Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.7, 2015

Quality Status Evaluation of Gurage Coffee (Coffea arabica L.), Southern Ethiopia

Abrar Sualeh[1]* FettaNegash[2] Ashenafi Ayano[1] Negussie Mekonnen[1] GebreEgnet[2]
1.Jimma Agricultural Research Center, P. O. Box 192, Jimma, Ethiopia
2.Wolkite University P. O. Box 07, Wolkite, Ethiopia
* Corresponding Author's Email: mabrarsualeh@yahoo.com

Abstract
Coffee (*Coffea arabica L.*) is originated from Ethiopia and used as export earnings in the national economy, contributing decisively to the country's foreign exchange. It is the major cash crop for small holding farmers who live in south, central and southwest parts of the country. The experiment was conducted in Gurage Zone found in Southern Nations Nationalities and Peoples Regional State, of Ethiopia located between 7.8^0 - 8.5^0 latitude and 37.5^0 -38.7^0 longitude. This research was designed to evaluate the status of Gurage coffee local land race in relation to growing altitude and shade effect on quality. Coffee type by altitude was highly significant for shape and make, raw quality, acidity, cup quality and total quality and also significant difference were achieved for screen size, body, flavor and overall quality. Coffee type by shade type was highly and significantly affects acidity, overall quality and cup quality and significant difference was exempted for body. Coffees grown in Gurage zone can be inter into specialty market if it is processed in recommended dry method. The effects of some soil properties were also evident on coffee quality, demonstrating the importance to consider soils for the sustainable production of high quality coffees.
Keywords: altitude , local land race, quality and shade.

INTRODUCTION

Coffee (*Coffea arabica L.*) is originated from Ethiopia and used as export earnings in the national economy, contributing decisively to the country's foreign exchange. About 550,000 ha of land in the country covered by coffee (MOA, 2010). The donation of Ethiopia with diverse coffee types and agro-ecology allowed production of high quality coffee to world market. Coffee grow widely in variable environments in Ethiopia has a variety of characteristics sought in the international market. It is the major cash crop for small holding farmers who live in south, central and southwest parts of the country.

Gurage zone is one of the coffee growing areas of Ethiopia. It is found in Southern Nations Nationalities and Peoples Regional State, located between 7.8^0 - 8.5^0 latitude and 37.5^0 -38.7^0 longitude. The zone encompasses areas suitable for coffee production. The total area of the zone is about 5,932 km^2 with three different agro-climatic zones: 28.3%, 64.9% and 6.8% of high land, midland and low land, respectively with an altitude range of 1000-3500 m.a.s.l (Meter above sea level). About 80,398 quintals of coffee is produced annually from 11,198 hectares of coffee land of the zone (GZAD, 2010) and the local populations have been widely adapted with this crop for economic, social and cultural circumstances.

The qualities of coffee genotypes in the area have not been properly evaluated and their attribute remains unknown by coffee specialists. Though it is not justified through quality evaluation, the local market price of coffee produced in Gurage zone is by far greater than those produced from neighbor zones because of its acceptable quality by the local people of the area. Though genetics, management practices and soil characteristics can affect coffee cup quality; no detailed work on evaluation of coffee quality in terms of genotypes, altitude, soil type, shade level is not made in the zone. Taking this fact into account, this research was designed to evaluate the status of Gurage coffee local land race in relation to growing altitude and shade effect on quality.

MATERIALS AND METHODS

Description of the Study Area

The experiment was conducted in Gurage Zone in collaboration with Wolkite during harvesting season 2013/14. Gurage Zone is found in Southern Nations Nationalities and Peoples Regional State, located between 7.8^0 - 8.5^0 latitude and 37.5^0 -38.7^0 longitude. High coffee producer districts Chiha, EnmorenaEner and Ezha were selected from the Zone.

