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Liquor Quality Performance of Some Early Released Coffee Varieties at Three Locations in South-West Ethiopia

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Abstract: Ethiopia is the origin for *Coffea arabica* L, which favors researchers, to select of 37 coffee berry diseases (CBD) resistance varieties for different agro-ecologies/regions. However, the bean qualities of these varieties are not well studied across locations. Therefore, the specific objectives of this study were, to assess the liquor quality performance of seven early released coffee varieties at Jimma, Gera and Metu under wet and dry processing methods to evaluate for liquor quality attributes. A factorial experiment in complete randomized design with three replications was used. The error variances were comparable for the quality attributes considered and the results of combined analysis showed that variety for flavor, cup quality value & grade and interaction effect of Loc*PM, Loc*Var, PM*Var for acidity, flavor and cup quality value, were significant. Likewise, coffee variety and interaction effects of location by processing methods were significant on coffee acidity and flavor. Accordingly, the highest cup quality (45.45), acidity (10.30) and flavor (10.09) were recorded for washed coffee at Gera. By contrast, the minimum cup quality value (42.26), acidity (9.08) and flavor (9.01) were measured for washed coffee at Metu. Similarly, significant variations were noted due to coffee varieties and interactions with processing methods on most cup quality characters and accordingly wet processed and varieties (74112, 74140 and 74158) exhibited the highest acidity and flavor as opposed (744 and 75227). Cup quality value and overall quality were significantly and positively correlated with acidity. But, grade was negatively and significantly correlated with acidity, cup quality value and overall quality but negatively and no significantly correlated with flavor. In general, it can be concluded that the superior coffee quality performance was determined under Gera, Jimma and Metu conditions in that order. Moreover, wet processing was noted to significantly improved cup quality attributes and grades at all locations.

Key words: Variety · Location · Processing method · Quality

INTRODUCTION

Coffee belongs to the family *Rubiaceae* and genus *Coffea L.* comprised 104 species native to forests and scrublands of tropical Africa, Madagascar and the Mascarene Islands in the Indian Ocean [1, 2] based on a pre-phylogenetic circumscription. As a result of evolutionary studies, [3] recently subsumed psilanthus Hook. f. into *Coffea* which increases the number of *Coffea* species to 124, with the geographic distribution considerably extended to tropical Asia and Australasia. Economically most important species of the genus are *Coffea arabica* L. with more than 70% of the world's coffee production and *Coffea canephora* pierre ex A. Froehner with nearly 30% [4].

Economically, coffee is the most important agricultural commodity which stands second to only oil in terms of international trading on the world market. In many producing countries, besides contributing a vast amount to the foreign exchange currency as a main cash crop, coffee also serves as a means of income for millions of people and plays a vital role in their socio-economic values [5, 6]. Physically, most of the coffee species are originated from tropical African countries. Ethiopia is

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Table 1: Characteristics of the early released and studied coffee varieties

Variety	Yield (q/ha)		Canopy nature	Raw quality	Cup quality	Commercial acceptance	Disease resistance	Released year
	Research	Farmer						
744	16.6	8.9	Open	Average/Good	Average	Acceptable	Resistance	1979/80
74110	19.1	9-10	Compact	Average/Good	Good	Acceptable	Resistance	1978/79
74112	18.1	9-10	Compact	Good	Good	Good and Acceptable	Resistance	1978/79
74140	19.7	9-10	Compact	Average	Average	Hardly Acceptable	Resistance	1978/79
74158	19.1	9-10	Compact	Good	Fairly/Good	Acceptable	Resistance	1978/79
74165	17.3	8-9	Compact	Good	Fairly/Good	Acceptable	Resistance	1878/79
75227	17.8	8-9	Open	FAQ	FAQ	Acceptable	Resistance	1980/81

where FAQ= Fairly Average Quality
Source: CLU report (1996-2004) as cited in [15]

Table 2: Detail description of the study areas

Variable		Research Center		
		Jimma	Metu	Gera
Altitude (m.a.s.l)		1753	1550	1940
Latitude		7°46'N	8°3'N	7°7'N
Longitude		36° E	36° E	36°E
Rainfall (mm)		1556.9	1810.6	1878.9
Air temperature (°C)	Maximum	26.7	28.6	24.4
	Minimum	12.8	12.5	10.5
Mandate areas		Mid-land	Low-land	High-land

Source: [16]

believed to be the origin and primary center of diversity for the tetraploid *Coffea arabica* and Central and West African countries are for other coffee species [7]. According to International Coffee Organization [8], Ethiopia is the first in Africa and fifth worldwide largest coffee producer next to Brazil, Vietnam, Indonesia and Colombia with a production of 6,500 thousand bags during the crop year 2011/12.

