International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 08, August-2015

Postharvest Transit Losses of Tomato in Different Packaging Unit in Nigeria

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***Abstract* - The current packaging method of tomato in Nigeria is packaging with traditional cane woven conical baskets. Preliminary studies on this packaging method lead to design of rectangular shaped woven baskets based on mechanical, physical and rheological properties of UC-tomato cultivar. The designed packaging is of specification 500mm length x 400mm width x 200mm depth with filling capacity of 25kg. The conical basket having specification: top diameter x bottom diameter x depth (550 x 340 x340mm) was found to carry 40kg of tomato. The two baskets at full load with UC-82tomato cultivar were field tested concurrently on a Canter Truck via a single asphalted high way from Mairuwa village(tomato production area in Katsina State) to Ibadan(tomato consumption area of Oyo State) a distance of 877km. At the destination of the journey tomato loss assessment were conducted; the conical basket recorded post-harvest loss in transit of tomato of 13.22% and tomato weight loss per day of 6.85%, rectangular basket recorded post-harvest loss in transit of tomato of 3.58% with tomato weight loss per day of 1.91%. Statistical analysis on the generated data using paired t-test indicated that, the difference in post-harvest loss in transit of two packages is highly significant (pr<0.5) and the difference in tomato weight loss per day is significant (pr<0.5).The rectangular shaped woven basket stands superior in transit loss saving.**

Keywords: Post- harvest, Packaging, Tomato, Transit, Loss

1.0 INTRODUCTION

The problem of food losses, particularly post-harvest loss has been and is still a global problem (Mijinyawa, 2006). The major step towards achieving a greater level of food increase and security is to prevent food losses between harvest and consumption. Among the horticultural crops, Nigeria produces about 6 million tones of tomatoes (Lycopercicum exculuntum) annually (Idah et al., 2007). The defect in post-harvest handling, transportation and storage had caused between 20-50% of the fruit loss (FAO, 1977, Olorunda and Aworh 1983, and Nwajiuba, 2000). The major cause of these losses was the mechanical damage as a result of static and dynamic stresses during post-harvest transit (Opadokun, 1996).The Nigerian tomato have been handled and transported using tradition Bamboo woven baskets. These baskets were not specifically designed to handle or transport tomato rather they have been in existence as the general agricultural produce support containers since pre-civilization times. Various sizes of these baskets have been employed for tomato distribution using un-refrigerated transport devices (DAF Truck, 911 Truck and Canter Truck) nation wide, covering a distance of over 1000km contributing to the above stated post-harvest losses. Dzivama, et,al.(2012) indicated that the transit losses of tomato in Nigeria are purely as a result poor packaging.

Current packaging method of tomato utilizes a woven conical basket of carriage capacity of 40kg. Based on the observed limitations of this basket (Low space utilization, Short life span etc) a new rectangular basket was developed using willow material. The rectangular basket was designed to carry 25kg of fresh tomato. Both the two packaging units were subjected to field trial using Canter truck (Plate1). The field trial was conducted in the month of April and the truck took up from Mairuwa town (11º11'N, 07o38'E) along a single asphalted highway and stopped finally at Ibadan (07º22'N, 03o 58'E) a distance of 877km.ss The main objective of this study was to measure the postharvest transit losses of tomato for the two packaging unit and come-up with the best package that can appropriately transport tomato in Nigeria.

Plate1: Canter Truck containing the tomato loaded packages at Ibadan.

2.0 MATERIALS AND METHODS

2.1 Materials

The conical shaped basket was produced in the southern part of Nigeria and distributed nation wide as tomato transport packages. The baskets were purchased from a dealer in Mairuwa town. The basket is made of bamboo cane, having specification: top diameter x bottom diameter x depth (550 x 340 x340mm), carriage capacity of 40kg (plate2).

The designed rectangular basket is made of willow strands and was produced by willow whickerers of the northern part of Nigeria. Its specifications were: length x width x depth (500 x 400 x 200mm), 25kg (plate3).

Vine ripened UC82 tomato cultivar produced at Mairuwa flood plain during dry season were used for the field trial.

The transport device used in the field trial was Canter Truck. The truck shock absorbers are made of spring and dumper, its carriage capacity was 4.5Tonnes.

Basic instrumentation used includes 50kg capacity flathead salter scale of resolution 50g.

