PROCESSING CONDITIONS ON PERFORMANCE OF MANUALLY OPERATED TOMATO SLICER

Kamaldeen O. S*, Abioye J. S, Awagu E. F and Isiaka A. A

Nigerian Stored Products Research Institute, Kano Station, PMB 3032, Hadeija Road, Kano, Nigeria
Corresponding author E-mail: ksk_deen@yahoo.com

Abstract

Modified tomato slicing machine and the old tomato slicing machine were evaluated to study the effects of tomato firmness on the slicing process of the two machines. The data from evaluation was analyzed using descriptive test analysis and these were compared using student t-test to know the level of improvement achieved on the new machine. The results show that tomato firmness has effect on slicing efficiency and output capacity of the machine. The modified slicer gave the best slicing performance of 94% with mature green tomato and also gave the highest output capacity of 3.09 kg/hr with ripe tomato while the old machine gave the best slicing performance of 65% with mature green tomato and as well gave the highest output capacity of 1.30 kg/hr with ripe tomato.

Key words: Tomato, Slicing, Knife, Firmness, Effects

Introduction

Tomato which is referred to as plant (selenium lycopersicum) or the edible is very nutritionally essential in body as a fruit or vegetable. It is believed to benefit the heart, among other organs. It contains the carotene lycopene, one of the most powerful natural antioxidants. In some studies, lycopene especially in cooked tomatoes has been found to help prevent prostate cancer but other

research contradicts this claim (Tervell 1979). Lycopene has also been shown to improve the skin's ability to protect against harmful Ultra violet-rays. A study done by researchers at Manchester and Newcastle university revealed that tomato can protect against sun burn and help keeping the skin youthful (Tervell 1979).

Fruits and vegetable wastages in Nigeria is high with annual tomatoes loss at an alarming rate of 50 -70% due to poor processing and preservation culture (Okunoya, 1996). In Kano State, 500kg of Tomato being a seasonal crop sells between ₦450 to ₦950 in its season and between ₦3000 to ₦7000 at off season.

Therefore, it is very important to process and preserve tomatoes to ensure its availability during off season. One of the major methods of tomato preservation is drying before storage. Tomatoes are best dried when sliced.

Slicing operation is achieved by cutting, which involves moving, pushing or forcing thin sharp blade or knife through the materials resulting in minimum rupture and deformation of the materials (Raji and Igbeka, 1994). Manual Slicing of tomatoes involves using knife to cut through the tomato to desired thickness for faster and effective drying. This had been considered difficult operation as it is energy and time consuming and off course prone to injury when not done carefully hence the need for slicing machine. The main objective of this work is therefore to investigate the effects of tomato ripeness on the performance of developed tomato slier.

Material and Methods

Experimental Procedure

The effects of processing conditions on the performance of the manual tomato slicing machine as shown in fig. 1 was investigated, such conditions considered are the 3 levels of tomato ripeness

such as mature green, fairly ripped and ripped tomato. The effect of these three levels of tomato ripeness was investigated on the slicing efficiency and output capacity of the tomato slicing machine.

Experiment to study the effects of processing conditions on the performance of the tomato slicing machine was carried out at Nigerian Stored Products Research Institute, (NSPRI), Kano, Kano State, Nigeria, where the modified manual tomato slicing machine was developed.

Fig. 1: Modified and Old manual tomato slicing machines

Performance Indices

The performance indices considered in evaluation of the tomato slicing machine were:

1. Tomato slicing efficiency (S. E %): This measures how effectively the tomato slicing machine slices the tomatoes in a regular size.

$$S.E = \frac{W_{sliced}}{W_T} \times 100$$

Where W_{sliced} = weight of tomato sliced

W_T = total weight of tomato fed into the machine

2. Slicer output capacity (OC kg/hr): This measures the quantity of tomato the slicer can handle per unit time

$$OC = \frac{W_T}{T}$$

Where W_T = total weight of tomato fed into the machine

T = time taken to slice all the tomatoes fed into the machine

Experimental index

The experimental index considered was tomato ripeness. The effect of three levels of tomato ripeness (mature green, fairly ripped and ripped tomato) were investigated on the slicer's performance indices.

Data analysis

Data collected from the experiment was analyzed using descriptive test analysis from excel statistical package.

