Fresh Fruit Handling Practices: A Case Study of Banana Value Chain in the Nairobi Metropolitan Fresh Produce Markets

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Abstract

Fresh banana fruit value chains play an important role in nourishing the nutrition of millions of people globally. With the growth in the demand of fresh fruits, challenges relating to the quality and safety due to unconventional practices such as increased prevalence of illicit ripening of fresh banana fruit in some of the markets emerge. In this study, fruit handling storage and ripening practices in fresh banana fruit value chains in some of the largest fresh fruit markets in Kenya were evaluated to establish some of the factors that drive food quality and safety problems. A semi-structured questionnaire was used to collect data. Stratified random sampling was used to identify the participants. Thirty traders were selected from each of the five markets and zones situated in three densely populated counties in the Nairobi metropolitan area. Data was analysed using SPSS. Fruit characteristics varied depending on the source of fruit, with the farm being the most popular point of sourcing fruit by traders across the five zones. All the traders had knowledge of the exact source of their fruit and the time the fruit was harvested. About 97% of the traders assessed the maturity of the fruit before sourcing them, with 73% and 24% of the traders using colour and fruit size as the criteria for assessing fruit maturity, respectively. A one-way ANOVA of the data showed that the source of fruit did not have a significant ($p > 0.05$) effect on the time the fruit took to ripen, quantities ripened by traders or time before fruit spoilt. Low sales (70%), poor storage conditions (13%) and use of poor ripening methods (3%) were reported to be the major causes of fruit spoilage. The use of passion fruit as a natural fruit ripening agent was associated with relatively higher fruit spoilage. The majority (96%) of players in fresh banana value chains had poor attitudes towards training in fruit handling, ripening and storage. This study recommends training of fresh fruit value chain players, the development of low-cost cooling solutions and the establishment of fruit storage and ripening infrastructure to mitigate against fruit spoilage within the fresh fruit markets in Kenya.

Introduction

Banana fruit is among the most important fruit globally (Ahmad *et al.*, 2001). It contributes 30% of the entire fresh fruit industry globally (UNCTAD, 2016) and is reported to be the fourth most cultivated food crop globally after maize, wheat and rice (Maduwanthi and Marapana, 2019). In Kenya and the region, banana fruit production is mainly carried out by small scale farmers. It is grown on about 74000 ha or approximately 1.7% of Kenya's available land for crop production (Karanja-Lumumba *et al.*, 2013). In 2019, the production of banana fruit in Kenya stood at 1715770 tons from a land area of 76912 ha (FAOSTAT, 2019).

Fresh banana value chains require different activities to be carried out sequentially from production to consumption, with the timing and the technologies used determining the quality of the product (Youryon and Supapvanich, 2017). These activities can be

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grouped into pre- and postharvest activities. Some of the pre-harvest activities include plantation establishment, tillage, pest control and irrigation. In the postharvest phase, some of the key activities include harvesting, cold chain management, handling, transportation, as well as ripening.

Although both the pre-and postharvest activities are inextricably linked to the resultant quality of fresh banana fruit, postharvest activities are critical in the management of the quality and shelf life of banana fruit (Islam *et al.*, 2018). Losses at the postharvest phase are the most serious economically, as the product is at the last mile of the value chain before being sold to consumers. Fruit ripening is one of the important postharvest operations when handling climacterics, as it serves as a transition point where fruit is made edible (Maduwanthi and Marapana, 2019). The ripening process involves subjecting mature fruit to physical and environmental conditions that trigger a chain of chemically and enzymatically controlled biochemical reactions that lead to colour changes and softening of the fruit (Maduwanthi and Marapana, 2019). Ethylene serves as an important chemical agent used to trigger ripening in climacterics (Medlicott *et al.*, 1987).

The optimum environmental conditions required for banana fruit ripening are well documented in the literature (Amarakoon *et al.*, 1999; Ahmad *et al.*, 2001; Ankita, 2018; Gandhi *et al.*, 2019). Over the years, there has been growth in the number of different ripening agents that have been tested and used commercially to ripen different fruit, signalling the importance ripening in the management of fresh fruit value chains (Islam *et al.*, 2018; Gandhi *et al.*, 2019). Along with this growth, there has been an influx of ripening agents that present fruit quality problems and human health risks. Fruit ripening also has significant ramifications on the fresh fruit quality and shelf life, with these parameters having a

bearing on the returns to different stakeholders in the value chain.

In Kenya and other developing countries, handling, distribution, storage and marketing of fresh banana fruit is carried out mainly by small scale traders and middlemen (Ayieko *et al.*, 2005; Karanja-Lumumba *et al.*, 2013). The banana fruit value chains have also been widely reported to be affected by the use of illicit ripening agents (Islam *et al.*, 2018; Gandhi *et al.*, 2019). One of the key issues driving the influx of these ripening agents is the poor understanding, by these traders, of the banana fruit ripening process and the effects these ripening agents potentially have on the quality, shelf life and human health. The objective of this study was to establish the banana fruit handling, storage and ripening practices, their drivers among fresh fruit traders and other stakeholders in Kenya and their net effect on food quality and safety.

Materials and Methods
Study area
In this study, six zones around Nairobi County, that has some of the largest fresh produce markets, were selected to represent other markets around the country. These included (1) Nairobi main market zone, (2) Juja market zone, (3) Thika market zone, (4) Ruiru market zone, (5) Githurai market zone and (6) Mlolongo-Athi river market zone. The basis for the selection of these markets, was due to the fact that that these markets receive fruit from nearly all parts of Kenya and would be representative of some of the most competitively produced fresh food products.

Sampling procedure
Each zone was used as a cluster that had unique locational characteristics. Random sampling was then used to select traders in each cluster that participated in the study. In each of the sampling zones, thirty traders were randomly selected and used as respondents. This gave a sample size of a hundred and eighty traders in the six zones.

Data collection

The data was collected using a structured questionnaire. Data was collected on sourcing of fruit, fruit characteristics, harvesting and handling practices, fruit ripening (including ripening methods), fruit ripening infrastructure and post-ripening information including storage practices, training of traders in fruit handling, as well as access by the traders to fruit ripening information. To eliminate bias, individuals trained on data entry used the questionnaires to collect data from the respondents in each zone.

Data analysis

The data obtained was analysed using SPSS version 27 (IBM, USA) to establish the relationships between different variables. Descriptive statistics were used to establish fruit ripening practices and the factors that drive the choices made by the traders. One-way ANOVA was also used to analyse the effect of some of the fruit ripening and handling practices on the spoilage of fruit. All analyses were carried out at 0.05 significance level and separation of means using Duncan's multiple range test.

