Review on Factors of Harvested Banana Fruits Safety and Quality and Its Effects

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Abstracts
Bananas are native to southern and southeastern tropical Asia and belong to the Musaceae family. Bananas are high in vitamin C, potassium, soluble fiber, and protease inhibitors, all of which aid in the elimination of stomach germs. Fruits are also known to be good for calcium and phosphorus. On the other hand, the export potential is huge and it is close to important markets such as Saudi Arabia, Djiboui, Somalia, etc. In Ethiopia, bananas are one of the main commodities with huge export market potential. Ethiopia is relatively close to major export markets such as the Middle East and Europe, Djibouti and Somalia, and can benefit a lot from banana exports. However, bananas are affected by various factors, such as the huge loss of quality and quantity after harvest in Ethiopia. When the product passes through the supply chain to reach the end consumer or the table, it often encounters various degrees of quality and quantity loss. Bananas are affected by several limiting factors in the non-biological and biological categories throughout the value chain. Post harvest losses are highest with crops like banana, which post harvest quality is much dependent on climatic conditions, nature of the crop, different pre and post-harvest practice, environmental conditions, such as temperature, irrigation water, nutrition, and light intensity also affect post harvest quality of *banana. Additionally* the various factor such as lack of storage facilities, improper handling and lack of packaging and refrigerated storage facilities are the major problems banana production. The potential for solving some of the problems related to banana quality and its shelf life maintenance through keeping fruits in their optimal range of temperature and relative humidity, make appropriate decision, in selecting cultivars, cleaning, waxing treatment with fungicides for decay control, fumigation for insect control, modified atmosphere packaging/storage, selection of disease resistant varieties, *fertilizer trial and* irrigation trial technology of modified atmosphere application with consumer packaging and transport vehicles a high priority in future research. The main purpose of this review is to review the safety and quality factors of harvested bananas.
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1. INTRODUCTION

Bananas are a member of the *Musaceae* family and are used as desert fruits all over the world (Gowen, 1995). It is the most important fruit crop, with an average annual global production of close to 106 million tons (2009-2011) (FAO, 2014). Varietal development, disease resistance selection, fertilizer studies, clump management strategies, and irrigation trials were all part of banana research. Even though these pre-harvest procedures are required, many poor nations must combine them with post harvest management practices since postharvest losses are a major concern (Workneh *et al.,* 2011a, 2011b). In addition, packaging protects the product from the natural environment by isolating the product from the outside world (Beaudry, 2000). Agricultural product packaging is used to reduce weight loss and shrinkage during the marketing process. Because the consumption centers of fresh fruit are far from the producing areas, standardizing container sizes promotes efficient handling (Hailu *et al.,* 2013). Produce is transported and marketed in a variety of packages made of wood, fiber, board, jute, or plastics. Many packaging systems waste raw materials, but concerns about the environment and food safety have led to the recycling of fiber board, which is reused numerous times (Wills *et al.,* 1998).

Mechanical damage is minimized during harvesting, and subsequent loss due to microbial attack can reduced (Wills *et al.,* 1989). Low-temperature handling and storage are the most important physical aspects of post-harvest management (Johnson *et al.,* 1997). Growers in Ethiopia forced to dispose of their produce over a short period of time due to a rain-fed farming system, lack of storage facilities, limited access to transportation, and the risk of high losses (Haidar and Demisse, 1999). The post-harvest loss of fruits and vegetables worldwide ranges from 25-40% (Raja and Khokhar, 1993), even higher in developed countries (Iqbal, 1996), and as high as 50% in developing tropical countries (Anon, 1996). Due to lack of storage facilities, restricted transportation channels, and high risk of loss, growers are often forced to dispose of their products in a short period of time (Haidar and Demisse, 1999), which can lead to economic losses of bananas.

