java do. The imperfect dry processing can cause taste defects, such as earthy, moldy and musty. However, if the dry process is well done, it can produce a higher body [10].



**Figure 2.** Comparative Chart of Taste Testing Result of Dry and Wet Processing Coffee Taste Test of Kemiri Village

Based on the chart above, it can be concluded that there are differences in the test results on the Kemiri Village coffee produced without being processed (dried) with coffee that has been treated with a wet processing system. Wet processing on the Kemiri Village coffee beans can increase the fragrance /aroma, flavor, aftertaste, balance and overall on coffee, but for the level of viscosity or the body of the wet coffee that is tested slightly decreased compared to dry coffee.

The next taste parameters of robusta coffee are balance and preference. Balance on the cup test shows a harmonious or balanced taste terminology that was clear and difficult to express. Harmony also shows proportionality in quality and mild/mild character without dominance. Balance is a combination of flavor and textural sensation or between aftertaste and flavor in steamed coffee. Based on the picture above it was known that coffee with wet processing is more balanced in taste than dry coffee.

In general it can be concluded that coffee with wet processing can increase the value or score of coffee produced. This showed that wet processing on coffee can be beneficial for farmers to increase the coffee they produce.



### **5. Development Of Wet Coffee Processing Technology In Farmer Levels**

Smallholder coffee farming generally consists of small gardens (area of 0.5 - 2 hectares), where with these conditions it is advisable to conduct processing business in groups. The stages of wet processing for red pickled coffee can improve the quality of low quality coffee. The added value of wet coffee bean processing technology will produce coffee beans of better quality, namely 1 and 2. While the processing of farmers' original coffee beans is usually still in quality 6. With the wet processing, a better quality and better the spirit of the relatively higher selling price of the original coffee beans. Mechanical processing equipment that can be used in groups, among others [16]. Therefore, the wet processing system for coffee, mainly coffee, needs to be done because it has been proven to improve the quality of the coffee produced.

### **6. Conclusion**

In general, coffee processing with a wet system can improve the physical quality and taste of coffee beans produced compared to the quality of coffee beans with dry or non-processing systems.

### **7. Suggestion**

Resources The Wet Processing System in the post-Arabica Coffee Fruit harvest is important to improve the quality and taste of the coffee produced.

- [13] Duarte, G. & A. Farah (2008). Chlorogenic acids and lactones on Brazilian commercial Coffees. Proceedings 22nd International Conference on Coffee Science (ASIC) 2008. p. 224—227. Campinas, Brazil..
- [14] Wibowo, W. 1985. Evaluasi Karakteristik Berbagai Jenis Biji Kopi Cacat dan Sifat Organoleptik Seduhannya. Skripsi Fakultas Teknologi Pertanian IPB Bogor.
- [15] Sulistyowati. 2001. Faktor yang Berperan Terhadap Cita rasa Seduhan Kopi Warta Pusat Penelitian Kopi dan Kakao Indonesia 2001. **17 (2)**, 138 - 148.
- [16] Pusat Penelitian Kopi dan Kakao Indonesia. 2008. [icri.net/pengolahan kakao](http://icri.net/pengolahan-kakao). Diakses pada Tanggal 20 Agustus 2018.
- [17] Sugiarto, Yusron. 2013. Teknologi Pengolahan Kopi secara Baah. Pertemuan Gelar Teknologi Sarana dan Prasarana Pengolahan. Dinas Perkebunan Provinsi Jawa Timur.

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