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INDIGENOUS METHODS OF PREVENTING POST-HARVEST LOSSES OF MANGO FRUITS AMONG FARMERS IN BENUE STATE, NIGERIA

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ABSTRACT

Postharvest losses of mangoes are the bane of mango fruits farmers in Benue state. However scientific methods of preventing postharvest losses are not available to the farmers. These farmers therefore utilise indigenous methods to prevent these losses so as to enjoy the fruits of their labour. The objective of the study was to assess indigenous methods used in preventing postharvest losses of mango fruits among farmers in Benue state, Nigeria. Cluster sampling technique was used to select 400 farmers. Questionnaires and Key Informant Interviews (KII) were used to collect data. Quantitative data was analysed using percentages while qualitative data analysis involved transcription of responses of Key informants. Findings revealed that majority (24.9%) of farmers were 30-39 years while those who were 20-29 were the least (14.5%). Also, indigenous methods of preservation included open air (70.2%), Pit (12.4%), Hot water (9.1%), hut (8.3%) and potting methods. In general, the efficacy of the indigenous methods was rated moderately (60.9%). Harvesting the fruits in mature and unripe form prevented attacked from wasp and bats. The indigenous methods significantly prevented the quantitative losses (58.8%); maintained freshness of mangoes (8.8%) prevented shrinking (7.8%) and controlled attacks from insects and animals (7.2%) especially Peter and Local varieties. The methods were also found to have prevented postharvest losses of mangoes mainly for a period of 7 – 14 days (58.0%). Hot water method ensured longer shelf life than other methods but produced low quality fruits. It worked better on Peter variety. However, the methods contributed more towards ensuring quantitative losses rather than maintaining quality of the fruits. The study recommended for open air method for mass preservation of mangoes and adoption of potting method for ensuring of freshness of the fruits.

Keywords: Farmers, Indigenous methods, Mango fruits, post-harvest losses, and Tivland

INTRODUCTION

Mango (*Mangifera indica*. L) is one of the most important and valuable fruits in the world (Altendorf, 2017; FAOSTAT, 2016). However, the fruits seem to be vulnerable to high post-harvest losses (FAOSTAT, 2016). In Nigeria, these postharvest losses seem to be the bane of mango production. It has been reported that in Benue state, one of the highest producers of mango fruits in Nigeria, about 20 to 80 percent of mango fruits produced are subjected to post-harvest loss every year (State Ministry of Agriculture, 2015). The high post-harvest losses are because the fruit possesses a very short shelf life (Akimbamowo, 2013). As a result of the seasonality nature of mango, the fruits availability during the period of high season is always above demand which leads to low market value and high post-harvest losses (Maloba, Ambuko, Hutchinson, and Owuni, 2017). The high post-harvest losses of mango fruits have adverse effects on the income of the farmers who incur huge economic losses from mango fruits production (Agyapong, 2013).

Postharvest losses of mango fruits in developing countries are perceived to be prevented by predominant utilisation of indigenous methods of preservation (Agyapong, 2013). This is because scientific methods are not available to the farmers. The indigenous methods are based on local, traditional, non-western beliefs and customs and usually refer to as informal methods of preservation (Horsthemke, 2004). The methods may be expressed in the form of skills, craft, techniques, technologies,

ideas, beliefs, values, norms, rituals, totems, plant species and animal breads. It is usually passed from one generation to another or from one person to another, through word of the mouth (Warren 1987; Risiro, Tshuma and Bhasikiti, 2013). Indigenous methods of preservation operate without direct inputs from formal and scientific institutions. These methods tend to suit the peculiar socio-economic and environmental conditions of peasant farmers in developing countries. The methods appear to be widely used by small holder farmers who are predominantly poor, with low educational attainment. The indigenous methods of preservation are easily compatible with farmers in terms of economic cost, application and use (Aluma 2005). Most local farmers in developing countries basically depend on this knowledge for decision making regarding their farm operations.