1.1 Objective

To review factors of harvested banana fruits safety and quality and their Effects

2. LITERATURE REVIEW

2.1. Origin, Distribution and Production

Bananas are native to tropical southern and south east Asia, but they grown all over the world in conditions ranging from humid tropical to subtropical (Ploetz1, 2005; Jain *et al.,* 2009; Voldeck, 2010). Secondary centers of banana diversity, both as desert and culinary forms, emerge later in East Africa, West Africa, and Latin America's highlands and coasts (Ploetz1, 2005). Banana production is limited to tropical or near-tropical areas, usually between 30 degrees north latitude and 30 degrees south latitude. Bananas are the world's fourth most significant crop, after rice, wheat, and maize, and third most important fruit in terms of volume output, after citrus fruit and grapes (FAO, 2000). They also contain small amounts of vitamin A, thiamine, riboflavin and niacin (Ferguson, 2002). In the baking and confectionery industry, as well as in the treatment of newborn meals and intestinal diseases, ripe banana powder is used (Adeniji *et al.,* 2006). According to Demirel and Turhan (2003), in addition to preserving bananas, drying can also increase the value of bananas.

The total number of cultivars of banana and plantain is estimated to range from about 300 to more than 1,000 (Chia, 1981; Huggins *et al.,* 1990). Cultivated bananas are parthenocarpic (fruit formed without ovule fertilization), making them sterile and incapable of producing viable seeds (Ploetz1, 2005; Jain *et al.,* 2009; Voldeck, 2010). To achieve their desired flavor, quality, color, edible nature, and other textural features, the fruits generate ethylene coupled with an increase in the rate of respiration throughout the ripening process (from starch to simple sugars) (Ploetz1, 2005; Jain *et al.,* 2009; Voldeck, 2010). After rice, wheat, and maize, banana (Musa spp.) are the world's fourth and fifth most important food crops, respectively (Salvador *et al.,* 2007). They are the most widely farmed fruit crops in the world, with around 130 countries cultivating them (Osava, 2003). According to FAOSTAT (2014), India, Tanzania, Brazil, Philippines, China, Burundi, Ecuador, Uganda, Angola, Indonesia, and Vietnam are among the top 11 banana-producing countries in the world, accounting for about 75% of total banana production. According to CSA (2014), the number of people in Ethiopia who grow fruit crops is substantially lower than those who grow grain crops. On the other hand, because it is close to important markets like Saudi Arabia, Djibouti, and Somalia, it has export potential (Workneh *et al.,* 2011a, and b). In Ethiopia, banana production ranges from small family farms to massive commercial plantations.

Bananas are the most widely grown and produced fruit crop in the country, both in terms of area and production (Central Statistics Authority, 2014). There have been recent reports that in some areas of the southern part of the country, bananas are replacing other fruit crops such as limes and mangoes, as well as the most important food crops such as corn and sweet potatoes (Seifu, 1999). In Ethiopia, the Southern Nations Nationalities and Peoples' Regional State is the largest banana producer, both on a small and large scale (CSA, 2014). The Arba-Minch, Mizan, and Tepi regions produce the majority of Ethiopia's bananas. The top banana-importing countries in the world are the United States, Belgium, Germany, Japan, Russia, the United Kingdom, Iran, Italy, France, Canada, Argentina, the Republic of Korea, Saudi Arabia, Poland, the Netherlands, and Turkey (FAOSTAT, 2014). Tanzania, Burundi, Uganda, Angola, Congo, Cameroon, and Kenya are the most banana-producing countries in Africa (FAOSTAT) (2014).

Figure 1. Banana exports by region 2009-2013, million tones (FAO, 2015)

