

Effect of different post-harvest processing on the sensory profile of Java Arabica coffee

Wenny B. Sunarharum*, Sudarminto S. Yuwono, Hasna Nadhiroh

Food Sensory and Applied Science, Department of Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Brawijaya, Malang, Indonesia

KEYWORDS

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ABSTRACT

Coffee consumption in the world is continuously growing and demanding high quality. Coffee cup quality is a complex matters involving several factors that includes post-harvest processing factor. The objective of this research is to investigate the impact of different coffee post-harvest processing methods i.e. fermentation methods (natural/dry, semi-washed and fully-washed processing), and drying methods (mechanical and sun drying) on the sensory quality of Java Arabica medium-roasted coffee beans. The sensory quality was evaluated through cupping test employing five expert judges. The result revealed that different post-harvest processing factors has a significant influence on coffee sensory quality, particularly on four cupping attributes, namely fragrance/aroma, flavour, defects and final scores. Fermentation using more water and controlled mechanical drying were found to yield a better coffee sensory profile due to less identified defective characters in the cup. Nevertheless, different processing created specific coffee character that would have its own market provided the quality is properly controlled.

Introduction

The popularity of coffee had been well-acknowledged worldwide. Millions of people depend on coffee and coffee-based products for their livelihoods. Therefore, it's economic and social impact is inevitable. Coffee export activities had shown considerable growth recently (ICO, 2018) in response to the increase in demand. Coffee consumption data is growing, not only in the consuming or importing countries but also in the producing countries showing the potential of coffee market. As an example, based on ICO data in 2018 (ICO, 2018), Indonesia as the world 4th coffee producers has currently climbing from the 7th coffee consumer in 2016 to become the 6th in 2017.

Coffee quality is an important factor that driven the world's demand. However, coffee quality is quite complex as previously reported by Sunarharum et al. (2014). One of the important factor was thought to be the post-harvest processing method where coffee cherry was translated into green coffee beans (Sunarharum et al. 2018).

The most common method of green coffee processing, or coffee fermentation methods are natural (dry) and washed (wet) process. Previous

research had reported the influence of post-harvest processing methods on coffee defects and or coffee quality (Mori et al. 2003; Yusianto and Widiotomo, 2013; Sunarharum et al. 2018). The impact of post-harvest processing particularly on green coffee sensory profile difference had also been acknowledged (Sunarharum et al., 2018). However, further research is required to investigate its influence on the cup profile due to significant transformation of coffee during roasting process. This research aimed to investigate the impact of different coffee post-harvest processing methods including three different fermentation methods (natural/dry, semi-washed and fully-washed processing), and two drying methods (mechanical and sun drying) on the sensory quality of Java Arabica roasted coffee beans. Since local coffee development had gain more attention nowadays, the result of this research is expected to have an important contribution for this purpose. The results and sensory profile will aid as the information for further quality improvement and marketing strategy applicable for local coffee commodity being studied.

* Corresponding author
E-mail address: wbsunarharum@ub.ac.id

Research Methods

Materials

Green coffee beans used in this research was obtained from research by Sunarharum et al. (2018). Those samples were Java Arabica coffee cultivated on the slopes of Arjuno Mountain, Universitas Brawijaya (UB) Forest Malang, East Java processed under three different fermentation methods i.e. natural/dry, semi-washed and fully-washed followed by two different drying methods i.e. sun drying and mechanical drying (each of 3 kg). The samples were further roasted into medium roasted level by a local commercial coffee roaster and packed before sensory evaluation. Other equipment involved includes digital balance and cupping test equipment.

Methods

Sensory quality of 6 (six) samples (NM = Natural, mechanical drying; SM = Semi-washed, Mechanical drying; FM = Fully-washed, Mechanical drying; NS = Natural, Sun drying; SS = Semi-washed, Sun drying; FS = Fully-washed, Sun drying) were evaluated using standard cupping protocols (SCAA,

2015) performed by 5 (five) expert judges or cuppers from local coffee industries. Samples and water to coffee ratio were prepared according to this standard, 55 g of coffee/litre of water (8.25 ± 0.25 g whole beans to 5.07 fluid ounces or 150 mL of water). The cupping worksheet was also based on SCAA cupping test form, which involved fragrance/aroma, flavour, aftertaste, acidity, body, balance, uniformity, clean cup, sweetness, overall, and defects. The description for each attributes can be seen in Table 1. Score from 0-10 was used in the assessment of each attribute. Final score was the sum of scores for all primary attributes (called as a "total score") deducted by defects score. Final score of more than 80 points were classified as specialty quality.

Quantitative and qualitative data were collected and tabulated in Microsoft Excel 2013. Descriptive statistics, Analysis of Variance (ANOVA) and post-hoc Tukey-Kramer HSD at 95% confidence interval were performed using XLSTAT version 2015 (Addinsoft, New York, USA).

