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QUALITY OF POSTHARVEST HANDLING OF MARKETABLE OKRA FRUITS SOLD IN MINNA, NIGER STATE, NIGERIA.

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ABSTRACT: *An appraisal of the current practices used in the post harvest handling of fresh fruits in Minna was conducted to identify the inherent problems involved. This is with the view to generate useful information and results to maintain quality and curtail losses. The Investigative Survey Research Approach (ISRA) was used, thus structured questionnaires were administered to the okra farmers and marketers in the selected locations within Minna environs i.e. Sabon–gida, Garatu, Gidan-mangoro and Minna central market through personal interviews. The result shows that the current post harvest system was faced with a lot of problems, some of which were poor road network, lack of pre-cooling systems, poor harvesting methods, unavailability of desired vehicles for transportation and the produce from to farms the homes or to the markets at the right time, have been identified as the major points where the reduction in quality occur. The result of the study suggests that better methods should be paid to these points in order to reduce / minimize the current losses and maintain the quality of marketable okra.*

KEYWORDS: Postharvest handling, Okra, Pre-cooling systems

INTRODUCTION

Post-harvest losses in horticultural fruit crops are related mainly to handling beginning first from harvest and on to retail shops. Losses can be caused by mechanical injuries, inadequate storage, unsuitable handling in transporting and delay in the display time while at the retail market (CEAGESP, 2002). These losses may result in as much as US $ 0.02 cost increase per kilogram (FNP Consultoria and Comercio, 2001). Changes in quality of Okra can be of mechanical, physiological, or pathological in nature. Mechanical injuries may cause metabolic and physiological changes in Okra leading to the appearance of both typical external or internal signs (Moretti *et al*, 1998; Sargent *et al*; 1992) and alterations in respiratory metabolism (Galvis Vanegas, 2007) flavors and smell (Moretti and sargent, *et al* 2000; Sargent *et al*., 1997) and firmness (Jackman *et al*., 1990)

Physical damage may also significantly affect chemical and physical composition of the pericarp and locular tissue in okra. The incidence and severity of physical and internal damages to vegetables depend on the impact energy; number of impacts; cultivars and the ripening stages, and it's cumulative during post harvest handling practices (Sargent *et al*., 1992). Therefore the various handling steps, from the field to the consumers, must be carefully co-coordinated and integrated to maximize produce quality (Sargent *et al*., 1992). Spurgeon has suggested that a post-harvest system should be thought of as encompassing the delivery of a crop from time and place of harvest to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for all involved (Spurgeon, 1976)

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Okra suffer from severe post harvest losses particularly under hot tropical conditions, hence the need for careful handling during harvesting and after, to minimize mechanical injuries such as scratches, punch and bruises to crop. The use of measurement to determine internal bruising from impact has proven suitable to evaluate injuries in vegetables like Okra (Chen and Yazdani, 1991; Sargent *et al*., 1992; Moretti *et al*., 1998).

However in developed countries losses are generally small during processing, storage and handling because of the efficiency of the equipment, good quality storage facilities, and close control of critical variables by a highly knowledgeable cadre of managers. Conversely, in developing countries losses in processing, storage and handling tends to be rather higher because of poor facilities and frequently inadequate knowledge of methods to care for the food property.

Statement of the Problem

Okra farming is seasonal and highly perishable; therefore consumption changes according to availability in the market and also it quality. Attempts have been made to meet consumers demand interims of its market quality. This therefore leads us to those factors that constitute drastic reduction in the quality of Okra produced. It is therefore expected that the result will provide useful solutions which will be useful to Okra producers.

Justification of the Study

The main reason for carrying out this research work is to establish the fact that poor post harvest handling affect the quality of marketable okra.

Objectives of the Study

The objectives of this study are:

- To identify the socio-economic characteristics of the okra farmers in the study area.
- To identify those factors affecting the quality of marketable okra by post harvest handling operations.
- To make recommendations based on the research findings.