Results and Discussion
Fruit characteristics

Ninety eight percent of all traders/respondents affirmed that they knew the variety of the banana fruit they supplied to consumers. The Nyoro variety was among the most traded banana fruit across all the six market zones. There were nearly 15 fruit varieties that were available in the selected markets although the Nyoro (50%), Muraru and Kampala varieties were the most popular varieties across the selected markets (Figure 1). The Nyoro variety was also the most popular variety across all the zones except zone 5 (Mlolongo and Athi-river) (Figure 2).
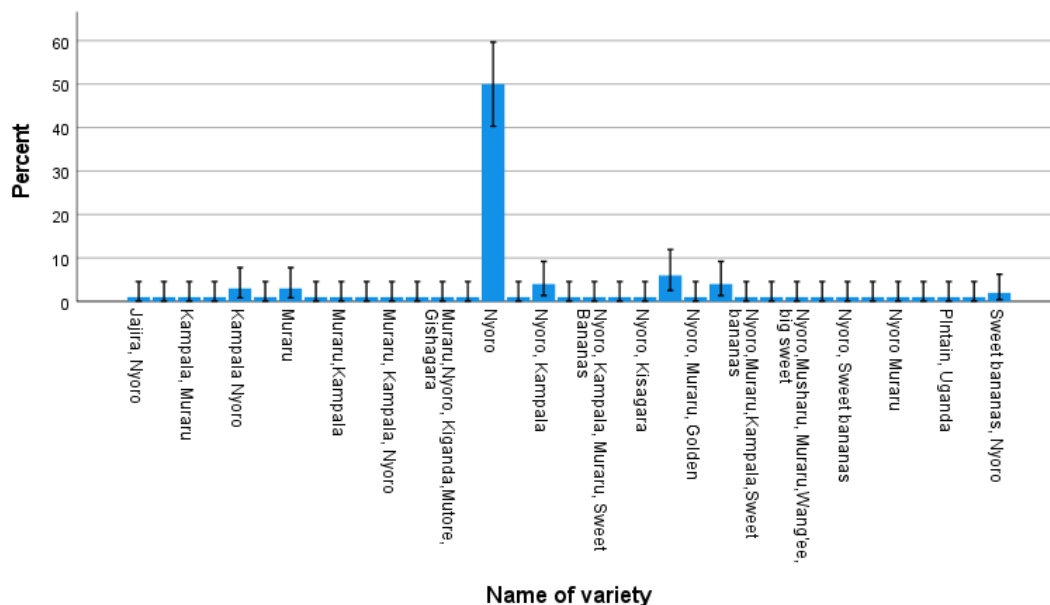

Figure 1: Fresh banana fruit varieties traded in markets across the Nairobi metropolitan area. Error bars are means±SEM
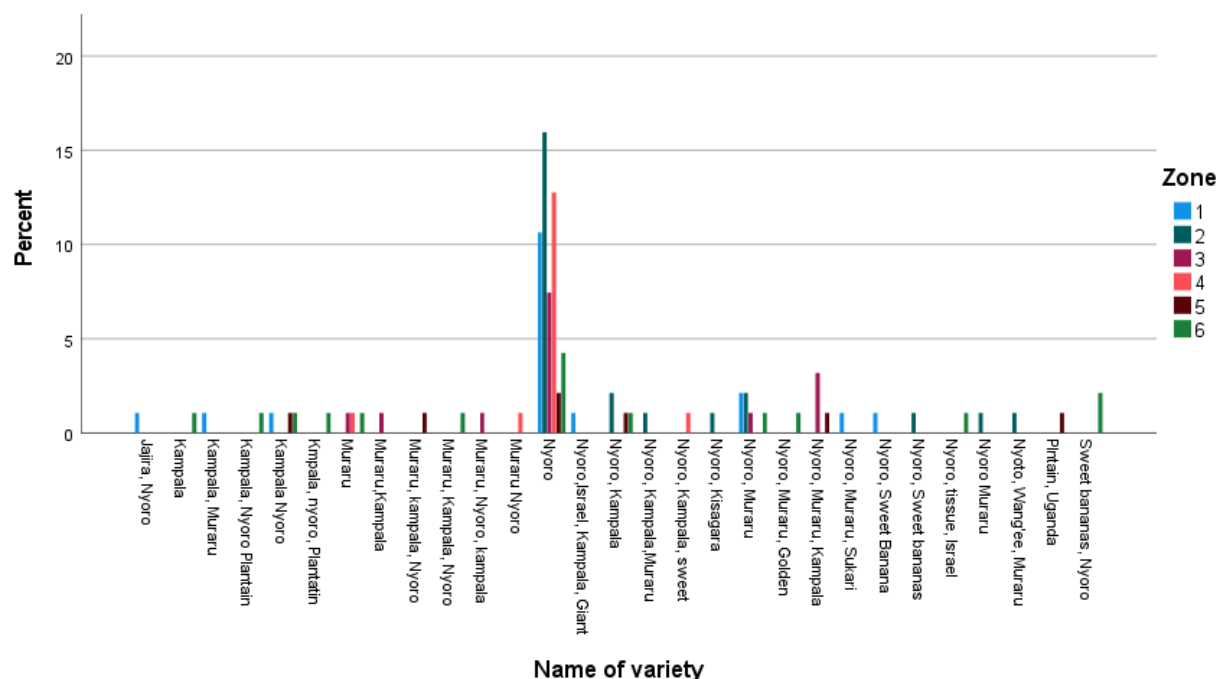
Figure 2: Distribution of fresh banana fruit varieties across 6 trading zones among traders and fruit vendors in fresh produce markets

The preferred source of fruit in decreasing order of preference was farms (57%), market (26%) and middlemen (14%). The Nyoro and Kampala varieties are the most popular commercial varieties in Kenya (Mwangi *et al.*, 2009). These varieties are also known to have excellent taste hence their preference by consumers (Mwangi et al 2019). Sourcing fruit directly from farms was preferred by traders probably due to the lower fruit purchasing costs from farms compared to sourcing fruit from middlemen and traders from other markets. This choice directly improves the earnings to these traders. The study by Wahome et al (2021) that investigated the factors leading to low banana yields in Kenya established that farmers in Embu county, that supplies 12% of all bananas sold in Kenya, mainly used traditionally grown varieties. The commonly grown hybrid varieties in Embu were reported by Muthee *et al.*, (2019) as Williams (22%), Grand Nain (20%), Giant Cavendish (18%) and Kampala variety (10%). The Kampala variety was also reported to be popular in Muranga, Meru and Kirinyaga (Muthee *et al.*, 2019). The popularity of Kampala was attributed to the long shelf life, good yields and excellent taste (Muthee *et al.*,

2019). However, other studies have reported Israel and Moraru as the most popular varieties in Embu county (Wahome *et al.*, 2021).

