



## Evaluation of Postharvest Handling and Marketing of Mango (*Mangifera Indica*) in Ghana; A Case Study of Northern Region

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**Abstract:** A survey conducted in the Northern Region of Ghana to evaluate the postharvest handling of mango fruits from the farm gate to the market. The study mainly aimed to determine the factors that contribute to postharvest losses of mango fruits in the region. Data recorded from the research was analyzed using the Statistical Package for Social Sciences (SPSS) version 17.0. The study revealed that the varieties being cultivated by the farmers in the Region for both export and local markets were; Keitt, Amelie, Kent and Zill. It was also realized that sellers purchase these varieties at the full ripe stage, compelling farmers to harvest at that stage and causing fruits to deteriorate faster. Besides, both the farmers and sellers stored the harvested mango fruits in baskets, boxes, spread on floor or heaped on the ground, which caused fruits to senescence early. From the study, the causes of postharvest losses in the Northern region among mango farmers and sellers were found to include poor harvesting practices, storage and packaging methods. The results also showed that anthracnose disease affected the matured fruits on the field especially Keitt, which led majority of the farmers to remove the plants from their fields. It was obvious from the study that market women purchased their fruits at full ripe stage which deteriorate faster and that demand compels most of the farmers to harvest at this stage. Educating the sellers and farmers on harvesting at mature green stage will enable them keep their fruits longer. The study also revealed that, there is no proper storage facility for the market women and the farmers to store their produce after harvesting. This has created serious economic losses to all the actors in the supply chain of the fruits. This calls for proper storage facility in future for both growers and sellers in the region

**Keywords:** Management, Mango, Market, Postharvest, Producers, Sellers

### I. INTRODUCTION

The mango fruit (*Mangifera indica* L.) is one of the most popular fruits in many countries among millions of people in the world. In the tropical areas, it is considered to be the choicest of all indigenous fruits. Mango, as an emerging tropical fruit, is produced in over 90 countries worldwide with a production of over 28.51 million metric tons in 2005. Asia accounts for approximately 77% of global mango production, and the Americas and Africa account for approximately 13% and 9%, respectively (FAOSTAT, 2007). Currently, only about 3% of the world production of mango is traded globally representing a noticeable increase over the quantities traded 20 years ago (Evans, 2008).

Mango belongs to the Anacardiaceae family to which cashew nut and some other fruit crops belong (Samson, 1986). The genus is native to South-East Asia and consists of 62 species. About 16 of these have edible fruits but apart from mango, only *M. caesia*, *M. foetida* and *M. odorata* are regularly eaten, although they strongly taste for turpentine (Samson, 1986).

In Ghana, fruits and vegetables are abundantly produced during peak seasons but due to lack of proper storage and preservation facilities, the market becomes overstocked during such seasons and a large proportion get rotten before reaching the final consumer. Alzamora *et al.*, (2000) has reported that about 30-50% of fruits and vegetables harvested in developing countries including Ghana are never consumed due to spoilage during transportation, storage and processing.

In Ghana, mango fruits are primarily consumed in the fresh state usually as dessert and sometimes as a

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fruit drink or juice.

Consumers tend to prefer fresh fruits and vegetables rather than processed or canned food, and postharvest losses of fresh fruits and vegetables are one of the major problems of the food industry (Borrud *et al.*, 1996). Surveys have revealed that a substantial portion of the harvest is wasted annually due to improper harvesting and postharvest practices, disease and lack of facilities and technology to extend storage life. Postharvest losses have been estimated in developed countries to range from 5-25 % while in developing countries it is 20-50 %, depending upon the commodity (Kader, 1992). This continues to cause heavy losses in revenue for the grower, wholesaler, retailers and exporters.

World trade in fresh mango fruit is restricted by the highly perishable nature of this climacteric fruits (Lizada, (1993); Mitra and Baldwin, (1997), that displays characteristic peak of respiratory activity during ripening (Tucker, 1993). Postharvest losses not only reduce the availability of mango, but also result in increase in per unit cost of transport and marketing (Subrahmanyam, 1986).

## **II. METHODOLOGY**

### **2.1 Overview Of Research Design**

The research employed desk study in gathering relevant literature and secondary data. During the field study, the research employed a survey and a case study in gathering data and information from actors and stakeholders in the major mango producing areas in Northern Region of Ghana.

