

Review Article

# Factors Affecting the Quality of Ethiopian Coffee (*Coffea Arabica* L.)

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## Abstract

Ethiopia is fortunate in this regard, as it is home to many different types of. Arabica coffee (*Coffea arabica* L.) is the main coffee variety in global coffee production, accounting for more than 60% of total production. Arabica coffee accounts for 30% of Ethiopia's foreign exchange earnings. Arabica coffee is a popular coffee variety in coffee producing and consuming countries due to its unique aroma and taste and lack of caffeine. Ethiopia's most important export is coffee, which is also its most important crop. Ethiopia is well known for producing very high-quality coffee, renowned for its excellent aroma and taste, and is also the birthplace of Arabica coffee. The coffee industry attaches great importance to coffee quality. Cup quality is a complex trait that depends on many factors, including species or variety (genetic factors), environmental conditions (ecological factors), agronomic practices (cultivation factors), processing systems (post-harvest factors), storage conditions, and industrial factors. process, beverage preparation and consumer preferences. However, the quality of coffee produced by Ethiopian farmers sometimes deteriorates. Additionally, local genotype, climate and soil characteristics, agricultural practices, harvesting strategy and timing, post-harvest handling procedures, grading, packaging, storage and transportation conditions all affect coffee quality, either improving or decreasing coffee quality.

## Keywords

Coffee, Factors, Quality

## 1. Introduction

Coffee is a perennial crop that grows in tropical and sub-tropical climates and is a member of the Rubiaceae family [7]. With the exception of *Coffea arabica*, which is a typical allotetraploid ( $2n = 4x = 44$ ) selfpollinating species, almost all coffee species are diploid ( $2n = 2x = 22$ ) and most are self-incompatible [7]. There are 124 species of the genus *Coffea* described to date [13]. Arabica coffee is one of the most important beverages in the world and an important source of foreign currency for many countries [28]. In the consumer

market, Arabica coffee is preferred because it provides a better drink, has a better aroma and contains less caffeine than Robusta coffee. Robusta is characterized by its bitterness and high caffeine content. According to [30], Arabica coffee accounts for 65% of the world coffee production.

Ethiopia has been considered the country of origin of coffee since the coffee tree was first discovered and planted in the Kaffa region (Ganga, Makira) of Ethiopia. The origin and location of the genetic diversity of Arabica coffee is Ethiopia

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and the availability of genetic potential for coffee fortification [21]. Ethiopia is the origin, cradle and center of evolution and transmission of the coffee plant, as well as the birthplace and breeding ground of Arabica coffee seed biodiversity [3]. According to [9], Ethiopia's estimated coffee cultivation area is about 700,474.69 hectares, and the country's estimated annual clean coffee production is about 469,091.12 tons, with an average production of 669.6 kg ha<sup>-1</sup>. Ethiopia remains Africa's largest producer of coffee, ranked fifth in the world after Brazil, Vietnam, Colombia and Indonesia, accounting for approximately 4.2% of all coffee produced worldwide [24]. Coffee is one of the most traded products on the world market in terms of volume and value [45]. It is estimated that world coffee production in 2013 was 8.75 million tons and total exports reached 23.4 billion US dollars. Approximately 60 to 70% of the world's coffee is produced in the United States, and Arabica is grown in 85% of coffee-producing countries [24]. More than 100 million people are employed in the coffee industry worldwide [34]. Coffee is a global crop, given that coffee provides an important source of income for many farmers [25].

In Ethiopia, coffee is grown in agroecological zones divided into different regions and political zones. The southwest and southeast of Ethiopia are the coffee-producing regions of the country, while the central region is in the north. Climate change has been reported to have a negative impact on coffee production [13]. Coffee is grown in a variety of habitats, including forests, semiforests, gardens and plantations. Different people have different ideas about how big a farm should be for small coffee. More than 90% of the coffee grown in the country is produced by small farmers and 10% by medium and large growers [39]. The average farm is less than 2 hectares and accounts for most of the production; however, the yield is low at 0.7 to 0.8 tonnes per hectare [39]. It is reported that small farmers produce an average of 0.67 hectares. The main problems include underdeveloped local coffee varieties and cultural and labor practices that greatly affect the production of the country's small farmers and the country's total coffee production [38]. The Ethiopian coffee market is based on origin (varietal), known for its quality and agricultural characteristics. According to [33], the first postharvest process accounts for 40% of coffee quality decisions, followed by the second process, accounting for 40%. But many factors contributed to the decline of coffee cultivation there. This is mainly due to poor agricultural management, poor postharvest management, lack of wet and dry systems and inadequate storage systems. Therefore, the gaps created by these problems may affect the connection of the coffee trade between the country and the world. The main purpose of this review is to examine the variables affecting coffee quality in Western Ethiopia.