MATERIALS AND METHODS

Description of the Study Area

Niger State is located between latitude 8^0 20^I N and 11^0 30^I N and longitudes 3^0 30^I E and 7^0 20^I E in the southern guinea savannah zone of Nigeria. The State is bordered to the Southwest by Kebbi State, to the north by Zamfara state to the south by Kwara state while Kaduna and Federal capital territory borders the State to the Northeast and Southeast respectively (Olayide, 1992).

Furthermore, the state shares a common international boundary with the Republic of Benin at Babana in Borgu Local Government Area of the state. Currently the State covers a total land area of 76000 square kilometers of Nigeria is total land area. That makes the state the largest in the country (Olayide, 1992). The five Administrative zones of the State are Bida, Suleja,

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Kontagora, New Bussa and Minna which is the State capital. This area experiences two distinct seasons, dry and wet season. The mean annual rainfall varies from 1200-1300mm. The duration of the raining season ranges from 140-190 days or more with mean temperature of 20^0C - 29^0C (Awoseyin 2002). The maximum temperatures usually occur between December and January. Dry season in this area commences in October. The main languages of the people are Gwari, Nupe and Hausa. The main occupation is farming because of their fertile soil.

The study involved both field and market survey. Sabon gida, Garatu and Gidan Mangoro were the selected farm sites used for the field survey while Minna central market was the selected market used for the study due to the large number of okra marketers.

Sample size and sampling Technique

The sampling procedure employed was simple random sampling. The study area was limited to Sabon-gida (64km Minna to Bida road), Garatu (29km Minna to Bida road), Gidan mangoro (This is about a radius of 27km of Minna) and Minna central market. The sample size of 75 vegetable farmers were randomly selected from the study areas for the research.

A Photographic Camera was used for taking photographs of some features, like the type of vehicles used in transporting the okra to the market, nature of the road in which the produce are transported, and how the okra are harvested on the field.

Method of Data Collection

The primary data which was used for the study was obtained by well structured questionnaires and oral interview on randomly selected okra farmers in the study areas chosen. The questionnaire contains the socio-economic characteristics of the farmers like: age, sex, marital status, educational qualification, years of experience in farming, area of land under cultivation, mode of transportation, mode of storage and some other post harvest handling methods employ by the farmers.

Method of Data Analysis

Analysis as defined by Oxford Advanced Learners Dictionary, is a process of fact finding that results in the qualitative expression of significant relationship and serves as a basis for taking decision. The analytical techniques that were used in this analysis include:

Descriptive statistics: such as, frequency distribution and percentage to analyse the socio-economic characteristics of the okra farmers.

RESULT AND DISCUSSION

This chapter presents the analysis of the primary data collected from the farmers. The responses were mainly from okra farmers with their respective frequencies and percentages tabulated and discussed.

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Demographic characteristics of respondents

Age

Age is of immense importance in carrying out any agricultural activity with particular reference to vegetable production which seems to be labour intensive.

Table 3 shows that majority of the okra farmers in the study area were between the ages of 31-40 years (34%) with the age ranges of 20-30 years and 41-50 years coming closely behind with 27% and 12% respectively. The minority of the okra farmers in the study area were above 50 years (2.0%). This shows that the occupation is for those in their active age despite its labour intensity of farm work.

Sex

Table 4 shows the distribution of respondents farmers. The place of gender cannot be overlooked in agriculture and in vegetable production. It was observed that in the study area, more men were involved in vegetable production than the women.

Table 1: Age and sex distribution of respondents

Age	Frequency	Percentage
20-30 years	27	36.00
31-40 years	34	45.30
41-50 years	12	16.00
Above 50 years	2.0	2.70
Sub- Total		100.00
Sex of farmers		
Male	58	77.3
Female	17	22.7
Total	75	100.00

Source: Field survey 2014.

Marital status

The marital status of the respondents also played a good role in the population of those involved in okra production. It was observed that 74.7% of the okra farmers in the study area were married and just about 14.7% were single. Production is expected to be increased, since the married men could engage their family labour in farming.

