

## Assessment of Postharvest Supply Chain Loss of Banana and Tomato in Asella Town

Yonas Tega Gebeyehu<sup>1\*</sup>, Tesfaye Mekuriyaw<sup>2</sup> and Yidersail Hune<sup>1</sup>

<sup>1</sup>Department of Food and Nutritional Sciences, College of Health Science, Debre Markos University, Debre Markos, Ethiopia

<sup>2</sup>Department of Food Science and Nutrition, College of Natural Sciences, Addis Ababa University, Addis Ababa, Ethiopia

\*Corresponding Author: Yonas Tega Gebeyehu, Department of Food and Nutritional Sciences, College of Health Science, Debre Markos University, Debre Markos, Ethiopia.

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### Abstract

Postharvest loss is quantitative and qualitative food loss in the postharvest system which is a serious problem in Ethiopia. Fruit ripening is a complex process that dramatically changes in colour, texture, flavour, and chemical compositions. Tomato fruit ripening happens after harvest this ripening processes and storage temperature can severely affect the final product. Banana is a climacteric fruit with poor storage characteristics as it presents a high respiration rate after harvest and ethylene production, which make it highly perishable and prone to postharvest losses. This study was conducted in Arsi zone, Asella town. The objective of this research was to assess the postharvest supply chain loss of banana and tomato, Study the extent of loss in the supply chain (from wholesaler to consumer), put suggestive solutions to reduce such postharvest loss of banana and tomato. Asella town was selected purposely to study due it is known as major marketing activity in the region. In this study, the survey was conducted with about 102 respondents to assess for such fruit losses. The result revealed with 18.2% and 11.82% loss of banana and tomato postharvest supply chain respectively. Transportation, loading and unloading and storage condition were the main factors in postharvest supply chain loss of banana and tomato and storage condition is identified as the key issue for product loss.

**Keywords:** Postharvest Loss; Fruits; Banana; Tomato; Asella Town

### Introduction

There is a major issue for postharvest losses of products are due to problems related to transportation, storage and display for sale. Use of public transportation for transporting passengers and commodities together, overloading and stacking and high temperature, rough road with high vibration and collision are major problems [1]. Postharvest loss of fruits such as tomato and banana occur due to lack of proper handling and subsequent damages during harvesting and marketing process. Postharvest loss is mainly due to poor infrastructure, lack of technology, insufficient skill, and knowledge and management capacity of supply chain actors and

lack of markets. The postharvest loss strategy should be better integrated into agricultural programs to provide technical advice and affordable solutions [2]. In Storage, without control of cleanliness, temperature, and humidity these are significant problems for loss of products both quality and quantity. Peoples are unaware about biological causes of deterioration include respiration rate, ethylene production and rates of compositional changes (associated with colour, texture, flavour, and nutritive value), mechanical injuries, water stress, sprouting and rooting, and physiological disorders. The rate of biological deterioration depends on several environmental factors, including temperature, relative humidity, air veloc-

ity, and atmospheric composition, and sanitation procedures [3]. Mechanical damage during harvest can become a serious problem by disposing of it to decay, increasing water loss, respiration and ethylene production rates, which leads to deterioration of fruits [4]. Climacteric fruits can be harvested when mature but before the onset of ripening. After the climacteric, the respiration rate slows down as the fruit ripens and develops quality [5]. Among them, postharvest loss of vegetables such as tomato is of critical importance [6]. Tomato (*Solanum Lycopersicum*) is a highly dramatic metabolic change that occurs during development [7]. Tomato damage assessment at wholesale is maximum than other vegetables. Storage condition and transportation facilities, diseases and insect pests are factors contributing to postharvest losses in horticultural crops [8].

The storage of tomatoes must low O<sub>2</sub> concentration to effectively prevent ethylene biosynthesis, this fruit remains firm and green in color until the end of storage. Oxygen is a factor for the synthesis of endogenous ethylene. The low O<sub>2</sub> concentrations inhibit ethylene biosynthesis that leads to tomato ripening. Ripening initiates the climacteric fruits, such as tomato with increasing temperature. Lycopene, which is responsible for the red color of tomatoes [9]; varies considerably between cultivars, stage of maturity and growing conditions [10], and is regarded as an antioxidant with high biological activity in the body [11]. Banana (*Musa spp.*) is a climacteric fruit usually harvested at the mature but unripe condition and is subsequently allowed to ripen [12]. Banana, like other climacteric fruits, has a distinct ripening pattern with increased respiration and ethylene biosynthesis rates during ripening. Bananas in most Ethiopian markets are also ripened with smoke generated from kerosene burning. Banana bunches are heaped on the floor of airtight rooms where kerosene burners are on for 24 to 48 hrs. depending on the external environmental conditions [13]. The change from the unripe to the ripe stage of banana accompanied by a sharp rise in respiration, decrease in dry matter, starch hydrolysis, and increase in sugar content, acidity, and glycoside glucose. As the fruit ripened at a higher temperature, there is a sharp increase in carbon dioxide and a decrease in oxygen content. Consequently, the increased respiration rate leads to more products to be a loss. In Ethiopia, the average total postharvest losses of banana at the wholesale level are estimated to be 22.05 percent; while the retail level is about 8.05 percent of loss [14].