The factors that drive choice of farmers on the banana variety to grow included the demand in the market, suitability of the prevailing agroclimatic conditions, ease of crop management and resistance to diseases such as fusarium wilt (Gold *et al.*, 2002; Kasyoka *et al.*, 2010; Mwangi and Mbaka, 2010; Wahome *et al.*, 2021).

Banana fruit handling, storage and ripening practices

i) Fruit quantities traded across the market zones

The unit of purchase by the traders was mainly by the full bunch or kilogram. Fingers were the least preferred unit for purchasing fruit by the traders across the 6 zones that participated in the study. Those who purchased fruit in bulk (>500 kg^{-1} week), used the full bunch and the kilogram as the trading unit (Figure 3).

ii) Pre-ripening maturity assessment

The approaches used for maturity assessment of fruit prior to purchase was mainly by colour (visual) (72.53%) and assessment of finger size (23.53%) (Figure 4).

iii) Pre-ripening handling practices

A lapse in a day between harvesting and transportation to the market was reported by nearly 70% of the respondents, with 20% of the traders fast tracking fruit transport to the market immediately after harvest (Figure 5).
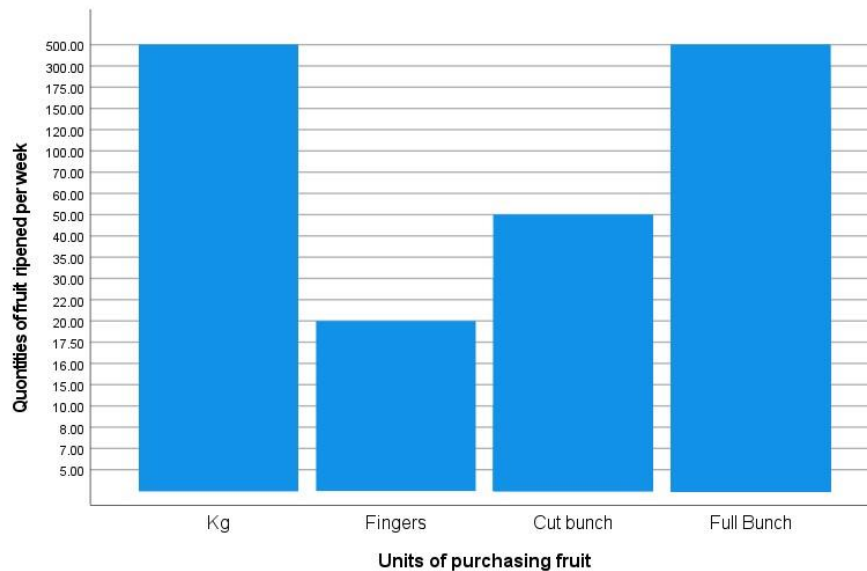

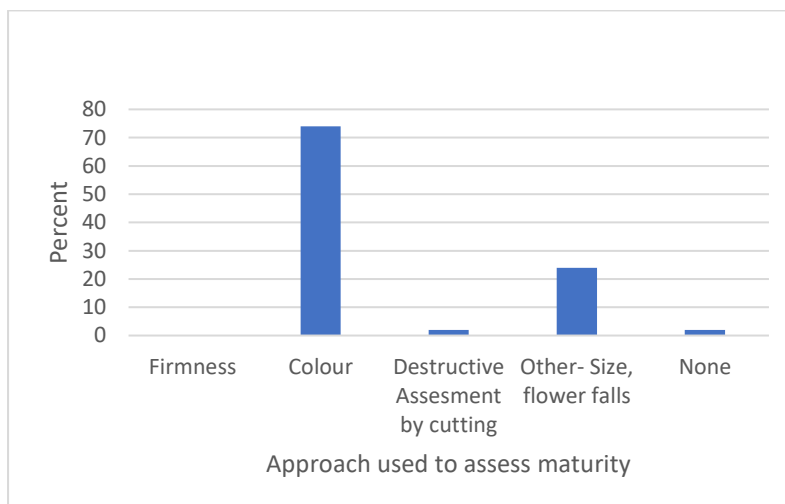Figure 3: Unit of trade when purchasing fruit and associated quantities purchased

Figure 4: Methods used by fresh fruit traders for assessing maturity of fresh banana fruit by fresh fruit traders
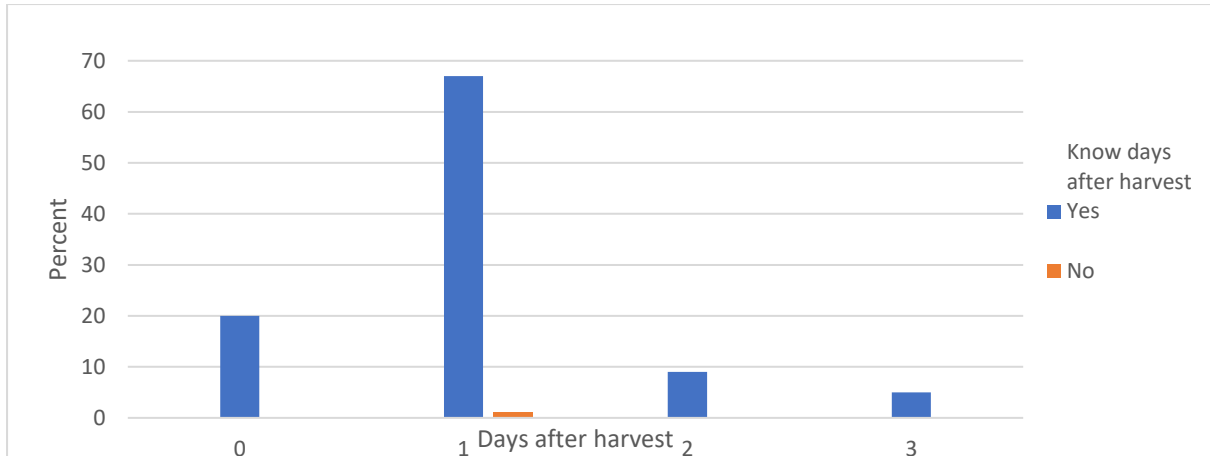
Figure 5: Time lag during logistics between point of sourcing fruit and the market.

