Physical Quality Analysis of Roasted Arabica Coffee Beans Subjected to Different Harvesting and Postharvest Processing Methods in Eastern Ethiopia

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Abstract
Improper pre and postharvest processing practices are among the factors that has been directly or indirectly affecting the physical quality of green and roasted coffee beans. Thus, comprehensive information on the effect of harvesting and postharvest processing methods and their interaction on physical roast coffee bean quality are very crucial. From this point of view, this study was conducted to evaluate the effect of harvesting and postharvest processing methods on the physical quality characteristics of roasted coffee beans. The coffee samples were prepared from one Hararghe coffee genotype (H-622/98) at Mechara Agricultural Research Center. The experiment was designed as a factorial combination of two harvesting (selective and strip harvesting) and six postharvest processing methods (dry processed dried on bare, cemented and plastic sheet ground floor, and dry, wet and semi-washed processed dried on raised mesh wire) in CRD with three replications. The results indicated that the main of effect of harvesting and postharvest processing methods was highly significantly influenced all physical roast quality attributes whereas their combined effects was highly significantly affected roast volume change and bulk density of roasted bean. Selective harvesting was better than strip harvesting in producing low roast weight loss and volume change. Selective harvesting coupled with dry processing and drying on raised mesh wire was best in producing roast coffee beans with lowest (55%) roast volume change and highest (0.41 g/ml) bulk density of roasted bean. Variation on roast physical properties of Arabica coffee due to different harvesting and postharvest processing methods was profound for coffee quality. The result can be used to improve cup quality of Arabica coffee directing at different harvesting and postharvest processing methods.
Keywords: roast coffee beans; physical quality; weight loss; volume change; bulk density

INTRODUCTION

Arabica coffee (*Coffea arabica* L.) and Robusta coffee (*Coffea canephora* P.) are the two most economically important commercial coffee species. Of which *C. arabica* is originated in Ethiopia which is considered as a high quality coffee and contributes more than 70% of the world coffee production (Lashermes et al., 1997; Carneiro, 1999; Anthony et al., 2002; Stieger et al., 2002). Economically, coffee is the most important cash crops grown and exported by more than 80 developing countries to all industrialized countries (Dutra et al., 2001; Pearl et al., 2004) and stands second only to oil in terms of international trading on the world. As a result it is one of the most widely consumed beverages throughout the world because of its typical smell and flavor characteristics (Dutra et al., 2001). In many producing countries, besides contributing a tremendous amount to the foreign exchange currency as a main cash crop, it serves as a means of livelihood for millions of people and plays a vital role in their socio-economic values (Orozco-Castillo et al., 1994; Carneiro, 1999; Anthony et al., 2001; Stieger et al., 2002). Thus it represents one of the most important crops of the world (Vieira, 2006). Coffee plays a major role in Ethiopia's economy and is deeply intertwined with cultural traditions and day-to-day living. More than 15 percent of its population is deriving their livelihoods from coffee (Abu, 2015).

There are two main primary processing methods *viz*: dry process which produces naturals, and the wet process, which produces washed coffees (ITC, 2011). Ethiopia is the most important producers and exporters of both processed coffee. Quality is a determining factor in the price of coffee beans (Richard *et al*., 2007). It is describes whether the coffee will be bought at a standard commodity price or may acquire a "specialty" price. Moreover, coffee quality comes from a combination of the botanical variety, topographical and weather conditions, and the care taken during growing, harvesting, processing, storage, export preparation and transport (ITC, 2011). Hence, quality of coffee is associated to a set of factors that involve physio-chemical and sensory aspects which in turn, depend on postharvest handling and processing (Coradi et al., 2007; Lima et al., 2008). The best quality is obtained from selective picking in which only red, ripe cherries are gathered by hand in successive picking rounds whereas it is difficult to produce typical quality coffee when the cherries are simply stripped all at once, regardless of the degree of maturity (ITC, 2011). These shows only boosting coffee production will not yield high quality coffee unless and otherwise ideal harvesting and postharvest processing practices performed. Richard et al. (2007) reported that, coffee quality is affected by 40% at pre-harvest, 40% at post-harvest practices and 20% at secondary/export processing and handling practices.