Experimental Material and Design

Bulk of coffee berry disease (CBD) resistant nationally released and two locally known (Witasaja and Abesha) landraces were used. Coffee trees of between 10 to 20 years of age were used for red coffee cherry sources from three different altitude (low, mid and high land) and two different shade level (with shade and without shade). A 3x3x2 (3 coffee genotypes, 3 altitude levels, and 2 coffee shade types) factorial combination in Completely

Randomized Design (CRD) arrangement were used.

Sample Processing Method

From systematically selected coffee farm about six kg fully matured red coffee cherry was harvested including three different altitude (Highland, Midland and Lowland) strata and different coffee genotypes for each sample separately under shade and without shade grown trees. Each sample was left to dry after foreign materials and unripe green berries removed by sorting using raised compartmented mesh wire drying table (about 0.8m above the ground) and regularly turned to maintain uniform drying to moisture level of 10.5 to 11%. After 15 days samples were dried to the appropriate drying moisture content. Samples were prepared at farm site of Wolkite University. Each coffee sample prepared from each treatment was separately labeled (having the name of coffee type, altitude and shade conditions). The samples were packed and sent to Jimma Agricultural Research Center Coffee Processing and Quality Laboratory for quality analysis.

Raw Quality Analysis

Three hundred gram of green bean was used for each sample during raw quality analysis. Above screen size 14 (%), shape and make, color and odor were assessed having 40 % out of the total were measured as follows. Screen size carried out by means of rounded perforated plate called screen. The screen size holes was 14 (1/64 inch of 14) which means 5.6mm coffee bean retained above recorded in percentage. Shape and make was evaluated as very good, good, fairly good, average, mixed and small and weighted accordingly using ranges 4 to 15 scale. Color was evaluated as bluish, Grayish, greenish, coated, faded and white using ranges 4 to 15 scale. Odor was evaluated clean, fair clean, trace, light, moderate and strong ranging from 0 to 10. The finally the sum of shape & make (15), color (15) and odor (10) were recorded as total raw quality out of 40 percent.

Roasting, Grinding and Brewing

From each sample 100 g of green coffee bean was roasted using 200°C heated probatBRZ6 roaster machine for six minute (medium roast) (Abrar and et al, 2014). Roasted samples were left to cool down. Samples were blown to remove the loose silver skins before grinding. Then samples were grinded to medium seized ground using Mahlkoing electrical grinder. Soon after grinding, coffee powder weighing about 8g was placed in a cup with a capacity of 180 ml. Then, boiling (about 92^0c) water was poured on to the ground coffee up to about half way in the cup. The cup was then filled to the brim with boiled water. The brew was made ready for panelists.

Cup quality analysis

It was carried out once the beverage cooled to around 60°C (drinkable temperature). Three cups per sample were prepared for tasting session. The cup quality attributes Acidity, Body, Flavor and Overall Quality were scored using scales ranging from 4 to 15. Total cup quality (60%) was recorded using the total sum of acidity, body, flavour and overall quality. Each sample unit of the treatment was evaluated by three panelists independently. The sum of total raw quality and total cup quality was considered as total quality (100%). Finally, the average results of all panelists were used for data analysis.

Data Analysis

All collected data were subjected to three way ANOVA using SAS (SAS 2008) software. In all cases statistical significance were computed at 5% probability level and treatment means were separated using LSD mean separation procedure.

RESULTS AND DISCUSSION

Out of the quality records there were no significant interaction effects for three way interaction coffee type with altitude and shade type. Coffee type by altitude was highly significant for shape and make, raw quality, acidity, cup quality and total quality and also significant difference were achieved for screen size, body, flavor and overall quality. Coffee type by shade type was highly and significantly affects acidity, overall quality and cup quality and significant difference was exempted for body. Altitude by shade type was highly significant for overall quality only. Except screen size all parameter recorded were highly and significantly affected by coffee type. In addition screen sizes, shape & make, total raw quality, acidity; overall quality and total cup quality were highly and significantly affected by altitude. Body and flavor were significantly affected by altitude difference. Effect of shade type was significant only on total cup quality.

