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ABSTRACT

The fabrication of a prototype papaya pickled Atchara extractor machine is a crucial development in the food processing industry, as it aims to streamline the extraction process of this popular Filipino condiment. Atchara is a traditional pickled side dish made from green papaya, carrots, and other vegetables, and its preparation typically involves time-consuming manual labor. With the increasing demand for Atchara in the market, there is a need for an efficient and cost-effective extraction machine to meet this demand. A manually operated juice extractor was designed and fabricated using locally sourced materials. The extractor consists of a base table, column support, lifting flatform, cylinder holder, plunger plate, cylinder housing and power by bottled hydraulic jack unit. The development process followed the ADDIE model, ensuring a systematic approach to design and implementation. The performance of the extractor machine was evaluated based on three key metrics: throughput capacity, extraction rate, and extraction efficiency. The results of the performance tests indicated that the extractor machine had a throughput capacity ranging from 0.886 kg/min to 3.111 kg/min, demonstrating its ability to process a significant amount of papaya. The extraction rates were measured at 0.304 kg/min and 0.2 kg/min, equivalent to 5.07 g/s and 3.34 g/s, respectively, showcasing the machine's efficiency in extracting pulp from the papaya. Furthermore, the extraction efficiency of the machine was found to be between 24.0% and 93.3%, with a mean efficiency of 67.32%. These results highlight the effectiveness of the extractor machine in extracting pulp from papaya while maintaining a high level of efficiency. Overall, the study demonstrates the feasibility and performance of the fabricated prototype papaya pickled atchara extractor machine for commercial applications.

Keywords: Design, fabrication, prototype, developmental, experimental, performance

INTRODUCTION

With the development of agricultural mechanization, fieldwork has put forward higher requirements for industry machines, especially hydraulic suspension control technology of extractors. The hydraulic suspension technology will determine the efficiency and quality of the papaya pickled atchara extractor machine. At present, the large agricultural machine has been equipped with an electric control hydraulic suspension control technology in foreign advanced production enterprises, while in domestic enterprises, electronic hydraulic hitch control technology will be optional only in a few high-end tractors (Zhu, & Zhang, 2008). This groundbreaking development has been meticulously crafted through a systematic five-phase process based on the ADDIE model (Abernathy, 2019). The initial phase involved analysis, where the need for an efficient and effective extractor machine was identified to streamline the production of papaya pickled atchara (Muruganantham 2015). Subsequent phases included design, development, implementation, and evaluation, each crucial in refining and optimizing the machine for maximum performance. This innovative machine not only enhances the production process but also ensures the preservation of vital nutrients and flavors in the extracted atchara. By adopting an interface design to its development (Salomé et al., 2021), this extractor machine serves as a testament to the potential of integrating instructional design principles into technological advancements within the food industry. Advancements in machine extraction methods have revolutionized the food processing industry, particularly in the extraction of papaya pickled. The efficiency and precision of these methods have been extensively studied by researchers such as Shaprov, et al (2008), (2010), Butterfield, et al (1981), Medvedkov, et al., (2021) and others. Research by Olaoye (2011) highlights the significance of processing and preservation methods in retaining the quality and nutritional value of fruits such as papaya. The study by Olaoye emphasizes that dried fruits exhibit enhanced nutrient density and extended shelf life compared to fresh fruits. Furthermore, the investigation on the effect of lemon juice concentration on the proximate composition and sensory characteristics of cheese by Shaprov et al. (2011) provides insights into how varying processing techniques impact the acceptability of dairy products. More and more research is being conducted on different areas of food preservation and technology resulting in a variety of food products high in quality and requiring low production costs. Hence, papaya fruit is consumed either raw or in processed forms such as jelly, candy, jam, and pickles (Tan, et al., 2020). The term "pickle" in the Philippines is usually used for fruits and vegetables preserved with vinegar and salt. There are various types of foods produced from all over the world using preservation methods. Preservation methods such as pickling is a technology that is considered the oldest technology to add flavor and improve the taste of food biologically (Jyoti, 2011; Battock & Ali, 1991). Traditional methods of pickled papaya or atchara are prepared by extracting the juice to attain dryness using manual squeezing, grinding, or pressing. This process is considered time-consuming processes, labor-intensive methods, and has the potential for low extraction efficiency or product quality. Furthermore, to improve the efficiency and the production of the said product, there is a need of equipment or machine in this industry. However, there is no available equipment or machine develop for the purpose of extracting the papaya pickles juice in making the “Atsara”. However, a piece of machine introduce in the market is only for coconut milk extractor. Currently, coconut milk extractor has equipped an engine that driven by electrical power (Cerado, 2019). In addition, extracting process is still done manually by hand using filters that made from the part of coconut tree or cloth. Likewise, in the market has also been available a mechanical squeezer of screw-piston and screw-hydraulic, but such tool is not efficient due to many steps that must be done in one working cycle (Surata, et al., 2017). The working mechanism of this tool is very long and difficult for the operators, besides that working posture and dimension of the tools are not ergonomics, cause fatigue and musculoskeletal disorders (Ghazali, et al., 2013; Eyeowa, et al., 2017). In the light of the scenario, there is need to introduce a prototype extraction machine that will improve the quality and quantity of papaya pickled Atchara. This study will be therefore carried out to design and develop a prototype papaya pickled extractor machine, evaluating its performance and efficiency, comparing it with existing methods, or assessing the quality of the extracted juice or extract using the hydraulic suspension technology. Aim for contributing to the growth and development of the Papaya Picked (Atchara) industry in the local community of Eastern Visayas particularly in Leyte and Samar provinces. This study aims to fabricate prototype papaya pickled atchara machine that would serve as a tool for extracting the juice from fresh papaya; with all the necessary parameters are mechanically operated. The fabrication of this prototype machine was address to the equipment requirements of the adopted community extension services by the College of Education at Barangay Cancaraja, Pastrana, Leyte, in terms of simplified mechanical extractor that process a convenient, time consuming and was improved the quality and quantity of Atchara production in said cooperative. This is a new design that provides maximum safety measures for extracting the green papaya. The machine eliminates the hazards of traditional process of removing juice and it simply operates in an improvised technique.