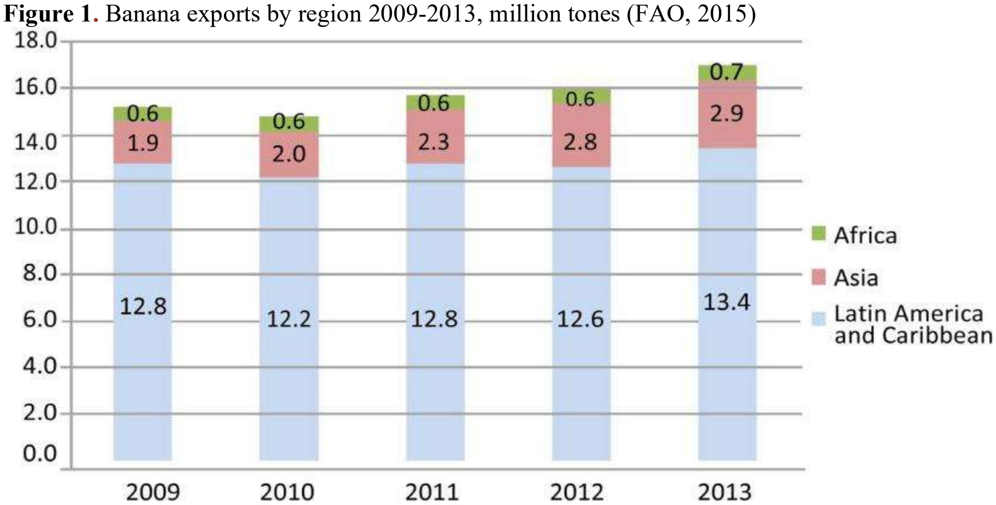
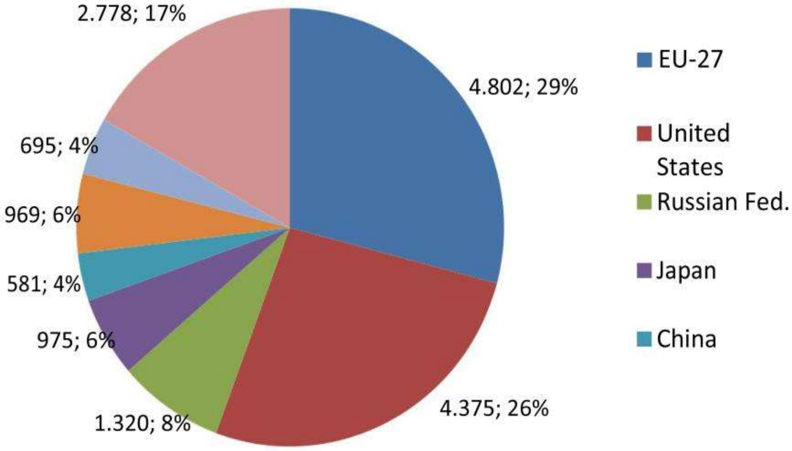


Figure 2. Distribution of global imports by market, (FAO, 2015) (thousand tonnes and share in global imports)



2.2. Factors Affecting Banana Fruit Safety and Quality

Bananas are affected by several limiting factors in the biological and non-biological categories throughout the value chain. According to Asare-Kyei (2009) and Gustavsson et al. (2011), post-harvest losses are largest with banana crops, whose post-harvest quality is highly reliant on meteorological circumstances, crop nature, and various pre- and post-harvest procedures.

2.2.1. Pre-Harvest Factors

Pre-harvest factors that affect the quality of bananas after harvest. The quality of fresh fruits and vegetables available to consumers limited by the level of quality reached at harvest which, can not enhanced by post-harvest handling but it can maintained. The growth, development, and final quality of fresh fruits and vegetables influenced by a variety of pre-harvest, genetic and environmental factors. These factors include the crop's genetics, the growing environment, management strategies, harvest ripeness, and harvesting method (Shewfelt and Prusia, 1993).

2.4.1.1 Factors in the Environment

Environmental conditions such as temperature, irrigation water, nutrition, and light intensity also affect the quality of bananas after harvest (Kader, 2002; Hewett, 2004). For example, temperature affects the absorption and metabolism of mineral nutrients, because as the temperature increases, transpiration increases (Kader, 2002).

2.2.1.2 Factors of Genesis

The quality of plant material is an important factor that controls the quality of the fruit (Hewett, 2004). According to the author, the fruit size, shape, color, productivity level, dry matter and taste attributes, as well as the time and rate of maturity and lifespan after harvest may vary due to genetic variation. Therefore, growers must make appropriate decisions to select cultivars before planting, unless their choice is limited by the availability of planting materials (swords and water absorbers, virgin plants, bulbs, eye buds or seedlings).

