



Post-Harvest Properties of Tomato and Effect on Its Marketing Efficiency

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Abstract

In this study the effect of post-harvest properties of tomato on its marketing efficiency was investigated by surveying 60 tomato marketers. Surveyed tomato marketers were purposively selected from two major tomato markets (Ogbegonogo and Igbodo markets) in Delta state, Nigeria. Primary data were collected from the respondents with the use of observation and interview schedule. Data collected were analyzed using price correlation coefficient and shepherded-futrel coefficient of marketing efficiency. From the result, the price correlation between the two markets was 0.7 indicating the presence of fairly high spatial price integration. However, inter seasonal price correlation coefficient of 0.4 implies the existence of weak inter seasonal price integration in the tomato marketing system. The Shepherd-Futrel coefficient of marketing efficiency of 78.15% suggests that the level of marketing efficiency of tomatoes in the study area is low (21.8%). Further analysis of data revealed that profitability and hence efficiency of tomato marketers is significantly affected by post-harvest perishability in the study area. It is recommended that marketing infrastructures should be provided to improve post-harvest properties of tomato and its marketing efficiency.

Keywords: Post-Harvest, Perishability, Tomatoes, Marketing Efficiency

Introduction

Tomato (*Solanum lycopersicum* L) production is a major source of income for majority of households in Nigeria. It is cultivated in both tropical and sub-tropical regions. It is grown for its edible fruit which can be eaten raw in salad, cooked and made into puree in canning industries (Komolafe and Adegbola, 1979).

Tomato is used as condiments for stew which is a regular feature of African meals. Hence it is an important ingredient in the confectionary industry. Today in Nigeria, it is very important in the diet of both rural and urban dwellers. Tomato contains protein, edible oil, vitamin A, B and C and mineral (Igene and Akinbolu, 1994).

The bulk of the tomatoes traded in Nigeria are produced by small-scale farmers. Population growth and development has led to increase in demand and marketing activities for tomato. Tomato marketing is a source of livelihood (i.e it creates employment and generates income) to a sizeable number of households in Nigeria. In spite

of the popularity of these plants, spoilage problem is commonly encountered in its marketing.

The goal of transport in marketing is to convey produce from production centers to consumer markets with minimal loss of quality (Karaköy et al., 2012). An inefficient transport system is a disadvantage to tomatoes marketing since it has direct influence on cost, its quality and overall postharvest losses. As high as 10-20% postharvest losses occur due to delays in transport arrangements and long distances to urban markets (Sugri et al., 2013). This huge loss is unacceptable since economic resources would have been expended, and given that myriads of recommendations exist on postharvest quality management. A glut occurs at harvest and follows shortly by acute scarcity, which results in excessive price fluctuations.

Post-harvest properties of tomato fruit include: color, firmness, total soluble solids of tomato and shelf-life of tomato (Akter and Khan, 2011; Babatola et al., 2008; Gautier et al., 2008; NurHossain et al., 2011; Safdar et al., 2010; Sargent

et al., 1992; Tadesse et al., 2012a; Tadesse et al., 2012b)

In Nigeria, postharvest storage and processing have been identified as the main causes of seasonal fluctuations of supply and price, high quality loss and socio-economic loss to producers. In Nigeria, tomatoes are harvested at vine-ripe due to lack of cool-chain and ripening facilities to handle mature-green to turning stages. However, as tomatoes ripen and senesce during transportation, greater care is required to minimize physical damage. Processing the fruits into preserved products could ameliorate this situation, unfortunately processing equipment is lacking, and some families prefer to use fresh tomato for cooking. Depending on the target market, tomato handling, transportation and marketing may require sophisticated technologies and facilities. However, simple recommendations exist to extend shelf life at ambient conditions. General recommendations are that tomatoes can be harvested at mature-green stage and ripened under controlled conditions

Post-harvest perish ability is a major threat to the marketing of tomatoes. As high as 10-20% postharvest losses occur due to delays in transport arrangements and long distances to urban markets (Sugri et al., 2013). An efficient agricultural marketing system ensures that both the producers and consumers attain equilibrium benefit. Evaluation of tomato marketing efficiency would require information on post-harvest perish ability (Abbot and Markeham, 1986). Inefficient transportation of tomato to the market, is one of the problems of tomato marketing as it leads to high degree of spoilage (Afolabi and Ayinde, 2001). The rural growers and marketers of fresh tomato fruits recognize the perish ability of the product. Consequently it is sold off in a hurry, sometimes at uneconomic rates. Perishability implies deterioration or loss of natural quality or marketable life or salable quality. Marketable life was expressed as the number of days after storage that the fruits maintained salable quality (Sugri et al., 2013). Spoilage of fresh tomatoes is capable of increasing total cost, which may ultimately translate to loss to the marketer. Tomato production and marketing could alleviate poverty and boost food security. But more research works should be conducted on post-harvest losses/perish ability of tomato, because it is a source of discouragement to both producers and marketers in rural Africa.