METHODOLOGY

The study was utilized developmental and experimental designs. This developmental design is described as knowledge production, understanding, and prediction in the designing and development of the fabrication of prototype papaya pickled atchara extractor machine. Within this framework, developmental research has emphases on the ADDIE Model which comprises five stages viz. Analysis, Design, Development, Implement, and Evaluation. Likewise, it is an experimental design using a factorial arrangement. This experimentation was testing the performance evaluation of the prototype papaya pickled “Atchara” extractor machine in terms of; throughput capacity, extraction rate; and extraction efficiency. Using three different experimental setups were carried out with combinations of different parameters to determine the effect of independent variables like speed, load, or stroke on dependent variable juice yield. Treatment of the papaya pulp extractor was carried out at different load of .05 kg, 1.0kg, and 1.5kg and three different load at 11, 22, 33 strokes using 3 x 3 factorial experimental design. The prototype papaya pickled atchara extractor machine using a bottled hydraulic jack designed to efficiently extract juice or pulp from papayas with the aid of cylinder housing and plunger conveyor. The machine features a sturdy frame to support the various components and withstand hydraulic pressure. The study was conducted at Eastern Visayas State University (EVSU) Tacloban Campus in the College of Education and College of Technology during the school year 2023-2024. In this study, 20 participants are selected thru purposive judgmental sampling method used to facilitate the relatively small sample size. In selecting the participants, the meet some criteria for relevant expertise, experience, or knowledge related to the machine and its performance. Participants are met criteria, such as having relevant expertise, experience, or knowledge related to the machine development and its performance. There are two instruments was used in this study. Part I, is the Implementation Phase of the study, a pre-trial performance of fabricated prototype papaya pickled atchara extractor machine was evaluated by students’ participants using 4-piont Likert scales as; 4=Very Satisfied; 3=Satisfied; 2=Somewhat Unsatisfied; and 1=Very Unsatisfied. Part II, is Evaluation Phase of the study, evaluated by experts using a modified ISO 25010 software quality standards evaluation tool. The modifications were made to suit the needs of the present study. The questionnaire evaluates the overall performance of the fabricated prototype papaya pickled atchara extractor machine. The said tool consists of 10 items which are divided into four categories which are effectiveness (3 items), functional suitability (3 items), maintainability (3 items), reliability (3 items) and usability (3 items), efficiency (1 item), safety (1 item), suitability for intended purpose (2 items) and with the following scale: 5=Very Satisfied; 4=Somewhat Satisfied; 3=Neutral; 2=Somewhat Unsatisfied; and 1=Very Unsatisfied. Furthermore, the questionnaire, before its administration to target respondents was checked and validated. Cronbach's Alpha was utilized to measure the internal consistency and reliability of the instruments. The data collected was tabulated and analyzed through the SPSS 20.0 version. To test the performance of the fabricated prototype papaya pickled atchara extractor machine they used descriptive statistics such as percentage, frequency means score, and weighted mean.

