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Effect of methods of processing on Raw and Intrinsic quality of Sidama and Yirgacheffee coffee type

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Abstract

Coffee quality can be affected by variety, climate and soil factor, field management practices and post harvest handling and processing techniques. Arabica coffee (*Coffea arabica* L.) is an economically important crop, which is contributing the highest of all export revenues in Ethiopia. The study was undertaken in Dilla zuria and Yirgacheffee districts, representing the known Sidama Yirgacheffee coffee brands, respectively, in South National Nationalities Peoples' Regional State. The objective of study were to examine the effect of methods of processing on raw and intrinsic quality of Sidama and Yirgacheffee coffees and to identified the best methods of processing that can keep the inherent quality of coffee landrace of Sidama and Yirgacheffee specialty coffee. For this, fully ripe red cherries were hand collected from local coffee types. The harvested cherries were separately study under three processing methods (washed, semi-washed and sundried) at the two locations. In each case the treatment arranged in factorial experiment in completely randomized design with three replication. Data on raw and intrinsic quality (shape and make, color, odor, acidity, body, flavour and cup quality) were recorded. The result indicated the shape and make of green bean, the other quality parameters (color, odor, acidity, body, flavour and cup quality and total quality) were significantly different due to methods of processing at both sites. Among the processing method the wet processing resulted in the superior coffee qualities as compared to others at the two study areas. In addition, most quality traits significantly differ due to the interaction effects arising from location and processing method. The result finding also demonstrated that Yirgacheffee coffee was better than Sidama coffee types in terms of raw quality attributes, possibility due to positively effect of increased altitude in terms of quality attribute. The present findings would help at a small measure, on optimum processing practices to be applied at each locality and thus improve the inherent quality of Sidama and Yirgacheffee specialty coffees as the faces of increasing market demand for best coffee type. Nonetheless further repeated studies should be undertaken by taking into account among other the present physical and sensory attributes, other compounds and biochemical constitutes (caffeine, sugar.etc) with view of mapping the quality profile off Sidama and Yirgacheffe coffees grown under the various site and environmental conditions.

Keywords: Coffee, Cup quality, Methods of processing, Raw quality

1. Introduction

The word "coffee" comes from the name of a region in Ethiopia where coffee was first discovered – 'Kaffa'. The name 'Kaffa' is inherited from the hieroglyphic nouns 'KA' and 'Afa'. 'KA' is the name of God, 'AFA' is then of earth and all plants that grow on earth. So the meaning of Koffee (Coffee) from its birth-place bells on as the land or plant of God. In addition to this, as a result of the genetic diversity of Ethiopian coffee, botanists and scientists agree that Ethiopia is the centre for the origin, diversification and dissemination of coffee plant (Bayetta, 2001). According to (Tadse, 2015), there are four types of coffee production systems in Ethiopia: forest coffee (10%), semi forest coffee (35%), garden coffee (50%) and plantation coffee (5%). Climatic factors, type of soil, mulching, farm management method, crop production methods, etc. are among the prominent factors that affect the growth and development of plants including coffee.

Geographically, coffee grows between the tropics of cancer and tropic of Capricorn. Outside this area, there is opportunity for frost, which can damage the coffee plant. Hilly mountainous areas near the equator are more likely to be exposed to frost (Clifford and Willson, 1987). The main coffee growing areas are Latin America, Africa, Caribbean Islands, the Arabian Peninsula, and Indonesia. In choosing a given location for coffee growing, the chief considerations are altitude, soil, climate, diseases, and economy (Alistain, 2002).

Ethiopian Economy is highly dependent on agriculture. Among the agricultural production, Coffee sub-sector plays a major role in the economy of the country. Arabica coffee is the biggest source of foreign currency earning and has a major contribution to Gross Domestic Product (GDP) (Surendra and Ann, 2000), Which takes the lion's share of the foreign exchange earnings, fetching up to 35% the total GDP. Coffee cultivation plays a vital role both in the cultural and socio-economic life of the nation. About 25 %, (15 million) of the Ethiopian population depend, directly or indirectly on coffee production, processing and marketing (Esayas, 2005).