2.2.1.3 Cultural Activity

As described by Kader (2002) and Seleznyova et al. (2003) cultural practices such as types of planting material, irrigation, mulching, fertilization, weeding/cultivating flower and fruits (propping stems with support poles, bunch spraying against pests and disease, deflowering to maximize the concentration of food nutrients for fruit development, debudding/deblling to chanal food nutrients to the fruit bunch, bagging bunches to prevent insect pest from laying eggs and ribboning/tagging to determine the exact stage of harvest maturity) and fertilization ultimately affect shelf life and post harvest quality of fruits. For example, they pointed out that severe water shortages can increase fruit sunburn; moderate water stress can reduce fruit size while increasing total soluble solids and total acidity.

On the other hand, they explained that excessive water supply of plants can cause fruit to crack, increase susceptibility to physical damage, reduce fruit firmness, delay fruit ripening and reduce total soluble content. Cultivation practices such as pruning and thinning also determine the crop load and fruit size that affect the nutritional quality of the fruit, and the use of pesticides and growth regulators may indirectly delay or accelerate fruit ripening. Canopy management focuses on the amount of light and CO_2 that fruits receive. The peel of the former banana fruit is dark yellow in color, while the peel in part is bright yellow. Low light intensity hinders the development of carotenoids (Caussiol, 2001). Eliminating undesirable suckers and removing leaves can also help prevent fruit panic. Thinning reduces competition among fruits and increases fruit size. The average number of banana plants per hectare is about 2,500 (Stover and Simmonds, 1987). Plant health and leaf/fruit ratio also influences flavor (Hoffman and Smith, 1993).

2.2.1.3 Determination of Maturity

Deciding when to harvest banana fruits is usually one of the most difficult decisions a grower makes. The determination of harvest maturity has a very decisive influence on the subsequent quality of the fruit and the life potential after harvest (Kader, 2002). According to Reid (2002) and Crisosto *et al.,* (2001), there are many ways for determining fruit maturity or harvest maturity indices such as % of total soluble solid to obtain optimal flavor, % dry matter in the fruit, fruit acid content to obtain optimal test/flavor and total acceptability. Eduardo (2002) pointed out that commercial bananas are harvested when they are ripe and green and shipped to the destination market, where they ripen under controlled conditions because the ripened fruits on the plant tend to crack easily and have poor texture.

2.2.1.4 Methods of Harvesting

When the fingers of the first hand showed signs of maturity or yellowing and the fingers became round, the banana fruit was harvested (Dadzie and Orchard, 1997). Kader (2002) and Hewett (2004) pointed out that rough and improper harvesting methods and facilities can determine the degree of physical and mechanical (abrasion, surface abrasion, cutting, etc.). The damage will therefore affect the direct physical properties of the fruit, accelerate the loss of water and increase the susceptibility to pathogens that cause decay.

2.3. Factors after Harvest

Banana fruits are very susceptible to a variety of post-harvest issues due to their perishability. As goods move through the supply chain and eventually reaches the hands or dining tables of the ultimate consumers, various levels of qualitative and quantitative losses are common (Yahia, 2009; Gustavsson *et al.,* 2011; Adeoye *et al.,* 2013). Physical and mechanical damage, improper handling settings and facilities, and pests and pathogens are all common causes of damage.

Farm-gate and preparation of fruits (washing, sorting, grading, packaging, loading, and so on), transportation, unloading at wholesale centers, storing, ripening, de-handing, distribution to retail centers, and later handling or marketing systems all result in operational damages (Sisir Mitra, 2005).

2.3.1 After-Harvest Handling System and Methods

Banana fruits are easily damaged by abrasion and impact. Therefore, care should be taken not to let the fruit bunch fall on the ground and be damaged during the harvesting process (Nakasone and Paull, 1999). According to Kader (1992) cited by Irtwange (2006), microbial, mechanical, and physiological factors cause most of the loss of perishable crops. Other cause of losses, according to Irtwange (2006) is inadequate harvesting, packaging and handling skills, lack of adequate containers for the transportation and handling of perishable, storage facilities inadequate to protect the food and transportation inadequate to move the food to market before it despoils. During transportation, the thin plastic lining in the export carton minimizes scratches; fingers rubbing on the side of the carton are damaged during handling. Latex that is allowed to dry will oxidize into brown and black stains, and it will also result in the dawn grading of the fruit. Other problems are diseases, especially crown rot that can affect the entire carton and promote uneven fruit ripening. Due to the weak pedicels, the fingers of some varieties will fall from the hands during maturation, revealing the flesh (Nakasone and Paull, 1999).

