Int.J.Curr.Res.Aca.Rev.2022; 10(08): 121-132

EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 10 Number 08 (August-2022)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2022.1008.009

Review on Coffee Processing and Quality Research Achievement in Ethiopia

Abrar Sualeh[1*], Mikru Tesfa[2] and Negussie Mekonen[1]

[1]*Jimma Agricultural Research Centre, Jimma, Ethiopia*
[2]*Department of Agriculture, Food and Climate Science, Injibara University, Injibara, Ethiopia*

**Corresponding author*

Abstract

Coffee is one of the most popular drinks now a day all over the world. Its quality is critical importance to the coffee industry. Quality is a complex characteristic which depends on species/variety, environmental conditions, pre and postharvest practices. Processing is a major activity in coffee production and the most critical from a quality point of view and involves a serious of stages each of which has a distinct purpose. In general the aim of coffee processing is to select and develop postharvest handling methods which enable producers to produce high quality coffee. As a result the country produces more coffee with high quality for export in the growing world market. For the last five decades, coffee processing and quality research division has been engaged in coffee processing and quality research. The long-term different research activity was mainly concentrated on coffee fermentation, drying, storage, quality performance evaluation, profile mapping, assessment of genotypes for biochemical/ caffeine content, evaluation for cup quality, effect of post harvest processing techniques on quality. Influence of storage time at primary stores for quality deterioration was investigated. Results generated from the research that have been recommended and accepted by the coffee producers as standard practice for processing and ensure high quality Ethiopian coffee. The research achievements are reviewed in this paper. In addition this paper discusses on some of the most important aspects with a view to identifying major areas of research gaps on which future research and development activities must focus.

Article Info

Received: 08 July 2022
Accepted: 29 July 2022
Available Online: 20 August 2022

Keywords

Drying, fermentation, processing, quality, storage.

Introduction

Coffee Arabica is an essential commodity to the livelihood of millions of Ethiopians and its quality has critical importance to the coffee industry. Coffee is the major source of foreign currency for Ethiopia and contributes more than 35% of the total export earnings (FAO/WFP, 2008). Coffee processing is a very important activity in coffee production system and plays a crucial role in quality determination (Mburu, 1999). The quality of Ethiopian coffee is determined by two main factors, namely geographic origin and postharvest processing techniques (Musebe *et al.*, 2008).

Physical and organoleptic qualities are the most important parameters in the world coffee trade. It is estimated that 40 % of the quality of coffee is determined in the field (Agricultural practices), 40% at postharvest primary processing, and 20% at export processing and handling, including storage (Musebe *et al.*, 2008).This underscores the importance of primary processing in enhancing the quality and value of Coffee. For Ethiopian

coffee, natural fermentation is recommended as it improves both raw and roast qualities (Behailu *et al., 2008*). However, natural fermentation is time consuming and costly, causes weight loss and is laborious compared to demucilager. High quality coffee and reliability helps in establishing relationship in the market and help producer to minimize their marketing risks (Kawuma, 2003). In this respect, the fact that Ethiopia possesses numerous genetic diversity and different type of coffee reputed for their unique cup-taste on the world market greatly favors the country to be more competitive by supplying diversity of high quality specialty coffee.

Coffee quality is of critical importance to the coffee industry. Quality coffee is a product that has desirable clean raw and roasted appearance, attractive aroma, and good cup taste. However, it is beyond dispute that in Ethiopia the quality of coffee produced by farmers has been deteriorating form time to time. At different forum, serious complaints have been raised about the declining quality of coffee produced in different parts of the country. Factors that determine coffee quality are numerous, involving genotype, climatic conditions and soil characteristics of the area in which coffee is grown, agricultural practices, harvesting, post-harvest processing, grading, packing, storage condition and transporting, all contribute either to exaltation or deterioration of quality. However, of these various factors, some of the human controlled ones such as pre- and post-harvest processing techniques, grading, packing and transporting are believed largely contribute to the decline in coffee quality as the country is believed to possess diverse genetic base and other natural factors that favors both quality and productivity.

For about fifty years now, coffee processing and quality research division has been engaged in coffee processing and quality research. The long-term research activity was concentrated on coffee quality, fermentation, drying and storage of parchment coffee with a view to produce the highest quality and thus not only ensuring that farmers will get best price, but also that the reputation of Ethiopian coffee remains high in all consumer countries. The fact that the results of research have been of immense economic value to the coffee industry in Ethiopia demonstrated from many recommendations that have ensured and accepted by the coffee producers as standard practice for processing high quality Ethiopian coffee.

This review paper discusses some of the most important previous research works of Jimma Agricultural Research Centre (JARC) in Ethiopia on coffee processing and quality with a view to identifying major areas of future research gap on which further significant development must depend. Some important pre- and post-harvest practices known to enhance coffee quality and technical recommendations for every stage of processing have also been included. The constraints facing the implementation of the recommended practices by users have been identified and discussed thoroughly.