The Yirgacheffee and Dilla Zuria Woredas is the main coffee growing area of SNNPRS (MOARD, 2006). In Yigacheffee, from total area of 30,407ha, 20.080ha is covered by coffee production, with improved or new planted, stumped trees and mother trees covered

2950ha, 1184.31ha and 15945ha respectively. In Dilla zuria woreda from total of 13,934ha, 10,372ha is covered by coffee production with improved, stumped and mother trees. According to (Bartolo, 2008) the Yirgacheffe coffee the king of the flavour in the world with unique character of test and flavour incompetent quality. This idea also supported by (Bellachew et al., 2006) Yirgacheffee and Sidama brand are now internationally recognized and registered as properly right to Ethiopia with their distinct character /flavour and taste. AS ISO, 2003a stated most importers prefer wet processed coffee rather than dry processed which have superior price with superior quality. In both area, the wet processing of coffee products play major role for farmer sustainability. Even if dry processing methods are highly dominate in the areas, the farmers are getting premium price from wet processed coffee. According to (Silvetz and Desrosier, 2005) the method of processing of coffee determines the quality. The three main methods of processing are wet, dry and semi-washed. Wet processing is preparation of coffee by using apple amount of water that involves cherry harvesting, pulping and mucilage removal, dry processing is preparation of coffee by using natural sun involves harvesting, drying and hulling and the semi-wash process is the skin of the fresh cherry is physically removed by a pulper machine with addition of water, as with full-wash processing. Notably this process does not ferment the mucilage as it is mechanically removed. Immediately after pulping, the clean parchment is ready for drying until the bean inside reaches 12% moisture.

According to ISO, 2004 quality in coffee is keeping the inherent characteristics of cherries this is mostly affected by genotype, environment, processing methods, fermentation, storage conditions etc. Proper management and appropriate process can not at all improves the inherent quality of an input, it rather maintain it (Kamau and Warugun, 2002). On the other hand, bad processing can easily spoil the very good inherent quality of an input. Poor quality inputs can never be improved by good processing. Therefore, quality coffee can only be obtained from the field, which means proper selection of seed from the farm (Asledu, 1990).

Wet method is mainly used on Arabica coffee and is extensively used in Kenya. It produces superior quality coffee, which require more care than dry processing. Hence, the beans appearance, thus rendering the batches more valuable (Michael, 1963). Any coffee, be it Arabica or another type, does not belong to this superior category but still processed by the wet method, is qualified as wet. In Ethiopia, wet processed coffee only covers 30% and 70% prepared by dry processing (MOARD, 2008). Fully washed is the name given to coffee prepared by wet processing that has been fermented (Michael, 1963).

The main problem of wet processing in coffee quality is fermentation time. Under and over fermentation cause a great problem in both raw and cup quality of coffee (FAO, 2002). According to (Silvetz and Desrosier, 2005) little over fermentation cause onion flavour in cup and final over fermentation leads to development of stinker beans, which affect all lot of parchment coffee cause, foul or urea test in cup, decrease raw attractiveness of coffee, and become red color in appearance. In addition, the methods of processing affect the inherent quality of by damaging the physical appearance of coffee and by changing its superior quality when test.

Since, due to this existing gap concerning coffee processing to keep inherent quality, and method of processing have a significant effect on coffee quality so that the objective of study were to examine the effect of methods of processing on raw and intrinsic quality of Sidama and Yirgacheffee coffees and to identified the best methods of processing that can keep the inherent quality of coffee landrace of Sidama and Yirgacheffee specialty coffee. Therefore, it is undoubtedly very crucial to carry out research activities in order to properly manage our green gold resource coffee and to be competent in the worldwide by keeping its unique inherent quality standards.

2. Materials and Methods

2.1 Description of study area

The study was conducted in Ethiopia at Gedeo zone, Dilla Zuria and Yirgacheffee woredas during the main coffee-harvesting season. They are located 365km and 395 km, respectively, south of Addis Ababa –Moyale road in South Nation Nationalities and Peoples Regional State (SNNPRS). The studies were conducted at Dilla Zuria Woreda at Chichu coffee wet processing Limited Company and at Yirgacheffee

Woreda Huffurisa coffee wet processing co-operative Company.

