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Processing Conditions on Performance of Manually Operated Tomato Slicer

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Abstract: Evaluation of modified tomato slicing machine was carried out to investigate the effects of tomato firmness on operative processing conditions of the slicer. The data from evaluation was analyzed and compared using Duncan Multiple Rate Test (DMRT) on SPSS. The results showed 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 2593.4 g/hr. with ripe tomato.

Keywords: Tomato, Slicing, Knife, Firmness, Effects.

I. 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 [1]. 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 [1].

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 [2]. 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 [3]. 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.

II. MATERIAL AND METHODS

Experimental Procedure

The effects of processing conditions on the performance of the manual tomato slicing machine as shown in plate 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.

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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.



Figure 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 were analyzed and compared using DMRT from SPSS statistical package.

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III. RESULTS AND DISCUSSION

Slicing Efficiency Data from Experimental Evaluation

The data 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

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
4	93.7	90.8	80.3

Table 1: Experimental Data for siling efficiency.

Effect of Evaluated Factor on Slicing efficiency of Developed slicer

The results from the Duncan Multiple Rate Test (DMRT) are as presented in Table 2. The results show that the mean value of slicing efficiency for unripe tomatoes is statistically significant from that of ripped tomatoes but statistically at par with fairly ripped tomatoes at probability level of 5%. This might be attributed to the fact that at unripen and fairly ripped stage of tomatoes, there is still enough firmness to withstand little pressure exerted by knives while slicing but since firmness decrease as the degree of ripeness increases, the slicing efficiency tends to decrease. It was observed that at fully ripe stage of tomato, the deformation takes place more instead of cutting through (slicing).

Degree of ripeness	DMRT(Slicing efficiency)
Unripe	94.0b
Fairly ripe	91.4b
Ripe	84.5a

Table 2: Effects of Tomato Ripeness on Tomato Slicing Efficiency.

Values with same alphabet is not significant

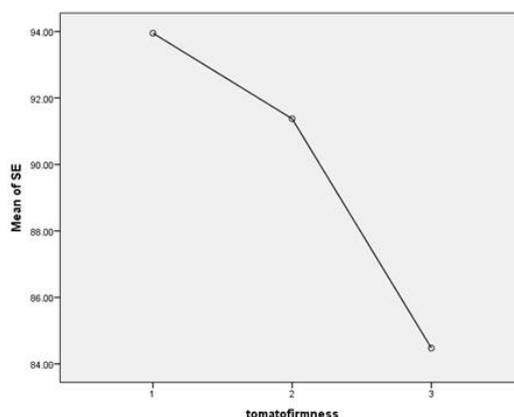


Figure 2: Effect of tomato firmness on slicing efficiency of the slicer.

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Output Capacity Data from Experimental Evaluation

The data from experimental evaluation of the effect of three levels of tomato ripeness on slicing efficiency of the developed slicer are as shown in Table 3.

S/N	Output capacity for unripe tomatoes (g/hr.)	Output capacity for unripe tomatoes (g/hr.)	Slicing efficiency for ripe tomatoes (g/hr.)
1	1117.2	1120.5	2492.8
2	1325.2	1425.2	1872.4
3	1153.8	1093.6	2806.9
4	1728.5	1638.4	3201.4

Table 3: Experimental data for output capacity.

Effect of Evaluated Factor on Output capacity (OC) of Developed slicer

The results from the Duncan Multiple Rate Test (DMRT) are as presented in Table 4. The results show that the mean value of output capacity for ripe tomatoes is the highest and statistically significant from that of unripe and fairly ripped tomatoes, while unripe is statistically at par with fairly ripped tomatoes at probability level of 5%. This might be attributed to the fact that since firmness decrease at the degree of ripeness increases, the slicing knives cut through the fully ripe tomatoes easier and faster thereby increasing the quantity sliced per unit time.

Degree of ripeness	DMRT(OC) g/hr.
Unripe	1331.2 ^a
Fairly ripe	1319.4 ^a
Ripe	2593.4 ^b

Table 4: Effects of Tomato Ripeness on Output capacity (OC).

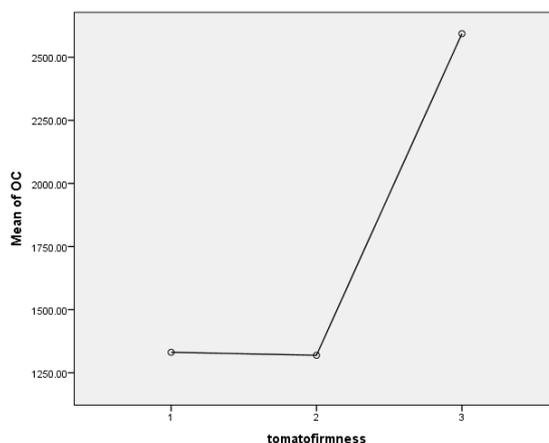


Figure 3: Effects of Tomato Ripeness on Output capacity (OC).

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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
3. The slicer should also be evaluated on other fruits and vegetables such as okra, plantain, pepper, etc. so as to make the more versatile hence enhancing its adoption rate.

IV. CONCLUSION

The modified tomato slicing machines 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 84.5 to 94.0 %, and 1331.2 to 2593.4 g/hr. respectively. The best slicing efficiency of 94.0 % was obtained using unripe tomato while highest output capacity of 2593.4 g/hr was obtained using ripe tomato.

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