At the wholesale during unloading is very rough as labors are in a hurry just to finish their work. This affects the fruits becomes

bruise and becomes easily perish. The other factor is in the ripening room, fruit bunches are stacked horizontally and receive airtight smoke treatment using kerosene burners to initiate the ripening process and there is no temperature and humidity control in the ripening rooms except that rooms are ventilated for some time. Poor handling, improper packaging and transportation are the cause for bruising, cutting, breaking, impact wounding and other forms of injury leading to fruit deterioration. Retailing is the business activities involved in sending products and services to their consumers for their family or household use [15]. In a retail level, a variety of actors along the supply chain engage in the retail sale. Farmers and traders can sell informally along the roadside or in markets and kiosks or formally in markets and greengrocers. Retailers use different types of packaging materials to transport from the wholesale market and store banana and tomato fruits. The retailers use plastic crates to transport banana and tomato fruits whereas the majority of the retailers use a wooden crate, bamboo basket or sack and even few retailers use no packaging to transport fruits. In Nigeria the loss of tomato at wholesalers is 50 percent on the average; while to the retailers ranged between 50 - 70%. And women are highly involved at the retail level [16].

To ensure quality and consistent supply of perishable products, supermarkets are pushing the food marketing system toward more vertical coordination, allowing retailers to standardize quality, improve bargaining power, and achieve economies of scale [17]. Usually, traditional retailing of fruits spatially scattered and therefore is tiresome and time-consuming. But, in modern retailing different products are available at one place. Consumers are directly buying their products to the retailer and covers large proportions. Consumers cover a large proportion of value due to the increasing supply chain from producer, wholesaler and retailer. From this supply value chain, there is increasing value and finally, the consumers cover the whole value. There are fewer damages on the consumer is than wholesaler and retailer. Postharvest technologies can contribute to food security in multiple ways. They can reduce postharvest loss, thereby increasing the amount of food available for consumption by farmers and poor rural and urban consumers. Controlled Atmosphere Storage (CAS) extends the shelf life and delivers better quality of products to the market [18]. CA storage is the precise control of oxygen and carbon dioxide concentrating usually with a decrease in oxygen and an increase in the carbon dioxide to extend the produce storage life. Proper storage conditions, temperature and humidity are needed to lengthen the storage life

and maintain quality of horticultural crops [4]. Understanding the metabolic changes underlying fruit development and ripening may help in developing new strategies to reduce postharvest loss and quality of fruit [19].

## Material and Methods

### Study area

The survey was conducted to assess the postharvest loss of Banana and Tomato through the supply chain from wholesaler to consumer. The study was conducted in the area of Arsi zone, Asella town. The town is located in Oromia region and about 175 km far from Addis Ababa. Although Asella town is not the major contributor of banana and tomato to the national market, the town is purposively selected to study the postharvest supply chain loss due to renowned for large volumes of wholesale, retail and consumer. The postharvest loss at supply chain (wholesalers, retailers and consumers) was surveyed in the town by taking a total of 9 wholesalers, 22 retailers and 71 consumers who were randomly selected based on probability proportional to size.

### Methods of data collection

Based on the present context of banana and tomato supply chain in Asella town, three stages were identified to assess the postharvest loss: wholesaler, retailer and consumer levels. Data were collected from primary and secondary sources in April 2016. Secondary data were collected from reading books, internet and as well as from other sources. Primary sources were collected from three stages through one-on-one survey focus on key informant interview. The wholesalers' survey covered nine samples while retailers and consumers were twenty-two and seventy-one samples respectively. Well-structured questionnaires were designed and used for the one-on-one quantitative interview. The questionnaires covered issues such as marketing, postharvest handling, extent, transportation, packaging and storage condition.

### Data analysis

Data were analyzed using parameters such as sum, mean, percentage and standard deviation to compare the differences in tomato and banana postharvest losses among the supply chain actors. The experiment was arranged based on the obtained data with a total of 102 respondents on the supply chain and the result analyzed using portable software analysis of tool pack in excel. The primary data were augmented with secondary data collected from various publications. The data which collected were encoded and

entered to Microsoft Excel spreadsheet contained a portable analysis of tool pack. Data obtained from various sources were checked for consistency and analyzed.

## Result and Discussion

### Demographic profile of traders and consumers

Among the total number of respondents, 102 (Table 1), the percentage of respondents of females is close to 51% and the remaining 49% are males. Females are mainly involved a retail category than wholesale and about marital status, most of the females are married. According to their educational level, about 42% of traders and consumers completed their primary education level and the remaining 47% and 11% of respondents hold their secondary and college level respectively. The numbers of wholesalers are small as compared to retailers and consumers. The number of respondents who are working on wholesale of banana and tomato was few and were taken about nine samples.