Before now, approaches to the determination of post-harvest losses of tomato was fraught with difficulties. As a result information on losses were estimates rather than actual measurement. Such calculation may be defective at

best (Shepherd, 1993). The problem of post-harvest losses may escalate the marketing risk and fears of tomato marketers in the study area. Market integration among two or more markets is a multi-dimensional concept implying similarity in price (Price integration), standardization of measure and common trade habits (Lutz et al., 1995). Price integration is therefore one of the several necessary conditions for market integration. In a competitive market, price integration is the outcome of an arbitrage process i.e exchange or trade between actors in different markets who aim at taking economic advantage of price differences that exceed transaction costs (Afolabi and Ayinde, 2001).

The study was designed to provide answers to the following research questions: Is there price integration in tomato markets? Is there correlation between tomato spoilage and its marketing efficiency? As it stands, there is lack of empirical information on tomato post-harvest properties and marketing efficiency in Nigeria. The findings of this study are expected to enhance the marketing efficiency of tomato in the study area. The specific objectives of the study were:

- i) to analyze the spatial and inter seasonal price integration of tomatoes in two different markets in Delta state, Nigeria;
- ii) to correlate post-harvest properties of tomatoes with profitability in tomato marketing;
- iii) to determine an index of marketing efficiency of tomato in the study.

The following null hypothesis was formulated to guide the study:

Ho: *There is no significant relationship between tomato post-harvest properties and its marketing efficiency.*

Materials and Methods

Description of Study Area

The study was carried out in Delta State, Nigeria. This location was chosen for the study because tomato marketing offers means of livelihood to a lot of people. Ogbegonogo market in Asaba (urban centre) and Igbodo market (sub-urban centre). These markets were purposively selected for the study due to their unique features with respect to tomato marketing. Ogbegonogo market attracts large supply of tomatoes from traders who travel to various parts of Northern Nigeria to buy tomato for resale. This is however, supplemented with supplies from adjoining farming communities during tomato season. On the other hand, Igbodo is both tomato producing and tomato marketing center. However, they supplement their inter-seasonal out-of-stock with tomato produced in the

Northern part of Nigeria. The major economic activities in the study area are civil service jobs, farming and trading in foodstuffs including tomato.

Sampling procedure

The sampling frame was made up of middlemen namely wholesalers and retailers. Hence 30 retailers and 5 wholesalers were purposively sampled from Ogbegonogo market, Asaba, while 20 retailers and 5 wholesalers were purposively sampled from Igbodo market. This gave a total of 60 tomato marketers (i.e 10 wholesalers and 50 retailers) that were chosen and studied. The distribution of respondents is shown in Table 1.0.



Fig. 1. Displayed tomato in local market store

Data Collection Techniques

Primary data were collected with the use of interview schedule and observation techniques. Primary data were personally collected from respondents by the researcher in 2005. Information was collected on tomato market price for the previous year (2004) and present year (2005), marketing cost, quantity of spoiled tomato and marketing revenue. Secondary data were also collected from journals and other published and unpublished materials to accomplish the study.

Data Analysis Techniques

Data collected were analyzed using simple descriptive statistics such as mean, standard deviation, percentage and frequency distribution table.

Correlation analysis was conducted to achieve two aims:

- (i) to establish relationship between tomato post-harvest properties and its marketing efficiency.
- (ii) to determine relationship between post-harvest properties of tomato and spatial / inter seasonal price integration in the study.

Table 1. Distribution of respondents according to scale of operation and markets

Markets	Wholsalers	retailers	Total
Ogbegonogo	5	30	35
Igbodo	5	20	25
Total	10	50	60

Source: Field Survey Data, 2005

Pearson product moment correlation coefficient is given as:

$$r_{xy} = \frac{n\sum XY - (\sum X)(\sum Y)}{n\sqrt{\sum X^2 - (X)^2 \sum Y^2 - (Y)^2}} \quad (1)$$

Experts such as Okereke,(1988), have used correlation coefficients to measure to determine price relationship as a measure of market integration. Where price correlation coefficient between markets is high and positive, integrated market was inferred.

Also Shepherd-Futrel Model of coefficient of marketing efficiency was adopted in measuring tomato marketing efficiency in the study as shown below; Shepherd-Futrel Model of coefficient of marketing efficiency is presented as:

$$M.E. = TC/TR \times 100/1 \quad (2).$$

(Arene, 2003).