The Yirgacheffee site was located within latitude of 8°20'N and longitude 42°16'E and at an elevation of 2400 m.a.s.l. The area had a humid climate with an average annual air temperature of 20° C. The monthly mean temperature ranges from highest 28° C to the lowest 12° C. The average annual precipitation was about 2150 mm, which ranges from 1800 to 2500 mm. The high rainfall felled between August and November and the medium rainfall season felled between March and June. Concerning the agro-ecological coverage, 92 % was highland (*dega*) and 8 % was medium altitude (*woina dega*). From total area of 30407 ha, 20,080 ha was covered by coffee production, with improved (new planted), stumped trees and mother tress covered 2950 ha, 1184.31 ha and 15945.69 ha respectively. Concerning coffee growing peasant Associations from 30 peasants, 24 were major, 4 were medium and 3 were low coffee produces. The area had both wet and dry processing plants/companies. There were 38 wet processing companies of which 29 were owned by private companies, and 9 were owned by co-operative companies. And also 16 dry processing companies, of which 12 privately owned, 1 owned by co-operative and 3 owned by government.

The Dilla Zuria site was located within latitude of 6°20' N and longitude 38° 16'E and at an elevation of 1500 m.a.s.l. It was possess sub-humid tropical climate receiving mean annual rainfall of 1500 mm, which ranges from 1200 to 1800 mm. The rainfall pattern was bi-modal, with short rainy season between March and May, accounting for about 30 % of total rainfall, and long rainy season lasts between July and October, accounting for more than 60 % of total annual rainfall. The mean monthly air temperature was 21.5° C with mean monthly maximum and minimum temperature of 25° C and 18° C, respectively. From total area of 13,934 ha, 10,372 ha was covered by coffee production, with improved (new planted), stumped and mother trees. The area had both wet and dry processing company. There were 18 wet processing plants, of which 14 were private companies owned and 4 were co-operative companies. There were also 16 dry processing companies, 14 were privately owned, and 2 were owned by co-operative.

2.2 Materials

The materials that were used in the experiments are coffee cherries, plastic fermentation pot, pH meter, shading materials, fermentation water, pulping machine, washing pot, coffee drying bed, cups, moisture measurement instrument, roasting machine, screen seiver, spoons. The coffee fruits were collected from the local farmer.

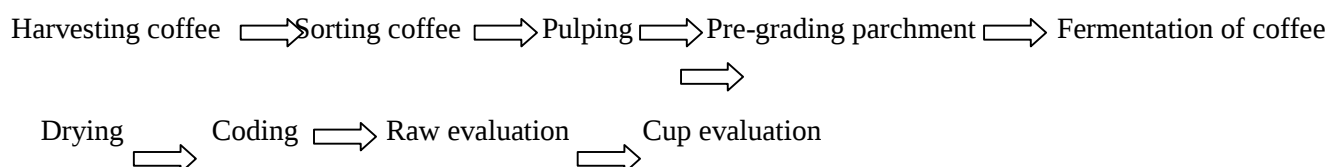
2.3 Experimental design and layout

Two experiments were carried out in the two locations, Dilla Zuria and Yirgacheffee woredas. The experiment was carried out to compare the quality

different between natural (sundry), wet and semi-washed processing with three replication. Hence, the total treatment combinations were 6 in the two study sites. Completely randomized design (CRD) with three replications was used to analyze the data under the more homogeneous laboratory conditions, where environmental effects are relatively easy to control (Gomez and Gomez, 1984).

2.4 Experimental procedure

The used experimental procedure or steps to evaluate coffee bean



2.5 Sampling and sample size

Three farmers to each site were selected with criteria that have high yielding coffee trees and best cultivation practices. From each farmer the coffee trees, which have best production randomly selected to each treatment, that means selection of high yielding coffee trees per treatments. Therefore, total sizes of samples were 42 high yielding coffee trees in both sites. The coffee cherries were collected from young or old stumped high yielding trees.

2.6 Parameters

Both qualitative and quantitative coffee quality parameters were taken. The laboratory measure was done in Addis Ababa Quality Control and Auction center.

2.8.1 Qualitative parameter

Parchment analyses were taken and overall observation of parchment like color, fermentation (over or under), improper fermentation, etc were seen and evaluated. .

2.8.2 Quantitative parameter

According to quality determination parameters raw quality was account for 40% and intrinsic quality of 60% (ECX, 2015)

2.8.2.1 Raw quality coffee analysis

This accounts for 40 %. The shape and make, colour and odour were evaluated as flows.