### **2.2 Data Collection**

Data collection was based on a survey of individual mango producers, out growers, sellers and stakeholders in the mango sector, using a set of questionnaires. The research therefore had a quantitative and qualitative approach on empirical basis and literature review. A detailed interview guide to elicit factual and in-depth data of postharvest; handling and marketing mango fruits was used. Questionnaires were administered to mango farmers and sellers who were selected based on their scale of production within the Northern Region to evaluate postharvest handling of mango fruits from the farm gate to the market. Questionnaire and interview schedule were used as techniques for gathering data in the study.

### **2.3 Study Area**

The Northern Region is much drier than southern areas of Ghana, due to its proximity to the Sahel, and the Sahara. The vegetation consists predominantly of grassland, especially savanna with clusters of drought-resistant trees such as baobabs and acacias. Between the months of May and October is the wet season, with an average annual rainfall of 750 to 1050 mm (30 to 40 inches). The dry season is normally between November and April. The highest temperatures reach their peak at the end of the dry season, the lowest in December and January. However, the hot Harmattan winds from the Sahara blows recurrently between December and the beginning of February. The temperatures may vary between 14°C (59°F) at night and 40°C (104°F) during the day.

### **2.4 Survey**

The survey research strategy was used to gather information and obtain a general overview of the current postharvest handling of mango fruits in the Northern region of Ghana. The survey was carried out on producers of mangoes and sellers in the Northern Region of Ghana. One hundred and forty nine (149) producers and twenty one sellers (21) were selected through a selective sampling from the total number of mango producers and sellers in the region.

### **2.5 Sample Size And Sampling Procedure**

The study employed both probability and non-probability sampling techniques in selecting the respondents for the study. Simple random sampling, a probability sampling method and purposive sampling, a non-probability sampling method was employed in the sample size of one hundred and forty nine (149) respondents of mango farmers and twenty one (21) mango sellers for the study.

### **2.5 Data Processing And Analysis**

The data collected from the field were examined from the completed questionnaires through quality control measures such as sorting, editing, and coding to identify and eliminate errors, omissions, incompleteness and general gaps in the collected data. The refined data were analyzed using Statistical Package for Social Sciences (SPSS Version 17.0) and Excel, to facilitate data description and analysis. Descriptive statistics such as cross tabulation and frequencies were employed to summarize and present the quantitative aspect of the data in the form of tables, to facilitate interpretation and analysis using frequencies, percentages,

### III. RESULTS

#### Stage Of Harvesting Of Mango Fruits And Marketing

The survey revealed that more than half (65.10%) of the farmers harvested their mango fruits at full ripe stage. Thirty-two percent harvest at half ripe stage, while 80.95% of the sellers purchase their mango fruits at full ripe and 14.29% at half ripe stage. Only 4.76% of farmers harvest fruits at physiologically matured stage (Table 1).

**Table 1.** Stages of mango fruit before harvesting and marketing.

Response	mango farmers		Mango seller	
	Frequency	Percent (%)	Frequency	Percent (%)
Half ripe	48	32.22	3	14.29
Full-ripe	97	65.10	17	80.95
Physiological matured(green)	4	2.68	1	4.76
Total	149	100.00	21	

#### Storage Method

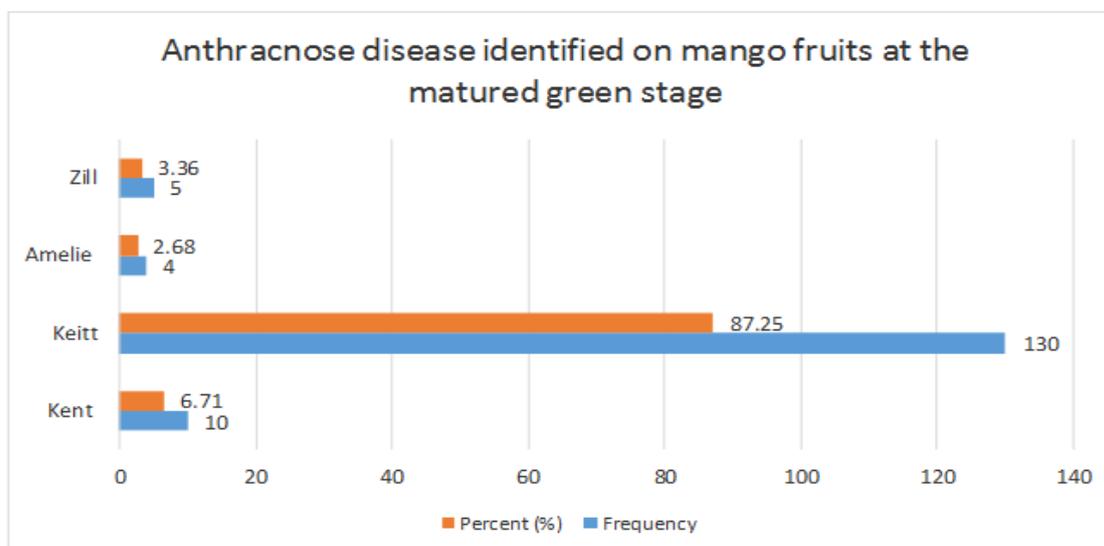
The study (Table 2) revealed that, 38.95% of the mango farmers in the Region stored their harvested mango fruits by heaping them on the ground at the farm, 27.52% spread on the floor and 15.43% put them in baskets. Moreover, 16.78% of the farmers used refrigerator to store their mango fruits and 1.34% stored in boxes. None of the sellers interviewed stored in refrigerators or heaped on the ground, however, over fifty percent (61.90%) of them stored their mango fruits by spreading them on the floor and 28.57% in baskets. A few of them, 9.52%, used boxes to store mango fruits.