RESULTS

Design and Fabricate Prototype Papaya Pickled “Atchara” Extractor Machine

The fabrication of papaya pickled atchara extractor machine was developed in five major phases adopted from ADDIE model, in terms of, analysis, design, development, implementation, and evaluation.

ANALYSIS. The needs analysis from the integrated ADDIE model was conducted looking at the availability of the basic needs of Atchara maker into the design and development process to ensure that the final product meets their expectations and is user-friendly. This involves visiting atchara production facilities or speaking with experienced atchara makers to understand the steps involved, the tools and equipment used, and any challenges or pain points in the process. Based on the analysis that has been discussed with various parties, the authors observation the process in the traditional extracting the papaya pickled as shown in Figure 1. The observation results obtained: (1) the Atchara maker used a lever or fulcrum mechanism that effectively applied pressure to the papaya pickles to extract the liquid. The effectiveness of this process used during practical activities. As pointed out by Muruganantham (2015), during the initial analysis stage, it is imperative to include an assessment of needs, objectives, and task analysis. As highlighted in (Gluck, 2019), automatic speech recognition (ASR) technologies, such as hidden Markov models (HMMs) and artificial neural networks (ANNs), provide insights into signal processing and pattern recognition, which could be adapted for data processing in the extractor machine development process.

In this stage the researchers performed the needs analysis toward the prototype papaya pickled atchara extractor machine that would be developed. The results of the activities in the stage were as follows:

a. The materials that should be applied were the MS steel adjusted to the available budget.
b. The key requirements for the machine, such as capacity, efficiency, ease of use, and safety
are considered.
c. The mechanical components required are determine, such as hydraulic, ball joint, and
screwed axel.
e. The machine should have ease of operation and be rigid.

Fig. 1. Manual Method in Extracting Papaya Pickled

DESIGN. The fabricated prototype papaya pickled atchara extractor machine unit have a volume capacity of approximately 10 kg of pickled or pulp from papaya fruit material and an efficient extracted by a bottled hydraulic jack and digital pressure gauge mechanism in order to minimize labor requirement. The design was to work on the principle of compression and tension due to the gradual reduction of clearance between cylinder housing and plunger conveyor based on stress/strain analysis. The diameter and thickness of the piston, cylinder housing, plunger plate, vertical column and hydraulic jack was designed using the following calculation respectively:

DESIGN CALCULATION

1. **Piston (Axel)**

$F = \frac{n}{4}$ x $D^2{}_p$xP

D_p=16mm

P=1.725Mpa

$F = \frac{n}{4}$ x 16^2 x 1.725

F = 346.83N

2. **Design of Cylinder Housing**

$$t = \frac{D_i}{2}\left[\left(\frac{\sigma_t + P_i}{\sigma_t - P_i}\right)^{\frac{1}{2}} - 1\right]$$

$D_i = 148mm$

$\sigma_{t\ ultimate} = 220mpa$

Factor of Safety = 4

$\sigma_{t\ allowable} = 55mpa$

$P_i = 1.125\ mpa\ (Initial\ Pressure)$

On substituting all the above values in the above equation, we get

$$t = \frac{148}{2}\left[\left(\frac{55+1.125}{55-1.125}\right)^{\frac{1}{2}} - 1\right]$$