Research Achievements

Coffee Quality Study

Summary on evaluation of coffee quality for released

The 35 pure line and 7 hybrid varieties were evaluated for their overall quality. All have shown commercially acceptable quality (Table 1). The evaluated different pure line and hybrid coffee varieties were recommended and produced under varies agro-ecologies of Ethiopia. These coffee types know a day contributes more for major and new coffee producing area. All variety development program should include quality test as an important parameter as cup quality is the characteristics of most interest to all coffee buyers. In effect, the work in progress today to develop varieties with best quality for each agro-ecology should be strengthened.

Ethiopian mild coffee quality study

Brownbridge and Eyassu (1968) described the quality of some of the main Ethiopian mild coffees. The work was carried out to provide basic information on the quality of the main coffees of Ethiopia. Several distinct coffee types were separated based on bean shape and quality assessment using raw, roast and liquor characteristics. They described Limu-Enaria, Gera, Mizan Teferi, Bonga, Jimma and Agaro coffee types under Kaffa coffee which had very heterogeneous beans of all shapes and sizes. The liquor is plain probably because there is such a mixture of types. Good quality coffees were present in most samples. Under Sidamo coffee Dilla, Yirgalem and Yirgacheffe coffee type were grouped having less homogeneous type samples than the Sidamos and three distinct types recognized. It has a roast of fair average quality with good liquor. Metu coffee had more homogeneous samples than the coffees of Kaffa and from the bean shape; the predominant type had been tentatively classified under Illuababor coffee. Anfillo and Gimbi coffee were classified under Wellega coffee type which had heterogeneous types. The predominant type

was oblong to oval and small round bean of "fair to good" liquor. Harar and Asebe Teferi coffee were grouped under Harar coffee type being found either oblong or round to slightly oval. The shape and style of the bean corresponded more with Enaria type than with oblong bean. The color was very uniform, being golden-amber bean.

Abe Dongoro coffee quality

Seven local landrace with one cheek (74110) coffee samples were prepared by dry method and evaluated for quality from Abe Dongoro district in Horo-Guduru Wollega Zone, Oromia Regional state. Bean sizes of all tested coffee samples had more than 85% over screen 14 which full fill the export market standard requirement. Lagie, Edoboti and Wollegie kebeles coffees were pointed acidity, full body and balanced with very good flavour as well as very good overall quality standard. Others coffee types from Lomecha, Garero, Botoro and Gortie kebeles had got medium to pointed acidity, medium to full body and good to very good overall standard quality (Table2). Edoboti, Garero and Lagie kebeles coffee resembles to Limmu coffee falvour (Winey flavour). Both raw and cup quality test results of the selected potential coffee growing kebeles of Abe Dongoro woreda were commercially acceptable to highly acceptable quality and fit to export market standard if it follow the recommended postharvest practices (Mikru *et al.*, 2020).

Guraghe coffee quality

Coffee samples (18 samples) collected from different districts of Guraghe zone were prepared under dry method processing and evaluated for quality. 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 3). In addition total quality was highly significant ($P \leq 0.01$) affected by coffee type (Table 4). 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. 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 (Abrar Sualeh *et al.*, 2015).

Raya Azebo coffee quality

Seven coffee samples from Werabaya, Munora and Beiru kebeles of RayaAzebo district in Southern Tigray region of Ethiopia were collected prepared in dry and semi-washed processing methods for quality evaluation. The raw and cup quality evaluation result indicated that the coffee produced in Werabaya, Munora and Beiro was generally good with acceptable to highly acceptable cup test (Table 5). Furthermore, it has Harare coffee flavor when dry processed (Abrar and Negussie, 2013), which can guarantee good price in international market. This indicated that the possibility to produce high quality Raya Azebo coffee for global market and enable the region to diversify foreign earnings largely to improve the livelihood of rural people in the region.

Gidame coffee quality

Gidamei is one of the districts in Kelem Wollega zone in Oromiya region Of Ethiopia. The woreda is the second largest coffee producer next to Anfilo. From the selected 16 kebeles 23 coffee samples were collected and processed under semi washed method of processing. Samples were collected based on their growing condition (under shade and without shade). Seven samples were collected from open sun grown coffee trees and 16 were collected under shade grown coffee trees. Out of the evaluated samples the coffee prepared from Kure kebele had got best cup quality which was grown under shade. The physical quality of coffee had shown significant difference between kebele samples. The highest result was recorded 37 out of 40 for coffee sample prepared from Dito Robo grown without shade (Table 6). The highest screen Size No. 14 (%) was recorded for coffee samples collected from open sun grown coffee farms. Raw quality was best when the coffee tree grow without shade. Even if there is no significant difference between with and without shade grown coffee for cup quality (Table 7), higher score (44.76) was achieved coffee grown under shade at kuri kebele (Table 6). So that for best cup and raw quality balance coffee should be cultivated under shade.