**Table 2:** Storage Methods By Farmers And Sellers

Response	Mango Farmers		Mango Seller	
	Frequency	Percent (%)	Frequency	Percent (%)
Basket	23	15.43	6	28.57
Box	2	1.34	2	9.52
Spread on floor	41	27.52	13	61.90
Refrigerator	25	16.78	0	0
Heap on ground	58	38.93	0	0
Total	149	100	21	100

#### Anthracnose Diseases

It was observed from the study that 87.25% of Keitt variety is most susceptible to anthracnose, while a small 6.71%, 3.36%, 2.68% affect Kent, Amelie and Zill varieties respectfully, at the mature green stage (Table 3)



**Figure 1:** Anthracnose Disease identified on mango fruits at the matured Green stage

Response	Mango Farmers		Mango sellers	
	Frequency	Percent (%)	Frequency	Percent (%)
Wholesalers	23	15.44		
Retailers	33	22.15		
Middlemen	4	2.62	6	28.57
Export market	26	17.45		
Farm gate	32	20.81	15	71.43
Processors	31	21.47		
Total	149	100.00	21	

**Table 3:** Mango fruits supply chain in the Northern Region

### Grading Methods Used By Farmers And Sellers

From the results of the study, less than half of the mango farmers (36.24%) of the farmers graded their mango fruits by looking at uniformity in size and shape. Nineteen point four-six percent graded based on mechanical damage. Moreover, 18.79% of the respondents graded based on variety. Only 12.08% of the farmers considered flesh firmness as their grading method. On the other hand, 42.86% of the sellers graded their mango fruits using uniformity in size and shape. Twenty-eight point seven-five percent used skin colour and 14.29% for free from mechanical damage. Only 4.76% of the sellers considered variety of mango.

Response	Mango farmers		Mango seller	
	Frequency (%)	Percent	Frequency	Percent (%)
Variety	28	18.79	1	4.76
Flesh firmness	18	12.08	2	9.52
Uniformity in size and shape	54	36.24	9	42.86
Skin colour	20	13.54	6	28.57
Free from mechanical damage	29	19.46	3	14.29
Total	149	100.00	21	100.00

**Table 4:** Grading Methods Used By Farmers And Sellers

Response	Mango Farmers		Mango sellers	
	Frequency	Percent (%)	Frequency	Percent (%)
Wholesalers	23	15.44		
Retailers	33	22.15		
Middlemen	4	2.62	6	28.57
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Farm gate	32	20.81	15	71.43
Processors	31	21.47		
Total	149	100.00	21	

**Table 5:** Supply Chain Of Mango Fruits

The results of the survey conducted showed that 22.15% of the farmers sold their harvested mango fruits through the retail outlet, 21.47% of them sold to the processors and 20.18% sell at the farm gate. Fifteen and half (15.44%) of farmers sold to wholesalers and 2.62% to middlemen. On the other hand, more than two-thirds of the respondents (71.43%) of the sellers purchased their mango fruits at the farm gate and 28.37% from middlemen

### Storage Method

According to results of the current study in table 6, a little less than forty percent (38.95%) of the mango farmers stored their harvested mango fruits by heaping them on the ground at the farm, 27.52% spread on the floor and 15.43% put them in baskets. Sixteen point seven-eight (16.78%) of the farmers used refrigerator to store their mango fruits and 1.34% stored in boxes. In the same way, more than fifty percent (61.90%) of the sellers stored their mango fruits by spreading them on the floor and 28.57% in baskets. Only 9.52% used boxes to store mango fruits.