2.3.2 Marketing Distance

Banana bunches after harvest are transported to the packing shed on padded trailers or on an overhead cable system. Dehading can be performed in the field with the hands transported to packing shed on pedded trailers.care is essential these steps to avoid any mechanical injury that would reduce fruit quality (Nakasone and Paull, 1999). The bunches are piled up to maximizing loading and to speed up transportation. They were accidentally unloaded at the destination. These different packaging and transportation methods make the fruit vulnerable to damage and low market quality (Dadzie, 1998). In Ethiopia, large trucks are used to transport immature bananas from major growing areas to big cities. Bunches were loosely piled on the truck and then covered with banana leaves. Owing to the distance from the planting area to the city, the fruit may stay for a day without boxing and boxing, which results in mechanical damage that is not obvious on the immature fruit, but its commercial value may be considerably reduced when it ripens (Seifu, 1999).

According to Morton (1987) said that transporting banana for export purpose, boxing was experimented in the previous time but now abandoned because of various types of spoil. Modern means of contesting the organisms that cause that problems as well as better systems of handling and transport, quality control and food container design have made carton packing not only feasible but necessary.there are several advantages of boxing over naked bunch transport. Transporting fruit bunches in boxes forces growers to produce bunches of specific sizes. This also avoids more waste disposal and export (Salunkhe and Kadam, 1995).

2.3.3 Conditions of Storage

Fruit deterioration during storage mostly determined by temperature (S. Mitra, 2005). The most significant aspect in decreasing the impacts of respiration, transpiration, and ethylene, and thus maintaining their quality and avoiding post-harvest losses, is to keep fruits their optimal temperature and relative humidity ranges (Kader, 2002). In order to avoid or postpone microbial growth, keep track of the temperature and relative humidity in the cold store. Remove produce from cold storage during the day's coolest hours to avoid "sweating," or moisture condensation on the product, which promotes microbial growth (Sisir Mitra, 2005). Easy handling (consumer package); protection from injuries; reduction of water loss, shrinkage, and wilting; reduction of decay by modified atmosphere, reduction of disorders (chilling injury), retardation of ripening and senescence processes, and insect control in some commodities are advantages of film packaging.

Controlled atmosphere (CA) storage is a technology that maintains process quality in an environment where the ratio of O_2 and CO_2 is different from that of air (Abdullah *et al.,* 1990). Will *et al.,* (1998) described CA storage as precise control of oxygen and carbon dioxide to extend product storage life. The breathing rate of fresh produce slows down as the oxygen of fresh produce decreases. It has previously been reported by Salunkhe and Desai (1984) as cited by Ahmad *et al.,* (2006) that controlled The high CO_2 atmosphere can inhibit the decomposition of digestible substances, maintain the texture of the fruit and restore firmness for a longer time. CA storage conditions inhibit the production of ethylene and delay the ripening of bananas (Quazi and Freebrain, 1971). Lui (1976) reported that pre-treated bananas (ethylene treated) stored for 28 days in 1% O_2 at 14^0C remained green and firm until the end of storage but started to ripen almost immediately after these were placed at 21^0C in air without addition of ethylene treatments. Acedo and Bautista (1993) reported that fruits can be successfully stored under low oxygen conditions without increasing carbon dioxide in the atmosphere. Generally the application of controlled atmosphere storage has a considerable significance in the proper shipment, storage, and ripening of banana as a result respiration rate of the produce slowed down as a consequence processes associated with ripening were slowed (Thompson, 2001).