Different factors can influence the preservation of coffee thereby its final quality (Melo, 2004;

Baggenstoss et al., 2008) and significant changes to coffee's physical properties have been observed to occur during roasting (Mwithiga and Jindal, 2003). Therefore, studying the physical properties of roasted coffee bean is important due to potential market conditions. Furthermore, only qualitative coffee quality evaluations through raw and organoleptic are not enough to describe the effects of harvesting and postharvest processing on quality of roasted coffee. Thus the knowledge of the descriptive physical quality analysis of roasted bean is recommended (Nebesny and Budryn, 2006). Additionally, in recent years, the quest of knowledge regarding physical quality of roasted coffee is spreading due to the growing appreciation of coffee since, quality of coffee beverage is closely related to the physical appearance of the roasted beans, which is affected by the composition of green beans and postharvest processing conditions (Franca et al., 2005a; Illy and Viani, 2005). Although, pre and postharvest management practices can affect coffee quality, but there had not been much research done on its effect in the physical quality characteristics of roasted coffee beans.

Physical changes in coffee during roasting include reduction in mass due to loss of moisture and decomposition of carbohydrates, increase in volume of coffee beans, lowering of density due to puffing and increase in brittleness (Mwithiga and Jindal, 2003). It is well known that during roasting, coffee beans lose their strength and toughness and become brittle and fragile (Pittia et al., 2007). Such parameters like weight loss, volume change and density can be used to control the coffee bean roasting quality (Schenker et al., 2000; Pittia et al., 2001; Alessandrini et al., 2008). Coffee roasting is a complex heat transfer process, where coffee beans are subjected to a steady weight loss, increase of volume and consequently decrease of density during entire roasting process (Noor-Aliah et al., 2015). The volume increase of non-defective beans was higher than for black beans (Franca et al., 2005a). The total weight loss of green coffee beans after roasting can be one of the criteria for determining the degree of roasting (Jokanovića et al., 2012) and the way of green bean preparation. Bulk density changes are implied in bean expansion and in the formation of a characteristic porous structure of the roasted coffee bean (Pittia et al., 2001).

Although various studies on the influence of the overall processing and level and degree of roasting effect on the beverage and chemical composition of coffee quality have been carried out, until recently there is no data on the distinctive influence of the harvesting and postharvest handling practices on physical quality of roasted coffee beans. Hence, knowledge of physical quality attributes of the roasted coffee beans subjected to different harvesting and postharvest processing methods is important in understanding the contribution of harvesting and postharvest handling practices on the physical quality of roasted coffee beans since it is an important quality factors considered at the exporter or importer level (Leroy et al, 2006). Considering this fact into account, this research was designed for the objective to evaluate the methods of harvesting and postharvest processing effects on the physical quality characteristics of roasted coffee beans.

MATERIALS AND METHODS

Experimental material and design

The coffee samples used for the experiment was prepared from one young promising Hararghe coffee selection (H-622/98) planted at Mechara Agricultural Research Center. The treatments consisted of the combination two harvesting methods (strip and selective harvesting) and six post-harvest processing methods such as dry processing drying on bare ground, cemented ground, plastic sheet ground and raised mesh wire table, and semi-washed and wet processing drying on raised mesh wire table. The experimental treatment was laid out in a completely randomized design (CRD) in factorial arrangement with three replications. Hence, the experiments consists a total of 12 treatments per replications.

Sampling procedures

Sample cherry harvesting

Coffee cherries were harvested following two harvesting methods *viz.*, strip and selective harvesting. Accordingly, under strip harvesting, all the cherries on coffee trees were harvested by stripping from bearing branches to mimic the common practice of the farmers of the areas in which the ripe red, turned red, immature green, turned to drying and dried cherries were manually harvested together at a time when approximately 75% of the coffee cherries on each tree attained red ripe cherries. While under selective harvesting, only fully ripe red cherries were selectively handpicked from the trees. Finally, about six kilogram of cherries per each sample treatment was harvested and passed into each postharvest processing method.

Sample cherry processing

The cherries harvested by both harvesting methods were processed using three different processing methods *viz.*, dry, wet and semi-washed method and dried using four different drying methods. Accordingly, for dry processing, the cherries were directly spread out to dry in the sun using four proposed drying methods (bare, cemented and plastic sheet ground, and raised mesh wire drying table). They were stirred regularly to promote even drying, prevent fermentation and the development of mold and maintain uniform drying moisture level and dried up until their outer shell skin became dark brown and brittle or up to their moisture content of 11% attained.