Where:

M.E. = Marketing Efficiency

TC = Total Cost (₦)

TR = Total revenue (₦)

This shows the percentage of total gross revenue that was gulped by marketing cost. The lower the coefficient, the higher the level of marketing efficiency it denotes.

Assessment of Tomatoes perishability criteria includes loss of fruit firmness, weight loss, colour loss and presence of mechanical injuries. Perishability is therefore the disappearance of all or some of the acceptance features of tomato. The financial worth of tomatoes that lack acceptance criteria was determined by the marketer using the following notation. Value of spoiled tomatoes:

$$CSt = Qt(Pt) \dots\dots(3)$$

Where:

CSt = Cost of spoiled tomatoes (₦)

Qt = Quantity of spoiled tomatoes (baskets)

Pt = Unit price of tomatoes (₦)

This was done to convert the quantity of spoiled tomatoes to its money (Naira) worth.

Table 2. Demographic characteristics of respondent tomato marketers

Gender	Frequency	Percentage
Male	13	21.5
Female	47	78.5
Total	60	100
Age range		
<20	2	3.3
21-30	4	6.6
31-40	31	51.7
41-50	16	26.7
>50	7	11.7
Total	60	100
Educational attainment		
No. formal education	13	21.7
Primary	15	25
Secondary	30	50
Tertiary	2	3.3
Total	60	100
Year of experience		
<5 years	20	33.3
6-10 years	39	65
>10 years	1	1.7
Total	60	100

(Source: Survey data, 2005.)

Results

Socio-economic Characteristics of Tomato Marketers in the Study area

The demographic characteristic of tomato markets in the study area is presented in table 2.0. The findings of the study shows that majority 47(78.5%) of the marketers were female and fall within the age range of 31-40 years. This implies that tomato marketing was dominated by women. This perhaps was due to the fact that tomato marketing in the study area was mainly on small-scale. The market was bias towards women folk. This result agrees with the earlier reports of previous authors (FAO, 1993), that African women dominate small-scale agricultural marketing but with less participation in wholesaling of perishable items. They agreed that the income realized was

used to support the household expenses and little savings. Majority of the tomato marketers (50%) had secondary education and 65% of them had been in the business for the past 6 to 10 years.

Profitability in the marketing of tomatoes is presented in Table 3. The Wholesalers sold tomatoes in the tomatoes in baskets and buckets while the retailers sold the product in plastic plates in the study area. The study revealed that about 38% of the respondent marketers (retailers) made profit range of ₦4000 - ₦5000 per month. Also 45.3% of the marketers (retailers) had a profit range of ₦6000-₦7500 per month. The remaining 16.7% of the marketers were wholesalers. The profit range was between ₦10, 750 per month.

Table 3. Profitability in the marketing of tomato

Profit range/month	Frequency	Percentage
below-₦4000	6	10
₦4000 - ₦5000	17	28
₦6000-₦7500	27	45.3
₦10,750 & above	10	16.7

(Source: Survey data, 2005)

Tomato Marketing Efficiency Index

The Shepherd -Futrel marketing efficiency (M.E) coefficient for tomatoes is computed to be 78.15%.

$$M.E = \frac{TC}{TR} \times \frac{100}{1}$$

$$= \frac{211,000}{270,000} \times \frac{100}{1}$$

$$= 78.15\%$$

This shows the percentage of total gross revenue that was gulped by marketing cost. It further revealed that the value added was 21.8%. This is the productivity of resources invested in the tomatoes marketing system.

Table 4. Correlation between post-harvest properties of tomato and spatial / inter seasonal price integration

Markets	Spatial price corre. coeff.	Interseasonal price corre. coeff
Ogbegonogo	0.7	0.4
Igbodo		

(Source: Survey data, 2005.)

Spatial integration in tomato marketing in the study area

The two major tomato markets (Ogbegonogo and Igbodo markets) that were studied were commercially well behaved. They

were spatially interrelated by the price links between them at a correlation value of 0.7. Price correlation coefficient of 0.7 implies that tomato price changes in Urban market (Ogbegonogo) is associated with similar price changes in the neighboring rural market at Igbodo. The price variation between locations was therefore insignificant. This result shows that since the markets were integrated in terms of price behaviour, they can be classified as one market, especially when transportation cost is considered. This is in accordance with “law of one market”. This implies that there is spatial integration in the tomato marketing system. Hence it is not economical to move the product in between the two markets. The existence of spatial integration would lead to the availability of the product in any of the markets with relatively lower price. Though Ogbegonogo market sells at relatively higher price than Igbodo market, considering the cost of transport and possibility of spoilage tomato marketers may find it unprofitable to move the product in between the two markets. This post-harvest perishability tends to encourage spatial market integration.