Shape and Make

This parameter was evaluated from 15 %. If it very good, it was score 15 %. If it good, average, mixed, and small it was score 12 %, 8 %, 5 %, and 2 %, respectively.

Colour

This parameter was evaluated from 15 %. If the colour of bean was bluish, it was score 15 %. If the colour of bean was grayish, greenish, faded and brownish it was score 12 %, 8 %, 5 % and 2 % respectively.

Odour

This parameter was evaluated from 10 %. If the odour of bean was clean (if there was no off smell), it was score 10 %. If the odour of bean trace, light, moderate, and strong smells, it was score 8 %, 5 %, 3% and 1 % respectively.

Combined analysis

The raw quality of each replication was evaluated form 40 % and analyze cherries were collected from young or old stumped high yielding trees.

2.8.2.2 Cup quality coffee analysis

To analysis cup quality, five cups were filled with liquor and at least three cuppers were evaluated, the average of three cuppers were taken and evaluated from 60 %. The cup quality analysis accounts for 60 % depending on the following standard parameters.

Acidity

It indicates the sweetness of coffee. This parameter was evaluated from 20 %. If the acidity of coffee is pointed, it was score 20 %. If the acidity of coffee is medium/pointed, medium, light and lacking it was scored 15 %, 10 %, 5 % and 2 % respectively.

Body

It indicates fullness of coffee throughout in mouth. This parameter was evaluated from 20 %. If the body of coffee is full in mouth, it was score 20 %. If the body of coffee is medium/full, medium, light and thin in mouth, it was score 15 %, 10 %, 5 %, and 2 %, respectively.

Flavour/character

It indicates the origin of coffee. This parameter was evaluated from 20 %. If the flavour of the coffee very good (shows the origin of production), it was score 20%. If the flavour of the coffee is good, average and fair, it was score 15 %, 10 % and 7 %, respectively.

Combined parameter

The cup quality value of each replication was taken and evaluated the coffee sample for 60% **2.9**

Statistical analysis

Quantitative data for each parameters was subjected to analysis of variance (ANOVA) using the procedures described by Gomez and Gomez (1984). SAS computer software was employed for data analysis. Simple correlation coefficients between the relevant parameters were made.

3. Results and Discussion

3.1 Shape and make

The shape and make coffee due to the different methods of processing (washed, semi washed and Sun dried) non-significant ($P \geq 0.05$) at both localities. This confirmed by (Bertrand et al., 2004) and (Avellino et al., 2005) who stated that any methods of processing not affect the shape and make of bean. But, this can be affected by the canopy region and altitude.

Table1. Effect of processing methods on the green bean quality parameters of coffee landrace

Location	Processing methods	Shape and make	Color	Odor	Raw
Sidama	Sundried	12.00	10.00 ^b	9.33 ^a	22.67 ^b
	Washed	12.00	15.00 ^a	9.00 ^a	36.00 ^a
	Semi-washed	12.00	8.00 ^b	8.00 ^b	28.00 ^b
	LSD (0.05)	NS	2.31	1.33	11.78
	CV (%)	5.31	10.49	7.32	19.51
Yirgacheffee	Sun dried	13.00	10.00 ^b	9.33 ^a	23.67 ^b
	Washed	13.00	15.00 ^a	9.00 ^a	37.00 ^a
	Semi washed	13.00	8.00 ^b	8.00 ^b	29.00 ^b
	LDS (0.05)	NS	2.31	1.33	11.78
	CV (%)	5.31	10.49	7.32	19.51

Mean values showed by the same letter (S) within a column are not significantly different

The two-way interaction between methods of processing and location had significant ($P \leq 0.05$) on the shape and make of coffee beans. The highest value shape and make Was the coffee processed by wet methods at Yirgacheffee and the lowest value observed by sundry. At Sidama coffee the highest shape and make Observed by the Wet methods Of processing where as the lowest shape and make observed in sundried coffee

The shape and make of Sidama coffee was significantly positively correlated with bean color ($r = 0.68^*$), highly significantly positively correlated with raw quality ($r = 0.90^{**}$) due to the various processing techniques. Likewise, it was positively significantly correlated with color ($r = 0.84^*$), raw quality ($r = 0.91^*$) and for the Yirgacheffe coffee.