Fermentation Studies

Natural fermentation of coffee is the function of many parameters, such as environmental, pH, temperature, micro flora and level of pollution in the water used, variety difference in the ripe cherries used for pulping, its geographical and cultural origin, the standard of picking and minor variations in the processing method, some of which have never been investigated fully. In the washed coffee production, final quality, among other factors is greatly dependent up on the fermentation process (Woelore, 1993). Brown bridge and Michael (1971) have reported that the method of removing the mucilage (dry fermentation, under water fermentation, peptic enzyme-accelerated fermentation, or chemical cleaning) has no effect on the liquor quality and there is no evidence that any one method can produce significantly better liquors than another (Table 8). There is, thus, no quality advantage gained by developing a system of mechanical demucilaging, although such a system may have other attractions.

It has been confirmed that under-water soaking following "dry" fermentation, i.e., two-stage fermentation enhances the appearance of both raw and, particularly and consistently, the roast of coffees compared to 'dry' fermentation only (IAR, 1969). Post- fermentation soaking for 24 hours produced better raw and roast appearances than either 8 or 16 hour soaking. Extending the soak to 48 hours in un-replicated trial did not cause any further improvement to the raw, and actually reduced the roast quality. The two-stage fermentation method produces coffee of better raw and, more particularly, roasts quality than dry fermentation alone. The influence of the two stage technique on the liquor quality has less marked, but where it reduces the development of brownness of the raw bean, its effect is likely to beneficial. Owing to the rapid dehydration of the surface of the dry-fermenting coffee, a modified two-stage process is proposed for Ethiopia in which under-water fermentation replaces the normal dry fermentation of two stages. The second stage would remain as an under-water soaking stage for 24 hours duration. Moreover the result has shown that the main value of post-fermentation under water soaking in Ethiopia is that the raw colors and more especially the roast quality were improved by this technique.

A rapid and more fermentation hours is necessary in order to avoid congestion at the factory, and eliminate the possibility of occurrence of deleterious off-flavors and taints such as 'sourness', 'onion flavor' and 'stinkers', which resulted from concomitant microbial and /or bean physiological and biochemical activities. For Ethiopian conditions an underwater fermentation technique is recommended (Woelore, 1993). Regarding the time of fermentation, recommendation had been given for different agro-ecologies. Any time in the range of, below 24 hours, 24 to 48 hours; 48 to 72 hours or above 72 hours of mucilage degradation washed at the first, the second, the third, or after the third day from pulping, respectively, are well recommended (Table 9). As a guide, washed coffee producing factories may arbitrarily be grouped altitudinal as 1200 m and below, 1200 - 1500m, 1500 -1800 m and above 1800 m for varying fermentation practices, as extrapolated from the study by Woelore (1993).

Influence of shade during fermentation stage on coffee cup quality has been investigated (Behailu and Solomon, 2006). It was reported that the time taken for fermentation period is affected by shade level and variety. Coffee fermented under shade takes more time than the un-shaded one. The shortest fermentation period was associated with the lowest cup quality value where as the highest cup quality value recorded on longest fermentation period (Table 10). Positive correlation observed between fermentation period and cup quality. Although coffee fermented under shade takes more time, using shaded fermentation tanks help to achieve uniform fermentation process and better quality coffee (Behailu and Solomon, 2006).

Investigations on the recirculation of coffee factory water for fermentation, was carried out at Melko. It was confirmed that, using pulpery water as fermentation inoculum, helps in accelerating fermentation without significant adverse effect on final cup quality of coffee (IAR, 1997). Due to effects on parchment appearance and subsequent quality, such inoculum should be used in a concentration not exceeding one to four mix of water (1:4). A report by Brownbridge and Michael (1971) indicated that high level of coffee skins in fermenting coffee produces inferior raw, roast and liquor qualities compared to skin-free controls, with the liquors adversely affected by the development of off-flavors variously described as coarse, bitter, fruity, or unclean. The same work suggested that a lower level of skins (at 1% by weight) might have beneficial influence on the liquor quality.