Banana fruit ripening practices among traders

Twenty-six and thirty-three percent of the traders reported that their fruit ripened in 2 and 3 days, respectively, when they harvested, transported and ripened them within a day (Figure 6). There were no reports of the use of chemical/artificial ripening agents, although one commercial fresh fruit distributor declined to participate in this study.

Ninety percent of the traders used cut avocado as a natural ripening agent with a limited number (4 %) using passion fruit to ripen their fruit (Table 1).
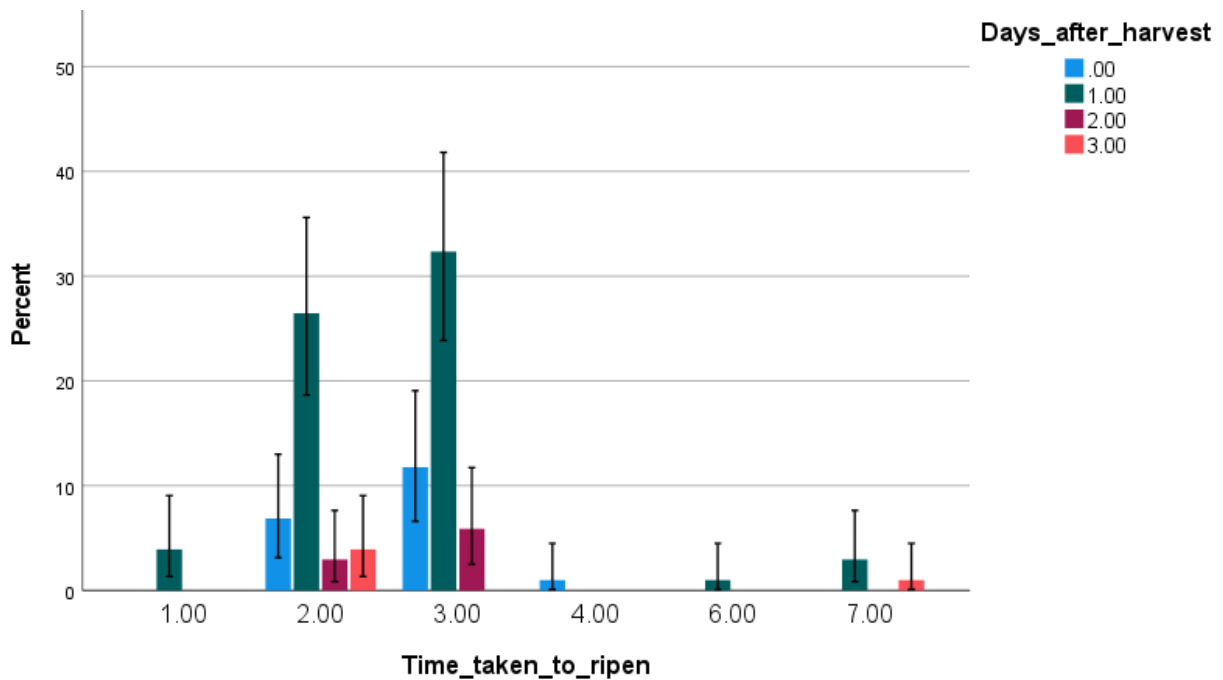

Figure 6: Relationship between the time fruit took to ripen and days after harvest. Error bars are means±SEM

Table 1. Proportion of different ripening agents that was reported to be used by fruit traders in markets across the Nairobi metropolitan area to ripen fresh banana fruit. Numbers in the table are means±SEM.

Ripening agent	Type	Proportion (%)
Ethylene	Chemical	0±0.00
Kerosene	Chemical	0±0.00
Calcium carbide	Chemical	0±0.00
Avocado	Natural	98.98±0.28
Passion fruit	Natural	1.02±0.69

Fruit ripening practices and the effects on fruit spoilage

Approximately 5% spoilage was reported by 80% of the traders with no association between the quantities ripened and the degree of fruit spoilage (Figure 7). Although the results showed that fruit ripened using cut avocado as a ripening agent had relatively high spoilage levels, the traders reported that when passion fruit was used as a ripening agent to ripen bananas, it resulted in much higher spoilage levels.
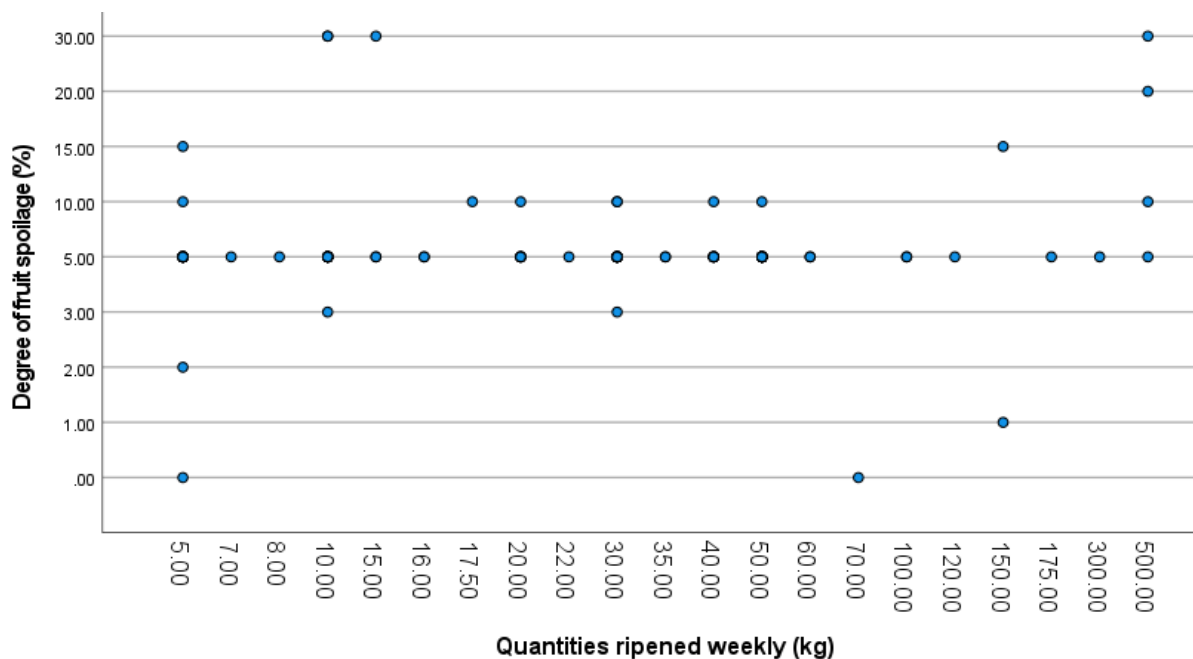