Modified atmospheric storage is defined as an environment formed by changing the typical composition of air (78 percent nitrogen, 21% oxygen, 0.03 percent carbon dioxide, and traces of other gases) to provide an optimal environment for extending the storage length and quality of food/produce. Using these methods (Farber *et al.,* 2003), it is possible to actively or passively control or change the atmosphere around the product in the package composed of various types and/or combinations of films. Active modification occurs when gases in the package are displaced and replaced with a desired mixture of gases, whereas passive modification occurs when the product is packaged using a specific film type, and a desired atmosphere forms naturally as a result of the product's respiration and gas diffusion through the film (Farber *et al.,* 2003). Once bananas are introduced to high levels of ethylene to induce ripening by unconventionally, MAP storage conditions will reduce respiration and allow bananas to ripen for at least one month (Basel *et al.,* 2002). According to Hassan (2004), the development of controlled atmosphere technology allows bananas to be stored at 14°C for more than eight weeks. The effect atmosphere modification on post harvest disease development can be direct by repressing various stages of the pathogen growth and its enzymatic activity, or indirect by maintaining the resistance of the host to infection as a result of keeping it in a superior physiologic condition (Irtwange, 2006). Unripe bananas subjected to ripening in polyethylene bags of 150 gauge thickness at ambient temperature had significantly lower values of pulp: peel ratio, moisture total soluble solid, total sugar, titrable acidty, and total yellow pigments, and significantly higher values of alcohol insoluble substance, ascorbic acid, starch, and total chlorophyll, indicating that ripening was delayed by about 6-7 days (Salunkhe and Kadam, 1995). The packing of the banana cultivar 'Kolikuttu' as individual hands in low density polyethylene (LDPE) bags with a warped ethylene absorber, according to Chamara *et al.,* (2000), could be of substantial economic relevance in places where cold storage is not commonly available or expensive. Easy to handle (consumer packaging); protection from injuries; reduction of water loss, shrinkage, and wilting; reduction of decay by modified atmosphere, reduction of physiological disorders (chilling injury), retardation of ripening and senescence process, and control insects in some commodities are all advantages of film backaging.

Film packaging has a number of negative impacts, including greater susceptibility to decay due to excess humidity; beginning and/or aggravation of chilling problems; irregular ripening in incorrect CO_2/O_2 concentrations; off-flavors and off-odors; and off-flavors and off-odors (Irtwange, 2006). Plastic wraps and liners can used to prevent water loss, but the resulting of ventilation can produce difficulties such as low oxygen, high carbon dioxide, or water accumulation, which is alleviated by perforating the films (Burdon, 2001). Low density polyethylene, linear low density polyethylene, medium density polyethylene, high density polyethylene, polypropylene, and polyvinyl chloride are the permeable films used for packaging fresh fruits and vegetables, each has a varying permeability for gases and water vapor (Thompson, 2001).

2.3.4 Packaging Methods for Transportation

Fruit is frequently carried over a significant distance after harvesting in order to reach a demosticat or export market. The use of plastic boxes for the handling and transportation of fruits can help to reduce post-harvest losses (P.S Phisker, 2007). Fruit for export is usually packed in corrugated cardboard (fiber board) boxes with partitions for separating individual fruits and cushioning material to minimize mechanical damage to the fruit. Pallets have become the most common unit load of packaging, especially on a global scale. A pellet can store anything from 20 to 100 unit boxes, depending on the size of the packaging units. Wide-mesh plastic tension netting or a combination of corner post protectors and horizontal and vertical plastic warping are used to secure pallet loads for stability. Individual packaging is frequently attached to one another with low tensile strength glue, allowing for independent units yet preventing slippage (P.S Phisker, 2007).

2.3.5 Packaging Materials and System of Packaging

Fruits packaged in plastic film help to maintain high relative humidity and change the concentrations of O_2 and CO_2 in the atmospheres around them. The significance of high humidity in suppressing chilling injury was recognized as early as the 1930s by various researchers, and the protection of chilling injury by film wrapping is likely due to these functions (Brooks and Mc colloch, 1996). The buyer can buy based on grade, the buyer is assured of consistent quality with each purchase, the supplier can match consumer demands, and pricing differentials between grades can be formed (Hortifield *et al.,* 1991). Sorting include probing produce for consistency in size, shape, ripeness, and texture, as well as the removal of infected, insect-infested, and mechanically damaged commodities, as well as other unmarketable food. After the rejections have been removed, the fruit should be cleansed to remove any extraneous elements. This can be accomplished by washing, brushing/wiping, or a combination of the two. Fruit is sized to provide uniformity in order to maximize consumer appeal and market demand. Grading is the process of classifying fruit based on market grade (Hortifield *et al.,* 1991).