Mango farmers in developing countries appear to take advantage of the indigenous methods which utilises their knowledge, natural resources and physical environment. Indigenous methods such as sun drying techniques rely heavily on sunlight and creativity in processing to prevent their mango fruits from postharvest losses. This was basically through processing of the fruits into chips, powder and cakes and drying them in the sun. This method ensured that mango fruits' products were available to the farmers through the year while ensuring their income and available of the fruits throughout the year. Sun drying is utilised among the Khonda tribe in India (Baul, Dhal and Mukherjee, 2015). Farmers also tend to utilise natural cold air to prevent post-



harvest losses. They achieve this through spreading mango fruits under shade of trees and other cold environments such as local hut. The cold air was found to control substances in the fruits that facilitate decay (Agyapong, 2013; Weor, 2007). The practice of harvesting mango fruits at maturity but unripe stage is another indigenous practice of preventing post-harvest losses. Mango fruits which are fully ripe on the tree appear to soften and decay within few days. This practice seems to prevent the fruits from fully ripening on the tree as it gives farmers the opportunity to slow down the ripening process (Agyapong, 2013).

Studies on indigenous methods of post-harvest preservation of mango fruits had been conducted in the study area. Weor (2007) investigated some of the different harvesting methods and storage life of mango varieties stored in Gboko Local government Area, while Sambe, Ikwuba and Sugh (2019) investigated utilisation and challenges of indigenous methods of postharvest preservation of mango fruits among farmers in Tivland. The investigations ignored assessing the efficacy of the indigenous methods in controlling postharvest losses of mangoes in Tivland. Therefore, this study assessed the indigenous methods used by farmers to prevent postharvest loss of mango fruits in Benue state.

The specific objectives of the study were:

1. To identify the indigenous methods in controlling of post-harvest losses of mango fruits in the study area
2. To determine the efficacy of indigenous methods used in preventing postharvest losses of mango fruits

METHODOLOGY

Benue state is one of the states in the North-Central region of Nigeria. It is inhabited by Tiv, Idoma, Igede and Etulo. The state is predominantly an agrarian state; popularly famous for grown crops such as Mangoes, Oranges, yams, Cassava, rice, soya beans, groundnuts, and others. The Tiv people are the commercial producers of mango fruits.

The Tiv speaking area is bordered in the North by Nasarawa and Taraba States. In the East, the area shares boundary with Cross-River State and Cameroon. In the south it is bordered by Otukpo and Oju Local Government Areas, while in the West it is bordered by Apa and Agatu Local Government Areas. The vegetation of the area consists of rain forests which have tall trees and tall grasses that occupy both the western and southern fringes, while the Guinea savannah is found in the eastern and northern parts with mixed grasses and trees that are generally of average height (BNARDA, 2006; Our Benue Our Future, 2009).

Tiv farmers cultivate mango fruits in commercial quantities. In recent times, several varieties of mango are produced in the area

including Local mango, Hindi, Julie, Peter, Ma Broken, Dubsha, John Bull, John Peter, Zill, John and Angbira. There is also evidence of production of most popular varieties in the international market such as Kent, Tommy Atkins, Haden and Keiths in the area. The fruit is also consumed massively by the local population (Nyishir 2004).

This study adopted a cross sectional survey design. To collect quantitative data, cluster sampling technique was used for selection of 400 farmers. Within this sampling technique, multi-stage sampling was used to select respondents. Stage one involved a purposeful selection of Tivland out of Idoma land and Igede lands. This selection was based on fact that the area produces mangoes commercial quantities than the other areas in the state. Stage two, four local government areas (LGAs) were purposively selected out of 14 LGAs in Tivland. These were Kwande, Ushongo, Gboko and Buruku LGAs. This was based on geographical location and presence of highest proportions of mango farmers in the areas. In stage three, four council wards were purposefully selected in each of the LGAs, based on fact that the council wards produce mango fruits in commercial quantities compared to the other council wards. In Kwande, Usar, Kumakwagh, Tondov II and Liev I were selected and in Gboko, Yandev I, Mbakper, Igyorov and Mbavarakaa were selected. For Ushongo LGA, Ikov, Mbagwaza, Mbagba and Mbayegh were purposefully selected while Shorov, Binev, Mbaityough and Mbatirkyaa were selected in Buruku LGA. Stage four: the researcher went to each of the selected council wards (clusters) and obtained list of mango farmers associations from the officials. After the acquiring the list, the researchers systematically selected mango farmers on the list whose names were within the first even numbers required in each of the council wards. This done during peak periods of mango production to ensure that most of the farmers were contacted