### 1.1. Ethiopian Coffee Production

Ethiopia's main export product is coffee [34]. Arabica coffee,

produced only in Ethiopia, has a good aroma, mild taste and pleasant acidity and is considered superior to Robusta coffee [45]. The country is the world's third largest producer of Arabica coffee and produces the best coffee in Africa [24]. Twentyfive percent of the Ethiopian population depends directly or indirectly on income from growing coffee [45]. The coffee industry in Ethiopia is jointly supported by the regional and federal governments [6, 11]. The country managed to surpass other countries and become the world's largest producer of coffee, mainly due to the quality of its coffee [22]. According to [2], Ethiopian coffee is known for its rich taste and aroma, making it suitable for blending with coffees from other countries. Changing consumer behavior and increasing demand for quality coffee present opportunities for coffee-producing countries such as Ethiopia. Increasing coffee exports and achieving better coffee prices can be two benefits of improving coffee quality [27]. According to [23], Ethiopia is famous for producing the best Arabica coffee in the world market.

### 1.2. Coffee's Qualitative

Part of the quality of coffee can be attributed to the plant, soil characteristics, weather conditions, management used throughout the growing season, harvesting, storage, preparation, export and transportation. This includes human involvement, whose motivation is the main factor in the final decision about green coffee. Various actions of producers and the environment can often affect the quality of coffee [25]. According to [35], preharvest practices have a 40% impact on coffee quality, postharvest practices have a 40% impact, and export marketing has a 20% impact. In recent years, production and export volumes of different coffee countries have increased significantly [4]. Considering the current economy based on overproduction and low prices, improving and evaluating coffee quality can bring new energy to coffee chains [29].

Production levels, cost and ease of cultivation among farmers influence coffee quality. At the exporter or importer level, large beans, no defects, consistent supply, tonnage, physical properties and price all make up good coffee. Moisture content at the roasting level, stability properties, date, price, biochemical composition and sensory quality all influence coffee quality [29]. Producing and supplying the best quality coffee seems more important than ever for coffee exporting countries. Therefore, in various coffee development programs in some countries, it is important to evaluate coffee quality as well as disease resistance and productivity [24]. Looking at the current situation, it seems that countries like Ethiopia cannot overcome the problems and threats by increasing production alone. That is why it is often said in many forums that offering good coffee is the only way and real option to enter the world market and still be competitive [4]. Ethiopia's most important export is coffee, which remains the most important crop. Known for producing quality coffee,

Ethiopia is the source of Arabica coffee and is also appreciated for its aroma and taste. Sidamo, YirgaChefe, Haerge, Gimbi and Limu coffee varieties stand out with this quality [43]. However, due to its exceptional quality and proper processing, coffee grown in special regions of Ethiopia, especially Harar and Yirgashev, is always sold at a high price in the domestic and international coffee market [24]. However, due to improper processing, sundried Jimma coffee becomes one of the cheapest coffees on the world market, while Limmu washed grade 2 coffee is more expensive, despite being grown in the same agroecological zone [17]. [17] also pointed out that although Jima coffee always has a nice wine quality, some pitting defects include moldy, earthy, and secondary contamination defects in the wine, often resulting from post-harvest management.

The International Organization for Standardization defines quality as "the ability of a product, system or process to meet the needs of customers and other interested parties in accordance with required criteria." The word "attitude" can also be used to describe such characteristics. Quality coffee standards and decisions may change over the years. However, today this concept varies from production to consumption [29]. For example, at the farmer level, good coffee is a combination of production quality, cost and ease of cultivation; At the exporter or importer level, good coffee is a combination of coarse grain, flawless, regularity of products and tonnage. Physical properties and associated costs; Coffee quality at the roasting level is related to moisture content, stability properties, history, price, biochemical composition and sensory quality [29].

It must be said that each consumer market or country can define its own perspective; Coffee quality among consumers; price, taste, awareness and impact on health, historical, environmental and social (organic coffee, honest marketing etc.) ISO in particular, for green coffee, the region and region where the coffee is grown, year of harvest, humidity, all issues, respectively hundreds of lines and more It creates quality standards that require many details such as. - Damaged beans and large beans. This ISO standard specifies how to measure some of these properties, including spots, moisture content, core size, some chemical compositions, and pitting preparation standards. Quality is defined as conformity to the requirements of the Ethiopian Quality and Standards Authority or fitness for use. Requirements must be agreed upon by all parties involved in the work (customers, processes, suppliers, etc.) and understood by all parties involved in the procedure. On the contrary, the purpose of establishing the Coffee Quality Control and Auction Center is to control the quality of coffee, thus making coffee a business in line with standards, with the development and traditional work of Ethiopia's widespread coffee production. Coffee has only one purpose: to give happiness and pleasure to users with its taste, aroma and physical benefits. Therefore, the relative price and value of an amount of coffee depends on its quality, especially the quality of its liquid or cup [1]. An important part of coffee is a

good cup, also known as a good drink or a good wine, which is the price standard [1].