Poly-ethylene is one of the most widely used packaging materials today. They're also common in laminations, where they supply the inner layer that needs to be heat resistant. Perforated polyethylene plastics are strong but flexible, chemically inert, clear, and cost a lot of money. Polyethylene also has a high permeability to oxygen, carbon dioxide, and other gases while having a low permeability to water vapor. They are heat-seamless and produce a strong seal practically immediately (Famurawa *et al.,* 2013). It is preferable if the natural interaction between the product's respiration, and the packaging results in an environment with a low level of oxygen and a high level of carbon dioxide. The growth of decay-causing organisms slower, and the product's life extended. Further, the desirable environment might reduce respiration rate and ethylene generation, resulting in physical changes.

For example, it can prevent the employment of additional chemicals or thermal processes such as freezing, dehydration, and sterilization by inhibiting chemical, enzymatical, and microbiological pathways linked to the delay of fresh items (Danish technological institute packaging and transport 2008). Carton performance is used as a secondary packaging medium and is refer to as a "shipper." Its primary function, just like all types of packaging, is to protect the contents. Simply put, the purpose of the corrugated carton rate is to ensure that the product reaches the end user or consumers in the state intended by the product's creator or manufacturer. The filling and packing procedure protects the items' high quality and maintains a consistent best and fresh appearance while enhances their shelf life. The flavor, color, texture, and nutrients of the items preserved for a long time inside the shelf stable carton box, which is hygienically and securely shielded from light and air. No refrigeration or preservative is necessary. Temperature resistance is provid by the sealed package and re-closeable screw cap opening, which adds to product safety (Gregoire *et al.,* 2013).

2.3.6 Physiological Factors after Harvest

Respiration is the breakdown of stored organic materials (carbohydrates, protein, and fats) into simple end products while releasing energy. The rate of deterioration of harvested goods is proportional to the rate of respiration in most cases (Irtwange, 2006). The basal respiration rate of mature green banana fruits is modest, and ethylene generation is nearly undetectable. The longest feasible pre-climactric time is desired during this era, which is also known as the 'green life.' Green can be kept for longer by lowering the temperature to 14 degrees and storing it in an environment with low oxygen (less than 8%) and high carbon dioxide (more than 2%). (Hailu *et al.,* 2013). Ethylene production rates rise with harvest maturity, physical injury, disease incidence, temperature rises above 30°C, and water stress (Pesis, 2004). On the other side, storage at low temperatures, lowered O_2 levels, and elevated CO_2 levels around fresh horticultural items reduce ethylene production rates (Irtwange, 2006). The commencement of an irreversible spike in respiration rate and quick ripening was accelerated when climacteric fruits were exposed to ethylene. By lowering ethylene production and sensitivity, various packages can postpone the start of climacteric and extend the shelf life of fruits. Ethylene appears to play a key role in the onset of ripening in bananas and other climactric fruits, but its exact mechanism of action is uncertain (Seymour, 1993).

2.3.7 Factors of Storage Time

In the traditional distribution channel, simple measures to reduce desiccation and evapo-transpiration rate of fruits utilized to retain a specific level of freshness and acceptable quality for a number of days (Menzur *et al.,* 2007). Bananas can keep for three weeks at a temperature of above 13°C and a relative humidity of 85 to 95 percent. The fruit's storage life is extend by keeping it in an environment with a high CO_2 content and a low O_2 concentration (Manzur *et al.,* 2007). To minimize rapid spoiling, fruits should kept at 13.3-15.6°C and 80 to 85 percent relative humidity after removed from storage and during delivery to markets. To postpone ripening, green bananas are deliver or stored at 13°C to 14°C. Chilling injury, which has its own set of symptoms, can causes by high temperatures. Symptom development influenced by the temperature and length of exposure, and susceptibility is mostly determined by cultivar. Bananas can store for three weeks at a temperature of just above 13°C and a relative humidity of 85 to 95 percent. Keeping the fruit in a mixture of high and low carbon dioxide concentrations can help to extend the fruit's storage life (Menzur *et al.,* 2007).