Ethiopian coffee grows almost everywhere, under diverse environmental conditions ranging in altitude from 550 to 2600 m.a.s.l [9]. The crop prefers a slightly acidic soil with a pH of 4.5 to 6.5 and it requires rainfall amount of 1500 to 2500 mm, with the ideal average maximum and minimum air temperatures of 27°C and 13°C, respectively, which is well distributed for 8 to 9 months. The main coffee growing areas are located in the south eastern, southern and south western high-lands of the country. Ethiopia has more genetic diversity among its coffee varieties than any other country worldwide. All varieties with its ecological factors such as rain fall, temperature, shade, altitude and soil give individual bean varieties their unique local character [10].

The coffee species vary in terms of chemical composition [11]. Also, within *C. arabica* the variability in quality takes a particular pattern with mutants presenting specific quality attributes such as Caturra (dwarf, high productivity sometimes linked to a drop in quality) or Maragotype (very large beans low productivity but highly priced or the marked). In addition, some mutants have been identified, especially regarding low caffeine contents, such as *C. arabica* variety Laurina (0.6% dm) and more recently, in Brazil, an Ethiopian origin with traces of caffeine [12]. There are many factors that affect coffee quality such as environmental condition, genetics, climatic conditions and soil characteristics of the area in which coffee is grown, agricultural practices, harvesting methods and timing, pre-harvest and post-harvest processing techniques [13, 14]. Ethiopian coffee is processed and exported in two processing techniques, namely, natural sun-dried (70%) and washed (30%) coffees [15].

In the past four decades, the Jimma Agricultural Research Center (JARC) has been showing a concentrated effort to develop, release and distribute improved coffee varieties that are high yielding, disease resistance and adaptable to different agro-ecological zones. However, due to the urgency of arresting the progress of coffee berry diseases (CBD) in early 1970s as a serious disease outbreak in the country and lack of trained personal and detail quality evaluation criteria, the early released CBD resistant varieties lack recent quality standards. The limited information attached to these coffee varieties was their general quality and commercial acceptance as shown in Table 1. In line with the increasing focus to quality-oriented production and trading systems, it is an agenda of top priority to assess

and update the quality standard of all the released cultivars and promising under different locations using ideal processing methods.

Objectives:

- To assess liquor quality performance of some early released coffee varieties under Jimma, Metu and Gera conditions.
- To evaluate the effect of processing methods on liquor quality attributes of these coffee varieties under Jimma, Metu and Gera conditions.

MATERIALS AND METHODS

Experimental Procedures: The data was collected independently for each locality to see the variability that exists among the three locations on coffee liquor quality attributes of dry and wet Arabica coffee varieties. Red fully ripe cherry coffees were collected carefully selected from the already established coffee seed orchards having age of ten years. Harvesting was undertaken during the peak season of first round between September and December in 2012. Ripe cherry were simply random harvested from the coffee plant then weighted 3 kg for washed processed and 3 kg for sundried directly spread on the mesh wire drying table and the wet process continue according to the procedure described by ECX. Then, each variety was sub divided in to two processing methods (dry and wet) as follows. Dry processing: After foreign materials and unripe green berries removed by sorting, samples (three kg per sample) were sun dried on raised compartmented mesh wire drying table (about 0.8m above the ground) and regularly turned to maintain uniform drying to moisture level of 11.5%. During drying the moisture content of the bean was measured using Electronic Rapid Moisture Tester (HE 50, Germany) to know and maintain the moisture level of all samples at similar level. Finally, after three weeks fully dried coffee cherries were collected and packed separately. Dried cherries were hulled using manual/hand hulling machine.