Education

Table 6 indicates that 28.0% have Islamic school education, 37.3% of the farmers have primary school education, and 8.0% have secondary school education while 26.7% of the farmers have no formal education. With the primary school recording the highest percentage. Njoku (1991) observed that the level of education has a positive influence on the adoption of modern technology, its therefore possible for the farmers to adopt modern post harvest handling method if and when it is introduced.

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Experience

Experience is the number of years the farmer has been into the farming profession. The longer the number of year the more the experience acquired.

Table 7 shows that 18.7% of the respondents have between 1-5 years of farming experience, 52% have between 5-10 years experience, 21.3% have between 11-15 years experience, 1.3% have between 15-20 years experience and 6.7% have above 20 years of farming experience. Majority of the farmers are still new to the farming occupation.

Size of land cultivated

From Table 8.0, it is evident that 40.00% of the respondents cultivated less than 0.5 hectare, 22.70% cultivated land between 0.5 – 1.0 hectares, 26.70% cultivated land between 1.0 – 2.0 hectares, while 5.30% and 5.30% cultivated lands between 2.0-3.0 and more than 3.0 hectares respectively.

Table 5. Distribution of farmers by marital status and level of education.

Marital status	**Frequency**	**Percentage**
Single	11	14.70
Married	56	74.70
Widow	8.0	10.70
Level of educational		
Islamic school	21	28.0
Primary school	28	37.3
Secondary school	6.0	8.0
No formal education	20	26.7
Subtotal	75	100.00
Years of experience in farming		
1-5	14	18.7
5-10	39	52.0
11-15	16	21.3
15-20	1.0	1.3
Above 20	5.0	6.7
Total	75	100.00

Source: Field survey 2014.

Factors affecting the quality of marketable okra

This section deals with and discusses those factors that affect the quality of marketable okra during post harvest handling stages in the study area.

It can be seen from Table 9.0 that, 58 respondents (equivalent of 77.3%) used breaking/plucking method to harvest okra fruits, 15 others (20%) used knifes while the rest 2 (2.7%) used other means.

Results shows that about 56% (42 respondents) agreed that damage associated with method of harvesting could reach up to 0-10% by volume. No damage at harvesting and 11-20% due to method of harvesting had equal number of 16 respondents respectively. The computed chi-

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square based on the entries, yielded a value of 45.173 with associated 6 degree of freedom. It had a probability value of 0.0001 (P< 0.01), which indicates a highly significant difference between the methods of okra fruit harvesting.

This therefore implies that the null hypothesis should be rejected in favour of the alternative hypothesis. It can also be concluded that harvesting method contributes significantly to the level of post harvest okra fruit damage.

The result from Table 10.0 shows that 22 farmer respondents gave no response to the influence of training on level of okra damage, twelve others claimed to have been trained on how to harvest okra, while the remaining 41 respondents said they were not trained on how to harvest okra fruits. Results shows that about 56% (42 respondents) agreed that damage associated with training could reach up to 0-10% by volume. No damage at harvesting and 11-20% due to training had equal numbers of 16 respondents respectively.

Table 8. Distribution of farmers by farm size

Land size (Ha)	Frequency	Percentage
Less than 0.5	30	40.00
0.5 – 1.0	17	22.70
1.0 – 2.0	20	26.70
2.0 – 3.0	4	5.30
More than 3.0	4	5.30
Total	75	100.00

Source: Field survey, 2008

Table 9.Cross tab classification of harvesting method and level of post harvest damages.

	Level of damage during harvesting (%)				
Harvesting methods	**0**	**0-10%**	**11-20%**	**21-30%**	**Total**
Breaking/plucking	9(12.4)	34 (32.5)	15(12.4)	0 (0.8)	58 (77.3 %)
Using knife	7 (3.2)	7 (8.4)	1 (3.2)	0 (0.2)	15 (20 %)
Other means	0 (0.4)	1 (1.1)	0 (0.4)	1 0(.0)	2 (2.7 %)
Total	16 (21.3)	42 (56.0)	16 (21.3)	1 (1.3)	75 (100 %)

Source: Field survey, 2008.