Percent of Above Screen 14

Above screen 14 (5.60mm) revealed significant variations ($P \leq 0.05$) due to interaction effect of altitude by coffee type and also altitude effect for coffee samples collected from Gurage zone. Accordingly, the highest bold and large bean size was recorded for Witasaja coffee type collected at mid attitude. In which 96.50 % of the beans

was retained above screen 14. The selection coffee type at high altitude had reviled the smallest bean size with 63.17% of the beans retained above the screen (Table 4). In the case of single factor altitude was highly significant (P≤0.01) for above 14 screen size. As a result low land and mid altitude had got the highest above 14 screen sizes 93.06% and 92.72% respectively (Table 2). Bean size is determined by screening that has a particular importance to roasters since bean size would be exposed to roast uniformly, which is influenced by botanical variety and growth environment (EAFCA, 2008).

Shape and Make

There was significant (P≤0.01) variation in the shape and make affected by the interaction of coffee type by altitude. The highest value was recorded for Witasaja coffee type collected from mid altitude with an average value of 13.83 (Table 4). The lowest (8.67) was recorded for Abesha coffee type collected from high altitude. In another case shape and make was highly and significantly (P≤0.01) affected by coffee type. The highest value (12.28) was achieved for Witasaja coffee type. The lowest average values 10.83 and 10.00 were obtained for had reveled was and lowest (10.83) Abesha and selection respectively (Table 1). Witasaja have attractive shape and make with uniform bean size. Due to altitude highly significant (P≤0.01) difference was achieved for shape and make raw quality. Good shape and make average value of 11.67 and 11.22 were recorded for coffees collected from lower and mid altitude respectively. The lowest value of shape and make was 10.22 for higher altitude (Table 2). Bean physical characteristics such as bean size, shape and make are unified criteria for conducting coffee business within the international market (Agwanda *et al.,* 2003). Uniform, bold and heavy coffee beans are the most preferred and are usually priced high.

Color

The results showed significant (P≤0.05) differences among coffee type. The highest value (11.44) grayish color was recorded for Witasaja (Table 1). Selection and Abesha coffee type were achieved least value (10.50) and (10.22). The quality attribute color showed difference for all three coffee types, this due to genital effect on coffee types. Coffee beans with the poorest appearance can be observed due to coffee type (Sutherland, 1990).

Total Raw Quality

The total raw quality was significant (P≤0.01) affected by the interaction of coffee type by altitude. The highest average raw quality value (36.17) was recorded at medium altitude for Witasaja coffee type (Table 4). The least raw quality (29.00) was recorded selection coffee type collected at higher altitude. In addition the raw quality was highly affected by each factor coffee type and altitude (Table x). Witasaja coffee type had highest average raw quality (33.72) and also list value (30.50) was recorded selection coffee type (Table 1). Related result was obtained due to altitude difference. The lower and mid altitude had reveled the higher value of 32.67 and 32.17 respectively (Table 2). Based on the total raw quality result, variations were detected among coffee type and also altitude.

Acidity

Acidity is a primary coffee test sensation, and a high acid coffee has a pointed sharp pleasing flavor. Coffee types showed significant variations (P≤0.001) with acidity due to altitude. Consequently, the highest moderately pointed to pointed (12.15) acidity was recorded for Witasaja at high land, while the least medium acidity recorded at low land (10.28) and mid land (9.77) altitude for Abesha coffee type both (Table 4). Similarly, Shade effect on coffee type showed significant (P≤0.05) variability where Witasaja had medium pointed (11.93) acidity under shade condition. This was followed by selection coffee type under shade with an average value of 11.52 (Table 5).

The single factor coffee tape and altitude were significantly (P≤0.01) affects the quality attributes of acidity. As a result Witasaja (11.48) and selection (11.23) coffee type had got the highest result of medium pointed acidity (Table 1). In case of altitude effect the high land grown coffee had got best acidity (11.52) (Table 2). This shows that high land grown coffee have good acidity. A pleasant sharp taste or bite in the mouth is an indicator of good acidity of coffee. Sharp, pleasant aftertaste, a sharpness toward the front of the mouth; dryness at the back of the mouth and under the edges of the tongue; denotes the quality of coffee. Acidity ranges from lively to moderate to flat and dull.