In Kwande, 28 farmers were selected in each of the council ward, except Usar which had 29 farmers. In Gboko, 38 farmers were selected in Igyorov and Mbakper while 29 were selected in Yandev and Mbavarakaa. For Ushongo, 15 farmers were selected in Ikov and Mbagwaza while 14 farmers were selected in Mbagba and Mbayegh. In Buruku, 19 farmers were selected in all the council wards except Mbatirkyaa which had 18 farmers. In summary, Kwande and Gboko had 113 and 154 respondents while 58 and 75 respondents were selected in Ushongo and Buruku respectively.

For qualitative data, purposive sampling technique was used to select 84 key- informants. The key informants were the leaders of mango farmers associations in the various villages in the council wards. A maximum of 4 key informants in each of the council wards in the selected Local Government Areas. The selection process involved researcher

identifying the women and male leaders of fruits farmers associations or groups. After identification, the researcher employed the help of a trusted and respected person in the communities approached them and persuaded them to be part of the study.

The interview schedule was used to collect data. In the process of data collection, the researcher recruited and trained two research assistants who assisted him in the distribution of the questionnaires. After the completion of the training, the researcher and his assistants started administering the questionnaires. In each council ward, the researcher and his assistants personally asked questions from the questionnaire. Respondents responded to the questions while the researcher and his assistants filled in the questionnaires.

Key Informant interview was also held with leaders of mango farmers associations in each of the selected council wards. The processes involved the researcher visiting the informants on the scheduled time to conduct the interview. The language used in the interview was Tiv. Data gathering involved use of tape recorders, phones and notebooks and pen to capture the interviews.

For the data gathered through Questionnaire analysed using percentages while data gathered through Key Informant interviews was analysed by transcribing responses of the key informants.

Indigenous methods used in preventing postharvest losses - The researcher was aware of just two indigenous methods used in preventing postharvest losses. Therefore, farmers were asked to list the major indigenous methods used in preventing

postharvest losses of mangoes. The farmers identified the methods by naming the methods. The variables were measured at nominal scale and were also categorised.

Efficacy of indigenous methods of preventing postharvest losses - Variables for measuring efficacy were categorised and measured at ordinal level. This was by rating efficacy the methods from High, Moderate and Low. Quality control sub-variables were measured at nominal level. These categories were quantity of fruits preserved, freshness, protection from insects and control shrivelling. The period of prevention of postharvest losses was also categorised and measured at nominal scale. The categories were below 7 days, 7-14 days and more than 14 days.

RESULTS AND DISCUSSION

Socio-demographic characteristics

Table 1 shows that majority of the respondents (24.9%) fall within the age range of 30-39 years while those in the range of 20-29 were the least with 14.5%. With regards to sex distribution of the respondents, males were found to be slightly the majority with 51.6%, while females were 48.4%, constituting the minority in the study. On marital status, married respondents constituted the bulk of the study with 56.0%, while respondents who were widowed had the least with 3.9%. Data on educational qualification revealed that respondents with tertiary education had highest percentage with 49.7%, while those with primary education were the least with 19.4%.