Table 10: Cros tab classification of training and level of post harvest damages

	Level of damage during harvesting (%)					
Training	**0**	**0-10%**	**11-12%**	**21-30%**	**Total**	
No response	15 (4.7)	6 (12.3)	0 (4.7)	1 (0.3)	22	(29.3)
Yes	1 (2.6)	9 (6.7)	2 (2.6)	0 (0.2)	12	(16.0)
No	0 (8.7)	27 (23.0)	14 (8.7)	0 (0.5)	41	(54.6)
Total	16 (21.3)	42 (56.0)	16 (21.3)	1 (1.3)	75	(100)

Source: Field survey, 2008

The computed chi-square value of 47.438 based on the entries yield a probability value of 0.0001 (p<0.01) indicating that the issue of pre-harvest training of okra fruits harvesting had highly significant effect on post harvest damage and therefore the null hypothesis is rejected in favour of the alternative hypothesis.

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The result from Table 11 also shows that 42 farmer respondents used baskets in packaging their okra prior to transportation, 27 others used sacks, two use buckets while the final four farmer respondents use other means of packaging their products to the market. Results shows that about 52% (39 respondents) agreed that damage associated with packaging material could reach up to 0-10% by volume. No damage at harvesting and 14.6% (11 respondents) agreed that damages as a result of packaging materials could reach up to 11-20% while 6.6% (5 respondents) recorded about 21-30 % level of damage during transportation.

The computed chi-square value of 8.213 (with 9 degrees of freedom) had a probability value of 0.513 (P> 0.01) indicating a non significant effect of packaging material and level of post harvest damage of okra fruits. The null hypothesis is therefore retained, inferring that packaging had no significant influence on the level of damage during post harvest transportation of okra fruits.

From the Table 12, it was observed that one farmer gave no response question put to him. Twelve farmers transported their harvested okra on a tarred road, 15 of them transported their okra on an untarred road, 41 of the farmer respondents transported their okra on a pot hole ridden road and 6 of the farmer respondents reported other road conditions.

Table 11. Crosstab for Classification of Packaging materials and level of post harvest damage

Packaging materials	Level of damages during transportation (%)				Total	
	0	0-10%	11-20%	21-30%		
Baskets	11 (11.2)	21 (21.8)	6 (6.2)	4 (2.8)	42	(56.0)
Sacks	6 (7.2)	15 (14.0)	5 (4.0)	1 (1.8)	27	(36.0)
Buckets	2 (0.5)	0 (1.0)	0 (0.3)	0 (0.1)	2	(2.66)
Other means	1 (1.1)	3 (2.1)	0 (0.6)	0 (0.3)	4	(5.33)
Total	20 (26.6)	39 (52.0)	11 (14.6)	5 (6.6)	75	(100)

Source: Field survey, 2008.

Table 12. Crosstab for classification of road condition and types of damages noticed during transportation.

Road condition	Types of observed damages during transportation					Total	
	No response	Bruises	Disease infection	Punching	Discoloration		
No response	0 (.2)	0 (.0)	1 (.3)	0 (.1)	0 (.3)	1	(1.0)
Tarred	3 (2.7)	0 (.5)	5 (4.0)	0 (.8)	4 (4.0)	12	(12.0)
Untarred	6 (3.4)	0 (.6)	4 (5.0)	1 (1.0)	4 (5.0)	15	(15.0)
Pothole ridden	8 (9.3)	3 (1.6)	11 (13.7)	3 (2.7)	16 (13.7)	41	(41.0)
Others	0 (1.4)	0 (.2)	4 (2.0)	1 (.4)	1 (2.0)	6	(6.0)
Total	17 (17.0)	3 (3.0)	25 (25.0)	5 (5.0)	25 (25.0)	75	(75.0)

Source: Field survey, 2008.

The chi-square computed based on the entries yield a value of 13.8 with associated degree of freedom of 16. It has a probability value of 0.026 which is significant at 5% i.e. (P < 0.05). It therefore implies that the road condition has a significant influence on the type of damages

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noticed during transportation and therefore the null hypothesis should be rejected in favour of the alternative hypothesis.