3.2 Bean color

The color of bean was significant different ($P < 0.001$) due to the methods of processing at both areas. The wet processed coffee had bullish and very attractive color as compare to sun dry and semi washed coffee in both area that score 15.00 (Table 1). The sun dry processed coffee was observed higher than that of semi-wet processed that were 10.00 and 8.00 respectively with appearance greyish and greenish respectively. This is because of the mucilage remaining in the bean in semi-wet processing that change the natural color of coffee, largely because of lack of proper fermentation. Davids , 2001 showed that the green bean color was best where the mucilage had been removed by fermentation in (wet processing) and poorest the where the fruit dried around the bean. Anon, 2001 also indicated that the bean color was best (green blue) in the samples where the mucilage had removed by fermentation after the cherry pulped (wet processing); Furthermore. (Sutherland, 1990) confirmed that the beans with poorest appearance were those that were harvested as red cheery and dried down in their skins (sun dried or natural drying. This was also supported by (Drinnar, 2007) as these beans were pale yellow-straw color with a lot of silver skin attached to the bean.

The Silver skin and centre cut on these samples were dark brown in color. These beans were also rounder and more cupped shaped compared to beans pulped from pulped fruit. The research done by the (Violley et al. 1981, Wintegens, 2004) in line With this partecular research which indicated the beans from the fruit pulped and dried Without fermentation (semi-

washed) have a good greeny-blue color similar to the fermented wet processing but with some light brown silver skin attached and a light brown centre cut similar but not as pronounced as in the bean from dried in their skins. This was supported by (Gibson and Butty , 2002) in that bean color was darkest in the bean from fruit allowed to Over mature on the tree that is fermentation Start in the coffee tree. These beans were a dark green blue in color and as expected had the most and darkest brown Silver skin and centre cut.

This research in line with the conclusion made by (Jackels and Jackle, 2006) who reported that removing the pulp and mucilage from around the parchment contributes to good clean bean color and prevents the silver skin from discolouring or adhering to the bean. Leaving the pulp and even the mucilage to some extent around the parchment discolours the silver skin and centre cut and cause the silver skin to adhere to the bean.

The effect of the interaction of methods of processing and location was no significant different ($P \geq 0.05$) on bean color. The correlation result depicted that the color of bean was positively highly significantly associated with raw quality ($r = 0.50^{**}$), and positively significantly correlated with odor ($r = 0.72^*$) in the Sidama coffee. In the case Yirgacheffe coffee the color of bean highly positively significantly correlated with raw quality ($r = 0.87^{**}$) and significantly correlated with odour ($r = 0.72^*$).

3.3 Odor of coffee bean

The odor of coffee bean was significant different ($P \leq 0.05$) between the methods of processing at both of experimental areas. The highest value (10) observed in wet processed coffee both (Table 1). This Showed the altitude not matter Odor coffee. However, the methods of processing can affect it. The freshness of coffee bean had smelled in Wet processes coffees, which have clean Odor. In semi-wet coffee the remaining mucilage was create off odor in coffee bean which smell like yeast that was not clean smell of coffee bean. In sundry coffee the coffee smell clean but some off odor that was undetected. Two-way interaction effect between processing and location was no significant different ($P \geq 0.05$) on the quality of Odor. The odor of bean positively highly significantly correlated with raw quality ($r = 0.25^{**}$) for Sidama coffee similarly, the odor of bean positively significantly correlated with raw quality ($r = 0.55^*$) for Yirgacheffe coffees.

3.4. Raw quality

The methods of processing significantly ($P < 0.05$) influenced the physical quality of coffee at both study areas. The highest value of raw quality observed in wet processed coffee in both areas. The maximum value (37) of wet processed at Yirgacheffee coffee (Table 1). Even if the raw quality was not significantly ($P \geq 0.05$) influenced by the sun dry and semi-wet processed coffee, the semi wet have higher value than dry processed coffee in both experimental areas. The result depicted maximum value for all three methods of processing were seen at Yirgacheffee coffee than Sidama. This could come perhaps because of the increased altitude that resulted in the increment of shape and make, color and odour of coffee, finally to the increment of overall raw quality.

Two way interaction effect between methods of processing and location was no significant ($P \geq 0.05$) different on the raw quality of coffee.