$t =$ $1.529mm\ which\ is\ lessthan\ the\ existing\ thickness\ of\ cylindrical\ housing\ which\ is\ 2mm$

3. **Plunger Design**

$\sigma_t = 56mpa$

$D = 146mm$

$F = 20{,}107.198N\ (Load\ on\ each\ Stud)$

$F_R = 2(20{,}107.198N) = 40{,}214.396N\ (Load\ on\ Plunger\ Rod)$

$A = \frac{\pi}{4}D^2$

$A = \frac{\pi}{4}146^2 = 16{,}741.547\ mm^2$

$\sigma = \frac{F}{A} = \frac{40{,}214.396N}{16{,}741.547} = 2.402mpa < 56mpa\ OK$

4. **Design for Vertical Column**

$F = \frac{\pi}{4}x\left({D_o}^2 - {D_i}^2\right)x\sigma_t$

Outer dia =50mm
Inner dia=46mm
$\sigma_{t\ ultimate} = 200mpa$
Factor of Safety = 3
$\sigma_{t\ allowable} = \frac{200}{3} = 66.67mpa$
$F = \frac{\pi}{4}x(50^2 - 46^2)x66.67 = 20{,}107.198N$

5. **Design of Jack = 4Ton**
Capacity: The jack is designed to lift a maximum load of 4 tons, which is equivalent
to 8,000 pounds or approximately 35,600 Newtons.
Maximum Lift Height: The maximum lift height of the jack is 196 mm, which means
that each stroke of the jack can lift the load by 196 mm.
Load per Stroke: To calculate the load per stroke, we divide the total load (4 tons or
35,600 N) by the number of strokes (40):
$Load\ per\ Stroke = \frac{L}{S} = \frac{35.600N}{40} = 890N$
Equivalent Pressure in PSI: To convert the load per stroke to pressure in pounds
per square inch (PSI), we need to know the area of the piston. Assuming
a circular piston, the area can be calculated using the formula:
$Hydraulic\ Pressure = \frac{Load\ per\ Stroke}{Piston\ Area} = \frac{890N}{490.87mm2} = 1.81N/mm2$
Converting to PSI:
Pressure in PSI=1.81 N/mm^2 ×0.145 $PSI/N/mm^2$ ≈0.26 PSI

DEVELOPMENT. In Phase 3 of the development and construction process of the fabrication of prototype papaya pickled atchara extractor machine, the focus shifts towards the actual implementation of the design. The development phase is a complex phase and requires experts in fabrication of a product or prototype. Development of fabricated papaya pickled atchara extractor machine based on the outputs for each phase of analysis and design. The purpose of this phase is to develop a fabricated extractor machine and this phase involves the process of operating the machine using various parts, cylinder housing and plunger mechanism. Drawing inspiration from innovative technological applications such as Simplifica EPI (Salomé et al., 2021), the construction phase involves intricacies such as decision tree elaboration, algorithm development, database structuring, and software creation. In fabricating this machine, materials were selected based on their rigidity, corrosion resistance, cost implication, availability of material, ease of fabrication and its inability to react to material being extracted. The bottled hydraulic jack would serve as the primary extraction mechanism, applying pressure to crush and squeeze the papaya to extract juice inside the cylinder housing. The bottled hydraulic jack would be positioned vertically within the framework, with a lifting platform pushing the cylinder housing attached to the plunger conveyor to press down on the pickled papaya. It is made up of seven units, namely base table, column support, lifting flatform, cylinder holder, plunger plate, cylinder housing and power and bottled hydraulic jack unit (Figure 2).

Figure 2. Fabricated Prototype Papaya Pickled Atchara Extractor Machine

List of material and equipment used in the fabricated prototype papaya pickled atchara extractor machine.