Figure 7: A scatterplot showing the relationship between the degree of spoilage of banana fruit and the quantities ripened

Ripening of banana fruit is the final stage of development of the fruit that makes it soft, edible and attractive to consumers (Gunasekara *et al.*, 2015; Maduwanthi and Marapana, 2017; Maduwanthi and Marapana, 2019). Accelerated ripening of banana fruit results in food quality problems emanating from altered nutritional and chemical composition (Gunasekara *et al.*, 2015; Maduwanthi and Marapana, 2019). It has been shown that artificially ripened banana fruit using chemical ripening agents has lower physiological and nutritional quality than naturally ripened fruit (Gunasekara *et al.*, 2015). This may explain why most of the traders reported low spoilage levels of 5% (Figure 10). The ripening behaviour of banana fruit is known to be linked to the individual variety (Fernando *et al.*, 2014). This can explain why a majority of

the traders preferred the Nyoro variety as it has been reported to have a longer shelf life, excellent taste among other desirable attributes. The differences in the ripening behaviour of these fruit can be also attributed to the inherent chemical and biochemical composition of these cultivars (Fernando *et al.*, 2014).

Fruit ripening and storage infrastructure
All the ripening chambers used for ripening banana fruit were locally constructed by traders using locally available materials (Figure 8a), with no form of environmental control being implemented to achieve optimum ripening conditions (Figure 8a). The traders also affirmed that their ripening chambers worked adequately well and met their needs and felt that there was no need to purchase sophisticated, commercial fruit ripening equipment. Ripened fruit was also stored in ambient environment without any form of cooling (Figure 8b). A majority of the traders in the markets used the ripening chambers depicted in Figure 8a. Other larger traders had airtight rooms that doubled up as ripening rooms and storage facilities. The traders reported that the ripening chambers used produced banana fruit that ripened uniformly.
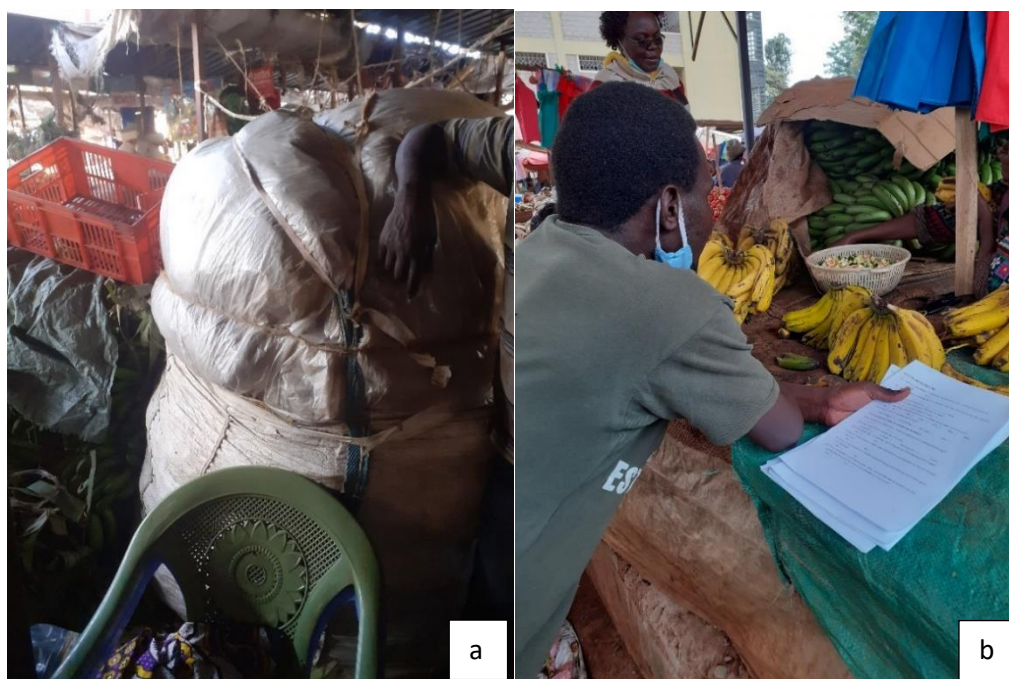

Figure 8: Banana fruit ripening infrastructure made using local materials (a) and storage of ripe banana fruit in ambient environment (b)

The optimum storage and ripening conditions for banana fruit is well documented in the literature (Hailu *et al.*, 2013; Thompson *et al.*, 2019). Although none of the traders implemented any form of environmental control during ripening and storage of banana fruit, their practices are inferior in comparison to commercial hypermarket fruit handling systems that have adequate packaging and storage systems with adequate cooling in terms of fruit quality and shelf life. The huge investment costs required for cold storage, as well as the development of bulk fruit ripening facilities makes them unaffordable to small-scale fresh fruit vendors, who control a larger percentage of the entire fresh fruit value chain in Kenya and other developing countries. County governments and other state actors can fill this gap by developing cooperatives to support and modernise these value chains.