Table 1: Socio-demographic characteristics of mango farmers

Category	Frequency	Percentage
Age		
20-29	56	14.5
30-39	96	24.9
40-49	84	21.8
50-59	71	18.4
60+	79	20.5
Sex		
Male	199	51.6
Female	187	48.4
Total	386	100
Marital status		
Single	107	27.7
Married	216	56.0
Divorced	48	12.4
Widowed	15	3.9
Educational Qualification		
Non formal education	84	21.8
Primary	75	19.4
Secondary	135	35.0
Tertiary	192	49.7
Total	386	100

Source: Field survey, 2019



Indigenous methods used by farmers in preventing postharvest losses of mango fruits

Table 2 presented indigenous methods of post-harvest preservation of mango fruits in the study area. The table has shown that most 70.2% of the farmers preserved mango fruits using “open air method”. This was followed by 12.4% of the farmers who used “pit method” and 9.1% of them used “hot water method”. Lastly, 8.3% of the farmers were found to have used “hut preservation method”

Majority of the key informants noted that, mangoes are usually preserved by open air, dug pits, hut and hot water and potting methods. One of the key informants said:

“...mangoes were preserved first harvesting the fruits in mature but unripe form and preserved. Then ashes is applied and stored in clay pots...but generally we use open air system where the fruits harvested in mature but ripe state and placed in open space where there is

free flow of air...some farmers preserve mangoes in dug pits and traditional huts while other preserve the fruits by applying hot water on them...”

(Key informant Interview, 2019)

These findings have been corroborated by some studies. Lakshminarayana *et al.*, (1970) showed that mangoes were preserved by plucking them at mature but unripe stage. This is also consistent with studies by Akurugu *et al* (2016), which found that farmers preserved mango fruits by keeping them in a cool open aired environment after harvesting. Studies by Weor (2007) and Korir *et al* (2014), also found that local farmers preserved mango fruits in huts or barns. The process involved harvesting the fruits at semi ripe stage and heaping them on the floor in a hut or barns constructed wood and bushes. Furthermore, Agyapong (2013) revealed that farmers preserved mangoes by exposing them to cold air

Table 2: Indigenous Methods of preventing post-harvest losses of mango fruits farmers

Preservation Methods	Frequency	Percentage
Open air method	271	70.2
Pit method	48	12.4
Hot water method	35	9.1
Hut method	32	8.3
Total	386	100

Source: Field survey, 2019

Efficacy of Indigenous Methods in Control of Post-harvest Losses of Mango Fruits

In Table 3, the rating of the methods was based on their degree of efficacy, majority of the farmers, 60.9%, gave moderate rating, followed by 17.1% who rated the methods high, then 15.5% gave the methods low rating. Furthermore, 6.5% of the respondents did not respond to the question.

On quality control, majority 58.8% of the farmers revealed that they use indigenous methods to control deterioration of mangoes in large quantities, 8.8% of them used the methods to maintain freshness of the fruits, 7.8% of the farmers indicated using the methods to avoid shrinking of the fruits and 7.2% of them revealed utilising the methods to prevent the fruits from attacks by animals and insects. Still 17.4% of the farmers did not respond to the question.

On the period of preservation, the Table indicated that the indigenous methods are capable of preserving mango fruits from 7 to 14 days before they could start to spoil with majority 58.0% of the respondents attesting to this. This was followed by 16.6% of the respondents who affirmed that the methods could only preserve mangoes for a period of below 7 days and lastly 8.0% of the farmers acknowledged the methods could preserve the fruits for a period more than 14 days as 17.4% of the farmers did not respond to the question.

Most of the key informants agreed that prevention of postharvest losses in mangoes begin with harvesting the fruits at a mature but unripe stage. Washed or not washed with water depending on the variety and preserved in open air, hut, pit, hut or hot water.

A female key informant in Mbakper council ward in Gboko, Local Government Area further said:

...we preserve all varieties using open air method ...all varieties may be washed before preservation except, Julie and Hindi varieties...Julie tend to shrink when washed...Hindi become blackened from the out layer when washed with water...hot water method works on all varieties we produce except Hindi...hut method works more on Peter variety, but other varieties are also preserved in huts...Pit method works on all varieties particularly the Local variety ...Potting method is used on all the varieties and is effective in maintaining freshness of mango fruits...