Body

The physical mouth feel and texture of a coffee. Full bodied coffees have a strong, creamy, and pleasant, mouth feel. Coffee types showed significant variations (P≤0.014) with body due to altitude. The highest moderately full average value 11.88 and 11.65 body were recorded for Witasaja at mid and high land altitude, while the least body (9.78) was recorded at low land altitude for Abesha coffee type (Table 4). In addition coffee type significantly (P≤0.049) affected by shade effect where Witasaja had got higher average value (11.68) body

which grow under shade; while Abesha grow under shade showed least value of body (Table 5). A coffees body (light, medium, or full) is its thickness due to the amount of dissolved and suspended solids and oils extracted from the coffee grounds, and may range from thin and watery to thick and creamy.

The individual factor coffee tape and altitude affects the body quality attribute of the coffee sample highly significant (P≤0.001) and significant (P≤0.019) respectively. As a result Witasaja (11.48) and selection (11.23) coffee had got the highest result of medium pointed acidity (Table 1). In case of altitude effect the high land grown coffee had got best acidity (11.52) (Table 2).

Flavour

The interaction effect of coffee types by altitude on coffee flavour showed significant variations (P≤0.02). As a result, the highest good flavour (11.27) was recorded for Witasaja at high land, while the least flavour recorded at low land (10.03) and mid land (9.52) altitude for Abesha coffee type both (Table 4). Flavour quality attribute also significantly (P≤0.01affected by the independent factor coffee type and growing altitude of the coffee. As indicated in table x Witasaja (10.94) and selection (10.93) coffee type had got good flavour quality (Table 1). Witasaja and selection coffee type had similar flavor to Sidama and Yirgacheffe coffees. **These coffees have** a good balance of body and acidity along with its other positive characteristics.

Overall Quality

Interaction of coffee type and altitude was significant (P≤0.03) affect overall quality. The highest average overall quality value (11.77) was recorded for Witasaja coffee type at mid altitude and the least (9.88) was recorded selection coffee type collected at mid altitude (Table 4). In addition the overall quality was highly significant affected by interaction of coffee type with shade and altitude with shade type. Under shade grown Witasaja coffee type had got the highest overall quality (11.60) and whereas Abash coffee grown under shade reveled list value (10.02) (Table 5). Due to the inter action of high land coffee grown under shade achieved the highest (11.68) average overall quality whereas the list value (10.18) recorded under shade grown coffee at lower altitude (Table 6). Overall quality is affected due to genetic environmental interaction. The coffee quality comes from a combination of coffee type, environment and processing. This indicates that the coffee quality of the study area has great potential.

Total Cup Quality

There was significant (P≤0.01) variation in total cup quality affected by the interaction of coffee type by altitude. The highest value was recorded for Witasaja coffee type collected from mid and high land area with an average value of 46.27 (Table 4). The list value recorded for Abesha coffee type collected from mid (38.90) and low land (40.65) altitude. Similarly, Shade effect on coffee type showed significant (P≤0.01) variability where Witasaja had highest (46.43) total cup quality under shade condition whereas the lowest value (40.28) was shade grown Abesha coffee type (Table 5).

The total cup quality was significantly (P≤0.01) affected by the individual factor coffee type and altitude. Highest value (44.97) and least (41.16) was achieved for Witasaja and Abesha coffee type respectively (Table 1). The high land grown coffee achieved highest (44.91) total cup quality than the mid (43.02) and low land (42.23) altitude (Table 2). Shade was significantly (P≤0.039) affect total cup quality where 43.89 and 42.88 were recorded for shade and without shade grown coffee respectively (Table 3). The result showed the presence of difference among coffee type for cup quality attributes. Variation for cup quality character among coffee type in the study area is good opportunity for production potential. It was reported by Van der Vossen (2005) variation for cup quality character among different *Coffea arabica* L, indicating the presence of great variability among Arabica coffee genotypes.

