Development of Pineapple Multi-Processing Machine

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Abstract

The pineapple multi-processing machine was constructed, and its performance was evaluated in terms of operating time, machine capacity, machine efficiency, number of desirable slices, and fruit weight composition. The machine comprised of three major components: base and support frame – provide placement and support to the blade assembly; cutting assembly - cut the top and bottom portion of the pineapple fruit; and blade assembly - peel, core and slice the pulp into four equal portions. The performance of the machine was evaluated using 10 pcs of pineapple fruits 10.1-11.4cm in diameter and weighed 1.07 to 1.50 kg for three trials. The pineapple multi-processing machine have better performance compared to themanual method in all test parameters such as operating time (0.92 min fruit!!), machine capacity of (66 pcs hr!!), machine efficiency (76.33%), relative efficiency (104.09 %), and percentage fruit weight composition of pulp, core, and peel was 30.89%, 3.95%, and 40.74% respectively.The constructed pineapple multi-processing machine could be efficiently operated with ease, needing only two fluid motions which entails less handling of fruit, thereby, producing uniform and better quality pineapple slices. The machine could be constructed with a minimum cost of Php4, 674. 30.

Keywords: *fruit corer, fruit cutter, fruit slice, peeler, pineapple processing*

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Introduction

Pineapple (Ananas comosus) locally called 'pińa' or 'pinya', is a tropical fruit which grows in countries that are situated in the tropical and sub-tropical regions. The fruit is cylindrical, about 20 cm long and 14 cm in diameter, and weighs 0.5-3.6 kg (PCAARRD, 2007).

Pineapple is an important food which can be eaten fresh or in a processed form. It is consumed worldwide due to its rich taste and flavour. In year 2017, the production of pineapple in the Philippines was 2,671.7 metric tons, 16.83 metric tons of which is from Western Visayas (DA-BAS, 2018).

Local household still practice the traditional peeling of pineapple that is by using bare hands and knife to peel of the fruit skin. The pineapple skin is thick, making it difficult to peel and cutting a pineapple skin is a difficult task. Due to that, after one pineapple is peeled, a person will feel the pain around the hand and the upper body including the arms. The peeling process also involved the upper body of a person thus making the body vulnerable to back pain and other musculoskeletal disorders (MSD) symptoms (Mat Rejab, 2009).

Processing pineapple requires a technical tool for easy and fast way of peeling, slicing, and removing of core, but still there is no such equipment or device in the market for the Filipino households and small business which can reduce their difficulty of peeling, slicing, and coring the pineapple. Finished product could be in the form of pineapple slices, chunk and dice, pineapple juice, fruit salads, sugar syrup, alcohol, citric acid, pineapple chips, and pineapple puree It is also exported to other countries as a fresh product.

Hence, this research is conducted to design and construct a hand operated multiprocessing machine that can cut, peel, slice and core pineapple fruits with ease, encompassing reduced labor and time and minimum physical handling of the fruit.

Objectives of the Study

Generally, the study was conducted to construct and evaluate the performance of a household type pineapple multi-processing machine. Specifically, this study aimed to:

1. construct a pineapple multi-processing machine;
2. evaluate the performance of the machine in terms of machine capacity, machine efficiency, relative efficiency, and percent fruit weight composition ; and

3. compare the performance of the constructed machine and manual method of above parameters; and
4. perform technology valuation in operating the pineapple multi-processing multi processing machine using cost method.

Methodology

Technical Description of the Pineapple Multi-Processing Machine

The pineapple multi-processing machine as shown in Figure 1 comprised of 3 major components: base and support frame (10), cutting assembly (20), and blade assembly (30). The base (10) provides support and placement for the blade assembly. It has a metal plate base (12) with four rubber tips (11) strategically placed that served as legs of the machine to prevent slippage. The upper part of the base (10) was firmly attached to a plurality of shaft (15) that gave support to the blade assembly (30), slicing board (17), U- shape fruit holder (13), plunger (18), and plurality of legs. Wherein the said legs (41) are hinged to a plurality of ankle (14) which act as support for cutting assembly (20).

The cutting blade (20) cut the top and bottom portion of the pineapple to form a cylindrical shape which consisted of opposite cutting blade (24) connected with two shafts (23) and adjustment shaft (22) loosely attached to the arm (14); the cutting lever (21) served as a handle of cutting assembly drilled with two holes that fitted with the shaft (23) and adjustment shaft (22) that cut different sizes of pineapple.