Inter seasonal Integration in Tomato Marketing in the Study Area

The study reveals that there was inter seasonal price differential in tomatoes marketing in the study area. The inter seasonal price correlation coefficient is 0.4. This implies that the prices of post-harvest tomato in between seasons were far apart. This is perhaps due to the fact that the product is perishable and cannot be stored in between seasons after harvest. That notwithstanding, the effect of the inter seasonal price differential can be compensated for the influx of fresh tomato from the northern part of Nigeria, where possibly, there is all-year round production of tomato due to the availability of functional irrigation facilities. This can sustain tomato marketers in business in the southern Nigeria throughout the year, though with little drop in profit.

Relationship between tomato post-harvest properties and marketing efficiency index

Table 3.0 above shows the correlation coefficient of the relationship between post-harvest losses in the marketing of tomatoes. The calculated value of correlation coefficient (r_{cal}) is -0.6, while the corresponding critical value (r_{crit}) at 1% level of significance is 0.32. Since the calculated value is greatest than the critical value, we reject the null hypothesis and accept the alternative hypothesis which states that “there is significant relationship between post-harvest perishability of tomato and its

marketing efficiency index in the study area. Furthermore, since the correlation coefficient value is negative (-0.6) it implies that the higher the post-harvest perishability of tomato, the lower the marketing efficiency and vice versa.

Discussion

The lower the coefficient of marketing efficiency of tomato in the study area could be attributed to its high marketing cost incurred due to post-harvest perishability. Majority (87%) of the surveyed tomato marketers admitted that the post-harvest perishability of the product was a major threat to its marketing efficiency. They identified some causes of post-harvest perishability of tomato in the study area to include: mode of transportation to the market, distance to the selling center, mode of storage length of storage, variety of tomato traded and turnover rate. The spatial market integration was present due to the inability to move tomato in between markets and the potential marketing risk or danger of losses in transit. Interpersonal market integration was absent due to inability to store the product long enough. The monetary value of tomato perishability correlates significantly and negatively correlates with tomato marketing efficiency index. Generally, the use of mechanical equipment for harvesting, packing and transporting fruits increases susceptibility to mechanical injury and respiration rate (Lee et al., 2007). Work done by Moretti et al. (2002) indicates that tomato fruits were subjected to several impacts during handling and packing; undergoing at least 15 handling steps. The proportion of visibly damaged tomatoes increased from 15% to 35% after dumping, while internal bruises increased from 5.2% to 23.8% for tomatoes sampled from the baskets and grading table, respectively. Mechanical injury has been correlated with metabolic disorders and quality changes in fruits and vegetable. For instance, changes in aroma volatile profiles in round-type tomato were induced by mechanical impact (Moretti et al., 2002). According to Lee et al. (2007) even rough dropping during handling could increase impact and subsequently reduced shelf life of tomato. Tomatoes handled at “turning” stage developed 4 times more bruising injury than those handled at mature-green stage, and 8 times more than immature-green tomato. Internal bruising was more pronounced on tomatoes handled at breaker-stage than at mature-green stage (Olorunda and Tung, 1985). Sugri et al. (2011), had similar result that despite the depth of information to improve post-harvest properties, little progress has done in tomato marketing in most parts of Africa. Also Olorunda and Tung (1985), observed that primary

and secondary causes of post-harvest losses were still prevailing in the food marketing system in the tropic. This result implies that commercial tomato

perish ability could be attributed to the low level of infrastructural development.

Table 5. Correlation between tomato post-harvest properties (perish-ability) and the marketing efficiency

Variation	Mean	N	DF	A	r.cal	r.crit	Remark
Efficiency(Y) 21.78%		60	58	1%	-1	0.32	Sig
Perishability(X) 4218.9							

Conclusion

Therefore, the study concludes that post-harvest properties increases tomato marketing cost and reduces marketing efficiency in the study area. Post harvest properties of tomato predispose it to losses. Post-harvest properties of tomato are an important factor in the tomato marketing efficiency model. Improving the post-harvest properties of tomato could enhance its marketing efficiency and bring more income to the marketer.

The authors recommend that under current market constraints, fruits will naturally maintain premium quality for only 2-4 days, but can be extended to 8-15 days if efficient storage facilities are available. However, access to such facilities is beyond the purchasing power of small-holder traders, thus the involvement of the Government and/or Private Sector to providing these facilities would be beneficial; particularly in urban markets where retail prices will merit such investments. By combining proper handling and preservation measures, post-harvest properties of tomato will be improved and traders can efficiently market tomatoes and earn more profit. Also tomato traders should have proper inventory control skills so as to avoid over stocking of tomato at a time in the store.

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