Postharvest losses and their link to pre- and postharvest practices
Sourcing fruit directly from the farms was preferred due to the least mean distances to

the trading zones compared to other sourcing methods (Figure 9). Fruit sourced near trading zones showed a lower degree of spoilage (Figure 9) underscoring the role transportation and handling plays in inducing quality losses downstream the supply chain (Cherono and Workneh, 2018).
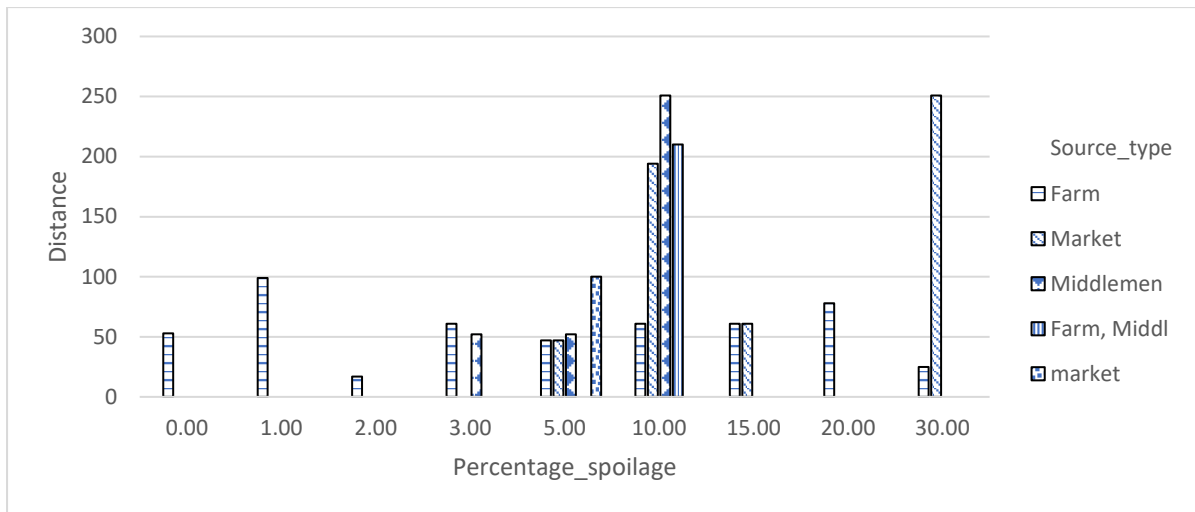

Figure 9: The relationship between the degree of banana fruit spoilage and distance of transport across five sources of fruit between the market and different sourcing points

A significant number of traders (67%) reported that the ripened fruit took about 7 days to spoil after attaining the yellow colour (Figure 10), with nearly 70% of the traders reporting poor sales as the leading cause of spoilage followed by poor storage conditions (13%) and improper ripening (3%) (Figure 11).
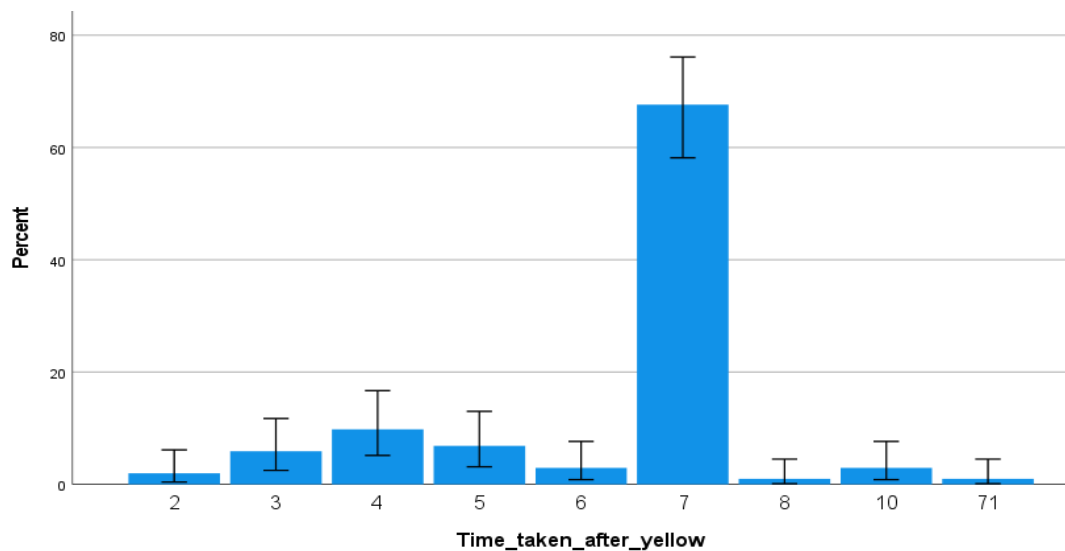

Figure 10: A graph showing the shelf life of banana fruit reported by fresh fruit traders at the Nairobi metropolitan area fresh produce markets. Error bars are means±SEM
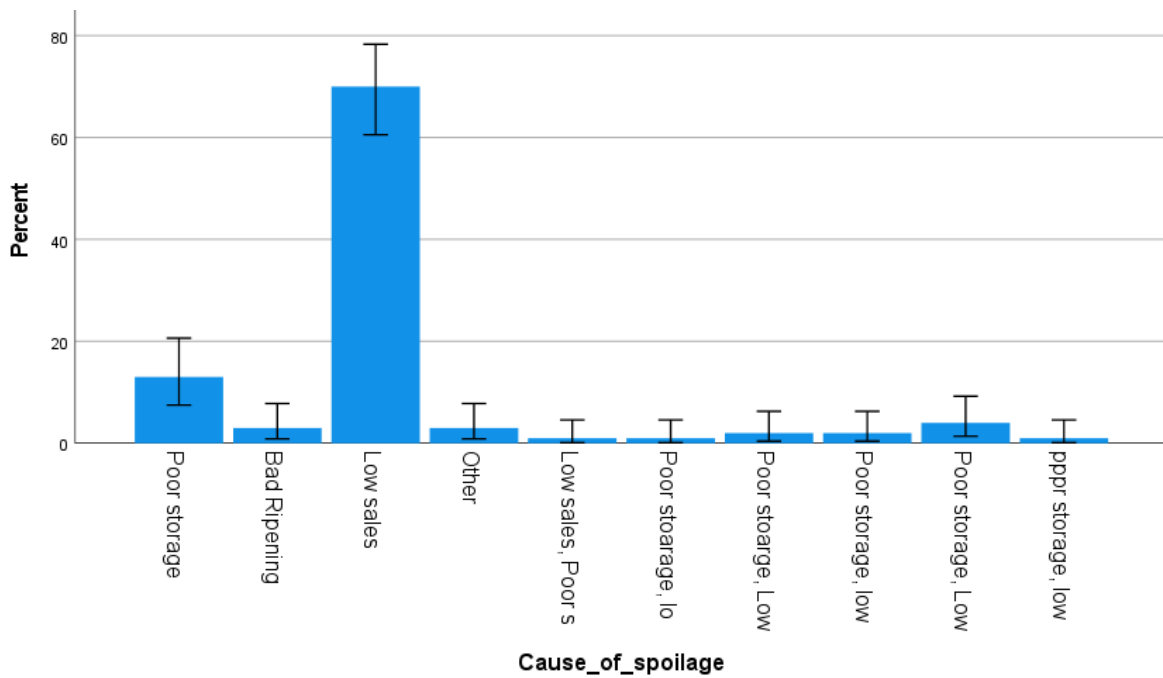
Figure 11: The causes of fresh banana fruit spoilage across markets at the Nairobi metropolitan area. Error bars are means±SEM