Under wet processing method, the harvested cherries were pulped using single disc hand pulper separately as per the harvesting method, then the pulped cherries were collected inside the large size plastic buckets where pulps and floater parchments beans were removed. Subsequently, the wet parchment beans were transferred into other bucket and fresh water was added on it until parchment beans were totally submerged inside the water for fermentation and the parchment beans were fermented for 40 hours (Woelore, 1993) during which the water was changed three times. When the mucilage was totally degraded, parchment beans were washed intensively for the total removal of mucilage. Under semi-washed processing practice, similar to wet processing method, the harvested cherries were pulped with single disc hand pulper and collected in large size plastic buckets, however, as opposed to it; the result parchment beans were immediately washed and rubbed with canavas cloth manually by hand until the mucilage was clearly removed from the parchment beans. Finally, the resulting wet parchment beans were prepared and allowed to dry under full sun condition on mesh wire until the beans were fully dried to uniform moisture content of 11%.

All samples prepared by using the above harvesting and postharvest processing methods were slowly hulled with mortar to remove and clean from their husk and/or parchment, and were brought to coffee quality laboratory of the Jimma Agricultural Research Center where the physical roast coffee bean evaluation was conducted.

Roasting procedure

In order to study the physical quality analysis of the roast coffee beans, from 500 g of green coffee beans prepared using different harvesting and postharvest processing methods, a sample of 100 g of green coffee bean per each treatment sample was taken and measured for its green bean volume with 100 ml graduated cylinder. The roaster machine with six cylinders (PROBAT Werke, Germany) was first heated to 200°C and the 100 g green beans coffee was put in to roasting cylinder and roasted for an average of eight minutes to a medium roast under roasting temperature of 200°C. The medium roasted beans were then, tipped out into a cooling tray and allowed to cool down for an average of 4 minutes by blowing cold air over the cooling plate. The roasted and cooled beans were blown to remove the loose silver skin and weighted with two digit sensitive balance, and measured using 500 ml graduated cylinder for their roast bean weight and volume quality, respectively.

Data collection

The weight and volume of coffee beans were measured separately for each sample unit just before and after roasting in grams using sensitive balance and in milliliter using 500 ml graduated cylinder. Then, the recorded results were converted into percent of weight loss and volume change after roasting and bulk density of roasted coffee bean was calculated using the following equations developed by Pittia et al. (2007):

Roast weight loss**:** It was determined by taking the weight of the green and roasted coffee beans before and after roasting, respectively as follows:

$$\text{RWL (\%)} = \frac{(\text{GBW}-\text{RBW})}{\text{GBW}} \text{x} 100 \quad \ldots\ldots\ldots \text{(Equation 1)}$$

Where: RWL = Roast weight loss; GBW = Green bean weight and RBW = Roast bean weight

Roast volume change**:** It was determined by taking the volume of the green and roasted beans before and after roasting, respectively as follows:

$$\text{RVC (\%)} = \frac{(\text{RBV}-\text{GBV})}{\text{RBV}} \text{x} 100 \quad \ldots\ldots\ldots \text{(Equation 2)}$$

Where: RVC = Roast volume change; RBV = Roast bean volume and GBV =Green bean volume

Bulk density of roasted bean**:** it was used to determine the density of roasted beans and evaluated as the ratio between the weight and volume of roasted beans as follows:

$$\text{BDRB (g/ml)} = \frac{\text{RBW}}{\text{RBV}} \quad \ldots\ldots\ldots \text{(Equation 3)}$$

Where: BDRB = Bulk density of roasted bean; RBW =Roast bean weight in gram and RBV = Roast bean volume in millimeter.

Data analysis

Data were subjected to analysis of variance (ANOVA) at 5% level of significance using GenStat 15th edition statistical software. Whenever ANOVA showed significant variation, Fisher's protected LSD at 5% probability level was used for treatment mean separation.