Table 1. Description of attributes used in coffee cupping

Attributes	Description
Fragrance/Aroma	fragrance: the smell or aromatic aspect of the dry ground coffee aroma: the smell or aromatic aspect of coffee when infused with hot water
Flavour	combination of aroma and taste quality perceived, the "mid-range" notes from the first aroma and acidity to final aftertaste
Aftertaste	duration of positive flavour remaining at the back of palate after swallowing or spitting coffee
Acidity	brightness (favourable) or sourness (unfavourable) when the coffee is first slurped into the mouth
Body	mouthfeel or tactile feeling in the mouth, perceived heaviness or thickness between the surface of tongue and roof of the mouth
Balance	balance combination of all aspects of flavour, aftertaste, acidity, and body, with no overpowering attributes
Sweetness	pleasant flavour and any obvious sweetness
Clean Cup	transparency of the cup with less negative impressions or defects
Uniformity	flavour consistency of different cups tasted
Overall	overall or holistic rating of the sample
Defects	negative flavours, classified as taint (noticeable off-flavour, usually on aromatic aspects) and fault (off-flavour, usually on taste aspects)

Source: SCAA (2015)

Result and Discussion

In this research, coffee was roasted at a medium level since coffee flavor is fully developed in this state (Illy and Viani 2005). All coffee samples from UB forest (Arjuno Mountain, Malang) were evaluated by 5 (five) expert judges following an SCAA standard cupping test protocols. The resulting scores for cupping test are summarized in Table 2 and analysis on product or sample effect based on ANOVA is presented in Table 2.

As can be seen in Table 2, in general, fully-washed coffee showed the best performance as

compared to the other methods. Naturally sundried coffee was scored the lowest quality while fully-washed sundried coffee was rated the highest. More agreement between judges was observed on the score of fully-washed processing than the other methods. However, all coffee samples had a final score of below 80 points based on SCAA quality qualification showing the need of quality improvement. It is not surprising considering that this is the first harvesting and production of coffee from Arjuno Mountain under UB Forest management.

Table 2. Cupping scores of medium-roasted coffee processed under different post-harvest processing methods

Postharvest processing	Cupping attributes											
	FRA	FLA	AFT	ACI	BOD	UNI	BAL	CLE	SWE	OVE	DEF	FS
NM	8.4	8.1	7.1	7.9	6.9	7.5	7.2	7.3	7.6	7.9	2.0 b	72.6 ± 7.2 ab
SM	7.6	7.5	6.8	7.7	6.8	7.9	7.1	7.2	7.2	7.6	2.8 b	70.4 ± 7.4 ab
FM	8.2	8.0	7.2	7.8	7.0	8.1	7.5	7.6	6.7	7.6	2.4 b	73.2 ± 4.2 ab
NS	7.8	6.9	7.5	7.4	7.6	7.3	7.0	6.6	6.0	7.0	9.6 a	61.3 ± 5.9 b
SS	7.7	7.7	7.3	7.4	6.4	7.9	7.6	7.2	6.8	7.4	4.8 ab	68.6 ± 7.1 ab
FS	8.3	8.0	7.7	7.7	7.0	7.2	7.5	7.9	6.6	7.9	1.2 b	74.4 ± 4.8 a

NM = Natural, mechanical drying; SM = Semi-washed, Mechanical drying; FM = Fully-washed, Mechanical drying; NS = Natural, Sun drying; SS = Semi-washed, Sun drying; FS = Fully-washed, Sun drying.

FRA= fragrance/aroma; FLA=flavour; AFT=aftertaste; ACI=acidity; BOD=body; UNI=uniformity; BAL=balance; CLE=clean cup; SWE=sweetness; OVE=overall, DEF=defects, FS=final score ± standard deviation.

Data mean scores (n= 5)

Means followed by different letters indicated significant different ($\alpha=0.05$)

Based on Table 3 it can be seen that there was product effect particularly on fragrance/aroma, flavour, defects and final scores. It means that the samples can be identified due to significant different in the scores of those four attributes while other attributes were rated similarly. Coffee sensory evaluation was found to be challenging particularly on the differentiation between samples based on the cupping attributes. Variability was found between judges indicating the requirement of cuppers' recalibration, regardless of their experiences in several coffee cupping sessions. Nevertheless, the variation as shown by standard deviation on the final score was generally below 10% (Table 2).