Plate2: Conical Basket

Plate3: Rectangular Basket

2.2 Methods

The experimental material used was the UC82-tomato, in order to have homogenous material; the UC-tomato was grown in the Mairuwa flood plain in Funtua local government area of Katsina State. The tomato received all the necessary cultural practice as done by farmers (production, harvest, sorting, grading and packaging). Nevertheless, 877 km was used as test span. This route includes: Mairua-Funtua, Funtua- Birnin Gwari, Birnin Gwari-Ilorin, Ilorin-Ibadan. Fifty packages were selected randomly from the lot of each packaging unit, cleaned and loaded with the graded tomato at net loading capacities of 40 and 25kg in the evening at the time of harvest (manual) at the farm gate. The conical baskets were arranged at the inner part of the truck in three layers (due to its stacking nature) while the rectangular baskets were neatly stacked in six layers towards the tail end of the truck body. Thus the two packing unit constituted an independent store on the same vehicle shearing similar advantages and disadvantages in terms of vibrations. The vehicle took off in the company of the researchers and covered the said distance on asphalted single highway for 11hrs in a night journey, two prayer time stops were observed for 25minutes.

At the final destination in Ibadan, the loaded baskets were immediately offloaded. A random sample of twenty baskets each was selected and set for loss assessment (Bani et. al, 2006 and Idah et.al, 2007). Gross weight of each basket was recorded and the net weight of tomato in each computed. In each basket damaged and undamaged tomatoes were separated and the damaged was further separated in those that are at hookean level(10% diameter bruise depth), non-hookean level (40% diameter bruise depth) and those at visco-plastic level (70% and above diameter bruise depth)(El-Okene,2008). All the weights were recorded separately for the conical and the rectangular packages. In Nigeria damaged tomatoes has some market values, as such they were integrated in the determination of the transit losses. Loss of weight of tomato per day was also computed from each selected basket.

Paired t-test was used in comparing the performance of the two packaging units.

Method used in calculating the post-harvest transit loss was:

the tomato market prices in Nigerian currency on the day at Ibadan were computed as:

Fresh vine ripened tomato;

Morning Price	₦1500/40kg	or	₦37.5/kg
Afternoon Price	₦1400/40kg	or	₦35.0/kg
Evening Price	₦1200/40kg	or	₦30.0/kg
Mean Price	₦36.9 /kg		

Damaged Tomato Prices;

Hookean and NonHookean	₦10.7/kg
Visco-Plastic	₦4.87/kg

However the price of this category was constant on the assessment day.

Sample Calculation of the post-harvest Transit Loss:-

Consider the first reading in Table1.0

Fresh farm gate marketable tomato = 40 kg

Price at market = 36.9 x 40 = ₦1476

Fresh undamaged tomato at market = 32.3 kg

Price at market = 32.3 x 36.9 = ₦ 1191.87

Damaged tomato (hookean) = 3 kg

Price at market = 3 x 10.7 = ₦ 32.1

Damaged tomato (visco-plastic) = 1.2 kg

Price at market = 1.2 x 4.87 = ₦ 5.84

Total price of the tomato at the market = 1191.87 + 32.1 + 5.84 = ₦ 1229.8

Loss of tomato = 1476 – 1229.8 = ₦ 246.8

% Post-harvest Loss of Tomato in Transit = (246.8/ 1476) x 100 = 16.7%

3.0 RESULTS AND DISCUSSION

The result obtained for the conical basket is shown in table1.0. Due to its geometry the tomatoes at the bottom suffers from hookean and visco-plastic damage. This is an indication of over loading of the basket. The basket that suffers more damage equally suffers more weight loss, from excel package of statistic the mean post-harvest transit loss of tomato with this package was 13.22% and mean tomato weight loss of 6.85% ($pr<0.5$), this result is in agreement with the findings of Idah et.al (2007) and Dzvama et.al(2012) .No collapsed basket was found in the truck during the off loading, meaning that the stacking layer (3) adopted as shown in plate1 was adequate.

Table 2.0 indicated the result of loss assessment of the rectangular basket. The package suffers hookean and non-hookean damage, no basket recorded visco-plastic damage. This could translate to mean that the tomato loading in the basket was adequate. The mean post-harvest transit loss of tomato in this package was 3.58% and a tomato weight loss of 1.91% ($pr<0.5$). From the result of the paired t-test, the difference of post-harvest transit loss of the two packaging unit is highly significant at 5% level where as the loss in weight of tomato is significant at the same level.