RESULTS AND DISCUSSION

Roast weight loss

The main effects of harvesting and postharvest processing methods were found to have highly significant influence in roast weight loss. However, the interaction of the two did not show significant variation. The effect of harvesting on the weight loss of roast coffee bean was from 14.42% for strip harvesting and 12.13% for selective harvesting (Table 1). Although naturally, coffee beans lose some amount of weight due to roasting, it was observed that strip harvesting highly affected roast bean quality by losing a lot of volatile substances in the bean than selective harvesting. This could be due to moisture and dry matter loss which leads to high weight loss of roasted coffee. This result agreed with the results of Abera (2006) that indicated roasting weight loss was in the range of 14 - 23% due to evaporation of water and loss of volatile substances in coffee beans. In addition Mwithiga and Jindal (2003) reported that, due to loss of moisture and decomposition of carbohydrates there is reduction in mass of roast coffee beans. Similarly, several studies found that roasting causes on average weight loss a 16% (Hicks, 2002) and 14% (Scholz et al., 2013) when coffee beans roasted to dark brown color. According to Oosterveld et al. (2003), the weight loss of 15% was recorded for selective harvested and medium roasted coffee beans. During roasting, the physical and chemical changes in coffee beans cause roast weight losses (Schenker et al., 2002; Oosterveld et al., 2003)

Processing methods also highly significantly affected roast bean weight loss. The maximum roast weight loss (15.52%) was recorded for coffee processed under semi washed followed by wet processed coffee (14.55%). In contrast, minimum weight loss was recorded for dry processed coffees dried on different drying treatments with a loss ranging from 12.1–12.68% (Table 1). This is may be due to the preparation of uniform bean size by sorting and clearing of abnormal bean during washed processing than dry processing. Abrar *et al.* (2014) also indicated that the maximum roast weight loss (16.97%) was recorded for coffee processed under semi- washed followed by wet processed coffee (16.66%), and the minimum weight loss was recorded for dry processed coffee with a loss of 15.64%

Table 1. Bean roast weight loss as affected by main effect of coffee harvesting and postharvest processing methods

Treatments	**Roast weight loss (%)**
Harvesting Methods	
Strip harvesting	14.42[a]
Selective harvesting	12.13[b]
LSD (5%)	0.80
Postharvest Processing Methods	
Dry processed dried on bare ground	12.32[b]
Dry processed dried on cemented ground	12.50[b]
Dry processed dried on plastic sheet ground	12.10[b]
Dry processed dried on mesh wire	12.68[b]
Semi-washed processed dried on mesh wire	15.52[a]
Wet processed dried on mesh wire	14.55[a]
LSD (5%)	1.38
C.V (%)	8.80
Mean	13.28

Mean values followed by the same letter (s) within a column are not significantly different at $P \leq 0.05$ level of significance

Generally, in the previous studies average weight loss of coffee bean was about 16% (Hicks, 2002; Abera, 2006; Abrar *et al*., 2014), 18% after (Romani et al., 2012) and 19% weight loss were found after roasting (Franca et al., 2009) when compared to the low value recorded in this study. This result might possibly due to the combined effect of the structure of the drying methods, the inherent variability that exists in the respective coffee variety and the location where the crop grown. Fareez-Edzuan et al. (2015) reported that, the weight loss of roasted coffee bean occurred mostly due to the water and volatile compounds loss. The beans sizes were doubled after roasting process caused by water vaporization, release of carbon dioxide and release of volatile components (Dutra et al., 2001).

Roast volume change

The main effects of harvesting and postharvest processing methods were highly significant variation on roast volume change. The highest (81%) roast volume change was recorded for strip harvesting and the lowest was 61% for selective harvesting (Table 2). This shows the existence of big variation in volume change due to the way harvesting which produce different coffee bean quality. In corresponding with this Franca et al. (2005a) reported that for the volume increase of samples of different quality were 40-65% in which the volume increase of non-defective beans was higher than for black beans. Likewise, volume changes recorded in ranges from 66.39% for semi-washed processed coffee dried on mesh wire to 76.79% for dry processed coffee dried on bare ground (Table 2).This showed the highest mean value of volume increment was recorded from dry processed coffee in which all samples prepared by dry processing method indicated higher volume increment than that of washed coffee. This is in full agreement with Abrar et al. (2014), who reported that, the highest roast volume change (84%) for dry processed coffee followed by semi-washed processed coffee (79%) followed by wet processed coffee (75%).

Mekonen (2009) also report similar result where different coffee accession showed highest volume increment under sundried than wet processed.