3.5 Acidity and body

Both acidity and body were significantly ($P < 0.05$) influenced by the methods of processing at both experimental areas. The highest value of acidity was observed in wet processed coffee in both experimental areas. This result indicated that wet pressed coffee was found to be more acidic than that of dry processed coffee. The highest values were 20.00 and 18.33 for Yirgacheffee and Sidama coffee, respectively (Table 2). This is because the acidity of coffee increased when the altitude increased. The higher body value was observed in sun dried coffee at both areas. This showed that sundry processed coffee had heavier body than that of wet processed coffee. The higher value for Yirgacheffee was 20 and for Sidama was 18.33 (Table 2). These values indicated that when altitude increased the fullness of coffee in mouth (body) also increased.

This result agreed with (Jackcels and Jackels, 2005) who indicated the fermentation in wet processed coffee had two things it broke down the cellulose of the mucilage layer converting the parchment husk enclosing the bean and it increased the acidity of the coffee. The result in line with (Vincent, 1987, Davids, 2001) and Anon, 2001) that carefully produced dry processed coffee can be as good or even better (with its more complex fruity sweet and full bodied flavour) than wet processed coffee. Davids, 2001 confirmed that coffees processed by the dry and semi dry (pulped naturals) methods tend to be the fruitiest, most complex and have the most body owing to the longer contact with fruit residue during drying.

This was confirmed by (Si vetz, 1972) who reported that the acidity levels should be the greatest and the body the least in wet processed coffees. On the contrary, the body should be the greatest and the acidity the lowest in samples of dry processed coffee. This agreed with Wrigley (1988) in that the process method where the mucilage is left on the parchment (semi-washed). The acidity and body levels can be around the average. Castle et al., 2006 who showed that dry processed coffees can exhibit more variance from cup to cup and a slightly lower acidity but fuller body than their wet processed counterparts. This agreed with (Bacon, 2005) who reported that the drying of the whole cherry imparts full body and natural sweetness to the beans.

The two-way interaction effect between location and processing method was significant ($P \geq 0.05$) on the acidity and body of coffee. The highest values for acidity and body were observed in the wet and dry processed Yirgacheffee coffees respectively. The lowest acidity value was observed in the sun dried and semi-washed coffee. In addition, the least body was recorded in semi-wet processed coffee. In case of Sidama coffee, the highest acidity value was observed for the wet processed coffee. Whereas, sun drying resulted in the highest body and in the lowest acidity (Table 2)

Table 2 Influence of methods of processing on the cup quality of coffee

Location	Processing method	Acidity	Body	Flavor
Sidama	Sun dried	10.00 ^b	16.33 ^a	7.00 ^c
	Washed coffee	16.33 ^a	11.67 ^b	16.00 ^a
	Semi-washed	13.30 ^b	12.33 ^c	10.67 ^b
	LSD (P - 0.05)	4.71	4.48	3.58
	CV (%)	16.97	16.67	15.68
Yirgacheffee	Sun dried	11.67 ^b	18.33 ^a	9.00 ^b
	Washed	18.33 ^a	13.67 ^b	16.67 ^a
	Semi-washed	11.67 ^b	12.57 ^b	9.00 ^b
	LSD(P = 0.05)	5.57	5.76	5.11
	CV (%)	20.78	20.78	20.57

Mean values showed by the same letter (s) within a column are not significantly different at 0.05. The acidity of coffee was very highly positively significant correlated with cup quality ($r = 0.91^{***}$), highly positively significant correlated with flavour ($r = -0.90^{**}$) and negatively highly significantly correlated with body ($r = -0.59^{**}$) in the Sidama coffee. Moreover, the acidity of Yirgacheffe coffee very highly positively significant correlated with total quality ($r = 0.91^{**}$) significant correlated with flavour ($r = 0.85^{**}$), cup quality at ($r = 0.89^{**}$) and negatively highly significantly correlated with body ($r = -0.44^{**}$). The body of Sidama coffee was very highly positively significantly correlated with cup quality ($r = 0.39^{**}$) and highly positively significant correlated with flavour ($r = 0.69^{**}$). In addition, the body of Yirgacheffe very highly positively significant correlated with cup quality ($r = 0.06^{***}$) and highly positively significant correlated with flavour ($r = 0.67^*$)