Table 3. Identification of the cupping attributes for which there is a product effect

Cupping attributes	F	Pr > F
FRA (fragrance/aroma)	2.44	0.07
FLA (flavor)	2.89	0.04
AFT (aftertaste)	0.96	0.47
ACI (acidity)	0.32	0.90
BOD (body)	1.77	0.16
UNI (uniformity)	1.12	0.38
BAL (balance)	1.06	0.41
CLE (clean cup)	1.50	0.24
SWE (sweetness)	1.94	0.13
OVE (overall)	2.05	0.12
DEF (defects)	9.92	< 0.0001
FS (final score)	7.40	0.00

Values in bold were not significant ($\alpha=0.05$)

Defects on the cups could be distinguished as shown by significant different found on this attribute ($\alpha=0.05$). This defect also had contributed a lot on the variation of coffee final score. Specifically, defect scores for each post-harvest processing methods was tabulated in Table 4.

Table 4. Defect scores of medium-roasted coffee processed under different post-harvest processing methods

Post-harvest processing	Means	
Fermentation method	Natural	5.8 ± 1.1 a
	Semi-washed	3.8 ± 1.1 ab
	Fully-washed	1.8 ± 1.1 b
Drying method	Sun drying	5.2 ± 0.9 a
	Mechanical drying	2.4 ± 0.9 b

Data mean scores (n= 5); Means followed by different letters indicated significant different ($\alpha=0.05$)

Coffee defects in the cupping test were evaluated as a poor flavour that could be differentiated into taint and fault. Where taint is defined as a noticeable abnormal aroma component, fault is an overwhelming off-flavour in the taste aspects. The defects observed in the sample was mainly described as unpleasant or poor aroma described as sour (acid) and fermented notes.

Defective character in the roasted and brewed coffee is related to the quality of the materials, which is the green coffee beans. Green coffee beans may contain undesirable compounds contributing to off-flavour, which is mainly a by-product of microbial activity (Toci and Farah, 2008). Several

factors from the cultivation, environmental and climate influence, coffee cherry harvesting, post-harvest processing and storage contribution on the coffee constituents and quality had been well-acknowledged (Sunarharum et al., 2014, 2018; Farah, 2012).

Previous research by Sunarharum et al. (2018) on green coffee beans had reported that natural and sun-dry processing yield more coffee defects as compared to other methods. This is due to prolong drying under the sun for 7 up to 21 days, where the temperature could not be carefully controlled. The mechanical drying at 45°C (4 up to 6 days) is therefore could produce less coffee defects. The defects in the green coffee beans as reported in Sunarharum et al. (2018) may includes black, partly black, brown, the presence of husk (large, medium, small size), dried cherry, and the presence of holes (one or more holes), spotty beans, broken beans, and beans with coffee parchments (large, medium, small size). However, immature beans, black, sour, black-immature, bored or insect damaged and broken beans had been reported to be mostly relevant for coffee quality (Toci and Farah, 2008).

Roasting of green coffee beans is a very important step in creating coffee beverage with a specific pleasant cup profile. Green coffee beans followed coffee roasting process in attempt for translating green, grassy, raw profile into more pleasant and aromatic coffee drink. Coffee processing steps are responsible for the transformation and biogenesis of chemical compounds important for coffee cup quality (Farah et al. 2006). In the coffee brew, the flavour was influenced by aroma volatiles released during brewing (Baggenstoss et al., 2008). When the batch containing defective green beans were further roasted and brewed, the cup quality would be low due to defective notes that could be carried out into the cup.

Besides roasting, brewing or extraction process is also influencing coffee beverage quality. In this research, coffee is roasted in medium level where coffee is in its flavourful stage. Based on the result, washing or wet fermentation produced a higher quality coffee as supported by previous research (Mazzafera and Padilha-Purcino, 2004) that wet processing produce a coffee with a more pleasant aroma and flavour. The use of no or less water during fermentation may produce coffee with particular profile influenced by the coffee fruits. Naturally processed medium-roasted coffee exhibited winey, berries, floral, acidic aromas and complex flavour, while semi-washed coffees showed berries, citrus, woody, chocolate notes, and balance

character. The fully-washed profile was found to be milder, described as exhibited chocolate, caramel, and roasted nut aromas along with a bright and smooth character.

Conclusions

Post-harvest processing methods including fermentation and drying was found to be responsible for the sensory quality of medium-roasted Java Arabica coffee beans originated from Arjuno Mountain. Product effects could be identified based on four cupping attributes i.e. fragrance/aroma, flavour, defects and final scores. The defect attributes expressed mostly as taints such as sour (acid) and fermented aroma had contributed significantly to coffee final score, particularly for naturally processed coffee combined with sun drying method.

The use of more water during fermentation or washing or wet processing had produced coffee with a better sensory quality. The fully-washed coffee was found to perform the best. Besides fermentation, different drying method was found to influence coffee sensory quality as well. The mechanical drying produced higher quality coffee potentially due to the application of controlled drying temperature that results in less observed defects. Nevertheless, different processing created specific coffee character that would have its own market provided the quality is properly controlled. The information of this research will be useful for the improvement of UB Forest, Arjuno Mountain coffee quality.

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Conflict of interest

The authors declare that there is no conflict of interest in this publication.

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