Among dry processed coffee, the beans dried on above ground raised mesh wire table exhibit minimum percentage (70%) of roast volume change recorded (Table 2). This indicates presence of bean quality variations on roast volume change in response to post processing handling practices which creates a major change on physical properties of roasted coffee beans due to roasting of different quality beans together evolves high water elimination, formation of gases and water vapors and thereby promotes the bean expansion as a result high volume changes observed (Pittia et al., 2001). The result also revealed that, the interaction effects of harvesting and postharvest processing methods was highly significant variation on roast volume change. The highest roast volume increment (93%) was observed from strip harvesting, dry processed and dried on bare ground, while the lowest (69%) was recorded for beans harvested in strip, semi-washed processed and dried on mesh wire. In contrary, selective harvesting produced the lowest volume change that ranges from 65% for dry processed beans and dried on cemented ground and 55% for dry processed bean dried on mesh wire (Figure 1). This perhaps is due to chemical and physical changes in the coffee bean caused by heat energy.

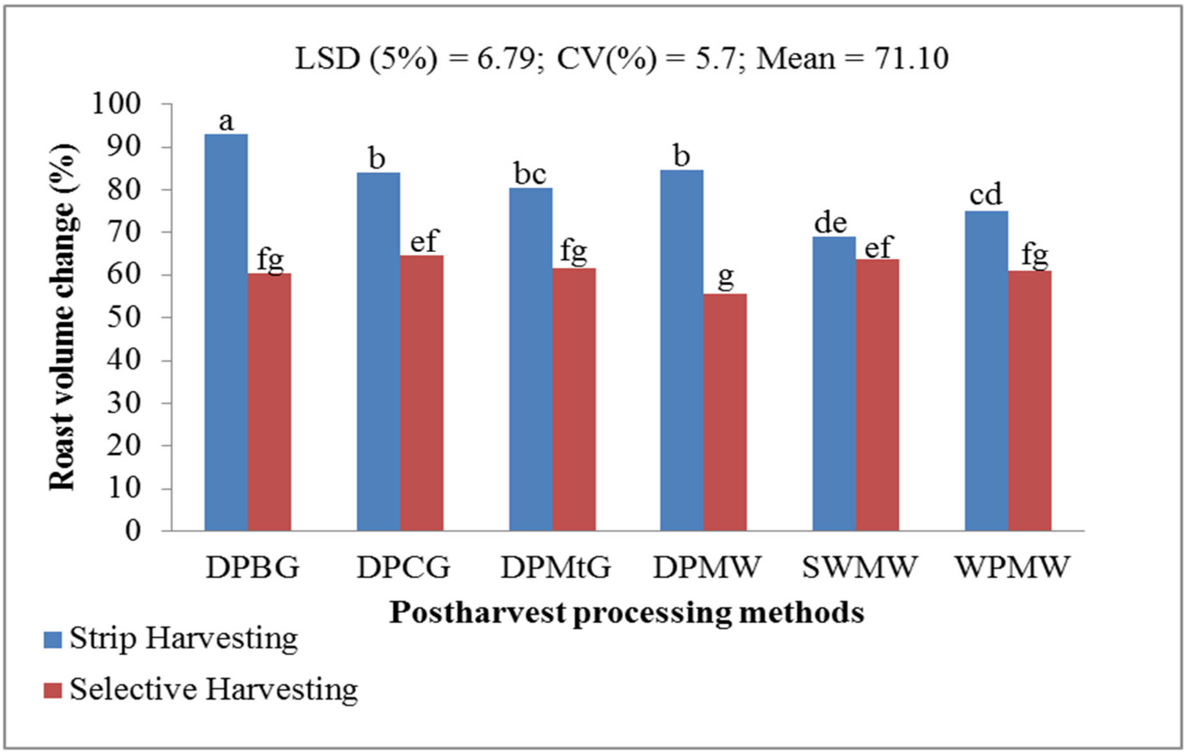
Bean prepared from badly harvested, processed and dried coffee were easily exposed to heat energy by releasing their physical and chemical composition than properly harvested, processed and dried coffee. This agrees with the finding of Abera (2006), who reported that increase in volume of coffee beans during roasting. The increase in coffee bean volume results from the softening of the cellulose bean structure coupled with the increase in pressure from the release of pyrolysis products (Sivetz and Desrosier, 1979). Pittia *et al*. (2007) also reported that coffee beans lose their strength and toughness and become brittle and fragile during roasting, and expansion of coffee beans during roasting leads to considerable volume change. According to Hicks (2002) roasting causes on average an increase in bean volume of 50-80%.