The result presented in Table 13 shows that 23 farmer respondents transported their okra fruits by the head to the road side, 14 used bicycles, 13 used motorcycles while 24 used motor vehicles in transporting their produce to the farm gate. Results show that about 52% (39 respondents) agreed that damage associated with type of vehicle used in transportation could reach up to 0-10% by volume. Twenty six percent (20 respondents) reported no damage at harvesting and 14.6% (11 respondents) agreed that damages as a result of type of vehicle used in transportation to the road side could reach up to 11-20% while 6.6% (5 respondents) recorded about 21-30 % level of damage during transportation to the road side.

Computed chi-square value of 19.09 (with 12 degree of freedom) presented a probability level of 0.013 ($P<0.01$). This implies a statistical level difference between the farmers respondents choice of how okra fruits are convene out of the farm to the road side. This means that the null hypothesis can be rejected in favour of the alternative hypothesis. This shows that there is a statistical difference between how the respondents respond to the different options.

The result from Table 14 shows that a total of 45 respondents at the market determine okra fruit quality by pressing the tip of the fruits to breakage point (snapping), six other respondents employ cutting with knife, 19 of the respondents determine okra fruit quality by mere looking at the fruits while the other five respondents use other means to determine fruit quality.

Results shows that about 33.3% (25 respondents) disclose that they noticed discoloration and disease infection due to the methods employed in determining quality, 22.7% (17 respondents) did not notice any type of damage resulting from different methods of quality determination while another 6.6% (5 respondents) noticed punches on the fruits. The computed chi-square value of 28.698 had a probability value of 0.004 ($P<0.01$) indicating that it is significant and therefore the null hypothesis can be rejected in favour of the alternative hypothesis. This implies that the method of quality determination had significant influence on the type of post harvest damages observed at the market place.

It was observed from Table 15 that 41 farmer respondents used hired labour in harvesting their okra fruit, another 33 used family labour in harvesting while only one farmer used both family and hired labour. Results show that about 56% (42 respondents) agreed that damage associated with the type of labour employed could reach up to 0-10% by volume. No damage at harvesting and 21.33% (211 respondents) agreed that damages as a result of the type of labour employed in harvesting could reach up to 11-20% while 1.33% (one respondent) recorded about 21-30 % level of damage during harvesting.

Table 13. Cross tab classification of type of vehicle used in transportation and the level of damage during transportation from farm to the road side.

Type of vehicle used	Level of damage during transportation to the farm gate (%)				Total
	0%	0-10%	11-20%	21-30%	
By head	5 (6.1)	16 (12.0)	2 (3.4)	0 (1.5)	23 (31.66)
Bicycle	5 (3.7)	4 (7.3)	2 (2.1)	3 (0.9)	14 (18.66)
Motorcycle	5 (3.5)	9 (6.8)	15 (1.9)	0 (0.9)	13 (17.68)
Motor vehicles	5 (6.4)	10 (12.5)	7 (3.5)	2 (1.6)	24 (32.0)
Total	20 (26.6)	39 (52.0)	11 (14.6)	5 (6.6)	75 (100)

Source: Field survey, 2008.

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Table 14. Cross tab classification of the methods of determining quality and the types of post harvest damage of okra fruits

Methods of determining quality	Types of damages observed					Total
	Nil	Bruises	Diseased	Punching	Discoloration	
Pressing the tip of the pod	6 (10.2)	1 (1.8)	14 (15.0)	2 (3.0)	22 (15.0)	45 (60)
Cutting with knife	1 (1.4)	0 (.2)	4 (2.6)	0 (.4)	1 (2.0)	6 (8.0)
By mere look	9 (4.3)	2 (0.8)	3 (6.3)	3 (1.3)	2 (6.3)	19 (25)
Other means	1 (1.1)	0 (0.2)	4 (1.7)	0 (0.3)	0 (1.7)	5 (6.6)
Total	17 (22.7)	3 (4.0)	25 (33.3)	5 (6.6)	25 (33.3)	75 (100)

Source: Field survey, 2008.