Total Quality Evaluation

Total quality significantly (P≤0.01) affected by the interaction of coffee type with growing altitude. The highest value of total quality (82.43) was recorded for Witasaja coffee type at mid altitude and the least (68.07) was recorded Abesha coffee type collected from mid altitude (Table 4). In addition total quality was highly significant (P≤0.01) affected by coffee type (Table 1). Witasaja coffee type had got the highest total quality (78.69) and the least (72.21) was achieved for Abesha coffee type. The result of the study showed coffee quality affected coffee type, growing environment as well as agronomic practices. Damanu (2008) reported that coffee quality is a combination of botanical variety, topography, and climatic conditions. Similarly, Behailu et al., (2008) agreed that determine factors of coffee quality are genotypes, climatic conditions, soil characteristics of the area, agronomic practices, and post harvest processing techniques, all contribute either exaltation or deterioration of coffee quality.

CONCLUSION

The findings indicate variability among the coffee types for raw and cup quality characteristics. From all coffee types evaluated Witasaja was found to be the best at high land altitude. This coffee type had desirable quality which is similar to Sidama and Yirgacheffe coffee quality flavour type. The cup quality attributes were best at mid and high land altitudes than low land. Under shade grown coffee type were best for total cup quality. Coffees grown in Gurage zone can be inter into specialty market if it is processed in recommended dry method. The effects of some soil properties were also evident on coffee quality, demonstrating the importance to consider soils for the sustainable production of high quality coffees.

Table 1: Effect of coffee type on coffee quality

CT	Sc.14%	SM	CL	OD	RAW	AC	BO	FL	OAQ	CUP	TQ
Selection	83.50	10.00^{b}	10.50^{b}	10	30.50^{b}	11.23^{a}	10.94^{b}	10.93^{a}	10.98^{a}	44.03^{a}	74.43^{b}
Witasaja	91.56	12.28^{a}	11.44^{a}	10	33.72^{a}	11.48^{a}	11.94^{a}	10.94^{a}	11.22^{a}	44.97^{a}	78.69^{a}
Abesha	88.56	10.83^{b}	10.22^{b}	10	31.06^{b}	10.40^{b}	10.32^{c}	10.19^{b}	10.32^{b}	41.16^{b}	72.21^{c}
CV%	14.93	12.08	11.28	0	6.43	5.69	5.50	6.08	0.43	3.94	3.63
LSD	ns	0.90	0.82	ns	1.38	0.43	0.41	0.44	0.58	1.16	1.85

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** Sc.14% = percent of above screen 14, SM = Shape and make, OD= odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

Table 2: Effect of coffee growing altitude on coffee quality

AL	Sc.14%	SM	CL	OD	RAW	AC	BO	FL	OAQ	CUP	TQ
Low Land	93.06^{a}	11.67^{a}	11.00	10	32.67^{a}	10.69^{b}	10.69^{b}	10.48^{b}	10.44^{b}	42.23^{b}	74.89
Mid Land	92.72^{a}	11.22^{a}	10.94	10	32.17^{a}	10.89^{b}	10.74^{b}	10.52^{b}	10.94^{a}	43.02^{b}	75.19
High Land	77.83^{b}	10.22^{b}	10.22	10	30.44^{b}	11.52^{a}	11.23^{a}	11.07^{a}	11.14^{a}	44.91^{a}	75.35
CV%	14.93	12.08	11.28	0	6.43	5.69	5.50	6.08	0.4275	3.94	3.63
LSD	8.87	0.90	ns	ns	1.38	0.42	0.41	0.44	0.43	1.16	ns

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** Sc.14% = percent of above screen 14, SM = Shape and make, OD= odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