**Table 6:** Storage Method

Response	Mango Farmers		Mango Seller	
	Frequency (%)	Percent	Frequency	Percent (%)
Basket	23	15.43	6	28.57
Box	2	1.34	2	9.52
Spread on floor	41	27.52	13	61.90
Refrigerator	25	16.78		
Heap on ground	58	38.93		
Total	149	100	21	100

#### IV. DISCUSSION

The findings revealed that mango farmers and sellers harvest their mango fruits for sale based on certain indicators. It was realized that 65.10% of the mango farmers and 80.95% of the mango sellers either harvest or buy mangoes when they were fully ripe. On the Contrary, 2.28% of the farmers harvested when it was physiologically matured and 4.76% of the sellers also bought mangoes when they were physiologically matured. Lakshminarayana *et al.* (1970) reported that, mangoes are usually harvested green. Harvesting usually takes place after 15-16 weeks of fruit set when they are physiologically matured. Late harvesting may result in uneven ripening, and can lower sugar to acid ratio. Mangoes harvested at mature but unripe (green) stage will naturally ripen off the tree, but harvesting the fruits prematurely, however, will prevent fruit from reaching full ripeness (Lakshminarayana *et al.*, 1970). Harvesting fruit at stages beyond the mature green state will also reduce their shelf stability and shorten their fresh market life. It is therefore obvious that a lot more mango fruits are lost to growers in the Region, since harvesting of their fruits were reported to be done at the full ripe stage. Kalra *et al.* (1995) reported that mature ripe mangoes deteriorated within 6 days under ambient conditions similar to that experienced in the Northern Region of Ghana. Malik *et al.* (Eds.) (2005), similarly, reported that 25 - 30% of mango produce is lost due to improper postharvest operations; as a result, there is considerable gap between the gross production and net availability due to improper handling by the actors involved.

The current study revealed that there are differences in the way mango farmers and sellers stored their harvested fruits in the Northern region. It was observed that 27.52% farmers spread their harvested mango fruits on the ground, whilst 38.93% of the farmers heaped them on the ground. For the mango sellers on the other hand, whereas 61.90% of them spread their mango fruits on the floor after the daily sales, none of them heaped their fruits on the ground. The commonest method being practiced by majority of the farmers (heaping of the harvested fruits) could cause the middle of the heap to experience temperatures above the ambient, perhaps leading to high losses. Mitra and Baldwin (1997) have recommended storage temperatures for mangoes to be between 12° and 13° C similar to that of Jobling (2000) who also recommended that mango fruits should be stored at temperatures above 10°C.

Pantastico *et al.* (1975); Raghavan and Gariépy, (1985) stated that, the basic concept of storage is to extend the shelf life of products by storing them in appropriate conditions to maintain their availability to consumers and processing industries in their usable form. The authors further explained that, in the natural storage the product is left in the field and harvesting is delayed, while in artificial storage, favourable conditions are provided, which help to maintain product freshness and nutritional quality for a longer period. The storage methods used by both farmers and sellers in study area are likely to have negative impact on the postharvest quality of the mango fruits treated that way, since only 16.78% of farmers use refrigeration systems to store their fruits at the pack house.

Further findings of this study revealed that the varieties cultivated had different susceptibility to diseases that affected matured mango fruits, especially, anthracnose. For instance Keitt variety was much more affected by anthracnose diseases compared to the other varieties being cultivated by the farmers. According to Fitzell and Peak, (1984); and Jeffries *et al.*, (1990), anthracnose disease caused by *Colletotrichum gloeosporioides* is one of the common but major diseases of pre-and postharvested fruits and is associated with high rainfall incidence as well as humidity. The harvesting of Keitt takes place between June and July which is the peak of the rainy season in the Northern Region and could be attributed to the causes. For the Northern Region, therefore, it will be advisable and therefore recommended for farmers to concentrate on producing the other varieties, Kent, Amelie and Zill in the wet season and plant the Keitt variety during the dry season.

#### V. CONCLUSION

It was obvious that market women purchased their fruits at full ripe stage which deteriorate faster and that demand compels most of the farmers to harvest at this stage. Educating the sellers and farmers on harvesting at mature green stage will enable them keep their fruits longer

The study revealed that, there is no proper storage facility for the market women and the farmers to store their produce after harvesting. This has created serious economic losses to all the actors in the supply chain of the fruits. This calls for proper storage facility in future for both growers and sellers in the region.

The research indicated that anthracnose disease caused lots of losses of mango fruit at the mature stage, especially the Keitt variety and negatively affected most of the farmers in the Region. For this reason some farmers had cut down trees of the Keitt variety and were replacing them with Kent and Amelie, which are able to tolerate the disease. A method of prevention of the disease would help farmers continue to cultivate and produce the cultivar.

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