## 2. Contributors to Coffee Quality

Since many activities have different effects on coffee quality, many authors have included them. Therefore, the precautions to be taken are briefly explained below. Cup quality is a complex characteristic affected by many variables, such as species or variety (genetic variables), environmental conditions (ecological variables), agricultural practices (cultivation variables), production systems (postharvest), storage conditions, industrial processing, drinking water, etc. . planning and consumer preferences [4]. The coffee industry uses very good coffee. One of the products in great demand is premium coffee. These include raw and roasted meat, nice aroma and good taste [4].

However, over time, the quality of coffee produced by Ethiopian farmers decreased. Additionally, land genotype, climate and soil characteristics, agricultural practices, harvesting techniques and timing, postharvest procedures, grading, packaging, storage production and transportation all affect, increase or decrease the quality of coffee [4]. Likewise, [16] said that everything such as various plants, characteristics of the planting site and climate, as well as care during planting, harvesting, storage, preparation for export and transportation, are necessary for good coffee. Although factors other than climate can be influenced by humans and play an important role in the final decision regarding green coffee, the authors believe that the plant varies and important events are constant and therefore control the characteristics of green coffee. Coffee. In addition, inadequate harvesting, processing, storage and transportation systems of Ethiopian coffee also contribute to the coffee's inability to maintain its quality.

### 2.1. Climate and Soil Variables

The environment also has an impact on coffee quality [15]. The distribution of rainfall and sunlight affects flowering, growth and maturation of legumes. Main variables include elevation, daily variation, rainfall amount and distribution, and soil physical and chemical properties. Climate, elevation and shading have significant effects on temperature, light and humidity during ripening. According to [14], at higher altitude (lower temperature) or in the shade, coffee fruits ripen more slowly, allowing more time for the coffee beans to ripen, resulting in more coffee beans than at the bottom. Coffee beans come from us. The community growing in the area is denser and tastes better. Altitude (or total sun). Slow time is therefore important for a good cup and is probably sufficient for all the biochemical processes necessary to develop a good drink to occur [37]. For example, Arabica coffee plants at higher altitudes were found to contain more oil and chlorogenic acid. In comparison, a more dedicated space for fruit (large bean pot investment) will be associated with a better

cup as well as the quality of longlasting beans. After extensive research, he realized that the best coffee beans were those grown in fertile volcanic soil. Coffee quality has long been thought to be greatly affected by the acidity of the coffee brew. Acidity is often thought to be desirable, especially in some East African and Central American coffees [44]. However, acidity is the ultimate in acidity and can be negative. Grown in mineralrich volcanic soil and at high altitudes, coffee is associated with acidity. Additionally, [44] stated that if other variables are constant, higher altitudes will produce better coffee, while coffee from lower regions is quite fullbodied. Additionally, coffee from higher altitudes is stronger, more flavorful, and more acidic. According to [41], submerged fermentation process is recommended for the Ethiopian environment, while long fermentation is recommended for various agroecologies. The authors say that depending on the fermentation technology, it will be carried out at altitudes of 1200 m and below, 120015000 m, 15001800 m and above 1800 m. According to [41], factors such as total precipitation, relative humidity, maximumminimum temperature affecting water vapor in the air and storage time are effective on the quality and preservation of parchment coffee. Prolonged drought can also reduce legume quality [40]. Most coffee drinkers now agree that there is little (if any) difference between purebred Arabica varieties grown under the same agroclimatic conditions [40].