The result from table 16 shows that 62 farmer respondents reported they notice the effect of sunlight on their product while 13 of the respondent farmers did not notice any sunlight effect on their okra. The computed chi-square value of 8.998 had a probability value of 0.031 ($P< 0.05$), indicating that it is significant and the null hypothesis should be rejected. It is therefore concluded that sunlight has significant influence on the different types of damages noticed.

The computed chi-square value of 41.446 presented a probability value of 0.0001 ($P<0.01$). This indicates that there is a highly significant difference in the response to the option of labour. For this reason the null hypothesis is rejected in favour of the alternative hypothesis. It is therefore concluded that the type of labour used in harvesting okra has significant influence on the level of damage to okra fruits during harvesting and subsequently affecting the marketing quality of the fruits.

Table 15 Cross tab Classification of the type of labour used in harvesting and the level of damage noticed during harvesting

Types of labour	**Level of damage during harvest (%)**				**Total**
	0	**0-10%**	**11-20%**	**21-30%**	
Hired labour	1 (8.7)	36 (23.0)	4 (8.70	0 (0.5)	41 (54.66%)
Family labour	15 (7.0)	6 (18.5)	11 (7.0)	1 (0.4)	33 (44.00%)
Both	0 (0.2)	0 (0.6)	1 (0.2)	0 (0.0)	1 (1.33%)
Total	16 (21.33)	42 (56.0)	16 (21.33)	1 (1.33)	75 (100%)

Source: Field survey, 2008.

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Table 16. Cross tab Classification of effect of sunlight and the types of damages noticed

Sunlight effect	Types of damages noticed					Total	
	No response	Bruises	Diseased	Punching	Discoloration		
Yes	13 (14.1)	3 (2.5)	17 (20.7)	5 (4.1)	24 (20.7)	62	(82.7)
No	4 (2.9)	0 (0.5)	8 (4.3)	0 (0.9	1 (4.3)	13	(17.3)
Total	17 (22.7)	3 (4.0)	25 (33.3)	5 (6.7)	25 (33.3)	75	(100)

Source: Field survey, 2008.

SUMMARY OF THE FINDINGS

An appraisal of the current practices used in the post-harvest handling of fresh fruits in Minna was conducted to identify the inherent problems involved. This is with the view to generating useful information and results to maintain quality and curtail losses. The Investigative Survey Research Approach (ISRA) was used, thus structured questionnaire were administered to okra farmers and marketers in the selected locations within Minna environs i.e. Sabon–gida, Garatu, Gidan-mangoro and Minna central farm and market through personal interviews. The result shows that the current post harvest system is faced with a lot of problems. The poor road network, lack of pre-cooling system, poor harvesting method, non-availability of desired vehicle for transportation, unavailability of vehicles to transport the produce to the market at the right time, have been identified as the major points where the reduction in quality results. The result of the study can be utilized to conceptualize appropriate handling device that will minimize the current losses and maintain the quality of marketable okra.

CONCLUSION AND RECOMMENDATIONS

Based on the result and the observations made during study, it seems the current post harvest handling systems for okra fruits in Minna are inadequate. The people involved are actually helpless and so they are living with the inherent problems. However there is room for improvement in the system so as to ensure the delivery of quality products and reduce the losses and also promote markets both locally and internationally for this produce. The study reveals some of the problems quality of marketable okra to be associated with such issues as: Method of quality determination of okra fruits, poor harvesting methods, level of training of the okra harvesters, non-availability of good vehicles, bad roads and inadequate pre-cooling facilities.

Based on the above observations, the following recommendations are made in order to improve the post harvest handling of okra fruits in the study areas.

1. Packaging houses for adequate sorting and pre-treatment should be provided at the major collection centers to minimize adverse effect of the environment.

2. Well ventilated vehicles, such as pick-up vans should be used in transporting the produce to the market to avoid increase in respiration rate of the okra fruits which leads to detoriation.

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3. Avoid overloading and compression of packaging materials while transporting the produce to the market.

4. Knives are recommended as the best harvesting tools rather than hand plucking which causes damage to the pericap.

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