Two vertical opposite shafts (15) were connected with bolts and nuts to the shoulder (19) provided with two holes between the shafts (13) and served as support and stopper for the blade assembly (30). The opposite legs (41) were hinged to two vertical column legs (16) with bots and nuts, wherein the said legs can move at a certain angle upward during operation. The arm (41) was loosely connected with the blade assembly (30) by a skirt (36) and bolted in the arm with a certain ratio of the vertical column (42), where the handle (43) was positioned.

The blade assembly, generally designed to peel, slice, core and slice the peel into two parts, consisted of two cylindrical blades: the peeler blade (31) and corer blade (37). Four slicers (33) were radially arranged between the two cylindrical blades (37) which serve as guide. The blade assembly was firmly attached to the vertical shaft (35) fitted with holes in the shoulder (19). The skirt (36) was attached to the upper part of vertical shaft (35) by bolts and nuts.

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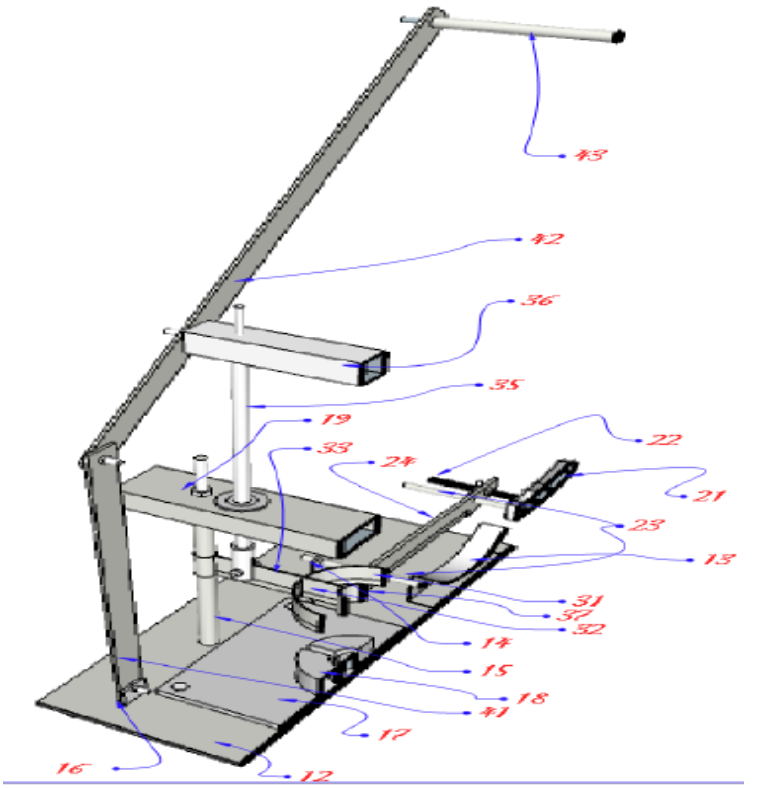

Figure 1. Cross-sectional view of the pineapple multiprocessing machine.

Principle of Operation

The following procedures were followed in processing pineapple:

Sorting. Small-sized smooth cayenne (hawaiian) variety with 10.1-11.4 cm in diameter, weighing 1.07 to 1.50 kg and about 25% of the eyes were yellowish orange (quarter ripe fruit) were used as samples.

Cutting. The top (crown) and bottom (base) part of pineapple fruit was cut using the cutting assembly to form a uniform cylindrical shape.

Peeling/slicing/coring. The cylindrically-shaped pineapple was centrally positioned in the plunger and was peeled, sliced, cored and cut into four equal longitudinal slices using the blade assembly.

Weighing. The crown, peel, core and slices of pineapple were weighed individually using a digital weighing scale.

Packing and sealing. Pineapple slices were packed in ziplock plastic.

Data Gathering

In the evaluation of pineapple multi-processing machine, the following data were determined:

Operating Time. The machine operating time was obtained by dividing the total number of fruits by the total operating time.

Machine Capacity. The machine capacity was obtained by dividing the total weight of whole and peeled fruit by the total time of peeling.

Machine Efficiency. The efficiency of machine in peeling pineapple was measured by dividing the total number of desirable slices to the total number of pineapple slices multiplied by 100.