Wet Processing: Fresh cherries were pulped using single disc motorized pulper which squeezes the cherries between fixed and moving surface. Subsequently wet parchment coffees were put in fermentation tank according to the agro-ecology to facilitate breakdown of mucilage. After complete fermentation the parchment coffee was properly washed and under gone further fermentation time of soaking [17], followed by washing, using clean water to remove all traces and decomposed products of mucilage. Then, wet parchment coffee was sun dried on mesh wire raised bed. Continuous follow up took place till the needed moisture content was achieved. The moisture content of the beans was uniformly maintained at 11.5% for all samples. Finally, the samples were hulled and hand polished to remove the parchment and silver skins from green coffee beans.

Cup quality value/Liquor Quality: Sensory evaluation was done using four quality criteria: cleanness, acidity, body and flavor, which were scored based on the standard and procedure outlined by Ethiopia commodity exchange [18]. The coffee samples were medium roasted and medium ground. A team of three experienced and internationally certified Q-grade cuppers of the Jimma Research Center were involved in evaluation of the coffee brew. They participated in a panel for cupping to evaluate the aroma and taste characteristics of each sample. Average result of each cupper was used for the analysis. For liquoring, three cups were prepared by mixing 8 g of coffee powder in each cup with boiled water and stirring the content to ensure the homogeneity of the mixture for aromatic stringent and quality. The cup was then stirred and any grounds that still float were removed. Tasting was carried out when the beverage cooled to around 60°C (palatable temperature) [19].

Data Collected

Cup quality/Liquor quality

Cleanness: It indicates freeness of the coffee from defects

Acidity: To identify the sense of coffee on the tongue strengthens of the coffee

Body: The texture and sensation of coffee in the mouth.

Flavor: It was the combination of body and acidity, over all taste of the brew.

Cup quality value: The sum total of sensory evaluation of each treatment; accounting 60% of the total coffee quality.

RESULTS AND DISCUSSION

Analysis of Variance: Analysis of variance results for liquor attribute (acidity, flavor and cup quality) of varieties were showed highly significantly ($P<0.01$) by the main factors location and variety also significantly

Table 3: Mean value of Acidity, Flavor and CQV of coffee quality as influenced by location and processing method

Parameter	Acidity		Flavor		Cup Quality Value	
Location	DP	WP	DP	WP	DP	WP
Gera	9.57^{bc}	10.30^{a}	9.47^{abc}	10.09^{a}	43.67^{bc}	45.45^{a}
Jimma	9.96^{ab}	9.46^{bc}	9.67^{ab}	9.04^{bc}	44.34^{ab}	42.88^{bc}
Metu	9.39^{bc}	9.08^{c}	9.22^{bc}	9.01^{c}	43.46^{bc}	42.26^{c}
LSD (5%)	0.68		0.63		1.65	
CV (%)	10.48		10.11		5.71	
Mean	9.62		9.42		43.68	

Means followed by same letter(s) with in a column are not significantly different at P<0.05
Where Loc=Location, DP=Dry processing; WP=Wet processing; CQV=Cup quality value

different (P<0.01) for the interaction effect of Loc x PM. However, there was no significant difference for processing method, Loc x Var, PM x Var and Loc x Var x PM.

Cup Quality Value: The two way interaction between location and processing methods was significant (P<0.01). As Table 3, indicated the best cup quality value recorded from treatment combination Gera x wet (45.45) and statistically similar with treatment combination of Jimma x dry but the smallest amount of cup quality value obtained for treatment combination of Metu x wet (42.26) this is statistically similar with Gera x dry, Jimma x wet and Metu x dry. In general in both processing method and among locations cup quality value was registered greater than 42% out of 60% for the liquor quality. This result may be due to the highest significant difference of cup quality attributes. The present are in agreement with the finding of Eastern African Fine Coffee Association [20] indicates high acidity and good flavor gives better quality and more intense aroma to the beverage. These results was similar with those reported by Agwanda [21] in that acidity and body are reliable and suitable quality attribute that can be used as selection criteria for the genetic improvement of the overall liquor quality. As value of acidity and body even flavor increase the significance of overall also increase, so acidity and body were directly related with overall quality.