Table 2. Effect of harvesting and postharvest processing methods on roast volume change of coffee beans

Treatments	Roast volume change (%)
Harvesting Methods	
Strip harvesting	81.05[a]
Selective harvesting	61.16[b]
LSD (5%)	2.81
Postharvest Processing Methods	
Dry processed dried on bare ground	76.79[a]
Dry processed dried on cemented ground	74.32[ab]
Dry processed dried on plastic sheet ground	71.08[bc]
Dry processed dried on mesh wire	70.06[bc]
Semi-washed processed dried on mesh wire	66.39[c]
Wet processed dried on mesh wire	67.97[c]
LSD (5%)	4.87
C.V (%)	5.7
Mean	71.10

Mean values followed by the same letter (s) within a column are not significantly different at P ≤ 0.05 level of significance

The present finding indicated that strip harvesting methods showed maximum roasting volume increment level with dry processing compared to semi-washed and wet processed coffee. This is may be due to the density of small and immature beans collected during strip harvesting that might be attacked easily with roasting heat by releasing their strengthen by losing much internal chemical composition and expansion of gas become brittle and fragile that finally increase its volume up to above maximum level. In contrast, selective harvesting coffees processed with all types of processing methods showed low percentage of roasting volume change (Figure 1). In this regard, the bean obtained from selective harvesting become resistance to keep their volume change into lower level than strip harvesting due to its low moisture and dry matter losses. This result confirmed with finding reported by Mekonen (2009) who indicated that, high moisture and dry matter loss during roasting affect volume increment by creating creaked roasted coffee bean. Also, it is corroborated with the result of Abrar *et al*. (2014) who showed variation between selective harvested and differently processed coffee in volume change with 76% and 84% values for wet and dry processed beans, respectively. Clark (1985) suggested that, physical change in coffee beans during roasting leads to considerable expansion of beans. Similarly, Frisullo *et al*. (2010) reported the occurrence of volume change during coffee roasting due to gas expansion, as roasting creates a major change on physical properties of roasted coffee beans. This clearly indicated that the deterioration of inherent physical quality of roasted coffee beans. The variations in the bean volume probably reflect the bean porosity and compressibility of ground coffee, thus being a consequence of commercial percolation (Franca et al., 2005b).



Bars capped with same letter(s) are not significantly difference at P≤0.05; DPBG= Dry processed dried on bare ground; DPCG= Dry processed dried on cemented ground; DPMtG= Dry processed dried on mat ground; DPMW= Dry processed dried on mesh wire; SWMW= Semi-washed processed dried on mesh wire; WPMW=Wet processed dried on mesh wire.

Figure 1. Interaction effect of coffee harvesting and postharvest processing methods on roast volume change of coffee beans

Roast bulk density

The analysis of variance showed that bulk density roasted coffee bean was highly significant influenced by harvesting method; however this is not affected by postharvest processing method. It was found to be 0.39 g/ml and 0.32 g/ml under selective and strip harvesting, respectively (Table 3). The highest mean value recorded for selective harvested bean was due you to the fact that, only harvesting ripe red cherries with uniform size that can increase the firmness of the coffee beans thereby decrease weight loss and volume change and, as a result, bulk density of roasted coffee increased. In contrast, lights and broken beans occur due to the picking of immature cherry by strip harvesting cause uneven roasted bean as a result the bulk density of roasted bean was affected. In agreement with this ITC (2011) reported that, improper harvesting of under and over ripe cherry together is a good reason in making uneven roasting bean thereby decrease bulk density of roasted bean. This due to, the water vapor formation in the initial warmth phase causes the internal pressure of the bean to increase, promoting volume expansion. Similarly, as the roasting goes on it is possible to observe a decreasing in appearing density, due to weight loss and increase of bean volume (Pittia et al., 2001).