3.6 Coffee Flavour

At both locations the different processing methods had highly significant ($P < 0.01$) effect on Coffee flavour. Hence, The highest value of flavour is observed in wet processed coffee at both experimental areas (Table 2). The highest respective value of 16.67 and 20.00 was obtained for Sidama and Yirgacheffe coffees. The result indicated that the wet processed coffee Cherries had pleasant flavour as compared with the methods. The result also showed that the coffee produced in higher altitude had Spicy flavour than the coffee processed in lower altitude. The result corroborated with the work done by (Alpizar and Bertrand, 2004) in that when the altitude increased the flavour of coffee increased from floral to Spicy

The present finding is line with (Clarke, 1985) that wet processed coffee had increased flavour and body and thus the coffee develops sweet berry flavour. In contrast sundry and semi-washed can help in mechanically removing the mucilage from the coffee bean. Davids, 2001 reported that where the coffee was pulped and fermented, consistently good acidity and sweet fruity flavours were recorded as opposed to the sun dried and semi-wet processed coffee.

This was supported by (Kubale, 1979) in that prepared using wet processing was described as

sweet, Clean, tangy, good acidity, floral and nutty flavour. Whereas some of the samples produced with the sundry were described as harsh, sour and astringent flavour. Bytof et al., 2000 suggested that post harvest process can affect the balance in low molecular Weight compounds, key precursors of coffee aroma and flavour. As Selmar et al., 2001 indicated, the wet processed Arabica clones had higher levels free Carbohydrates (glucose; fructose and galactose); Organic acid (quince, phosphoric and oxalic acid); mineral compounds (K^+ , Ca^{+} , Mg^{*2} and Cu^{+2}) and trigonelline. Moreover, (Balyayu and Clifford, 1995) found wet processing can result in higher levels of chorogenic acid, lipids and cell wall polysaccharides (arabinogalactans) and Storage polysaccharides (mannans). The effect of the interaction of methods of processing and location had significant effect ($P \geq 0.05$) on flavour. The highest value Observed at Yirgacheffe coffee processed by wet whereas the lowest value observed in sundry and semi-wet. The coffee processed Sidama, the highest value Observed in wet and lowest value in sundry coffee (Table 2).

The flavour of positively very highly significantly correlated with cup quality ($r = 0.74^{***}$) and in the Yirgacheffe coffee. In addition, the flavor of coffee positively very highly significantly correlated with Cup quality ($r = 0.92^{***}$).

3.7 Cup Quality

The cup quality of coffee was significantly ($P < 0.01$) influenced by the methods of processing coffee at the both experimental areas. The result indicated that the methods of processing had a large impact on the liquoring quality (cup quality) of the coffee. The wet processing of coffee had highest value (50, 34 and 46.00) at Yirgacheffe and Sidama coffee respectively than that of sundry and semi-wet processed coffee (table 2). This showed that the wet processed coffee produce superior cup quality than that of sundry and semi-wet processed because coffee was not over and under fermented in both experimental areas. Even if there was no significantly ($P > 0.05$) differences between the semi-wet and sundry processed coffee, the semi-wet had score higher value (46.07 and 37.00) Yirgacheffe and Sidama respectively than that of sundry coffee.

Table 3. The influence of methods of processing on the cup quality and total quality of Sidama and Yirgacheffee coffee

Location	Processing method	Cup quality	Total quality
Sidama	Sun dried	35.3032223 ^b	64.07 ^b
	Washed coffee	42.00 ^a	87.33 ^a
	Semi-wet	37.00 ^b	65.00 ^b
	LSD (P=0.05)	5.81	8.13
	CV(%)	7.18	5.62
Yirgacheffee	Sundried	39.00 ^{ba}	64.66 ^b
	Washed coffee	49.07 ^a	90.33 ^a
	Semi-washed	46.07a	67.00b
	LSD(P=0.05)	9.03	14.34
	CV(%)	11.24	10.29

Mean values showed by the same letters (s) within a column are not significantly different.

The report by Castle et al., 2006 is in line with the present result of semi-washed processing methods, which did not significantly differ from that of the natural sun dried coffee. Hence, there is no risk of unripe cherries interfering with the cup. Either method was yield coffees that were sweeter and somewhat less acidic than those that undergo a fully washing process (wet processes). As Kulaba, 1979 reported wet processing generally produces a more consistent quality compared to dry processing; however, even wet processing does not guarantee perfect quality as many factors can go wrong if not carefully managed. For example, delays in processing after harvest can lead to fermentation within the fruit giving off tastes. This result is in line with Selmar et al., 2001 using fermentation (wet processes) instead of mechanically removing the mucilage growers believe the flavours increase as well as the body and the coffee develops sweet berry flavours finally with best cup coffee quality. While dry processing can produce a coffee with more body and more complex fruity flavour with less acidity, occasionally these coffees will be strong and harsh in taste and contributed to less cup quality.