Table.1 Quality status of released pure line and hybrid coffee varieties

Ser. no.	Selection	Raw quality	Cup quality	Commercial acceptance
1	741	Fair/Good	Average	**Acceptable**
2	744	Average /Good	Average	**Acceptable**
3	7440	Fair/Good	FAQ	**Acceptable**
4	7454	Fair/Good	Fair/Good	**Acceptable**
5	7487	Fair/Good	Average	**Hardly Acceptable**
6	74110	Average/ Good	Good	**Acceptable**
7	74112	Good	Good	**Good & Acceptable**
8	74140	Average	Average	**Hardly Acceptable**
9	74148	Average	Average	**Hardly Acceptable**
10	74158	Good	Fair/Good	**Acceptable**
11	74165	Good	Fair/Good	**Acceptable**
12	754	Good	Fair/Good	**Acceptable**
13	75225	FAQ	FAQ	**Acceptable**
14	Dessu	Good	Average/good	**Good & Acceptable**
15	Catimor J-19	FAQ	Average	**Hardly Acceptable**
16	Catimor J-21	FAQ	Average	**Hardly Acceptable**
17	Geisha	Average	Average	**Hardly Acceptable**
18	Me'oftu	Average	Average	**Acceptable**
19	Angafa	Good	Good	**Good & Acceptable**
20	Bunowashi	Average/ Good	Average +	**Acceptable**
21	Merdacherico	Very good	Average	**Acceptance**
22	Wushwush	Good	Average +	**Acceptable**
23	Yachi	Average Good	Good	**Acceptable**
24	Ababuna*	Average	Average	**Average**
25	Melko CH2*	Average/Good	Average	**Acceptance**
26	Gawe*	Average/Good	Average	**Acceptance**
27	Feyate	Average/Good	Good	**Good &Acceptable**
28	Koti	Average	Average+	**Good & Acceptable**
29	Odicha	Average	Average	**Acceptable**
30	Gera CH 1*	Very good	Good	**Highly Acceptable**
31	Melko Ibsitu*	Good	Average/Good	**Highly Acceptable**
32	EIAR 50/CH*	Good	Good	**Highly Acceptable**
33	TepiHC5*	Average	Average/Good	**Acceptable**
34	Limu -1	Average	Average	**Acceptable**
35	Chala	Average	Average	**Acceptable**
36	Sende	Average	Good	**Acceptable**
37	Haru-1	Good	Good	**Good & Acceptable**
38	Menesibu	Average	Average	**Acceptable**
39	Mocha	Average	Good	**Good & Acceptable**
40	Harusa	Average	Average/good	**Acceptable**
41	Bulutum	Average	Average/good	**Acceptable**
42	**Mechara**	**Average**	**Average**	**Acceptable**

*Hybrid coffee varieties

Table.2 Raw and cup quality of coffee from Abe Dongoro woreda

Kebele/coffee type	Bean screen % > 14 size	Raw quality (40%)	Cup Quality (60%)	Total Quality (100%)	Typicity
Garero	95.50^{c}	33.75^{cd}	41.16^{bc}	74.91^{e}	Winy
Lagie	96.93^{b}	34.25^{bc}	43.41^{b}	77.66^{d}	Winy
Lomecha	96.33^{b}	35.00^{abc}	38.16^{c}	73.16^{e}	
Gortie	96.20^{bc}	34.50^{bc}	44.41^{b}	78.91^{cd}	
Botoro	98.50^{a}	35.50^{ab}	44.66^{b}	80.16^{bc}	
Edoboti	96.40^{b}	36.37^{a}	48.83^{a}	85.20^{a}	Winy
Wollegie	96.50^{b}	32.75^{d}	49.41^{a}	82.16^{b}	
74110(Cheek)	94.50^{d}	35.25^{ab}	44.50^{b}	79.75^{cd}	
CV (%)	0.48	2.87	4.60	3.22	
LSD (0.05)	0.37	0.70	1.66	2.15	

Source: - Mikru *et al.*, 2020

Table.3 Interaction effect of coffee type and growing altitude on coffee quality

Coffee type	Altitude	Bean screen % > 14 size	Raw quality (40%)	Cup Quality (60%)	Total Quality (100%)
Selection	Low Land	94.33^{a}	31.33^{bc}	43.65^{b}	74.98^{bc}
Selection	Mid Land	93.00^{a}	31.17^{cd}	43.90^{b}	75.07^{bc}
Selection	High Land	63.17^{b}	29.00^{d}	44.53^{ab}	73.53^{b}
Witasaja	Low Land	96.33^{a}	33.67^{b}	42.38^{bc}	76.05^{bc}
Witasaja	Mid Land	96.50^{a}	36.17^{a}	46.27^{a}	82.43^{a}
Witasaja	High Land	81.83^{a}	31.33^{bc}	46.27^{a}	77.60^{b}
Abesha	Low Land	88.50^{a}	33.00^{bc}	40.65^{cd}	73.65^{c}
Abesha	Mid Land	88.67^{a}	29.17^{d}	38.90^{d}	68.07^{d}
Abesha	High Land	88.50^{a}	31.00^{cd}	43.92^{b}	74.92^{bc}
CV%		14.93	6.43	3.94	3.63
LSD		15.36	2.39	2.01	3.20

Mean values with similar letter(s) in the column are not significantly different at $P < 0.05$
Source: - Abrar Sualeh, *et al.*, 2015

Table.4 Effect of coffee type on coffee quality

Coffee type	Bean screen % > 14 size	Raw quality (40%)	Cup Quality (60%)	Total Quality (100%)
Selection	83.50	30.50^{b}	44.03^{a}	74.43^{b}
Witasaja	91.56	33.72^{a}	44.97^{a}	78.69^{a}
Abesha	88.56	31.06^{b}	41.16^{b}	72.21^{c}
CV%	14.93	6.43	3.94	3.63
LSD	ns	1.38	1.16	1.85

Mean values with similar letter(s) in the column are not significantly different at $P < 0.05$
Source: - Abrar Sualeh, *et al.*, 2015