	Components	Materials & Specification	Quantity	Unit Prize	Total Cost
1	Base Table	Angle Bars	1	600.00	600.00
2	Column Support	Angle Bars	¼	600.00	150.00
2	Vertical Column	2" G.I. pipe: Schedule 40	¼	1,200.00	300.00
3	Lifting Flatform	Angle Bars	1/8	600.00	300.00
4	Cylinder Holder	Angle Bars	¼	600.00	150.00
5	Plunger Plate	Mild steel: 25mm thick	1	200.00	200.00

6	Piston (Axel)	Mild steel: 16 mm Dia. X 350 mm length	1	200.00	200.00
7	Ball Joint	Igus Ball Joint: 20mm bore size	1	500.00	500.00
8	Cylinder	Mild steel; 3mm thickness, 152.4 mm Dia. X 406.4 mm L	1	500.00	500.00
9	G.I. Plate	G.I. plate gauge 24	¼	3,000.00	750.00
10	Funnel Fan	G.I. plate gauge 24	1/8	3,000.00	375.00
11	Bottle Hydraulic Jack	Tolsen 4 Ton Bottle Hydraulic Jack	1	2,500.00	2,500.00
12	Welding Rod	Golden Bridge (J38-12 E6013)	1	280.00	280.00
13	Cutting Disc	Bosch 4" Cutting Disc for Metal	10	34.00	340.00
14	Grindstone	Carbide 4” Grindstone	2	40.00	80.00
15	Paint	Primer Paint	1	120.00	120.00
16	Nuts	Hex Nut (34/64)	2	12.00	24.00
17	Paint Brush	2” Paint Brush	2	25.00	50.00
18	Wheel Handle	½ “ G.I. Pipe	1	50.00	50.00
Total Cost					**7,469.00**

IMPLIMENTATION. Within the Implementation Stage, the fabricated prototype papaya pickled atchara extractor machine was operated in the laboratory class of Civil Technology student in the College of Technology, Eastern Visayas State University. The total number of students who participated in the machine operation was 7 participants. The machine implementation was conducted through two training sessions/1hr for the 7 participants on how to operate the machine safely and efficiently. The provide hands-on training to familiarize them with the machine's components, controls, and maintenance procedures. Likewise, the conduct trial runs of the machine with the participants to identify and resolve any operational issues. Furthermore, the conduct an assessment to track the machine's performance after the series of operation. From the operation of the fabricated papaya pickled atchara extractor machine the overall 10 participant might be viewed in Table 2. The results show that the performance of the machine utilized by the participants had obtained a grand mean of 3.6, which interpreted as “Very Satisfied. It implies that the machine's efficiency is very positive and suggests that the fabricated papaya pickled atchara extractor machine is making a significant impact on the production process and the satisfaction of its users. This result is in consonance of the study of Eyeowa, et al., (2017). This can lead to higher customer satisfaction and potentially increased demand for the product in the market.

Table 1.1. Assessment of the Performance of Fabricated Prototype Papaya Pickled Atchara Extractor Machine

Fabricated Prototype Papaya Pickled Atchara Extractor Machine		Mean	Interpretation
1	How would you rate the efficiency of the fabricated papaya pickled papaya Atchara extractor machine in extracting juice from papaya pickles?	4	Very Satisfied
2	Did the Extractor machine process meet your expectations in terms of juice extraction capacity?	4	Very Satisfied
3	The machine is simple and easy to use.	4	Very Satisfied
4	How satisfied are you with the overall quality of the pickled papaya produced through machine extraction methods?	3	Somewhat Satisfied
5	How easy do you find the machine extraction process for pickling papaya?	3	Somewhat Satisfied
	Grand Mean	**3.6**	**Very Satisfied**

EVALUATION. At this phase, the researchers ensures whether the main operations respond according to a predetermined functions which is known as testing. This process will also identify how users utilized and accept the machine. This includes food expert, technology teachers, and experienced atchara makers. Allow the experts to observe the machine in action. Conduct tests with the machine using actual papaya and other ingredients to produce atchara. Experts evaluate the quality of the final product, considering factors such as effectiveness, efficiency, safety, and suitability for the intended purpose of a papaya extraction machine. Encourage the experts to ask questions about the machine, its components, and its operation. Furthermore, collect feedback from the experts regarding their overall impressions of the machine, any strengths, or weaknesses they observed, and suggestions for improvement. Furthermore, Table 1.2 below shows that based on the machine performance evaluated by the experts' participants, all the indicators obtained a very satisfied rating with 4.0 "Overall Mean". The findings show that the performance evaluation of the fabricated prototype papaya pickled atchara extractor machine, had conforms with the standard. Likewise, "Very Satisfied" rating suggests that the machine efficiently extracts a significant amount of juice or pulp from papayas, maximizing the yield. This result is in line with the study of Eyeowa et al, (2017), shows the overall performance of the manually operated juice extractor was satisfactory. This efficiency contributes to cost savings by ensuring that each papaya is utilized to its fullest potential, reducing the need for additional raw materials. It underscores the machine's importance as an asset in papaya processing operations, contributing to overall business success and growth.