Table 3. Bulk density of roast coffee beans as affected by harvesting and postharvest processing methods

Treatments	Bulk density (g/ml)
Harvesting Method	
Strip harvesting	0.32^{b}
Selective harvesting	0.39^{a}
LSD (5%)	0.01
Postharvest Processing Method	
Dry processed dried on bare ground	0.34
Dry processed dried on cemented ground	0.35
Dry processed dried on plastic sheet ground	0.36
Dry processed dried on mesh wire	0.36
Semi-washed processed dried on mesh wire	0.35
Wet processed dried on mesh wire	0.35
LSD (5%)	NS
C.V (%)	3.4
Mean	0.35

Mean values followed by the same letter (s) within a column are not significantly different at P ≤ 0.05 level of significance: NS=Non significant

The interaction of Harvesting and postharvest processing methods on bulk density of roasted coffee was highly significant (Table 4). The highest mean value of bulk density of roasted coffee (0.41 g/ml) was recorded for selective harvesting and dry processed dried on mesh wire. The fact that only fully ripe coffee cherries are used which make the uniform roast bean (Sivetz and Desrosier, 1979). The lowest value recorded was 0.30 g/ml for strip harvested and dried on bare ground floor coffee bean (Table 4). This is due to the harvesting and different size fruit, immature, over mature insect damaged cherries together that make uneven roasting beans. Small lights, ears and chips in a grade of whole but small beans cause exactly the coffee awkward to roast and degrade the liquor quality (ITC, 2011). The diverse reactions between components present in beans determine the physicochemical features of the beverage and depend fundamentally on the harvesting and postharvest processing effects. In line with this, Knopp et al. (2006), during post-harvest treatment, various metabolic processes occur inside the coffee seeds which significantly alter the chemical composition of the green beans. Abrar (2014) suggested that, during roasting, firmness of the coffee beans decreases; weight loss and volume increases as a result, bulk density of roasted coffee decreases. Similarly Frisullo et al. (2010) found that, several physical changes, like weight loss and volume increments take place in coffee beans thereby decrease bulk density of roasted beans. Mwithiga and Jindal (2003) also observed that lowering of density was due to puffing and increase in brittleness. Besides Clarke (1985) reported that physical changes in the coffee beans during roasting may lead to considerably decreased density due to weight loss and expansion of the beans.

Table 4. Interaction effect of coffee harvesting and postharvest processing methods on bulk density of roasted coffee beans

Harvesting Methods	Postharvest Processing Methods	Bulk density (g/ml)
Strip harvesting	Dry processed dried on bare ground	0.29^{e}
	Dry processed dried on cemented ground	0.32^{d}
	Dry processed dried on plastic sheet ground	0.33^{d}
	Dry processed dried on mesh wire	0.31^{de}
	Semi-washed processed dried on mesh wire	0.33^{d}
	Wet processed dried on mesh wire	0.32^{d}
Selective harvesting	Dry processed dried on bare ground	0.39^{a}
	Dry processed dried on cemented ground	0.38^{ab}
	Dry processed dried on plastic sheet ground	0.39^{a}
	Dry processed dried on mesh wire	0.40^{a}
	Semi-washed processed dried on mesh wire	0.36^{c}
	Wet processed dried on mesh wire	0.37^{bc}
LSD (5%)		0.02
C.V (%)		3.40
Mean		0.35

Mean values followed by the same letter (s) within a column are not significantly different at P ≤ 0.05 level.

CONCLUSIONS

Taking the problems of physical quality attributes of roasted coffee beans observed due to improper harvesting and postharvest handling practices, this study was conducted to evaluate the effect of harvesting and postharvest processing methods physical quality attributes of roasted coffee beans. Hence, the finding indicated that, the variation on roast physical properties of roasted coffee beans due to the effect of harvesting and postharvest processing methods was profound. Roast weight loss and volume change of the bean were highly affected by the two main effects of the harvesting and postharvest processing methods and their interaction showed an effect only on roast volume change and bulk density. The highest roast weight loss and volume increment as well as the minimum bulk density were observed for strip harvesting coffee, indicating that firmness of the beans are more decreasing and volume is increasing as a result bulk density is decreased. This could suggest avoiding practicing strip harvesting by creating awareness on its negative influence on physical quality of roasted coffee beans. The result can be used to enhance roast quality of Arabica coffee aiming for different harvesting and postharvest processing methods.

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