Table.5 Mean Quality test result of JARC and CLU cuppers Raya Azebo district

No	Coffee type	Semi-Washed				Dry processing (unwashed)			
		% > Screen 14	Raw (40)	Cup (60)	Total (100)	% > Screen No 14	Raw (40)	Cup (60)	Total (100)
1	Werabaya type o1	95.0	32.0	37.5	69.5*	94.0	33.5	46.5	80.0**
2	Werabaya type o2	88.0	30.0	44.0	74.0*	85.0	31.0	44.0	75.0*
3	Werabaya type o3	87.0	29.0	37.5	66.5*	85.0	27.0	36.5	63.5*
4	Werabaya type o4	96.0	34.5	46.0	80.5**	95.0	33.5	43.0	76.5*
5	Werabaya Bulk	92.0	31.0	36.5	67.5*	92.0	30.0	37.0	67.0*
6	Beiru Bulk	97.0	30.0	43.0	73.0*	91.0	31.0	43.5	74.5*
7	Munora Bulk	97.0	33.5	39.5	73.0*	-	-	-	-

N.B: *, ** acceptable and highly acceptable in overall quality respectively
Source: Abrar and Negussie, 2013

Table.6 Quality test of coffee collected from Gidamei woreda of Kelem Wollega Zone

Ser. no.	**Kebele**	**Growing condition**	**Coffee quality**			
			Screen 14 (%)	Raw (40%)	Cup (60%)	**Total (100%)**
1	Geba Fechassa	Without shade*	98.00	34.00	41.52	**75.52**
2	Geba Fechassa	Without shade**	98.00	34.00	38.04	**72.04**
3	Geba Fechassa	With shade	97.00	34.00	40.20	**74.20**
4	Burie	With shade	97.00	34.00	39.96	**73.96**
5	Burie	Without shade	99.00	34.00	43.80	**77.80**
6	Abotei	With shade	93.00	30.00	37.80	**67.80**
7	Graye Horue	With shade	94.00	26.00	39.48	**65.48**
8	Graye Horue	Without shade	99.00	34.00	39.84	**73.84**
9	Dito Robo	With shade	95.00	32.00	36.72	**68.72**
10	Dito Robo	Without shade	96.00	37.00	41.76	**78.76**
11	Graye Shonkor	With shade	85.00	34.00	38.52	**72.52**
12	Graye Shonkor	Without shade	98.00	32.00	41.16	**73.16**
13	Kelem	With shade	95.00	30.00	37.56	**67.56**
14	Kuri	With shade	98.00	32.00	42.72	**74.72**
15	Kuri	With shade	95.00	34.00	44.76	**78.76**
16	Bata	Without shade	99.00	34.00	41.28	**75.28**
17	Chomen	With shade	96.00	37.00	42.24	**79.24**
18	HroKundi	With shade	97.00	34.00	41.04	**75.04**
19	AlichaJilo	With shade	94.00	34.00	43.08	**77.08**
20	WoroKoye	With shade	86.00	34.00	38.76	**72.76**
21	DaleGere	With shade	95.00	34.00	40.56	**74.56**
22	LaloGere	With shade	93.00	34.00	40.56	**74.56**
23	**Gidame Town**	**With shade**	**97.00**	**34.00**	**39.72**	**73.72**

N.B: *, ** Bronze tip and Green tip respectively

Table.7 Comparison of coffee quality grown with and without shade collected from Gidamei

Ser. no.	Growing condition	Coffee quality			
		Screen 14 (%)	Raw (40%)	Cup (60%)	**Total (100%)**
1	Without shade	97.68a	34.21a	40.68	**74.89**
2	With shade	94.39b	32.91b	40.32	**73.23**
LSD (%)		**2.12**	**0.33**	**ns**	**ns**

N.B: ns = non significant

Table.8 Liquor quality of dry-fermented, under-water fermented and NaOH- cleaned coffee.

Type of fermentation	Acidity	Body	Flavor
Two-stage fermentation 16 hours+24 hours soak	Light-medium+	Medium to light medium	**Fair/Good to FAQ**
Under-water fermentation 16 hours +24 hours soak	Medium to light medium	Medium to light medium	**Fair/Good**
NaOH-Cleaned +40 hours soak	**Medium to light medium**	**Medium to light medium**	**Fair/Good to FAQ**

Source: Brownbridge and Michael, 1971

Table.9 Composite quality data for raw, roast, and liquor at Limukosa, Melko and Bebeka*

Score	Limu kosa			Melko			Bebeka		
Time (hrs)	Raw	Roast	Liquor	Raw	Roast	Liquor	Raw	Roast	**Liquor**
24	4.9^{c**}	5.1^{b}	5.1^{d}	4.6^{bc}	5.0^{c}	4.6b	4.6c	4.8	**4.3ab**
36	4.9^{c}	5.1^{b}	4.9^{cd}	4.7^{c}	4.5^{bc}	4.5b	4.4bc	4.6	**4.1a**
48	4.8^{c}	$4.8a^{b}$	3.9^{a}	4.6^{bc}	4.1^{ab}	4.1ab	4.5bc	4.8	**4.3ab**
64	4.1^{b}	5.0^{ab}	3.9^{a}	4.1^{a}	3.8^{a}	4.0ab	4.3abc	4.9	**4.2a**
72/78	3.8^{a}	4.7^{a}	4.2^{ab}	4.1^{a}	3.9^{ab}	4.3ab	4.0a	4.7	**4.2a**
94/96	4.2^{b}	4.6^{a}	4.1^{a}	4.1^{a}	4.1^{ab}	4.0ab	4.2ab	4.8	**4.5b**
110	**3.9^{ab}**	**4.6^{a}**	**4.6^{bc}**	**4.4^{ab}**	**3.9^{a}**	**4.0ab**	**-**	**-**	**-**

* Lower score denotes better quality, ** Means followed by common letter under a column are not significantly different at 5% level.