Table1.0 Tomato Transit Loss Assessment (Conical Basket)

Basket S/No	Basket Wt (kg)	Farmgate Tomato Net Wt (kg)	Market Tomato Net Wt (kg)	Fresh Marketable Tomato (kg)	Damaged Tomato (kg)			Wt Loss (kg)	% Wt Loss	% Transit Loss
					Hookean Level	Non Hooke-an	Visco Plastic Level			
1	1.0	40	36.5	32.3	3.0	-	1.2	3.5	8.6	16.7
2	1.2	40	36.8	34.0	1.8	-	1.0	3.2	8.0	13.4
3	1.0	40	36.8	33.6	2.0	-	1.2	3.2	8.0	14.1
4	1.0	40	34.4	32.3	1.4	-	0.7	5.6	14.0	18.0
5	1.0	40	30.6	27.95	1.55	-	1.1	9.4	23.5	28.6
6	1.2	40	37.3	34.2	2.1	-	1.0	2.7	6.8	12.6
7	1.3	40	38.9	36.1	2.2	-	0.6	1.1	2.8	7.9
8	1.2	40	40	35.4	3.4	-	1.2	0.0	0.0	8.6
9	1.2	40	39.8	36.9	1.6	-	1.3	0.2	0.5	6.2
10	1.2	40	39.0	34.8	3.0	-	1.2	1.0	2.5	10.4
11	1.2	40	37.8	35.0	2.0	-	0.8	2.2	5.5	10.8
12	1.2	40	36.6	34.6	1.6	-	0.4	3.4	8.5	12.2
13	1.2	40	37.6	33.4	3.0	-	1.2	2.4	6.0	13.9
14	1.2	40	38.2	35.1	2.0	-	1.1	1.8	4.5	10.4
15	1.2	40	39.0	36.1	2.1	-	0.8	1.0	2.5	8.0
16	1.0	40	37.0	33.3	2.4	-	1.3	2.1	5.3	14.6
17	1.0	40	35.0	31.2	2.6	-	1.2	5.0	12.5	19.7
18	1.0	40	37.4	34.6	1.8	-	1.0	2.6	6.5	11,9
19	1.2	40	36.2	33.4	2.0	-	0.8	3.8	9.5	14.8
20	1.2	40	39.2	34.0	2.6	-	2.8	0.6	1.5	12.2

Table2.0 Tomato Transit Loss Assessment (Rectangular Basket)

Basket S/No	Basket Wt (kg)	Farmgate Tomato Net Wt (kg)	Market Tomato Net Wt (kg)	Fresh Marketable Tomato (kg)	Damaged Tomato (kg)			Wt Loss (kg)	% Wt Loss	% Transit Loss
					Hookean Level	Non Hooke-an	Visco Plastic Level			
1	2.2	25	24.25	23.55	0.4	0.3	-	0.75	2.0	5.0
2	2.2	25	24.8	23.95	0.6	0.25	-	0.20	0.8	3.2
3	2.2	25	25.0	24.25	0.5	0.25	-	0.0	0.0	2.1
4	3.0	25	23.6	23.40	0.2	-	-	1.4	5.6	6.2
5	3.2	25	24.0	23.2	0.6	0.20	-	1.0	4.0	6.3
6	2.5	25	24.3	23.9	0.4	-	-	0.7	2.9	3.9
7	2.6	25	24.2	23.75	0.45	-	-	0.8	3.2	4.5
8	2.6	25	24.6	24.20	0.6	-	-	0.4	1.6	2.7
9	3.0	25	24.6	23.90	0.6	0.10	-	0.4	1.6	3.6
10	2.6	25	24.2	23.45	0.75	-	-	0.8	3.2	5.3
11	2.4	25	24.1	23.70	0.4	-	-	0.9	3.6	4.7
12	3.0	25	24.8	24.00	0.8	-	-	0.2	0.80.	3.1
13	2.4	25	25.0	24.10	0.6	0.30	-	0.0	0.0	2.6
14	2.2	25	24.8	24.20	0.6	-	-	0.2	0.8	2.5
15	2.6	25	24.6	24.20	0.4	-	-	0.4	1.6	2.7
16	2.9	25	24.4	24.00	0.4	-	-	0.6	2.4	3.5
17	2.4	25	24.5	23.50	1.0	-	-	0.5	2.0	4.8
18	2.2	25	25.0	24.20	0.8	-	-	0.0	0.0	2.3
19	2.4	25	24.7	24.40	0.3	-	-	0.3	1.2	2.0
20	2.2	25	25.0	24.80	0.2	-	-	0.0	0.0	0.6

4.0 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

Post-harvest transit losses of tomato in the two packaging units were assessed and the following conclusions are hereby drawn:

1. There was high tomato loss in transit with the conical basket when compared with the rectangular basket. Thus the rectangular basket stands superior in mass transportation of tomato.
2. The conical basket suffers from tomato overloading which contributed to more tomato weight loss.
3. The rectangular basket had 100% truck space utilization whereas the conical had only 68%.

4.2 Recommendation

The rectangular basket can reduce the cost of tomato transportation, increase the income of tomato farmers and increase the availability of tomato to consumers. It is therefore recommended to tomato package service provides of Nigeria.

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