Table 3: Effect of coffee growing altitude on coffee quality

SHT	**Sc.14%**	**SM**	**CL**	**OD**	**RAW**	**AC**	**BO**	**FL**	**OAQ**	**CUP**	**TQ**
Shade	88.07	11.04	10.59	10	31.63	11.16	10.97	10.86	10.97	43.89^{a}	75.51
Without shade	87.67	11.03	10.85	10	31.89	10.91	10.80	10.52	10.71	42.88^{b}	74.77
CV%	14.93	12.08	11.28	0	6.43	5.69	5.5	6.08	0.43	3.94	3.63
LSD	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.944	ns

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** Sc.14% = percent of above screen 14, SM = Shape and make, OD= odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

Table 4: Interaction effect of coffee type and growing altitude on coffee quality

CT	AL	Sc.14%	SM	CL	OD	RAW	AC	BO	FL	OAQ	CUP	TQ
Selection	LL	94.33[a]	11.00[bc]	10.33	10.00	31.33	11.17	11.02	10.88	10.65	43.65	74.98
Selection	ML	93.00[a]	10.33[c]	10.83	10.00	31.17	11.27	10.78	10.77	11.17	43.90	75.07
Selection	HL	63.17[b]	8.67[d]	10.33	10.00	29.00	11.27	11.03	11.15	11.13	44.53	73.53
Witasaja	LL	96.33[a]	12.00[b]	11.67	10.00	33.67	10.63	10.65	10.52	10.63	42.38	76.05
Witasaja	ML	96.50[a]	13.83[a]	12.33	10.00	36.17	11.65	11.65	11.27	11.77	46.27	82.43
Witasaja	HL	81.83[a]	11.00[bc]	10.33	10.00	31.33	12.15	11.88	11.03	11.27	46.27	77.60
Abesha	LL	88.50[a]	12.00[b]	11.00	10.00	33.00	10.28	10.40	10.03	10.03	40.65	73.65
Abesha	ML	88.67[a]	9.50[c]	9.67	10.00	29.17	9.77	9.78	9.52	9.88	38.90	68.07
Abesha	HL	88.50[a]	11.00[bc]	10.00	10.00	31.00	11.15	10.77	11.03	11.03	43.92	74.92
CV%		14.93	12.08	11.28	0	6.43	5.69	5.50	6.08	0.4275	3.94	3.63
LSD		15.36	1.56	ns	ns	2.39	0.74	0.70	0.76	0.74	2.01	3.20

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** AL = Altitude, LL= Low Land, ML = Mid Land, HL = High Land, Sc.14% = percent of above screen 14, SM = Shape and make, OD = odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

Table 5: Interaction effect coffee type and shade type on coffee quality

CT	SHT	Sc.14%	SM	CL	OD	RAW	AC	BO	FL	OAQ	CUP	TQ
Selection	Shade	84.67	10.11	10.67	10.00	30.78	11.52[ab]	1.10[b]	11.10	11.28[ab]	44.94[a]	75.72
Selection	Without shade	82.33	9.89	10.33	10.00	30.22	10.94[bc]	0.78[b]	10.77	10.69[b]	43.11[b]	73.33
Witasaja	Shade	88.33	11.89	10.89	10.00	32.78	11.93[a]	1.68[a]	11.28	11.60[a]	46.43[a]	79.21
Witasaja	Without shade	94.78	12.67	12.00	10.00	34.67	11.02[bc]	1.10[b]	10.60	10.84[b]	43.51[b]	78.18
Abesha	Shade	91.22	11.11	10.22	10.00	31.33	10.02[d]	0.11[c]	10.19	10.02[c]	40.28[c]	71.61
Abesha	Without shade	85.89	10.56	10.22	10.00	30.78	10.78[c]	0.52[bc]	10.20	10.61[bc]	42.03[b]	72.81
CV%		14.93	12.08	11.28	0	6.43	5.69	.50	6.08	0.43	3.94	3.63
LSD		ns	ns	ns	ns	ns	0.60	.57	ns	0.61	1.64	ns

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** Sc.14% = percent of above screen 14, SM = Shape and make, OD= odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