Although the traders did not think that logistics was associated with spoilage, it can be deduced form the data collected that for the most reported time lag between harvesting and ripening (1-3 days), fruit that were ripened within a day reported lower levels of spoilage (Figure 12), with low sales featuring as the leading cause of fruit spoilage and losses (Figure 11).
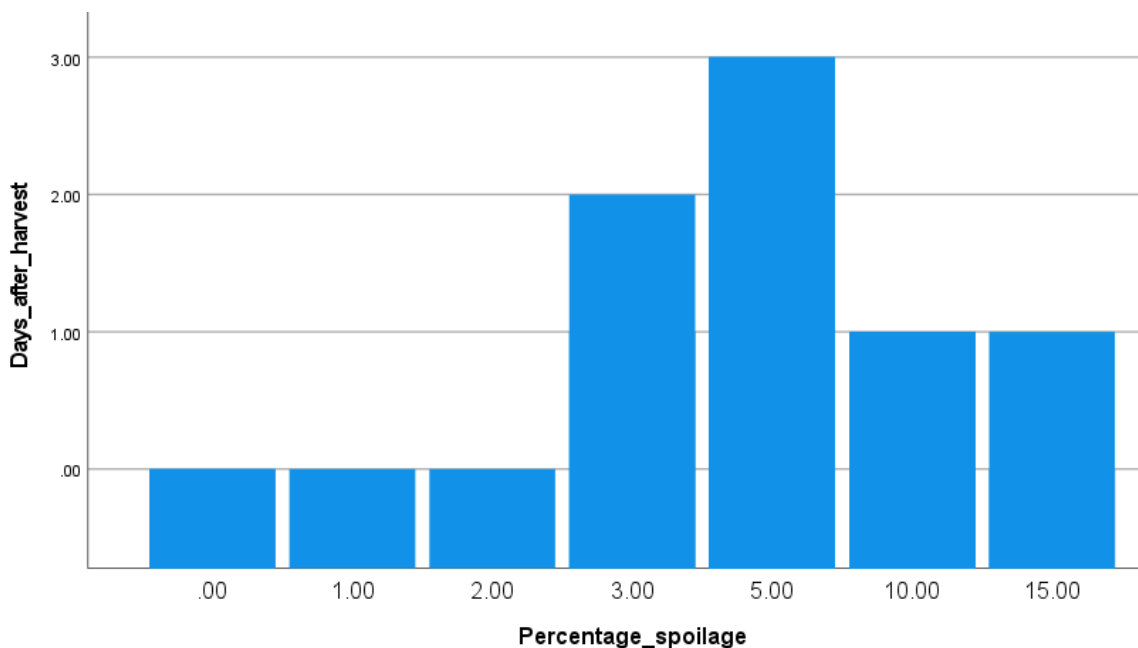

Figure 12: A correlation of the effect cof the delay in logistics on the degree of banana fruit spoilage reported by traders at the Nairobi metropolitant fresh produce markets

A one-way ANOVA of the data showed that the distance of transport between the markets and the source of the fruit did not have a significant effect ($p>0.05$) on the degree of fruit spoilage. However, the distance between the market and the point of sourcing the fruit significantly ($p\leq0.05$) influenced the time the fruit took to ripen.

These findings can be explained from the perspective of the time delay due to logistics affecting the biological age of the fruit. Fruit that has delayed in reaching the market would have biological processes such as ripening to have progressed compared to fruit whose transport to their markets had been expedited (Al-Dairi *et al.*, 2022). It therefore implies that fruit from sources much further from the market took a shorter time to ripen and spoil (Cherono and Workneh, 2018). Comparatively, banana fruit is less fragile compared to other fresh fruits such as tomatoes hence supporting the finding that distances to the market did not have a significant effect on the degree of banana fruit spoilage.

Access to scientific information and training needs assessment
A majority of the traders (99%) reported that they did not put into practice modern technological solutions that improve ripening and storage outcomes when handling fresh banana fruit in the market. The traders and marketers (96%) also felt that their present skill level was adequate and saw no need for training in postharvest handing and ripening of fresh fruits including bananas.

Across the 6 trading zones, all players responded that they do not have access to modern technological solutions for fruit ripening and storage (data not shown). Similarly, 100% of all respondents affirmed that their knowledge and skills are adequate in zone 3, 4 and 6, while 96%, 95% and 73% of traders in zones 2, 1 and 5, respectively responded that the skills and knowledge they have in postharvest handling of fresh fruit was adequate (data not shown).

Modern technological solutions in the preservation of fresh fruits is one of the important missing ingredient in the reduction of postharvest losses in developing countries, Kenya being no exception (Kitinoja and Kader, 2015). Poor attitudes, lack of sensitization, little or no investment and the use of modern infrastructure and technological solutions have been some of bottlenecks that have hindered the modernization and technological evolution of fresh food value chains in developing nations (Sibomana *et al.*, 2016). The poor linkages between industry and research institutions have exacerbated the problem. Robust extension and technological transfer mechanisms by research and training institutions, including investment by county governments in fruit storage and ripening infrastructure should be explored and implemented. Similarly, laws and regulations should be developed and implemented that ensures only licenced and trained fresh fruit vendors supply fruit to markets to guarantee food quality and safety.

Conclusion
Banana fruit was used as a typical fresh fruit with emphasis on practices occurring downstream various supply chains. It was established that fresh banana fruit varieties varied across different markets, with Kampala and Nyoro varieties, that had excellent taste being preferred by the traders. A majority of banana fruit traders (57%) preferred to source fruit directly from farm, as this practice shown to have improved margins. Maturity assessment prior to harvesting and ripening was done by visual methods (color-72% and size-23%). Sixty percent of traders reported that their fruit ripened in three days, with 94% of the traders reportedly using avocado and passion fruit as natural ripening agents. Although there were no reports of the use of chemical ripening agents, one of the large-scale commercial fresh banana fruit handling and distribution firm declined to participate in this study. The study showed salient links between delays in transportation and decreased fruit shelf life

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with the distance from the markets significantly ($p \leq 0.05$) influencing the degree of fruit spoilage. Fruit storage was done under ambient conditions with no attempt of implementing environmental control explaining the short fruit shelf life of approximately 7 days.