The research done by Clarke, 1985) indicate that samples pulped but not fermented (i.e. the mucilage is left on the parchment and dried or semi-wet) produced the best quality coffee with good acidity and body, sweet fruity flavours and smooth balanced pleasant cup. On his finding the fully fermented (wet processed) coffee best quality than semi-wet if only if the coffees were over fermented. The result also agreed with Vincent, 1987 reported the poorest quality coffee

was from the beans that were dried in the fruit (sundry). These coffees described as being defective, astringent, better, sour, over fermented, rough, medicinal and winey. As the result showed that, the methods of processing with higher value seen the coffee processed at Yirgacheffe. This is because Yirgacheffee coffee produced at higher altitude than that of Sidama coffee, when the altitude increased, the cup quality was increased.

The effect of the interaction of methods of processing and location had significant effect ($P < 0.05$) on the cup quality of coffee. The higher value observed at Yirgacheffe in coffee processed by wet and lowest value observed in sundry processed coffee. In Sidama coffee, on the higher value observed in wet processed coffee lowest value observed in sundry processed coffee (table 3).

3.8 Total quality

The methods of processing significantly ($p < 0.001$) influenced the total quality of coffee in the both experiment areas. The wet processed coffee had higher value in both experimental areas. The maximum value (87.33 and 90.33) for Sidama wet processed and Yirgacheffee wet processed coffee respectively (table 3). The result indicated that coffee prepared by wet processed coffee score grade one coffee and best quality at both experimental areas however the Yirgacheffee wet processed coffee superior quality than Sidama coffee because produced at higher altitude.

There was no significant ($P>0.05$) difference between the total quality of coffee samples which were subjected to sundry and semi-wet processing treatments. Although not significantly, the total quality of semi wet processed coffee samples was better than the sun dried coffee samples under both experimental locations. Generally, the total quality of Yirgacheffee coffee samples performed better as compared to the total quality Sidama coffee under all the three processing methods.

4. Summary and Conclusion

The quality of coffee is primarily determined by agro-ecology, genetic make-up management practices applied to coffee trees and post-harvest processing handling. It is highly associated with consumers' satisfaction and is an important aspect to remain in the increasing competitive global market. In this regard, maintenance of the inherent quality of the known Ethiopian specialty coffees is of paramount importance. This requires above focused efforts of expanding the improved technologies including pre- and post-harvesting operations. To this effect, this study was carried out to evaluate the effect of processing methods on the quality of Sidama and Yirgacheffee coffees. The result depicted significant differences due to main treatment and their interaction effects. The effect of location in washed coffee was evident, largely indicating contribution of factors including temperature. With regard to processing methods the wet processed coffees had the most desirable qualities at both localities. Suggesting the need to enhance the use of low-cost and environmentally friendly small-scale pulping. The results indicated that the methods of processing influencing the raw and liquor quality of coffee. The green bean color was found to be best when the mucilage was removed by fermentation as opposed to the poorest beans dried down in the fruit without pulping. At both locations, semi-wet processing resulted in medium quality responses. The result also revealed that wet processed had superior cup quality as compared with other processing treatments. This was particularly the case when the coffee was not over or under fermented. Moreover, the result underlined that the body of dry processed coffee had fuller body than the wet and semi-wet processed coffee.

However, the wet processing resulted in good acidity when compared with other methods. The combined effect of location by processing was found significant for most quality parameters such as shape and make, acidity, body, and flavour, cup quality and total quality. From the result we can recommend the best methods of processing is wet processed methods. In all case maximum care should be taken not to over-ferment the coffee above the optimum period at each location. But further works involving among others, the diverse coffee varieties, environmental conditions and field management practices, harvesting, processing and storage of dry coffee should deserve focused attention in improving the inherent quality of specialty coffees in the different agro-ecologies and production of Sidama and Yirgacheffee areas.

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