Cup quality value was significantly affected by variety (P<0.01). Accordingly, variety 74158 (45.51) recorded the highest cup quality value, which however was statistically similar with varieties 74110, 74112 and 74140. In contrast, least cup quality value was observed from variety 744 (41.83) and statistically similar with variety 74165 and 75227 (Fig. 1). This may be due to the genetic factor of varieties. Similar finding were reported by Tesfaye [22] and Behailu *et al*., [15] who elaborated that coffee genetic and genetic variations are the major components that affect quality.

Acidity: There was a significance difference (P< 0.01) between location and processing methods, the treatment combination of Gera x wet was the highest acidity with average of 10.30 and statistically similar with Jimma x dry processed coffees. However there was also another result of contrast to highest, the lowest acidity obtained from treatment combination Metu x wet with value of 9.08 and statistically similar with Gera x dry, Metu dry and Jimma x wet treatment combinations (Table 3). Generally, acidity of location x processing methods was medium to medium

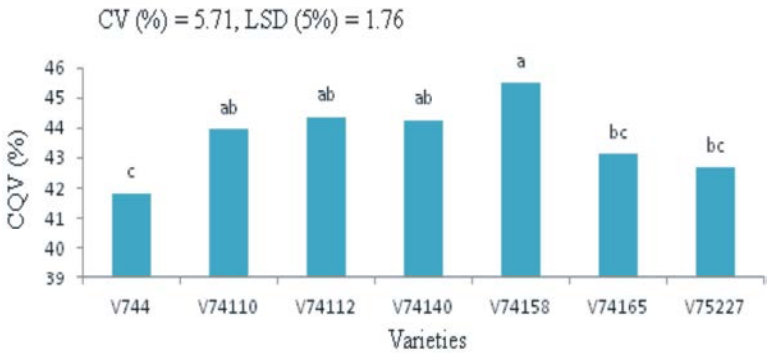

Fig. 1: Effect of variety on cup quality value of coffee Arabica in south west Ethiopia
Bars capped with same letter(s) are not significantly difference at P<0.05

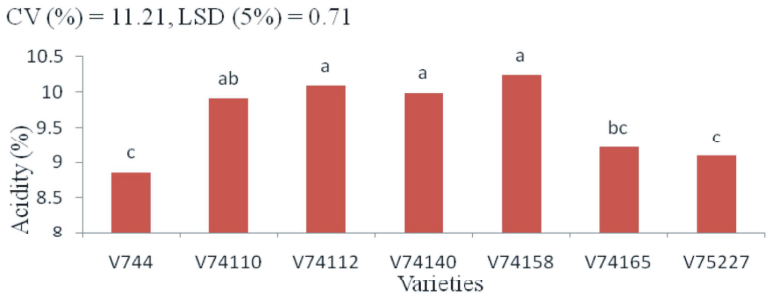

Fig. 2: Effect of variety on coffee acidity
Bars capped with same letters are not significantly difference at P<0.05

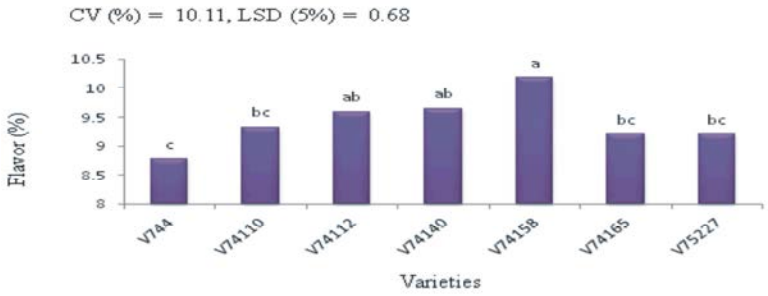

Fig. 3: Effect of variety on the flavor of coffee bean in south west Ethiopia
Bars capped with same letter(s) are not significantly difference at P<0.05

pointed. This was prospect due to removal of mucilage at the time of fermentation increases acidity of coffee but decreases body. These results are in agreement with those obtained by Clifford [11] indicating that wet processed Arabica was aromatic with fine acidity and some astringency, while dry processed Arabica was less aromatic but with greater body. This was in conformity with result of Anwar [23], who reported high mean values of acidity, body and flavor for wet processing method as compared to dry processing method. According to Beza [24], acidity of washed coffee is significantly higher than the acidity found in dry processed coffee. The main effect of varieties for acidity was significant (P<0.01). Varieties 74112, 74140 and 74158 gave higher value and there was no significant difference among 74110. However, variety 744 and 75227 recorded the lowest acidity (Fig. 2). Similar finding were reported by Abyot [25], indicated the existence of considerable variations among coffee genotypes.