## 2.2. Pre-Harvest and Harvest Factors

According to [44], South American coffee fertilized with more nitrogen is lower, lighter and finer than unfertilized beans. When nitrogen is too much, the caffeine content increases and the coffee tastes bitter. The phosphorus, calcium, potassium and magnesium content in the soil has little effect on the caffeine and chlorogenic acid content in coffee beans. Zinc deficiency can lead to the production of small, greyish beans that produce lowquality alcohol [40]. However, magnesium deficiency can affect the quality of your glass [31]. High levels of potassium (>1.75%) and calcium (>0.11%) in legumes are associated with a “hard” and bitter taste [40]. According to [38], application of decomposed coffee husks at the rate of 10 tons per hectare (1 ton per hectare) (4 kg body weight per tree) was found to increase the coffee yield of trees. A significant increase in the growth and yield of ripe coffee has been reported after the use of coffee beans and husks. On the other hand, there is no relationship between the structure and characteristics of the bean and its phosphorus concentration. However, frequent use of ingredients such as grass or animal feed can lead to a high percentage of brown coffee beans and poor quality products. This effect is associated with magnesium deficiency resulting from high potassium in grass and high potassium and calcium content in feces [40]. Bean size and taste are often affected by growing conditions (plant management, appropriate planting and pruning) [40]. However, the relationship between crop management and overall

coffee quality has not been investigated in detail. Diseases from pests and diseases can directly affect cherries or weaken the plant, causing the fruit to fail to ripen or become damaged.

Low yield can also be caused by diseases and insects (such as mites and leaf miners) [40]. For example, according to [40], the coffee berry weevil *Hypothenemus champii* feeds on coffee beans and multiplies there, thus reducing the quality of the coffee beans. Cockroaches are carriers of disease and can damage coffee beans and cause a bitter taste. Cherries become infected when the *Ceratitis capitata* fly feeds on the mucus, and the second infection gives the cherries their potato flavor. When coffee is dried on bare ground, *Ochola*, *Carbozoa* and *Melanozoa* species produce OTA (Ochrotoxin A), a mycotoxin [19].

According to [32], it has been found that shading, especially for coffee beans grown in suboptimal (optimal) coffee production, can improve the acidity and body of brewed coffee and the appearance of green and roasted coffee beans. This is done by encouraging slow and even grain harvesting and fruitlike ripening. Shade increases the sugar content, which is important in creating coffee aroma. Therefore, according to [44], young tree samples will be small, have a subtle smell, but have a pleasant smell. Ancient growing methods produce roug, unique, richly flavored beer.

Coffee beans with good taste, acidity and body are produced from middleaged trees that are 15 to 20 years old [44]. According to the results of two studies, tree physiology, age and harvest time are effective in determining the final properties of the product [7]. In fact, the chemical composition of mung beans has been shown to be greatly affected by the age of the tree, the location of the fruit on the tree, and the ratio of fruit wood to leaves. In addition, ripeness also affects the quality of the coffee.

The harvesting method has the greatest impact on natural coffee. Most experts agree that hand picking and growing produces the best green coffee by reducing the number of coffee crops compared to harvesting. According to [7], red cherries harvested at the beginning of the picking season contain fewer coffee beans than yellow or green cherries harvested at the end of the picking season. Bean size, chemical composition and cup quality are examples. On the other hand, picking early red cherries in Costa Rica produces the best Arabica coffee. In contrast, [18] noted that routine analysis using highperformance liquid chromatography showed low caffeine content in coffee beans stored at the immature stage (immature) and overripe beans (HPLC). Their research suggests this may be related to slow metabolism and biodegradation of caffeine during the immature and overripe stages of the fruit.

## 2.3. Post-Harvest Factors

Postharvest methods can affect coffee quality [26]. Processing is an important step in coffee production and determines the quality of the product [31]. Wet or dry methods are used to prepare coffee, each varying in complexity and quality

[40]. Ethiopia uses dry and wet processing technologies, which account for 70% and 30% of the country's total coffee production, respectively [26].

According to [12, 42], dry processed Arabica coffee has a rich aroma, moderate acidity, and a slightly astringent taste. Additionally, washed coffee is considered to be more acidic than processed (dry) coffee. This may be because organically processed coffee has more body than wet processed coffee; because the body hides the acidity of the coffee [44]. Analysis of roasted coffee provides the difference between dry and washed coffee with high correlation (11 out of 11 workers). According to their report, the work that occurs during the processing of coffee beans causes the initial product to be similar, although the coffee has different quality and is subjected to different processes. The natural sun drying system is the first technology used to harvest and dry whole fresh fruits and is used to make coffee in most of the study area. Farmers generally prefer to pick red fruits by hand; however, income and theft concerns may lead to early harvest of the crop [26].