Results and Discussion

Effect of Evaluated Factor on Slicing efficiency of Developed slicer

The results from experimental evaluation of the effect of three levels of tomato ripeness on slicing efficiency of the developed slicer are as shown in Table 1

Table 1: Experimental results for siling efficiency

S/N	Slicing efficiency for unripe tomatoes (%)	Slicing efficiency for fairly ripe tomatoes (%)	Slicing efficiency for ripe tomatoes (%)
1	94.9	89.3	96.3
2	95.5	92.6	83.3
3	91.7	92.8	78.0
4	93.7	90.8	80.3
Mean	93.95	91.38	84.48

The results were analysed using descriptive test analysis and the results of the analysis are as shown in Table 2. It can be seen from the analyzed results that the slicing efficiency mean value for unripe tomato is higher than that of fairly ripe and considerably higher than that of ripe tomato. This can further be illustrated using graph as shown in fig. 2. It can be concluded from these results that the firmer the tomato, the higher the slicing efficiency. This can be attributed to the fact that ripe tomato tends to be softer than the unripe thereby being pressed by slicer knives instead of slicing.

Table 2: Descriptive test for effect of tomato firmness on slicing efficiency

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
URT	4	3.80	91.70	95.50	93.9500	.83815	1.67631	2.810
FRT	4	3.50	89.30	92.80	91.3750	.82500	1.65000	2.723
RT	4	18.30	78.00	96.30	84.4750	4.08827	8.17654	66.856
Valid N (list wise)	4							

FRT = fairly ripe tomato

RT = ripe tomato

URT = unripe tomato

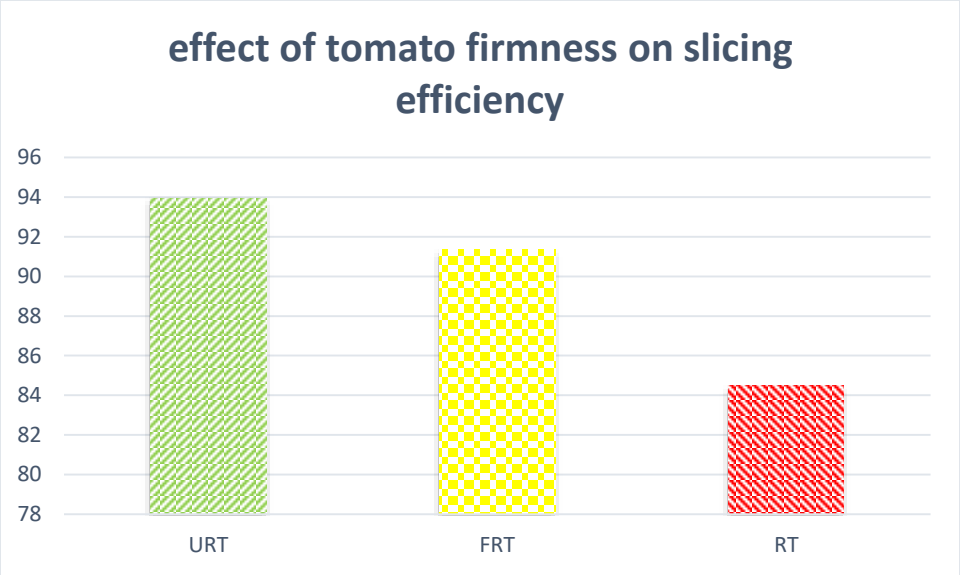

Figure 2: Effect of tomato firmness on slicing efficiency of the slicer

Effect of Evaluated Factor on Output capacity of Developed slicer

The results from experimental evaluation of the effect of three levels tomato ripeness on output capacity of the developed slicer are as shown in Table 3

Table 3: Experimental results for output capacity

S/N	Slicing efficiency for unripe tomatoes (%)	Slicing efficiency for fairly ripe tomatoes (%)	Slicing efficiency for ripe tomatoes (%)
1	1117.2	3492	1815.40
2	1325.2	2872.4	1524.60
3	1153.8	2806.9	2033.90
4	1728.5	3201.4	2040.60
Mean	1331.1750	1853.6250	3093.1750

The results were analysed using descriptive test analysis and the results of the analysis are as shown in Table 4. It can be seen from the analyzed results that the output capacity mean value for ripe tomato is higher than that of fairly ripe and considerably higher than that of unripe tomato. This

can further be illustrated using graph as shown in fig. 3. It can be concluded from these results that the firmer the tomato, the lower the slicing output capacity. This can be attributed to the fact that ripe tomato tends to be softer than the unripe tomato thereby making the passage of slicer knives through ripe tomato easier and faster.