Relative Efficiency. To determine the relative efficiency of the pineapple multiprocessing machine, the mean machine efficiency was divided to the mean efficiency of manual method.

Machine losses. This was calculated by dividing number of undesirable pineapple slice to the total number of pineapple slices, multiplied by 100.

Results and Discussions

Performance of pineapple multi-processing machine

The performance of pineapple-multi processing machine was evaluated using average measurements (Table 1) from three trials. \Results indicated that the developed machine had better performance in all parameters evaluated as compared to the manual method.

The differences among means were found to be significant in terms of operating time (machine -0.92 min: manual 3.86 min), number of desirable slices (machine - 30.67 pcs: manual -28.67 pcs) and capacity (machine - 66 pcs/hr: manual-16pcs/hr).

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Results revealed that the method of operation has greatly influenced the operating time, capacity and number of desirable slices in favour to the developed multi-processing machine. Results in the performance evaluation in terms of machine efficiency, relative efficiency, and machine losses were found to be statistically the same and are comparable. However, the machine efficiency of 76.33% could still be improved by orienting/training the operators prior to machine operation.

Table 1. Comparative performance between the pineapple multi-processing machine and manual method.

PARAMETERS	PERFORMANCE		MEAN DIFFERENCE	T - Computed	Pr(>/ t /)
	MANUAL	MACHINE			
Operating Time, min	3.86	0.92	2.94	16.14**	0.001
Capacity, pcs/hr	16	66	50	8.54*	0.0124
Efficiency, %	73.33	76.33	11	0.69ns	0.5249
Losses, %	28.33	23.33	5	0.28ns	0.5249
Relative Efficiency, %	96.07	104.09	8.02	0.97ns	0.3851
Number of Desirable Slices, pcs	28.66	30.67	2.01	11.20**	0.004
Percent Fruit composition,%					
a. Pulp	44.73	32.04	12.43	13.89**	0.0002
b. Core	7.22	4.03	12.43	12.26**	0.0000
c. Peel	29.17	39.31	10.14	2.13ns	0.1007

ns = not significant
* = at 0.05 level of significance
** = at 0.01 level of significance

Percent fruit composition using the multi-processing machine was found to be 32% pulp, 4.03% core and 39.31% peel. The result was found to be in conformity with the results of Dela Cruz, et. al. (2005) wherein he reported that a typical Cayena lisa pineapple has 33% pulp, 6% core, 41% peel, and 20% crown.

Technology valuation

All cost gained in the construction and evaluation of pineapple multi- processing machine was determined using cost method in terms of personnel services, maintenance and other operating expenses (MOOE) and equipment outlay.

Table 2 shows that considering the personnel services of Php9,488.40 and MOOE of Php9,091.93, the technology amounts to Php18,580.33. The pineapple multi-processing could be fabricated at a minimum costs of Php4,902.93.

Table 2. Technology valuation of pineapple multi-processing machine using cost method

COST METHOD	UNIT COST	TOTAL COST
I. Personnel Services		
1. Salary of adviser (rate/hr)	Php137.21 hr^{-1}	5,488.40
2. Research staff	Php50 hr^{-1}	4,000.00
Sub-total		**9,488.40**
II. Maintenance and Other Operating Expenses		
1. Supplies & Materials		
a. Construction/Fabrication		3,631.80
b. Testing and Evaluation Materials		4,189.00
2. Cost of Labor		1,271.13
Sub-total		Php9,091.93
GRAND TOTAL		**Php18,580.33**

Conclusion

Based on the result of the study, the following conclusions were drawn:

1. The fabricated pineapple multi-processing machine incurs lesser operating time, higher capacity, and increased machine efficiency as compared to the manual method

2. The machine could produce more desirable pineapple slices as compared to manual method.

3. Small scale entrepreneurs and local households could greatly benefit in using the machine because of its ease of operation involving only two fluid motions, easy mobility and the machine could be fabricated at a minimum amount of Php4,902.93 only.

Recommendations

Based on the findings of the study, the researchers recommend the following:

1. The use of the pineapple multi-processing machine is highly recommended in peeling, slicing, and coring pineapple fruits.

2. The machine may be further improved by:
a. providing adjustable blades to cater different sizes of pineapple.
b. providing a lock in the blade assembly for safety protection of the operator.
c. providing a all-in-one adjustment for cutting the length of the pineapple.

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