This study highlights significant gaps in banana fruit handling, ripening and storage, underscoring the need for investment in bulk, low-cost cooling solutions for small scale farmers, traders and marketers. Similarly, there is need for investment in fruit ripening infrastructure, as well as training of small-scale fruit vendors on the suitable and the importance of adherence to best practices when handling fresh fruits.

References
Ahmad, S, Thompson, A, Hafiz, IA, Asi, A. 2001. Effect of temperature on the ripening behavior and quality of banana fruit. *International Journal of Agriculture and Biology,* **3**:224-227.

Al-Dairi, M, Pathare, PB, Al-Yahyai, R, Opara, UL. 2022. Mechanical damage of fresh produce in postharvest transportation: Current status and future prospects. *Trends in Food Science & Technology*.

Amarakoon, R, Illeperuma, D, Sarananda, K. 1999. Effect of calcium carbide treatment on ripening and quality of Velleicolomban and Willard mangoes. *Tropical Agricultural Research,* **11**:54-60

Ankita, JL. 2018. *Development of rapid detection methods for acidic food spoilage and calcium carbide based artificial ripening of fruits.* PhD Thesis, Department of Food Science and Technology, Pondicherry University, Kalapet, India.

Ayieko, MW, Tschirley, DL, Mathenge, MK. 2005. Fresh fruit and vegetable consumption patterns and supply chain systems in urban Kenya: Implications for policy and investment priorities.

Cherono, K, Workneh, T. 2018. A review of the role of transportation on the quality changes of fresh tomatoes and their management in South Africa and other emerging markets. *International Food Research Journal,* **25**:2211-2228.

FAOSTAT. 2019. *Food and agriculture data* [Online]. Available: http://www.fao.org/faostat/en/#data/QC [Accessed 11th January 2021].

Fernando, H, Srilaong, V, Pongprasert, N, Boonyaritthongchai, P, Jitareerat, P. 2014. Changes in antioxidant properties and chemical composition during ripening in banana variety 'Hom Thong' (AAA group) and 'Khai' (AA group). *International Food Research Journal,* **21**:749.

Gandhi, S, Sharma, M, Bhatnagar, B. 2019. Comparative Study on the Ripening Ability of Artificial Ripening Agent (Calcium Carbide) and Natural Ripening Agents. *Global Journal of Biology, Agriculture & Health Sciences*, **5**(2):106-110.

Gold, C, Kiggundu, A, Abera, A, Karamura, D. 2002. Diversity, distribution and farmer preference of Musa cultivars in Uganda. *Experimental Agriculture,* **38**:39-50.

Gunasekara, S, Hemamali, K, Dayananada, T, Jayamanne, V. 2015. Post harvest quality analysis of embul banana following artificial ripening techniques. *International Journal of Science, Environment,* **4**:1625-1632.

Hailu, M, Workneh, TS, Belew, D. 2013. Review on postharvest technology of banana fruit. *African Journal of Biotechnology,* **12**(7): 635-647.

Islam, MN, Imtiaz, MY, Alam, SS, Nowshad, F, Shadman, SA, Khan, MS. 2018. Artificial ripening on banana (Musa Spp.) samples: Analyzing ripening agents and change in nutritional

parameters. *Cogent Food & Agriculture,* **4**(1):1-16.

Karanja-Lumumba, T, Argwings-Kodhek, G, Murithi, F. 2013. Effects of financing mechanisms in enhancing commercialization: The case of banana marketing in Kenya. *Uganda Journal of Agricultural Sciences,* **14**:85-94.

Kasyoka, M, Mwangi, M, Mbaka, J, Kori, N, Gitonga, N, Muasya, R. 2010. Preferred banana varieties and their seed systems in Eastern and Central provinces of Kenya, p. 897-900. *In*: Second RUFORUM Biennial Meeting held from 20 - 24 September 2010 in Entebbe, Uganda.

Kitinoja, L, Kader, AA. 2015. Measuring postharvest losses of fresh fruits and vegetables in developing countries. *PEF white paper,* **15**:26.

Maduwanthi, S, Marapana, R. 2017. Biochemical changes during ripening of banana: A review. *International Journal of Food Science and Nutrition, 2* (5): 166-169.

Maduwanthi, S, Marapana, R. 2019. Induced ripening agents and their effect on fruit quality of banana. *International Journal of Food Science,* **2019**:1-8.

Medlicott, A, Sigrist, J, Reynolds, S, Thompson, A. 1987. Effects of ethylene and acetylene on mango fruit ripening. *Annals of applied biology,* **111**:439-444.

Muthee, AI, Gichimu, BM, Nthakanio, PN. 2019. Analysis of banana production practices and constraints in Embu County, Kenya. *Asian Journal of Agriculture and Rural Development,* **9**:123-132.

Mwangi, M, Mbaka, J. 2010. Banana farming in Kenya: options for rejuvenating productivity p. 901-905. *In*: Second RUFORUM Biennial Meeting held from 20 - 24 September 2010 in Entebbe, Uganda.

Mwangi, M, Waudo, S, Kahangi, E. 2019. In vitro mutation induction for the improvement of Mycosphaerella fijiensis resistance in two banana cultivars grown in Kenya, p. 427-437. *in*: ISHS-ProMusa Symposium on Global Perspectives on Asian Challenges V International Symposium on Banana, held in the 13th May 2009 in Guangzhou, China.

Sibomana, M, Workneh, T, Audain, K. 2016. A review of postharvest handling and losses in the fresh tomato supply chain: a focus on Sub-Saharan Africa. *Food Security,* **8**:389-404.

Thompson, AK, Supapvanich, S, Sirison, J. 2019. Banana ripening. Science and Technology. SpringerBriefs in Food, Health, and Nutrition. Springer, UK. Pp 143.

UNCTAD. 2016. Banana: UNCTAD Trust Fund on Market Information on Agricultural Commodities. Geneva: United Nations Conference on Trade and Development.

Wahome, CN, Maingi, JM, Ombori, O, Kimiti, JM, Njeru, EM. 2021. Banana production trends, cultivar diversity, and tissue culture technologies uptake in Kenya. *International Journal of Agronomy,* **2021**:1-11.

Youryon, P, Supapvanich, S. 2017. Physicochemical quality and antioxidant changes in 'Leb Mue Nang'banana fruit during ripening. *Agriculture and Natural Resources,* **51**:47-52.

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