Category	Wholesaler (N = 9)	Retailer (N = 22)	Consumer (N = 71)
<b>Gender</b>			
Male	9	13	28
Female	-	9	43
<b>Marital Status</b>			
Married	8	15	34
Unmarried	-	7	37
Divorced	1	-	-
Widowed	-	-	-
<b>Educational level of traders</b>			
Primary	7	10	26
Secondary	2	12	34
College	-	-	11
Illiteracy	-	-	-
<b>Experiences (years)</b>			
< 5	4	-	-
5 - 10	5	22	67
> 21	-	-	4

**Table 1:** Demographic profile of traders and consumers in postharvest supply chain loss of banana and tomato: (N = 102).

Source: Own Survey, 2016./ \*where N is sample size.

Wholesalers of banana and tomato responded that they get the produce from producers and sell to retailers. After fruits are unloaded by labors upon arrival, fruits sorted, weighed and banana wholesalers treated the fruit with temperature for ripening mostly 2 to 4 days. The study found (Table 2) that postharvest supply chain loss of banana at the wholesale and retail level is about 10.8 and 7.4% respectively. This study is supported by [14] reported that postharvest loss of banana in Ethiopia 22.05 and 8.05% at wholesale at retail levels respectively. The same is true for tomato found (Table 3) with a total loss about 11.82%; separately 7.76%, 3.56% and 0.5% of loss recorded at wholesaler, retailer and consumer level respectively. Niguse, 2018 compared the extent of tomato loss with other vegetables at wholesale sub sectors and reported that damage assessment result at wholesale showed maximum damage for tomatoes than other vegetables. In this postharvest supply chain loss of fruits study, transportation, loading and unloading and storage issues were the major factors to loss. However, there are no separate factors for causes of postharvest loss between banana and tomato fruits. For instance issues in loading and unloading as well as storage of tomato loss are common to that of banana fruit loss. This statement is supported by the Author [2] reported that food losses are mainly due to poor infrastructure and logistics, lack of technology, insufficient skill, knowledge and management capacity of supply chain actors and lack to markets. The study found that, storage problem was the leading factor for tomato fruit loss at the wholesale level. Labors activity during loading and unloading of fruits was speedily just to finish their work. As the data showed that, the standard deviation at the wholesale level of banana was about 5.51, which were much more than the other stages. Studied at retail level 5.8 and 2.81% loss of banana and tomato respectively were recorded by storage problems. The study showed males were having an apparent difference in number than females of trading involvement. A reported by [16] a trend for more women involved in retailing than men did in Nigeria. This disagreement could be attributed to a perception system and cultural differences. Retailers purchase fruits from wholesalers and transport both from distant and nearby areas with poor transportation; loading and unloading caused for the occurrence of such fruit loss due to labors are hurried just to finish their work. Also, inappropriate storage facilities were factors contributing to fruit loss. The postharvest supply chain loss of banana and tomato (Table 2 and 3) at retail levels were about 7.4 and 3.56% respectively.

This study is agreed with the author [20] reported that inadequate storage and transportation facilities, diseases and insect pests are found to be significant factors contributing to postharvest losses in horticultural crops. Retailers' sale and store fruits in a very small area of the shop and its temperature rapidly rise during day time and cools during night time. This temperature fluctuation in the store affects the physiological process of fruits and leads to rotting due to unavailability of ventilation facility. These situations enhance the high postharvest loss. A report by [20] stated storage condition and transportation practice as important determinants for the postharvest loss of banana in Ethiopia. The study identified that the amount of postharvest supply chain loss of banana and tomato at the retail level is small compared to the wholesale level of both fruits due to the relatively rapid turnover of the produce between the retailers and final the consumers. Consumers can cluster to individuals and households and postharvest loss found is negligible and so problems are not given much attention. At the consumer level, unlike wholesalers and retailers, postharvest loss of banana at consumer level were null whereas tomato about 0.5% loss.

Postharvest marketing supply chain	Transportation, loading and unloading	Storage	Total loss
Wholesaler	9.3	1.5	10.8
Retailer	1.6	5.8	7.4
Consumer	--	--	--
Total	10.9	7.3	18.2

**Table 2:** Postharvest supply chain loss of banana in the study area (%).  
Source: own Survey, 2016.

Postharvest marketing supply chain	Transportation, loading and unloading	Storage	Total loss
Wholesaler	0.85	6.91	7.76
Retailer	0.75	2.81	3.56
Consumer	0.5	0.5	0.5
Total	2.1	10.22	11.82

**Table 3:** Postharvest supply chain loss of tomato in the study area (%).  
Source: Own Survey, 2016.

## Conclusion

The study identified how transportation and storage affect product loss on the supply chain of banana and tomato. In this study, loading and unloading factor is included and studied with great care because it is a bridge for transporting and storage of products. Transportation and loading and unloading activities were seen as a cause for loss of banana and tomato at the supply chain. On the other hand, Storage problem was the main issue for the occurrence of such fruit loss. Tomatoes are highly loosed due to storage problems especially at the wholesale level in the supply chain. The respondents handling activity were given less emphasis which indicated the traders faced limited awareness about the impact of poor transportation, loading and unloading and storage system.

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