(Key Informant Interview, 2019)

Another key informant in Usar Council ward in Kwande Local Government Area said:

...Practice of harvesting mangoes at mature and unripe stage is important...fully ripe mangoes are vulnerable to attacks by insects

such as wasps and bats...this practice prevents this occurrence...fully ripe varieties such as Peter will start to rot on the mouth as it is maturing and a fully ripe Peter will not give you the excellent taste compared the fruits which are harvested matured, unripe and preserved...Julie variety develops bumps inside the eatable tissue when it fully ripens on the tree...Hut and pit method also prevents insects such as wasp and other animals such as sheep, goats and cattle from eating the fruits...

The above findings corroborate Akurugu *et al* (2014) investigation which showed that mangoes harvested at mature but unripe (green) increased shelf stability and increased their fresh market life. Weor (2007) also found that indigenous method of storage of mango fruits especially Peter variety in

environment such as hut “increased storability” of the fruits for a period of more than fifteen days after harvest. This seemed to suggest that hut storage had positive impact on preservation of the fruits since the storage life of mangoes is limited to 2–3 weeks even when scientific methods were used under favourable conditions (Yahia 1998a). Potting method was found to be effective preventing attacks from pests and animals. The method appears to be similar with use of chemical which is used to treat fungicides attacks in mango fruits. Fungicide known as Prochloraz is used in treating mangoes from fungicides infections (Cavelier, Pineau, and Prunier, 1994). However, efficacy and application of the fungicide is scientifically proven while the efficacy of application of ashes before potting is not yet determined scientifically.

Table 3: Efficacy of indigenous methods of preventing post-harvest losses of mangoes

Responses	Frequency	Percentage
Rating of Efficacy		
High	66	17.1
Moderate	235	60.9
Low	60	15.5
N/A	25	6.5
Total	386	100
Quality control		
Control decay in large Quantities	227	58.8
Maintain Freshness	34	8.8
Avoid Shrinking	30	7.8
Prevent attack by animals and insects	28	7.2
N/A	67	17.4
Total	386	100
Period of Prevention		
Below 7 days	64	16.6
7-14 days	224	58.0
More than 15 days	31	8.0
N/A	67	17.4
Total	386	100

Source: Field survey, 2019

CONCLUSION

The indigenous methods preventing postharvest losses of mango fruits included open air method, pit method, hot water method, hut preservation and potting method. The methods begin with harvesting of the mangoes at mature but unripe stage. The methods achieved moderate rating in their efficacy and preserved the fruits and prolonged shelf life mostly from 7 to 14 days. The indigenous methods main prevented the quantity of losses of mangoes rather than ensuring and maintaining quality of the fruits. Open air method guaranteed preservation of large quantities of fruits and was suitable for all mango varieties produced in the area. Pit preservation protected the fruits from being attacked by insects and animals while maintaining the quality of the fruits. It is used for preserving all varieties especially the Local cultivar. Hot water

method appeared to slow down decaying process in the fruits while contributing less to ensuring quality of the fruits. The method worked for all varieties except Hindi variety but was more effective for preserving the Peter variety. Hut preservation increased quality of shelf life of the fruits, while also ensuring preservation on large quantities. The method was efficacious for storing all the varieties especially Peter and Local varieties. Potting method was found to have maintained freshness of the fruits. It was effective in preventing losses on all mangoes’ varieties.

RECOMMENDATIONS

- a. There is the need to develop open air method since it has been found to contribute to prevention of mass quantities



- of mangoes. This should be responsibility of indigenous mango scientist in Nigeria.
- b. To ensure qualitative preservation of mangoes, the farmers need to adopt potting method which appears to maintain quality of mangoes by ensuring freshness of the fruits. The Agricultural Extension Officers have a responsibility to ensure that farmers appropriate methods to reduce quantitative and qualitative losses in mango fruits.
 - c. The indigenous methods need to be scientifically tested in order to determine best conditions under which they can be utilised for improved efficacy of the methods.

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