Source: Woelore, 1993

Table.10 The interaction effect of shade and variety for fermentation period (hrs)

Shade	Variety and fermentation duration (hrs)			Shade means
	V1 (741)	V2 (74110)	V3 (74165)	
Shaded	33.17	26.00	40.00	**33.06**
Unshaded	29.83	25.00	29.92	**28.25**
Variety means	**31.50**	**25.5**	**34.94**	

CV% = 8.37; LSD 0.05 = 2.11

Source: Behailu and Solomon, 2006

Table.11 Effect of demucilager machineries and driers on coffee quality

Preparation methods	Values		
	Raw value (40%)	Cup value (60%)	Total value (100%)
Normal fermentation & sun drier	33.83^{c}	43.00^{c}	76.83^{c}
Normal fermentation & artificial drier	33.50^{c}	43.67b^{c}	77.17^{c}
Normal fermentation & tunnel drier	34.33^{bc}	44.17b^{c}	78.50b^{c}
Demucilager & sun drier	**35.50^{a}**	**47.00^{a}**	**82.50^{a}**
Demucilager & tunnel drier	**35.67^{a}**	**47.50^{a}**	**83.17^{a}**
Demucilager & artificial drier	35.00^{ab}	44.50^{b}	79.50^{b}
CV (%)	3.73	2.83	2.83
LSD (0.05)	1.05	1.32	1.84

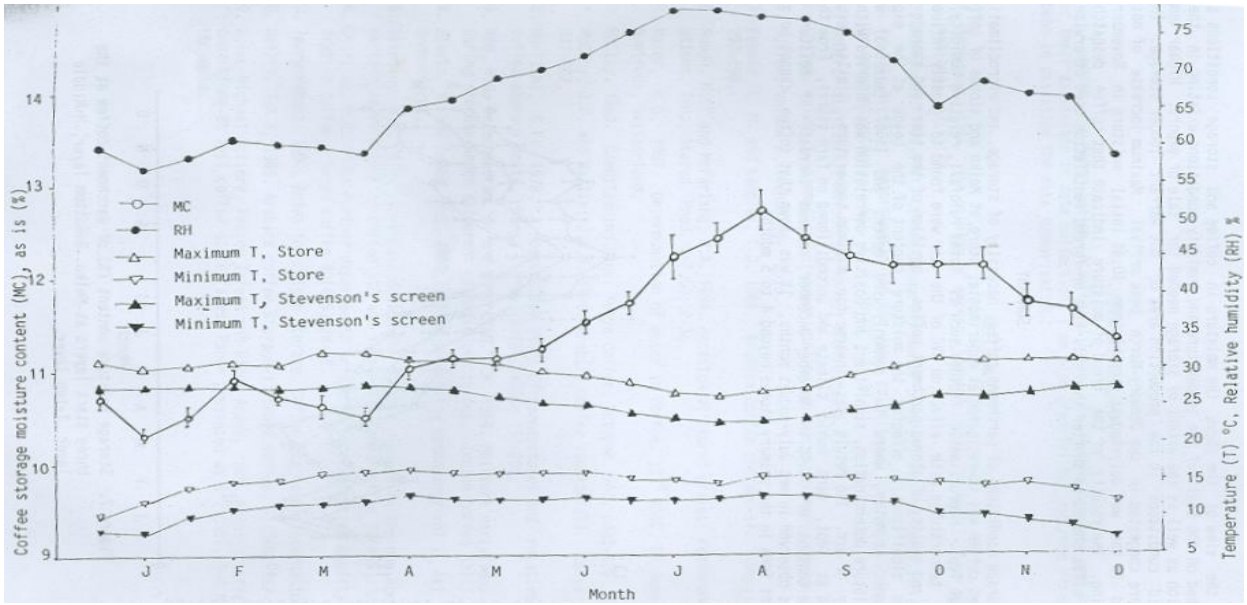
Mean values followed by the same letter with in a column are not significant difference (P ≥ 0.05).
Source: Mikru, *et al.,* 2021

Table.12 Effect of covering period and drying depth on drying time (days) of parchment coffee

Covering period	Drying depth (*cm*)				Means
	2	3	4	5	
Uncovered	5.98	6.2	6.88	7.18	6.56
10:30-14:30	6.77	7.68	8.98	9.73	8.29
11:00-15:30	6.90	7.80	8.83	9.74	8.32
10:30-16:30	8.19	8.82	9.63	10.47	9.28
10:00-16:30	8.04	8.83	10.21	10.8	9.47
DD *means*	7.18	7.87	8.91	9.58	

CV% = 1.84, LSD 0.05 = 0.11
Source: Solomon and Behailu, 2006

Fig.1 Storage moisture content (%) of parchment coffee and major climatic factors at corresponding storage period averaged over all the meters, layers and years at Melko (SD = ± 1).