Temperatures above 25^0C shorten the pre-climatic period, and the quality of the fruit is affected during ripening due to changes in metabolism. The growth of the peel and the pulp is desynchronized above 350°F, with the pulp softening faster than the peel coloring. This results in fruits with a soft pulp but a green peel, and these types of fruit are known as cooked or boiled green. At temperatures above 48^0C, the climatic is not triggered, and ripening is effectively blocked. However, banana fruit bloken at lower temperatures and should not be stored in the refrigerator (Gowen, 1995). The greater the loss of water and the shorter the duration of the pre-climateric, the lower the relative humidity. Low humidity accelerates the generation of ethylene and the rise in respiratory rate, but its impact on the intensity of ethylene production appears to be variable. Changes in the weight connection between pulp and peel, peel color, pulp softening, and soluble sugar content due to changes in relative humidity (Hailu *et al.,* 2013). Horticultural products' storage life is affected with the composition of gases in the storage atmospher. Changes in the concentration of breathing gases, such as oxygen and carbon dioxide, may help to extend the storage life. This is normally used as a supplement to low-temperature storage, although for particular commodities, changing the storage environment can usually replace refrigetore (Wills *et al.,* 1998). When bananas transported from low oxygen to normal air, Ahmad *et al.* (2006) found that oxygen and carbon dioxide swiftly re-equilibrated. According to Knee (1980), chlorophyll breakdown was significantly reduced when oxygen levels were reduced. Shorter *et al.* (1987) found that storing bananas in plastic film (where the gas content stabilized at around 2% O_2 and 5% CO_2) with an ethylene scrubber can extend their storage life by five times compared to fruit stored without wraps.

3. SUMMARY AND conclusion

Banana and plantain are the fourth leading food crops worldwide after rice, wheat and maize. Banana farmers (producers) and other district stakeholders report that banana production is decreasing from year to year in Ethiopia's several banana-producing regions. Declining of banana yield is a great concern to the farmers because, it is a source of food security in many homes in the country and also the major income generating crops for the producer. Banana production has made a significant contribution to the economic transformation of many families in the region. Its contribution to food security, income generation, employment opportunities and economic development is very important. What's more, inefficient agronomic techniques such as poor post-harvest processing, improper irrigation systems, bad land management practices, and the monocropping character of the banana production system will have a severe influence on the area's natural capitals. The spoilage of bananas is mainly caused by improper maturity. Physical damage during transportation and subsequent fungal infection and fungal decomposition after aging. Banana fruits ripen quickly at high temperatures and have a short shelf life. Losses occur due to various factors, such as lack of storage facilities, lack of information about proper post-harvest handling and farm storage, fruits will not only lose quality, but also suffer a large amount of post-harvest losses. Nevertheless, the marketing of freshly produced bananas is complicated by physical injuries after harvest, harvesting and transportation, lack of appropriate technology, and poor packaging materials and strategies. Therefore, this review will address this issue to promote the importance of proper handling and packaging of banana fruits from the field to consumption.

4. Future Research Direction

So, from this review the following aspect should be considered:

- In order to come up with a general recommendation, researchers should study the physical and chemical properties of different polyethylene bags and cultivars at different times and locations.
- Need to test the suitability and application of different types of polyethylene bag packaging to bananas and other crops.
- They're is also need to carry out research not only on the pre-harvest but also on the post-harvest approaches hand in hand to reduce losses and maintain quality.
- The lack of management of the production area and the handling of packaging system practices requires attention in the research results of the researchers.
- To reduce the quality of banana cultural practices, further research recommends any production area.
- The integrated management of the banana pre-harvest and packaging system is of excellent quality, supporting research and discovery in the production area and post-harvest processing.
- Finally, for the good quality and long life storage of banana product, the rsearch is required through incorporation of packaging material as well as pre-harvesting and post-harvest practices taking other factors under consideration in the specific locations.

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