Flavor: The interaction effect of location and processing method on flavor were significant (P<0.01). The differences showed that Gera x wet had the highest flavor with average value of 10.09 and statistically no variation with Gera x dry and Jimma x dry. Whereas the lowest value recorded treatment combination of Metu x wet (9.01) and it was also statistically similar with Gera x dry, Metu x dry and Jimma x wet treatment combination (Table 3). This result was comparable with Bertrand *et al*., [26] the flavor obtained in a coffee cup is the result of multiple aromatic compounds present and more than 800 in the roasted coffee. Getu [27], reported that genotypes were profiled for different distinct aftertaste quality profile. This indicated the presence of favorable environmental conditions that generate expression of specific coffee flavor.

Effect of variety on flavor was significant (P<0.01) and variety 74158 had high flavor with mean value of 10.19. This was comparable with varieties 74112 and 74140. In contrast to this result the minimum flavor was registered by variety 744 (8.86) and statistically similar with varieties 74110, 74165 and 75227 (Figure 3). This result was in line with Wintegens [28] and coffee genotype is a key factor, since it determines to a great extent important characteristics of chemical composition and flavor. The work done by Getu [27], also revealed that flavor is identified as an all-round good cup quality attribute which embraces positive values of aromatic attributes, acidity and body.

CONCLUSIONS

Arabica coffee is one of the most important beverages worldwide. It is economically important for

small scale producers as well as investors. There are different coffee varieties grown in our countries, which are high yielding and resistant to diseases. The objective of the experiment was to assess liquor quality performance of some early released coffee varieties under Gera, Jimma and Metu conditions and to evaluate the effect of processing methods on liquor quality attributes of these coffee varieties under Gera, Jimma and Metu. The analysis of liquor quality characters of seven coffee varieties (744, 74110, 74112, 74140 74158, 74165 and 75227) of varying suitability ranges has been evaluated at the Jimma Agricultural Research Center coffee quality research and liquoring laboratory. The relevant quality data were analyzed using a CRD with factorial arrangement of three replications.

The combined analysis of variance showed significant difference for flavor and acidity. With regard to cup quality value (liquor) attributes, acidity and flavor were significantly affected by processing method x location variety at the study sites. Accordingly, the highest value was obtained for washed coffees at Gera as opposed to washed coffee under Metu conditions, where the highest values were obtained from variety 74158 as opposed to variety 744. The highland compact coffee varieties (74112, 74140 and 74158) exhibited superior acidity whereas variety 744 had the lowest acidity.

In general, coffee varieties harvested from higher altitude (Gera areas) had the highest values for coffee acidity and flavor. And coffee varieties 74110, 74112 and 74158 had the highest values for liquor quality attributes. The present findings were quite in consistent with the earlier quality performances for the studied coffee varieties, demonstrating the long-year stability of quality traits for future quality evaluation. The interaction between genetic, environment and processing methods was also evident for increasing production and trading of traceable quality standards. As a whole, the results revealed superior coffee quality performance under Gera, Jimma and Metu conditions in that descending altitude order. Moreover, wet processing was noted to significantly improved liquor quality attributes at all locations.

Further, the study demonstrated that the compact coffee varieties were superior over the open large seed sized coffee cultivars (744 and 75227), indicating the influence of genetic factors and physiological processes, increased elevation in favoring adaptation and inherent quality traits and detecting the need to apply location specifically suitable processing techniques. The present findings also add evidence and demonstrate the immense wealth of coffee genetic diversity and suitable environments as well as the need to scale-up improved coffee quality knowledge and processing technique for ensuring traceable trading of high quality coffees. From the present study, it can be concluded that market-oriented and value-added high quality coffee types can be produced by considering coffee genetic diversity and environmental factors with ideal processing and quality improvement options at each locality.

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