Table 4: Descriptive test for effect of tomato firmness on slicer output capacity

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
RToc	4	685.10	2806.90	3492.00	3093.1750	158.50053	317.00106	100489.669
FRToc	4	516.00	1524.60	2040.60	1853.6250	121.51040	243.02080	59059.109
URToc	4	611.30	1117.20	1728.50	1331.1750	139.98513	279.97026	78383.349
Valid N (listwise)	4							

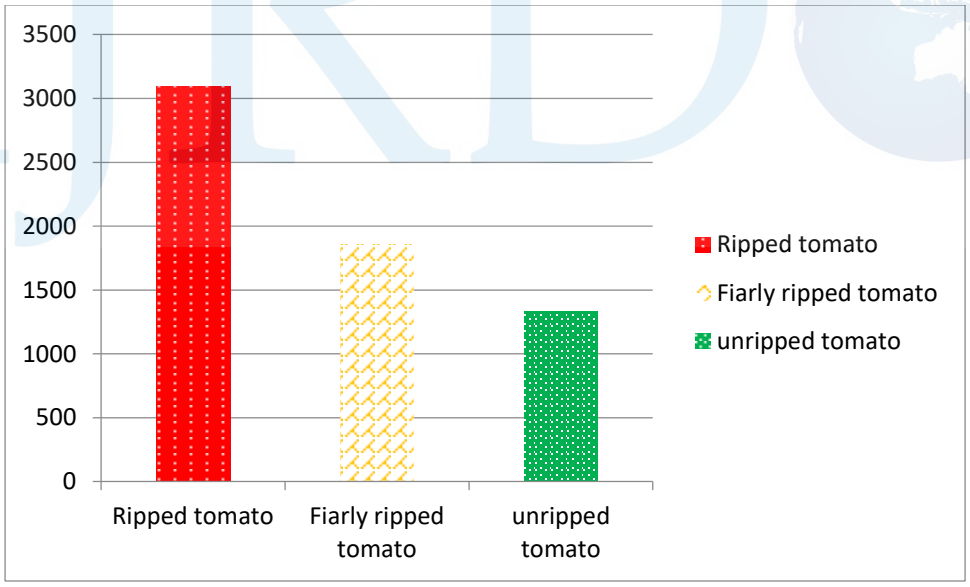

Figure 3: Effect of tomato firmness on output capacity of the slicer

Comparison between the Old Slicer and the Developed slicer

Table 5 shows the comparison between the existing and newly developed tomato slicing machine using student t-test. The results show that slicing efficiency and output capacity of newly

developed tomato slicing machine were significant at 5% probability level than those of the old tomato slicing machine.

Table 4.15: Comparison between Existing Slicer and Newly Slicer

Parameters	Mean values		t- value Tabulated	t-value Calculated	Significance
	Developed Slicer	Existing Slicer			
Slicing Efficiency (%)	90	65	4.303	15.364	**
Output capacity (kg/hr)	3.09	1.30	4.303	4.164	**

* * - Highly significant N.S - Not significant

Recommendation

1. The slicer is recommended to be motorized
2. Further research work should be done in the selection of better blades as slicer's knives

Conclusion

The modified tomato slicing machine have been evaluated. From the evaluation of the modified tomato slicing machine, slicing efficiency and output capacity of the modified slicer were in the range of 84.48 to 93.55 %, and 24.30 to 30.33 kg/hr respectively. The best slicing efficiency of 93.55 % was obtained using unripe tomato while highest output capacity of 30.33 kg/hr was obtained using ripe tomato.

Reference

Okunoya, J. A., (1996). Controlling Post Harvest Losses in Tomato and Pepper. Journal of Post-Harvest, 13(3): pp 40-48.

Raji, O. A. and Igbeka, J. C. (1994). Pedal Operated Chipping and Slicing Machine for Tuber. Journal of Agricultural Engineering Technology. Pp 90-99.

Tervell M.E. (1979) Professional food Preparation, John Wiley and sons Inc. U.S.A.