Source: Woelore, 1995

A severe form of an over fermented coffee bean characterized by the distractive odor obtained from the crushed raw bean can be defined as stinker. Stinker beans are particularly bad, as only a small proportion of these beans, when present in otherwise normal green coffee, are capable of totally ruining the liquor characteristics of that coffee. The characteristics of 'stinker' beans are nauseous odor, acid vapors. The evidence available seems to pinpoint at improper regimes of processing as the main cause. It can be seen that normal coffee, which otherwise been fetching normal price is rejected due to introduction of stinkers.

Drying Studies

Effect Demucilager and Driers on Coffee Quality

To investigate the effect of newly introduced coffee post harvest machineries and driers on coffee quality as compared to the conventional processing methods the assessment was conducted in Limu Kossa sites of the Limu Coffee Plantation Development Enterprise. The observed result among samples processed and dried in different preparation methods on raw, cup and total quality values are presented in Table 11. Samples pulped by demucilager and dried in poly tunnel drier exhibited the highest values, 35.67, 47.50 and 83.17, for raw, cup and total quality, respectively. Generally the result indicated that out of the six coffee samples assessed for raw, cup and overall quality, those demucilager pulped and dried in open sun (DPDS) and demucilager pulped and dried in poly tunnel drier (DPTd) showed very good overall quality standard and were found to be highly acceptable. So using newly introduced demucilager and drying technologies had no negative impact on both raw and sensory quality attributes and fit to export standards of samples and were found to be less time consuming and less laborious. It seems important to further study the biochemical content of samples prepared using in such new introduced demucilager and driers in the future.

Parchment coffee drying depth and covering period

Different drying depths and covering periods investigated to determine an optimum depth and suitable exposure (covering) period that correlates with above average cup quality of coffee. The covering period during drying and depth of parchment layer affects the total time required to dry parchment coffee to an optimum moisture level (Table 12). The extended drying time observed when drying depth and the duration of covering period increased (Solomon and Behailu, 2006). Parchment coffee dried at the highest drying depth (5 cm) gave the lowest value of cup quality, while the other drying depths (2, 3 and 4 cm) gave better values of cup quality. Though there were no quality problems with the parchment coffee dried at the lower depth (2 cm), considering the larger area required to dry parchment coffee at such low depth, it is better to use the higher depths. It is therefore essential to avoid drying at a depth higher than 4 cm as it prolongs the drying period and hence lowers the cup quality standard. Covering for a very short time or covering for a very long period should be avoided during drying parchment coffee as it affects cup quality. On the other hand, covering during the very strong sunshine hours to avoid excessive heating and care not to cover for a long time in the day should be practiced.

Storage Studies

In storage, dry coffees quickly deteriorate in quality unless proper measures are taken. It is known that parchment coffee deteriorates less rapidly than clean coffee, but even then, deterioration can occur rapidly under unfavorable conditions. Quality deterioration occurs due to an increase of moisture content of the bean, the spoiling of the raw appearance of the bean by loss of color fading or tainting, or to the introduction of unpleasant flavors, by infestation of storage insects or by infection with moulds or bacteria.

Factors such as total rainfall, relative humidity, maximum-minimum temperatures with effect on water vapor content of the air, and storage duration, greatly influence storability and quality of stored parchment coffee (Woelore, 1995) (Fig 1). In the view of the figure below, the moisture in coffee and storage conditions should be prescribed on the basis of the temperature and humidity conditions existing in the place of production as well as the extent of storage needed for sale or export.

Higher temperatures and humid conditions in the production area do not warrant longer storage. Maximum increase of moisture was observed in the wet July-August months from 10.4% initial moisture in November- December harvesting.

The result of moisture condition over month is indicate that coffee dispatches to the central mills should be shorter than this time or forced ventilation used otherwise. It was recommended that, a cool and dry environment, (10 - 18 ^{o}C, 50 - 70% RH) makes a great contribution towards preservation of coffee quality,

provided the coffee is initially well dried (Woelore, 1995). In control bean moisture content, temperature, and relative humidity are the factors primarily involved in quality deterioration in storage, whilst fumigation might become necessary for insect control. Coffee could not be stored in parchment form in primary stores beyond 4 to 5 months.

Due to rapid dehydration of the surface of dry-fermenting coffee, a modified two-stage process is recommended and in this case, under-water fermentation replaces the normal dry fermentation of stage-one. The two-stage fermentation methods produce coffee of better raw and more particularly, roast quality than dry fermentation alone.