Table 6: Interaction effect coffee growing altitude and shade type on quality

AL	SHT	Sc.14%	SM	CL	OD	RAW	AC	BO	FL	OAQ	CUP	TQ
LL	Shade	96.56	11.78	11.33	10.00	33.11	10.61	10.77	10.43	10.18	41.93	75.04
LL	Without shade	89.56	11.56	10.67	10.00	32.22	10.78	10.61	10.52	10.70	42.52	74.74
ML	Shade	92.56	11.22	10.78	10.00	32.00	11.18	10.87	10.68	11.11	43.78	75.78
ML	Without shade	92.89	11.22	11.11	10.00	32.33	10.61	10.61	10.36	10.77	42.27	74.60
HL	Shade	75.11	10.11	9.67	10.00	29.78	11.69	11.27	11.46	11.61	45.94	75.72
HL	Without shade	80.56	10.33	10.78	10.00	31.11	11.36	11.19	10.69	10.68	43.87	74.98
CV%		14.93	12.08	11.28	0	6.43	5.69	5.5	6.08	0.43	3.94	3.63
LSD		ns	ns	ns	ns	ns	ns	ns	ns	0.60	ns	ns

* Mean values with similar letter(s) in the column are not significantly different at P<0.05
** AL = Altitude, LL= Low Land, ML = Mid Land, HL = High Land, Sc.14% = percent of above screen 14, SM = Shape and make, OD= odor, Co = Color, AC = Acidity, BO = Body, FL = Flavor and OAQ = Overall Quality

REFERENCES

Abrar Sualeh, Solomon Endris and Ali Mohammed, 2014. Processing Method, Variety and Roasting Effect on Cup Quality of Arabica Coffee (*Coffea arabica* L.); Discourse Journal of Agriculture and Food Sciences, 2(2): 70-75.

Agwanda, C O, Baradat P, Eskes A B, Cilas C and Charrier A, (2003). Selection for bean and liquor qualities

within related hybrids of arabica coffee in multi-local field trials. Euphytica 131: 1-14.
Behailu, W., Abrar, S., Negussie, M. and Solomon, E. 2008. Coffee Processing and Quality Research in Ethiopia, in Coffee Diversity and Knowledge, Proceedings of a National Workshop. Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, 14-17 August 2007.
Damanu Tullu, 2008. Coffee production and marketing in Oromia Regional State. pp. 382-389. In: GirmaAdugna, BayettaBelachew, TesfayeShimber, EndaleTaye and TayeKufa (eds.). Coffee Diversity and Knowledge. Proceedings of a National Workshop Four Decades of Coffee Research and Development in Ethiopia. Addis Ababa, Ethiopia, 14-17 August 2007.
GZADD (Gurage Zone Agricultural Development Department). 2009. Documented report on socio-economic study of the zone.
Ministry of Agriculture (MOA). 2010. Yearly Report of the Ministry (Unpublished). Addis Ababa.
SAS (Statistical Analysis System) (2008). (Version 9.2). SAS Institute, Cary, NC. USA.
Sutherland K (1990). Developments in Coffee Processing. Proceedings of the New South Wales Coffee Marketing Summit, Murwillumbah; 51-53.

Appendix Table 1:- Scale of Raw and Cup quality attributes

Points	**Raw Value (40%)**			**Cup Value (60%)**			
	Shape & Make(15)	**Color (15)**	**Odor (10)**	**Acidity (15)**	**Body (15)**	**Flavor (15)**	**Overall cup Quality^{+}(15)**
15	Very Good	Bluish	Clean	Pointed	Full	V. good	Excellent
12	Good	Grayish	Fair Clean	Medium pointed	Medium full	Good	Very good
10	Fair good	Greenish	Trace	Medium	Medium	Average	Good
8	Average	Coated	Light	Light	Light	Fair	Regular
6	Mixed	Faded	Moderate	Lacking	Very light	Bad	Bad
4	Small	White	Strong	Nil	Nil	Nil	Unacceptable

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar