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Effect of Different Storage Materials on Ripening and Post-Harvest Quality of Avocado (persea, amerrican M) at Wolaita Sodo University, Ethiopia

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Abstract
The experiment was conducted in 2017 academic year at Wolaita Sodo University College of Agriculture Department of Horticulture laboratory class to test the effect of different storage facilities on ripening and quality of avocado (per sea amereca.) fruit of locally available variety. The treatments were established in four different storage facilities which are locally available materials i.e., (T1=Avocado fruit stored on open ground, T2= Avocado fruit covered with enset leaves, T3=Avocado fruit covered with plastic sheet and T4= Avocado fruit covered with carton). The experiment was laid out in CRD with three replications. Mature green avocado fruits were selected and stored by covering with above facilities, then allowed to ripe in the ambient condition of the study area. The result has shown all the storage facilities with differences on color, aroma, flavor, shape, and size, sugar, presence of defect, shelf life, decay percentage and marketable fruits on the responses of the respondents. The fruits stored or covered by plastic sheet as storage facilities have observed to provide all respondents preferred excellent to marketable skin color, aroma, flavor, shape, size, sugar, defect, marketable, and sweetness and lesser physiological weight loss. Next to plastic sheet carton storage facilities showed highest number of the respondent preferred fair.
Keywords: Packaging materials, Avocado, Shelf-life and quality

1. INTRODUCTION

Avocado (Per Sea, American mill) is commercially valuable crop whose trees and fruit are cultivar in tropical climates throughout the world, producing agrees skinned, pear shaped fruit that ripens after harvest. Shelf life for avocado defined as the period in which product should maintain a predetermined level of quality under specified storage condition" (perezet al –2004). The quality of avocado is comprised characteristics that changes at each stage of the maturation process. The physical quality parameters which are of concern to customers are the texture of the avocado and appearance which is essentially the color and presence of defects (Mattoonazed and ramaswamy, 2008).

The chemical quality parameters are also of importance as these are closely related to both the physical and sensors appeal of the avocado (Obenald et al, 2012). Some of the chemical parameters includes PH, total terrible acid, moisture content, oil content, dry matter content and total soluble sugars. The degree of change of these parameters depends on the harvest time, maturity, cultivar and storage condition (Mttoonazad andramaswamy 2008). Avocados continue respiring after harvest, which initiates the ripening process almost immediately due to their climacteric characteristic of high respiration rates. The duration of complete avocado ripening can take five to seven days at ^{250c} (villa-rodriguez et al, 2011).

Traditionally, former use different kind of local materials during storage mainly to avoid mechanical damage during transportation and avoid water loss. These materials are better to keep the fruit than open air, but there also other materials like polyethylene plastic sheet and carton. But the research work on avocado has been focused mainly on varietal development and field management practices little work has been done one post-harvest management of avocado, as a result, The quality of fruit reduced considerable amount is wasted from harvesting to final consumption. This loss can be minimized by improving post-harvest handling is one factor that reduce the quality and infuse ripening of avocado [villa-rodringuez et al, 2011].

Objective

General objective

To determine or identify better storage facilities from locally available materials for quality Avocado ripening.

Specific objective

- To evaluate effect of different storage facilities on the ripening time of avocado fruit.
- To evaluate the different storage facilities on quality of avocado

Hypothesis: - Null hypothesis [HO]; storage facilities have no effect on quality and ripening of avocado.

Alternative hypothesis: - storage facilities have an effect on quality and ripening of avocado.

2. LITRATUR REVEW

2.1. Post- production operation factors that affect avocado quality.

When avocado reaches the physiological maturity point (harvest point), it contains almost 80% of water. It is a

climacteric fruit with high respiration rates, and release carbon dioxide and ethylene. This means that after harvest, the live tissues degrade at a high rate, together with accelerated internal and irreversible chains. Avocado can dehydrate at the relatively high environmental temperatures, and the mechanical injuries during handling will stimulate higher and faster fruit decay. Sometimes physiological disorder in the post-harvest stage is originated in nutritional imbalances of the tree. Orchard should be handled carefully, in order to increase post- harvest like and preserve quality (Sanche2- pere2 2001).

2.1.1. Production or pre- harvesting

Special attention should be paid to the nutrition of avocado wood especially when producing fruit for international markets. The trees should not have a deficiency or an excess of nutrient. Even though the soil has natural nutrient contents, they consumed or lost during the development of the trees and need to be supplemented with mineral in the same amount as there are extracted. The main element for proper nutrition are nitrogen (N), phosphorus (P), calcium (Ca), potassium (K), magnesium(Mg) and zinc (Zn) (Eng. Jose cortez personal comm. Unication, 2003; sanche2, 2001).

The yield can decrease up to 70% when the soil is not proper fertilized, and the symptom of nutrient deficiency varies according to the specific minerals. Fertilization should be done according to the age, size, and specific needs of every tree. If these factors are not properly assessed, an excess of fertilizer may contaminate the phreatic water (Eng. Jose Cortez personal communication, 2003, sanch z, 2001).

2.1.2 Harvesting mechanism of Avocado

Manual clipping is the main harvesting method for avocado. This is achieved with or without standard or sell-propelled mechanical ladders, or in combination with picking poles. Sanitation of clippers is important to reduce the spread of tree disease and increase the shelf life. It is faster to harvest avocado by shaking (Lee and Burkner, 1971), pulling or shaping than by clipping, and the risk of mechanical damage by stem to fruit contact subsequent handling is reduced.

2.1.3. From harvest to the packing house

Once picked, fruit should be kept in the shade at all times, as excess heating will cause dehydration, sun-burn and reduced quality. Covering the field bins with leaves was found to be more beneficial in reducing flesh discoloration and disease after storage then covering with space blanket or paper, or leaving the bins uncovered (Arpaia, et al 1992). Fruit should be brought into the house within 2 hours (Hardy et al; 1995).

2.1.4. Sorting

Many avocado –producing countries also have standards and tolerance levels for several grades of fruit, which indicate the external characteristics such as mechanical damage, sun burn, carapace skin, hail damage, sooxy mould, netting[wind damage] lenticel damage and various other defects (Tree 1990, Anonymous, 1996 b).

2.1.5. Packing materials

Fruit should not be packed wet because of the increased risk of diseases, and of evaporative cooling causing physiological damage to the fruit during storing (C. Kaiser, Brisbane, 1996, personal communication). Modern packing house have rapid air drying systems to dry fruit before packing. Carton should be adequately ventilated to allow efficient and rapid cooling, while maintaining the mechanical string the required for transport and handling. About 9% free-flow area (area of holes relative to the total carton area) is enough to achieve satisfactory cooling and that there is no advantage in increasing their proportion (Hass and felsen stein 1985).

2.1.6. Storage

Avocado- because of its subtropical and tropical Origen, cannot be stored at low temperature for extend periods, so storage temperature of 3-7^{0}c are generally recommended. Typical avocado fruit cl-symptoms include internal flesh discoloration (pulp, spot, grey pulp and vascular browning, especially in Fuerte), skin blackening and skin pitting (covey, 1982).

2.1.7. Avocado cold chain

Transportation of avocado from the growing regions in to Ethiopian super markets requires extensive logical management unpublished studies by Blakey and Bower (2009) and kooky et al (2010) demonstrate that areak in the avocado cold chain is detrimental to the quality of the fruit. The storage of avocados at 1^{0}c for 28 days to stimulate shipping regimes reduced the rate of softening and mass loss. An example of avocado cold chain is illustrated in figure 1.0 where, Tx represents the temperature at each stage x in 0c (e.g. TH is the temperature at harvest).

2.2 Changes in Avocado quality parameters after harvest

2.2.1. Physical properties

Colure, texture, and aroma are essential avocado quality parameters and the main characteristics to which consumers refer during purchase (leeet, al, 1983 and Torero, 2007).

2.2.2. Skin color

Purity to both industry and consumers avocado skin colure is an important indication of the stage of ripening (cox et al 2004 and Aerate, Vazquez et al, 2011). Skin colure can be measured either objectively, commonly using

chromate or colorimeter, or alternatively using subjective means by experienced sensory pan lists using eye color rating. Skin color has been found to vary among different avocado cultivar. The "hass" cultivar for example, is the characteristics of color charge from green to purple and finally black (cox et al 2004, torero, 2007 and Arzate-vazquezet,al, 2011).However, Chen et al (2009) revealed that the skin color of the sharwil Varity dose not darken with maturity: there for other methods must be utilized to distinguish the various stage of maturity.

2.2.3. Texture

Texture can be quantified as the resistance to applied force experienced by the produce (Maftonazad and Ramaswamy, 2008) and is significant indicator of avocado quality and concern to the consumer (maftoonazad and Ramaswamy, 2008 Toivonen and Brummell, 2008 and landah et al, 2010). Chen et al (2009) stated that the oil content is akey component in the texture of avocado and which hormone et al (2002 a) identified as contributing to the smooth nesses despite the relationship between texture and oil content, it was discovered by chen et al (2009) that an increase in the oil content over the harvest period did not manifest to any change in the texture. Storage temperature oxygen and carbon dioxide concentrations and wounding directly affect the texture (Maftonazed and Ramaymy 2008)

2.2.4. Size

Fruit size is an important quality criterion for avocado because of its tendency for small size (wolesenholme,et al 1990; wolesenholme and wily, 1995) production season can affect fruit size distribution (Milne 1994)

2.3. Chemical properties

Identification of horticultural maturity is often difficult to determine in avocado as charges in external appearance are sometime not easily clear. Other maturity determination techniques that employ chemical properties are therefore, required. The chemical propertied of avocado discussed with in this section are total terrible acid, dry matter content and total soluble sugar (Lee et al , 1983).

2.3.1. Total terrible acid

Acidity is associated with both sweetness and sourness fruit. The method used to measure acidity is terrible acidity (Lobit et al. 2002). He explains that the PH is reprehensive of the free hydrogen ion activity bound; whereas terrible acidy is the quantity of weakly bound hydrogen ion. Bothe pectin based coated and non-coated avocados, an increase in the terrible acidity, was more apparent at higher storage temperature (Maftoonazed and Ramaswamy 2008).

2.3.2 Dry matter content

An extend maturation stage of avocado allows cost for more oil accumulation and dry matter content, however the risk of increased diseased is introduced. Maturity standards are being used by avocado producing countries to avoided marketing of low quality immature fruit. The standard adopted are the Californian minimum dry matter of 20.8% for 'Has" or slightly higher minimum dry matter content of approximately 25% to decrease disorders during storage (Gambel et al 2010).

2.4. Maturity and Ripening

2.4.1. Maturity

Avocado fruit harvested before horticultural maturity may have unacceptable eating quality, or fail to soften without shriveling, or may soften unevenly. It is commercially impotent to identify the minimum maturity (i.e. the maturity standard) that ensure acceptable quality when ripe, in order to advantage of higher early, season prices (Lewis , 1978) and Lee(1981)

2.4.2. Ripening

The most obvious event of ripening in avocados are fleshed softening, and color change of the skin in some cultivar. These changes are preceded by two other phenomena, known as the respiratory and ethylene climacteric (Biale and young, 1970).

3. MATERIALS AND METHOD

3.1. Description of the study area

The study was conducted in Wolaita Sodo University, Horticultural lab class, which is located in southern part of Ethiopian. It is 392km far from Addis Ababa and geographically located at 6^0c 49' latitude and 37^0c45' longitude east and an elevation of 1800 masl with annual rain fall of 1212 mm and it has a clay loam soil. The annual mean temperature is 200c (WSU student book 2009).

3.2 Sampling techniques and sampling size

Locally available cultivar of avocado fruit was collected from Wolaita area or zone. Based on visual maturity determination, mature green with full fruit avocado was selected .The avocado fruit, for the experiment was selected by considering uniformity with regarded to color, shape size and are free from defects

3.3. Treatment and experimental design

The experiment was consisted of four diffrent storage facilities for ripening, which were locally available at comity level, open ground (Control) covering with inset leaves, plastic sheet, and carton. The experiment was observed 12 times. The design of experiment was complete random design (CRD) with three replications. In each treatment there was 1 kg of avocado fruit with similar size or the same number of fruits from the same type and total of 12 kg per experiment. In accordance with specification of design, each treatment was assigned randomly to the experimental with in replication.

- Treatment one (T1) –open ground (control)
- Treatment two (T2) –Enset leaves
- Treatment three(T3) – plastic sheet
- Treatment four(T4) –carton

3.4 Data to be collected

Physiological weight loss (PWL) Beam balance was used to weigh to the representative sample from each treatment at two (3) days interval. It was determined by using

$$PWL = \frac{Wi - WF}{Wi} * 100$$

Where PWL = physiological weight loss
Wi= Initial weight
Wf= Final weight
Decay percentage (DP): Any decay during the storage time was assessed and it was identified by:

$$DP = \frac{ND}{TS} * 100$$

where DP= decay percentage
ND= number of decay
TS= total sample.

Color change: - color chart was used to cross cheek the ripening.
Pulp to peel ratio: - pulp and peel were separated when avocado reached color stage 6. Peel and pulp were weighing individually and were be expressed as.

$$\text{Pulp to peel ratio} = \frac{\text{pulp weight}}{\text{Peel weight}}$$

General analysis: - data on general appearance was made by visual observation considering color, attractiveness, defect and taste based on consumer performance with random sample of five (5) respondents.

3.5. Data analysis

Data was processed by using of variance (ANOVA) techniques based on completely
Randomized Design (CRD). LSD at p= 0.5% was used to test for significant differences of result.

4. RESULT AND DISSCUSION

4.1 Effect of storage facilities on ripening and post -harvest of avocado

The effect of different storage facilities on quality and ripening of avocado fruits was determined in terms of physiological weight loss and quality parameters such as skin color, aroma, flavor, shape, size, sugar, defect, shelf life, decay percentage and marketable fruit and was discussed separately in the following section for storage periods after harvest according to 5 respondent's response.

4.1.1 Effect of different storage materials on avocado fruit physiological weight loss

The data collection was started from April 03 /08 /2009 by using different packaging materials I.e plastic sheet ,cotton ,Enset leaf and open ground with having three replication at WSU Horticulture laboratory with unknown temperature. Then un damaged avocado fruits bought from wolaita sodo area which were already free from detect and uniform physiological mature stage and stored 5 avocado fruits randomly in each packaging material and observed every day consecutively .

Figure 2 The initial color of avocado.

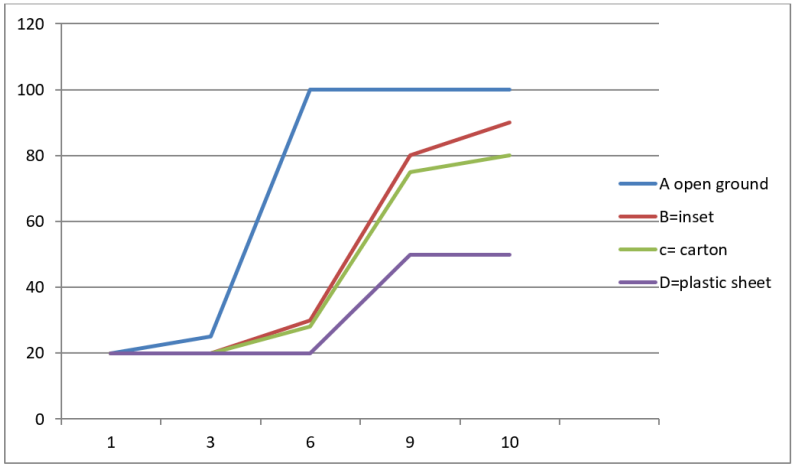

Fig 3 physiological weight loss of Avocado fruits stored at different packaging materials.

The result showed that the physiological weight loss of avocado fruits at different packaging materials at 10 days, i.e different packaging materials were responded different in weight loss.

For example , highest percentage of weight loss obtained in open ground than the other materials due to its exposure to the environment factors and pastes .After five days the fruits were out of use whereas the fruits were in plastic sheet less weight loss from other materials because of less respiration takes placed .Therefore , plastic sheet was very important if the consumers use properly ,and the consumers can stay the fresh avocado fruit in plastic sheet packaging materials.

Carton and enset leaf were the other packaging materials, so the carton was maintain good shelf life next to plastic sheet. The enset leaf was dry after 5 days .So different kind of insects and disease were occurred due to absence of covering materials.

4.1.2 Effect of storage facilities on sensory evaluation of avocado fruit color of at 10 days.

Table1; The average number of respondents to fruits color where E is for dark rip ,D is for pre- rip ,C is for breaking somewhat firm ready to eat ,B is for medium green ,A is for light green.

	Number of respondents said				
Storage facilities	E	D	C	B	A
Open ground	-	-	3	2	-
Enset leaves	2	3	-	-	-
plastic sheet	5	-	-	-	-
Carton	2	3	-	-	-

The table indicated that most of respondents or about 60% said breaking somewhat firm ready to eat that at

stored on open ground.

40% of the respondents 'said, dark rip and 60% of respondents said pre rip, that stored in enset leaves.

All of respondents or about 100% the respondents said dark rip that stored in plastic sheet.

Most of the respondents 60% of the respondents said pre-ripe and 40% dark rip that stored on carton.

Table 1 indicate that the color of avocado fruits stored at different packaging materials and evaluated the 5 respondents at 10 days packed, as the above table 100% for people or respondents give their attention for plastic sheet packaging material due to shiny appearance because the plastic sheet main tend the loss of respiration rate. The for, plastic sheet packaging material is recommended for better color attraction to consumers

4.1.3 Effect of storage facilities on sensory evaluation of avocado fruit aroma of at 10 days storage

Table 2; Number of respondents for aroma. Where E is Excellent, D is for good, C is for fair, B is for poor and A is very bad.

Treatments	Number of respondents that said				
	E	D	C	B	A
Open ground	-	-	1	1	3
Enset leaves	-	2	2	1	-
Plastic sheet	4	1	-	1	-
Carton	2	3	1	-	-

The result showed that most of the respondents (60% of them) said very bad, 20% of respondents said poor and fair aroma that stored on open ground. (40% of them) said the aroma of avocado fruit was good and fair, 20% of the respondents said poor that stored in enset leaves. Most of the respondents (80% of them) said the aroma of avocado fruit was excellent, 20% of respondents said good that stored in plastic sheet. But after 10 days or the day length increase, the fruits were under packed in plastic sheet was showed more water socked and bad sensing of aroma.

Most of the respondents (60% of them) said good, 40% excellent, and 20% of respondents said fair that stored in carton. This result indicated that the aroma of the avocado fruits stored at different packaging materials and evaluated by respondents at 10 days packed, from this study the acceptable of aroma of avocado fruits were achieved at10 days that stored in plastic sheet because plastic sheet is maintained the overall nutrient of the fruit without losses in the form of respiration until 10 days.

4.1.4. Effect of storage facilities on sensory evaluation of avocado fruit flavor at 10 days storage

Table 3 the mean number of respondents for flavor. Where E is for excellent, D is for good, C is for fair, B is for poor and A is for very bad.

	Number of respondents said				
Storage facilities	E	D	C	B	A
Open ground	-	-	1	1	3
Enset leaves	-	1	3	1	
Plastic sheet	4	1	-	-	-
Carton	-	2	2	1	

The result showed that most of the respondents (60% of them) said the avocado fruits had very bad flavor, 20% of respondents said poor and fair that stored on open ground.

The most responded respondents (60% of them) said fair, 20% of respondents said good and poor, the avocado fruits that stored in enset leaves.

Nearly all of respondents (80%: of them) said excellent, 20% of respondents said fair, the avocado fruits that stored in plastic sheet.

(60% of them) said good and fair flavor, 20% of the respondents said poor, the avocado that stored in carton.

Flavor can be measured by sweetness, which is an important test element for consumption quality .Therefore, from this study the acceptable flavor of avocado was achieved at 10 days that stored in plastic sheet. But when the day was over 10 the fruits were stored to be deteriorate due to more socked water and poor flavor.

4.1.5 Effect of storage materials on sensory evaluation of avocado fruit shape at 10 days

Table 4 The mean number of respondents to thee responded to shape .where E is for excellent , D is for good ,C is for fair, B is for poor and A is for very bad.

	Number of respondents said				
Treatments	E	D	C	B	A
Open ground	-	-	-	1	4
Enset leaves	-	-	3	2	
Plastic sheet	5	-	-	-	-
Carton	-	3	2	-	

The table showed that; 80% of this respondents said the shape of the fruits had very bad, 20% of respondents

said poor, and the avocado fruits that stored on open ground due to high respiration rat and loss of water leads to become shrink the fruits.

60% of the respondents said fair and 40% of the respondents said the fruits had poor shape that stored in enset leaves because the enset leaves was drying after four days so different insects and disease were occurred due to the absence of covering material on the fruits.

All respondents (100%) said excellent acceptance the fruit stored in plastic sheet due to low respiration rat and the pulp was fully size.

60% of respondents said good shape and 40% of them were said fair shape of avocado that stored in carton.

Table 4 indicated that the shape of avocado fruits stored at different packaging materials and evaluated the respondents at 10 days packed, as I have seen the above table 100% of respondents gave their attention for plastic sheet packaging materials there for , plastic sheet packaging material was favorable for avocado fruit in order to maintained excellent shape.

4.1.6 Effect of storage facilities on sensory evaluation of avocado fruit size at 10 days

Table 5; the average number of respondents to their responded to size .where E is for excellent ,D is for good ,C is for fair, B is for poor and A is for very bad.

	Number of respondents said				
Treatments	E	D	C	B	A
Open ground	-	-	1	1	3
Enset leaves	-	3	1	1	
Plastic sheet	5	-	-	-	-
Carton	3	1	1	-	-

60% of respondents said very bad, 20% of respondents said poor and fair size, the avocado fruits that stored on open ground because high loss of water in the form of respiration and the pulp became shrink. 60% of the respondents said good size and 20% respondents said fair and poor size that stored in enset leaves.

All of respondents (100%) said excellent acceptance of the avocado fruit size that stored in plastic sheet packed , as l have seen the above table 100% respondents gave their attention for the plastic sheet packaging material. Therefore, plastic sheet packaging material was favorable for avocado fruit in order to maintained excellent size. 60% of respondents said excellent size the fruit that stored in carton.

Among the four treatments of avocado fruit packaging materials plastic sheet showed an excellent size for avocado fruit.

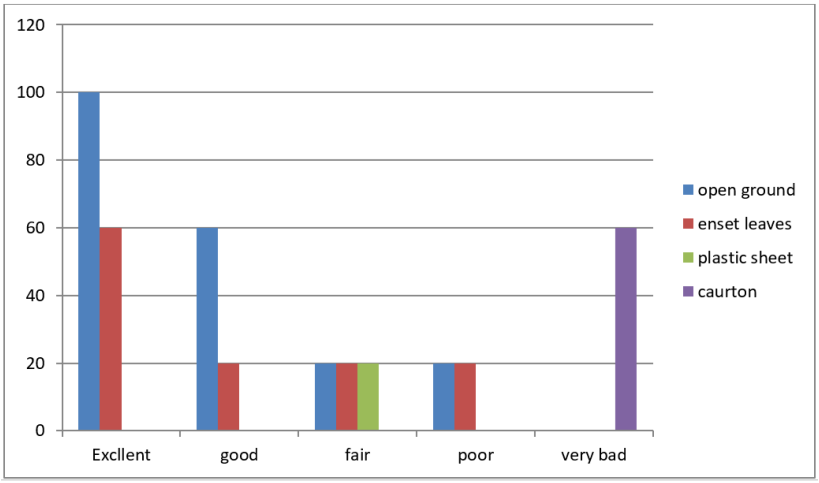

Fig 4 Based on the size acceptance of avocado fruit.

4.1.7 Effect of storage materials on sensory evaluation of avocado fruit sugar at 10 days

Table 6 : The average number of respondents to responded to sugar .Where E is for excellent ,D is fyor good ,C is for fair is for poor and A is for very bad.

	Number of respondents said				
Treatments	E	D	C	B	A
Open ground	-	-	-	2	3
Enset leaves	-	2	3		
Plastic sheet	3	2			
Carton	1	2	2		

The table showed; 60% of respondents said very bad sugar and 40% of them said poor sugar that stored on

open ground. 60% of them respondents said fair and 40% of respondents said good sugar that stored in enset leaves.

Most of respondents (60% of them) said excellent sugar and 40% of them said good sugar content that stored in plastic sheet.

20% of the respondents said excellent sugar, 40% of them said good and fair sugar content that stored in carton.

Carbohydrate changes (starch to sugar) are important because the resulting sugar, gives sweetness avocado fruit. This study indicated that the sugar of avocado fruit that stored at different packaging materials and evaluated by five respondents showed that the plastic sheet was an acceptable sugar of avocado fruit.

4.1.8 Presence of defect in avocado fruit at 10 days

Table 8 the average number of respondents to their responded to the overall acceptance .Where D is for no defect, C is for slightly defect, B is moderate defect and A is for bad defect.

	Number of respondents said				
Treatments	D	C	B	A	
Open ground	-	-	1	4	
Enset leaves	-	1	3	1	
Plastic sheet	3	1	1	-	
Carton	-	1	2	2	

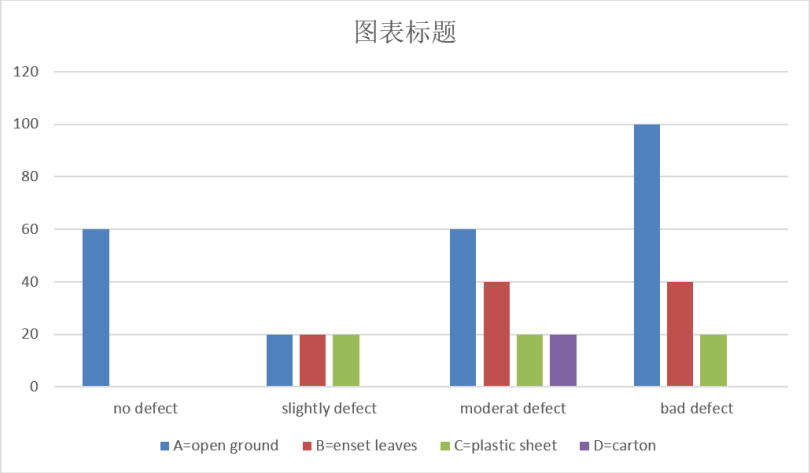

Fig 5 respondents response based on presence of defect in avocado fruit.

80% of respondents said bad defect, and 20% of them said moderate defect of the avocado fruits that were stored on open ground.

Most of the respondents (60%) said moderate defect, 20% of them said slightly defect and bad defect that were stored in enset leaves.

60% of respondents said no defect, 20% of them said slightly defect and moderate defect that were stored in plastic sheet.

40% of respondents said moderate and bad defect and 20% of them said slightly defect that were stored in carton.

Among the four treatments of avocado packaging materials open ground showed more defect avocado fruit. According to the observers respond 60% (fig 5) showed avocado fruits were no defected in the packaging materials of plastic sheet.

4.1.9 Effect of storage materials on shelf life avocado fruits at 10 days

Table 9; The average number of respondents to their responded to the shelf life acceptance .Where E is For excellent is for good, C is for fair, B is for poor and A is for very bad.

	Number of respondents said				
Treatments	E	D	C	B	A
Open ground	-	-	1	4	-
Enset leaves	-	2	3	-	-
Plastic sheet	4	1	-	-	-
Carton	-	3	2	-	-

The table showed that; Most of the respondents (80% of them) said poor shelf life, 20% of them said fair , the fruit that stored on open ground.

60% of respondents said fair, 40% of them respondents said good, the fruit that stored in enset leaves.

80% of them respondents said excellent shelf life 20% of them said well, the fruit that stored in plastic sheet.

Most of respondents (60% of them) said good shelf life 40% of them said fair shelf life, the fruit that stored in carton.

Among the four treatments of avocado fruit packaging materials plastic sheet showed excellent shelf life because plastic sheet suppress respiration and ethylene information there by promoting a longer avocado shelf life. According to the observers respond open ground showed poor shelf life for avocado fruit.

4.2 Decay Percentage of avocado fruits until 10 days.

Treatments	No of decay 3 days	No of decay 6 days	No of decay of days	Decay percentage
Open ground	-	7	8	25%
Enset leaves	-	-	7	11.7%
Plastic sheet	-	-	-	0%
Carton	-	-	6	10

The result showed that the decay percentage of avocado fruit at different packaging materials until 10 days, i.e different packaging materials were respond different decay percentage.

For example; high decay percentage obtained on open ground (25%) from the other materials due to environmental factors and including pastes. Whereas the fruits were in plastic sheet showed that 0% decay percentage because of less respiration rat and controlling the environment and pastes.

4.2.1 Effect of storage materials on pulp to peel ratio of avocado fruit at 10 days.

Treatments	Pulp weight in(g)	Peel weight in(g)	Pulp to peel ratio
Open ground	273.8	40	6.8
Enset leaves	355.7	48.1	7.3
Plastic sheet	363.8	49.4	7.4
Carton	303.2	45.3	6.7

The result showed that the pulp to peel ratio of avocado fruit at different packaging materials at 10 days , i.e different packaging materials were respond different pulp to peel ratio.

For example; the high pulp to peel ratio obtained in plastic sheet (7.4) from other packaging materials because of the less loss of respiration rat and the activity of metabolism have been well performed, due to this reason the pulp weight of the avocado was increased

Whereas the fruits were on open ground showed that less pulp to peel ratio (6.8) from other packaging materials due to high respiration rat and shrinking of the pulp.

4.2.2 Marketable percentage of avocado fruit 10 days

Treatments	No of marketable	Marketable percentage
Open ground	0	0%
Enset leaves	8	13.3%
Plastic sheet	15	25%
Carton	6	10%

The result showed that marketability percentage of avocado fruit at different packaging materials after 10dayes, i.e different packaging materials were responded different marketable percentage

The highest marketable percentage at 10 days obtained in plastic sheet (25%) from other packing facilities because plastic sheet facilities displayed more suitable modified atmosphere condition of low oxygen and high carbon dioxide and decrease the rate of respiration whereas open ground was indicted that all in all non-marketable fruits were recorded due to the reaction of carbon dioxide and oxygen in the environment resulted to increase decay rate.

5. CONCULUION AND RECOMMENDATION

The study was conducted determine or identify the effect of different packaging material on shelf life and postharvest quality of avocado (per sea America). Avocado fruits were packed in different packaging material i.e plastic sheet, carton(CFB), enset leaves and open ground, which are locally available community level and showed significant difference of physiological weight loss and sensory evaluation(general appearance). IN general as it was described in result and discussion portion of this experiment above, the plastic sheet packaging material was observed to provide highest number of respondent with excellent aroma, flavor, firmness and a significant result of marketability percentage, shelf life, pulp/peel ratio, with lesser decay percentage and physiological weight loss than the other treatments. Next to plastic sheet the respondent preferred and the result showed that carton packaging material that had fair flavor, aroma, and firmness and also showed a good result of shelf life, marketability,

pulp/peel ratio and lesser decay percentage and PWL next to plastic sheet than other treatments.

In this experiment out of four treatments the plastic sheet packaging material has observed to provide highest number respondent preferred excellent aroma, firmness, flavor and skin colors and good shelf life, marketability, pulp/peel ratio and lesser decay percentage and PWL in each day, therefore, plastic sheet which are very available at the community level were recommended as appropriate packaging material on shelf life and quality of avocado fruit. On the other hand enset leaves is not recommended as storage material due to easily dried the leaves after a few days and un enable to resist unfavorable environment condition, pests and metabolism activity of avocado fruits.

6. REFFRENCES

Arzate-vazquez, chanona-perezJJ, de Jesus-FloresM, calderom Dominguez G, Moreno AmendarizMA, CalvoH, Godoy-Calderons, QuevedoR, Gutierez-Lopez G(2011).Image processing applied to classification of avocado variety Hass(Peresa A mericana Mill).during the ripening process Food Bioproc.Techno 4(7);1307-1313.

Biale,J.B and young, R.E [1970] The avocado pear.In;Hulme, A.C[ed].The Biochmistry of fruits and their products, vol. H. Acadamic press,condon,pp.2-63

Blaky RJ, BowerJp [2009].The importance of maintaining the cold chain for avocado ripening quality. South Africa avocado growers association year book 32;48-52

Chen NJ, Wall, paul RE, Follet PA[2009].Variation in sharwil avocado maturity during the harvest season a ndrsistance toe fruit fly infection. Hortscince 44[6]1655-1661.

Covey,H.M.[1982]chilling injury of crops of tropical Origen. Hortscince 17,162-165

COX KM,McGhieTK,WhiteA,Woolf AB[2004].Skin color and pigment changes during ripening of avocado fruits.Posth.Biol.Technol.31[3];287-294.

Eng.Josecortez personal communication, 2003, sanchez perez2001.

Forero MP [2007].storage life enhacement of avocado fruit.Unpubelished MSC [space] EngDissertation,Departement of bioresourceEngenering,Mc Gill university,ste-anne Dc Bellevue.canda.

Gamble J,HarkerFR,Jacger SR, white A,BavaC,Beresford M, stubbingsB,WholersM,HofmanPJ,MarquesR,Woolf A[2010].The impact of dry matter,ripenes and internal defect on consumer perceptions of avocado quality and intentions to purchas.Posth.Biol.Technol.57[1];35-43.

Hardy,Finnemore,H.J,Partridge,C.andJouberti,J[1995] SAAGA Avocado exporters packing Guide,23pp.

HofmanPJ,Jobin-Décor Milne [2002a].Harvesting, packing, post-harvesting technology, transport and processing In;ed.Whily,AW,schaffer,B and Wolstenholme,BN,The avocado; Botany, production and uses,ch.14,363-401- CABI puplishing,walingford,oxon.

Hass,E and Felsenstein, G[1985] Factors affecting the cooling rat of avocados packed in corrugated cartons.In; procedinges of meeting of the international institute of Refrigeration. Orlando Florida, commission D1, D2, and D3, PP.291-299.

Kooky RD, Bower,.JP,Bertling I[2010].low temperature shipping and cold chain management of avocado; An opportunity to reduce shipping costs.Southern Africa avocado Growers Association year book 33; 33-37.

Lee , B. W. and Burkene. ,r ,P.F.[1971] A progress report on the shake harvest of avocados. Clifornia avocado society year book 55, 66-74.

Lee S.K [1981] Review and a back ground of the avocado society year book 65-74.

Lee SK, Young RE, Schiffman P M,Cggins Jr. CW[1983] maturity studies of avocado fruit based on packing dates and dry weight.J.Amer.soc.Hort.sci.108[3];390-394.

Lewies,C.E[1978] The maturity of avocados-a general review.Jornal of science of Food and agriculture 29,857-866.

LobitP,soing General M,Habib R[2002]. Regulatory mechanism of textural change in ripening fruit.

MaftoonazadN,Ramaswamy HS[2008]. Effect of pectin based coating on the kinetics of quality changes associated with stord avocado. J.Foodproc.preserve.32 [4]621-643.

Milne,D.L[1994] post –harvest handling of avocado mango and leeches export from South Africa.InChamp,B.R.Highly,E and John Son,G[eds] post –harvest handling of Tropical fruits.ACIAR,Canbeera,prociding NO.50,PP.73-89.

PerzK,MarcadoJ,soto-valdez H[2004].Effect of storage temperature on the shelf life of Hass avocado[persea Americana].Food sci.Technol.inter10[2];73-77.

Sanchez-pereze,J, 2001. Aguacate en post cosecha.Boletin informative dela APROAM EL Agacatero No.5 tthp//www aproam.com/aguacateer 5.htm SARH-DGSV.1981.

Tree,C.E[1990] Avocado quality standards. Australian avocado growers Federation, Brisbani[poster].

TovonemPMA,Brummell DA [2008].Biochemical base of appearance and vegetables .posth.Biol.Technol.

Wolestenholme B.N and Whiley,A.W[1995] prospect for increasing Hass fruit size. In proceeding of conference 95-The way ahead.Departement of agriculture,Western Australia,pp.89-102.

7. APPENDIXES

Appendix- 1 analysis of variance of physiological weight loss at 3days

Source variance	df	SS	ms	f-cal	f-tabu 5%	f-tabu 1%
Total	11	60.09	-			
Treatment	3	51.95	17.3	17.1^{XX}	4.07	7.59
Error	8	8.14	1.01			

CV=11.7 %
LSD=2.8%
Mean=8.5

Appendix -2 analysis of variance of Physiological weight loss at 6 days

Source varance	df	SS	ms	f-cal	f-tabu 5%	f-tabu 1%
Total	11	198.3	-			
Treatment	3	159.2	53	10.8^{xx}	4.07	7.59
Error	8	39.1	4.9			

CV=10.6%
LSD=2.56%
Mean=20.6

Appendix -3 analysis of variance of Physiological weight loss at 10 days

Source variance	df	SS	ms	f-cal	f-tabu 5%	f-tabu 1%
Total	11	593	-			
Treatment	3	531	177	22.8^{xx}	4.07	7.59
Error	8	62	7.75			
Cv=9.3% ,Mean=29.9 LSD=3.2%						

Appedx-4 analysis variance of pulp to peel ratio

Source varance	df	SS	ms	f-cal	f-tabu 5%	f-tabu 1%
Total	11	23.58				
Treatment	3	7.7	2.5	1.46^{ns}	4.07	7.59
Error	8	15.8	1.98			

CV=11.52%
LSD=2.7%
Mean=11.52

Appendix -5 analysis of variance of decay percentage

Source variance	df	SS	ms	f-cal	f-tabu 5%	f-tabu 1%
Total	11	28.1	-			
Treatment	3	20.2	6.7	6.9^{x}	4.07	7.59
Error	8	7.81	0.97			

CV=6.7%
LSD=3.31%
Mean=1.45

Appendix -6 analysis of variance of Marketability

Source variance	df	ss	ms	f-cal	f-tabu 5%	1%
Total	11	22.66	-			
Treatment	3	19.35	6.45	15.71^{XX}	4.07	7.59
Error	8	3.31	0.41			

CV=11.6
LSD=
Mean=5.5

AUTHOR'S PROFILE

Taye Buke Ashango, was born in Sorei Hombba kebele, Boloso sorie woreda of Wolayta Zone on February 23, 1975. He attended his primary, secondary and high school in Dubbo Catholic mission, Areka and Bodditi schools respectively until 1994. He joined Awassa College of Agriculture in 1995 and graduated with B.Sc. Degree in Plant Production and Dry Land Farming in 1999. He then served as senior expert in different positions for Office of Agriculture in Kacha Bira woreda of Kambata Tambaro zone for three years. And then he was appointed as head of Humbo woreda / district Agriculture and Rural Development Coordination office and worked there until he joined Hawassa University for his M.Sc study.