After drying, the cherries are sold to the local market "Akrabis" or to secondhand processing partners [10]. The second process is called wet processing and involves processing fresh cherries in three stages: removing the skin and mucilage, fermenting and washing the cherries, and drying the coffee parchment [10]. The time it takes to dry your coffee parchment to the desired moisture level depends on the time taken up during drying and the thickness of the parchment layer. According to [5], parchment coffee dried to the darkest depth (5 cm) has the lowest pitting quality, while other drying depths (2, 3 and 4 cm) give higher yields. Parchment coffee is dried and ready for delivery to the store (also in parchment paper). Like other Ethiopian coffees, Jimma export coffee must be traded through the central auction in Addis Ababa [10]. In addition, the fermentation process during coffee cleaning has a significant impact on the quality of the final product [41]. Twostage fermentation, or "dry" fermentation, followed by submersion has been shown to improve the appearance of green and roasted coffee [4]. According to their analysis, soaking for 24 hours after fermentation produces better raw and roasted meats than soaking for 8 or 16 hours, while soaking for 48 hours has the opposite effect, reducing cooking quality rather than improving it. However, according to [5], methods such as dry fermentation, submerged fermentation, digestive enzyme accelerated fermentation or cleaning to remove mucilage do not affect the quality of the wine, and there is no evidence that a specific method has been established. A better way to drink alcohol. According to the authors, fermented coffee high in coffee hulls produced better green coffee, roasted coffee and alcohol than the control without hulls, and alcohol was not affected well by desserts described as strong, bitter, fruity or dirty.

The natural fermentation of coffee depends on many factors such as the environment, pH, temperature, microflora and bacterial level in the water used, the variety of ripe fruit used for pulping, and the history of the beans depending on the

region and culture. Slight change in structure and job selection [4]. Moreover, according to [5], fermenting coffee in shaded tanks leads to more fermentation processes and better coffee compared to fermenting in dark tanks.

However, [4] examined the working water of Jimma coffee. He explained that their ingredients are diverse, including beans of all shapes and sizes and pure alcohol. This is most likely because this mixture contains adzuki beans, which are beautifully green in color and very tender. According to the authors, it cannot change the environment, plant seeds, or change the environment itself. Instead, we should focus on the most important postharvest processes that can have a major impact on coffee quality, such as picking, processing, drying, storing and transporting coffee cherries. Cup quality is also affected by the length of the coffee beans and storage conditions [44]. Prolonged storage in a warm, humid environment causes the coffee beans to become moist, thus reducing the appearance of green beans and roasting the quality of the wine [41].

## 2.4. Genetic Variables

Plant physiology, harvesting, postharvest techniques, and plant genetics (species and genotype) all influence coffee quality [29]. [1] tested the value of four variables (acidity, body, flavor and overall structure) as criteria for genetic improvement of the overall quality of wine for all samples. According to the authors, based on correlation, repeatability and sensitivity analysis, aroma testing was found to be the best option for genetic improvement of good preparation of Arabica coffee. This quality has a very good analysis, has a good genetic connection with taste and is very useful in distinguishing coffee genotypes. [44] also showed that genes play a role in determining the production of chemicals that serve directly as flavors or as flavors introduced during roasting. Therefore, container quality should be the most important factor in selecting varieties for planting [20, 44]. Additionally, [4] used coffee experts to improve the cup quality of different types of coffee. Both researchers found that drinkers described a similar range of food quality; This shows that each group can be confident in their choice of cupping quality. [1] Similar findings have been made regarding the quality of coffee beans and alcohol. In terms of effects of genotype x environment interactions on quality, [40] found small effects. Quality traits such as coffee bean size and cup quality were not affected by genotype x environment interactions. [36] noted that cup quality varied from good to excellent among 54 Arabica coffee varieties collected from Kaffa, Ethiopia. Genotype is very important because it affects the size and shape of the bean, as well as important factors such as color, chemical composition and flavor [40]. The shape and structure of elephants, peas and hollow beans are a combination of genetic and environmental influences [40].

### 3. Conclusion

The origin and genetics of Arabica coffee are in Ethiopia, which has good potential for crop development. Ethiopia produces lower yields and higher quality coffee than many other countries, but there are differences in genetics and agroecology. Besides low productivity and poor quality, the Ethiopian coffee industry faces many problems or constraints. This study improves the understanding of the various factors that influence the production of quality coffee for domestic and foreign markets. It also highlights the importance of postharvest management to reduce coffee quality issues or coffee problems that farmers develop in their crops. Good ideas for improving the quality of coffee and sustaining agricultural practices by creating good business, profit saving and new lifestyles. Future attention should focus on paying attention to factors affecting coffee quality when developing appropriate management strategies. More research is needed to improve coffee quality, especially pre- and postharvest management. It is also important to educate farmers and extensionists on good coffee management and to further encourage research into sustainable products, quality production and production.

### Author Contributions

Meseret Degefa Regassa is the sole author. The author read and approved the final manuscript.

### Conflicts of Interest

The authors declare no conflict of interest.

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