The under-water fermentation method was superior in all aspects of quality. In fermentation time study optimum quality was achieved somewhere at 64 hours at Melko, 78 hours at Limu Kosa and lower total fermentation time of about 48 hours at Bebeka. Based on the altitude, fermentation time in the range of 24 hours for 1200 m and below 24 to 48 hours for 1200-1500 m, 48 to 72 hours for 1500-1800 m and above 72 hours for above 1800 m were preferable to have coffee with superior cup quality in all aspects.

In addition shaded fermentation tanks help to achieve uniform fermentation and better quality coffee. A rapid and more controllable fermentation is necessary in order to avoid congestion at wet coffee processing factory, when over-burdened with coffee to be processed, and eliminate the possibility of occurrence of deleterious off-flavors.

Using coffee pulpery water as fermentation inoculums hastening of fermentation without adverse effect on final cup quality, inoculums should be used in a concentration not exceeding one to four mix of water. Leverage of drying parchment coffee from a depth of 3 cm to 4 cm and covering during very strong sunshine hours is recommended.

It is essential to avoid drying at depth higher than 4cm as it prolongs the drying period and hence lowers the cup quality standard. Covering for a very short time or covering it for a very long period should be avoided as it can negatively affect the quality of the beverage.

Moisture content of the bean, temperature, and relative humidity are the factors likely to be primarily involved in quality deterioration in storage. Microclimatic factors such as total rainfall, relative humidity, maximum and minimum temperatures with effect on water vapor content of the air were found to greatly influence storability and quality of stored parchment coffee.

References

Abrar Sualeh and Negussie Mekonnen, 2013. Evaluation of coffee quality of Tigray Regional State, Ethiopia (Case study RayaAzebo District); Prudence Journal of Agricultural Research, 1(2): 3-6.

Abrar Sualeh, Fetta Negash, Ashenafi Ayano, Negussie Mekonnen and GebreEgnet, 2015, Quality Status Evaluation of Gurage Coffee (*Coffea arabica* L.), Southern Ethiopia; Journal of Biology, Agriculture and Healthcare 5 (7): 206-212.

Anonymous. Coffee Liquoring Unit report on coffee quality analysis of JARC samples for the year 1996-2004.

Behailu W/Senbet, Solomon Endris. 2006. The influence of shade during fermentation stage of wet processing on the cup quality of Arabica coffee. P.549-553. Int. Conf. Coffee Science.21st, Montpellier, 11-15 sept.2006. ASIC, Paris

Brownbridge, J. M and Eyassu, G. E. 1968. The quality of some of the main Ethiopian mild coffees. Turrialba 18(4): 361-372.

Brownbridge, J. M. and Michael Sium. 1971. Coffee processing research in Ethiopia. Fermentation and its effect on liquor quality. Kenya Coffee August 1971.

Desse Nure. 2003. Oromiya Regional State Coffee quality, major quality problems and suggested solutions (Amharic). Paper presented on the workshop on Oromiya coffee quality improvement, Sept 2003, Jimma.

IAR, 1991. National Coffee Research Centre Jimma Progress Report for the Period of 1990/91. Jimma, Ethiopia.

IAR, 1997. National Coffee Research Centre Jimma Progress Report for the Period of 1997. Jimma, Ethiopia.

JARC.2002. Research Progress report of Coffee Processing for the period of 2001/2002. Jimma, Ethiopia. (Unpublished)

Kawuma, F. 2003.Quality Coffee in Africa. Paper presented on the Regional Coffee Wilt Programme Stakeholders and planning worshop.#5- December,2003, Nairobi, Kenya.

Mikru Tesfa, Abrar Sualeh and Nigussie Mekonen, 2020. Coffee Quality Evaluation of Abe Dongoro

District in Horo Guduru Wollega Zone, Oromia Regional State, International Journal of Research Studies in Science, Engineering and Technology, 7 (1): 29-33.

Mikru Tesfa, Abrar Sualeh and Nigussie Mekonen, 2021. Assessment of the Effectiveness of Coffee De-mucilager and Driers for Physical and Sensorial Coffee Quality, World J. of Food Science and Technology, 5 (2): 33-36.

Solomon Endris, Behailu W/Senbet. 2006. The quality of Arabica coffee as influenced by depth of parchment layerage and covering period during drying. Pp 544-548.Int. Conf. Coffee Science. 21st, Montpellier, 11-15 sept.2006. ASIC, Paris.

Woelore, W. M. 1993. Optimum Fermentation Protocols for Arabica Coffee under Ethiopian Conditions. P.727-733.Int. Conf. Coffee Science.15th, Montpellier, 6-11 June 1993. ASIC, Paris.

Woelore, W. M. 1995. Parchment Arabica Coffee Storage. P.565-573. Int. Conf. Coffee Science.16th, Kyoto, 9-14 April 1995. ASIC, Paris.

How to cite this article:

Abrar Sualeh, Mikru Tesfa and Negussie Mekonen. 2022. Review on Coffee Processing and Quality Research Achievement in Ethiopia. *Int.J.Curr.Res.Aca.Rev.* 10(08), 121-132.
doi: https://doi.org/10.20546/ijcrar.2022.1008.009