**Quality deterioration of *Musa acuminata, Musa acuminate canvendish and Musa balbisiana* in four different condition at Visakhapatnam, Andhra Pradesh, India**

**Abstract:**

Bananas are among the world’s main economic crops and one of the world’s most-selling fresh fruits. At present, research work done on microbial deterioration of 3 different banana *Musa acuminata, Musa acuminate canvendish and Musa balbisiana* available in gajuwka market. This paper summarized the microbial composition of spoiled banana. Moreover, the development of fungal cells on the banana was observed where there is no bacterial growth during the storage. This review is on 3 storage conditions i.e. polythene cover, refrigerator and open cupboard area. The spoilage was first observed on yellow banana that was stored in polyethene cover.

**Keywords:** Banana, microbial deterioration, *Musa acuminata, Musa acuminate canvendish and Musa balbisiana*

**Introduction:**

Bananas are classified as part of ‘Magnoliophyta’, class ‘Liliopsida’, order ‘Zingiberales’, family ‘Musaceae’, and genus ‘Musa’ [[1](https://pmc.ncbi.nlm.nih.gov/articles/PMC9602299/#B1-foods-11-03170)] and are the fourth largest food crop in the world. In the past two decades, banana production has continued to expand, rising from over 70 million tons in 1999 to around 121 million tons in 2021. Most of these peels are often disposed of in landfills or next to other waste **[7].** Ineffective agricultural waste management practices leave a large amount of this valuable raw material unused and even cause significant environmental damage. Transforming banana by-products into useful commodities would enhance agricultural development. The survey result revealed that losses of banana fruits due to spoilage and physical injury were common problems for all fruit vendors. Practices such as lack of sanitation, temperature management, and improper packaging and transportation problems were identified among the common causes for observed losses. This fungal infection may occur during the growing season, harvesting, handling, transport and postharvest storage and marketing conditions, or after purchasing by the consumer **[2].** Physical damage to the peel induced during handling and storage predisposes banana to be attacked by decay‐causing pathogens **[2].** Banana is also considered as the good source of proteins and amino acids. Chitinase enzyme is an abundant protein commonly found in the unripe banana. Many enzymes such as malate dehydrogenase, starch phosphorylase and pectate lyase are accumulated during ripening of banana **[6]**

### Sample collection and storage conditions:

### Fresh 3 different bananas *Musa acuminata, Musa acuminate canvendish and Musa balbisiana* were purchased from Gajuwaka market and brought aseptically to microbiology laboratory, St. Ann’s college for Women, Malkapuram, Visakhapatnam. The 3 bananas were stored in 3 different conditions separately i.e., polythene, dark condition and light conditions and kept for 1month observation (Fig 1)

### Fig 1 : Collection of samples

**Quality deterioration in bananas:**

The weight of 3 different banana that were kept in different conditions was continuously checked using weighing balance to know the natural quality deterioration

#### Isolation and identification of fungal pathogens associated with banana fruit

The samples collected from different banana vendors were first washed in tap water and then the fruits that displayed symptoms of fungal infection were selected for fungal isolation. The tissues were cut from active lesions surface of the fruits and surface sterilized by soaking in freshly prepared NaCl (3% w/v) for 3 min. After three serial washings in sterile distilled water, tissues were placed (four pieces per plate) on Potato Dextrose Agar (PDA) and incubated at 25°C in the incubator for 7 days. The colonies emerged from each plated fruit tissues were purified and sub cultured on the PDA media after 7 days. The plates were incubated at 25°C under similar conditions, and the setups were observed until the organisms became fully grown. Single‐spore cultures of the fungus were then prepared on PDA slants in test tubes, and the identification and characterization of the fungal isolates were carried out based on cultural and morphological structures described **[2].** **(Fig 2)**

**Fig :2 Isolation of fungal samples from spoiled banana that are kept in different conditions**

**Maintenance of the culture**

Organisms have property to change their characteristics with the period of time, so to avoid the mutation and to keep the organisms in log phase they were provided with continuous supply of nutrients. From that, the cultures were sub-cultured time to time.

**Microscopic and biochemical analysis**

Fungal samples were stained and observed under microscope. IMViC test was conducted to know the biochemical reactions.

**Results:**

Fungal growth was reported initially**.** The qualitydeterioration after 1week was observed in the yellow short banana which was stored in polythene cover later seen in banana kept in dark condition. quality deterioration was significant in ripened bananas. **( Fig: 3)** and weight of the 3 different banana during study period was noted and mentioned **(Graph 1,2 & 3)** **.** They were identified on the basis of their cultural and morphological structures such as shapes and sizes of macroconidia and microconidia, and colony colour **(Fig 4).** About 84% of colonies counted were contributed by *Fusarium* spp., and about 10% of colonies counted were accounted by Rhizopus spp kept in polythene bags after 6 days. Growths of light pink colony of Fusarium were observed on sample taken from different parts of ripe fruits.

**Graph 1, 2 & 3** representation of quality change in *Musa acuminata, Musa acuminate canvendish and Musa balbisiana* under four different conditions

**Fig 3: Quality deterioration of banana’s in different conditions**

**Fig 4: Microscopic images of fungal sample that was collected from spoiled banana**

**Discussion:** Banana (Musa species) is a significant staple crop has its importance in the developing world. Banana inflorescence has been reported to have a variety of nutritional components, being rich in phenolics and other functional substances such as proteins, dietary fibers, and enzymes that have been demonstrated to have potential health benefits **[5].** Deterioration of bananas occur due to some bacterial species causing it to undergo undesirable changes. The results showed us that sample 1 had a major microbial load when stored in polythene bags. Microbial spoilage of fruits may occur due to bacteria or fungi causing the fruits to undergo undesirable changes. From the study it is concluded that spoiled banana when stored in polythene bag becomes more susceptible to spoilage causing organisms. Inoculation of spoiled banana in nutrient broth also gives presence of organisms causing spoilage. It was also seen that spoiled banana doesn’t show presence of organisms when plated immediately without incubation. If they are exposed to undesirable environmental conditions during handling, the tissue will soften and easily bruise, causing rapid microbial deterioration. In the study area, quality and safety assurance problems such as lack of temperature management, uniformity of quality within containers, sanitation problems in the market, transportation‐related problems, careless handling during loading and unloading were identified as the main factors, which favoured fungal pathogen development and associated banana fruit losses. So it is better to store the banana in open conditions in hanging mode. *Colletotrichum* spp. and *Fusarium species*  were identified as fungal pathogens causing rot development. This could be associated with high temperature used during ripening which may create more favourable condition for crown rot development, and Fusarium have been occasionally associated with crown rot disease of banana (Marin, Sutton, Blankenship, & Swallow, [1996](https://pmc.ncbi.nlm.nih.gov/articles/PMC5980282/#fsn3591-bib-0017)). The use of banana by-products for value-added purposes to meet demand in areas such as food alternatives, feed, renewable energy, textiles, and fiber composites is a constant challenge [3]. The fruit contains high levels of sugars and nutrients element, and their low pH values make them particularly desirable to fungal decayed **[4].** It is estimated that in average, about 20%–25% of the harvested banana fruits are decayed by different fungi during postharvest handling, and everyday 1.6 million bananas are thrown in developing countries **[1]**

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