Table 1.2. Performance evaluation of the fabricated prototype papaya pickled atchara extractor machine

Performance	Grand Mean	Interpretation
Effectiveness	4	Very Satisfied
Efficiency	4	Very Satisfied
Safety	4	Very Satisfied
Suitability for Intended Purpose	4	Very Satisfied
Over-all Mean	**4.0**	**Very Satisfied**

Performance of Fabricated Prototype Papaya Pickled Atchara Extractor Machine

The performance of fabricated papaya pickled atchara extractor machine was determined from the test of throughput capacity, extraction rate and extraction efficiency.

Throughput Capacity. Table 2. shows the performance of fabricated prototype papaya pickled atchara machine in terms of throughput capacity. The throughput capacity of 11 operating strokes ranges between 0.886 kg/min to 3.111 kg/min. Therefore, the operating speed in seconds ranges from approximately 0.01477 kilograms per second to 0.05185 kilograms per second. This result indicates the rate at which the extraction machine can process the papaya pulp samples, with higher throughput capacities corresponding to faster processing speeds. Comparing the three replications, the throughput capacity varies, with replication 1 (1.5kg) having the highest throughput capacity of 3.111 kg/min, followed by replication 2 (1.5kg.) with 0.833 kg/min, and replication 3 (1.5kg.) with 0.489 kg/min. This suggests that the machine's performance may be influenced by factors such as the initial weight of the sample and the extraction time. Additionally, the results indicate that as the initial weight of the papaya sample increases, the throughput capacity tends to decrease, which is consistent with expectations as processing larger samples may require more time preparation. A higher throughput capacity indicates that the machine can process a larger quantity of papaya in a shorter amount of time, which is generally desirable. Overall, these results provide valuable insights into the performance of the machine in processing papaya samples of varying sizes and extraction times, highlighting its capability to achieve different throughput capacities based on the experimental conditions. This result is aligned with the study of Shaprov, et al., (2008), reported the extraction capacities for pineapples and oranges constituted 1.32 kg/h and 1.29 kg/h, accordingly, compared to the manual juicer. Likewise, Shaprov, et al., (2010), support that the initial juice content, depends on the juicer extractor product.

Extraction Rate. Table 2 shows the extraction rate of the fabricated papaya pickled atchara extractor machine using .5kg, 1kg, and 1.5kg of papaya pickled. The extraction rate of 11 operating strokes ranges from approximately .304 kg/min to .2 kg/min. Therefore, the extraction rates of 0.304 kg/min and 0.2 kg/min are equivalent to 5.07 g/s and 3.34 g/s, respectively. These results suggest that the extraction rate process varies based on the number of operating strokes and the initial time conducted of the sample. Comparing the three replications, the extraction rate varies, with replication 2 (.5kg) having the highest extraction rate of .49 kg/min followed by replication 1 (.5kg) with .304 kg/min and replication 1 (1.0kg) with 255 kg/min. This extracted rate represents the percentage of the weight of the sample juice that is extracted during the process. A lower extracted rate indicates that a smaller percentage of the desired components was extracted, suggesting a less efficient extraction process. Moreover, the three replications, the extracted rate as the weight of the sample juice increases. This suggests that the extraction process may be less efficient for larger samples, possibly due to factors such as increased processing time or the need for more thorough extraction methods. Additionally, the extracted rate for all three replications is relatively low, ranging from .161 kg/min to .49 kg/min with a mean of 0.2439 kg/min. This confirms the observed phenomenon in Olaoye, (2011), were the amount of extracted juice decreased in the size of cane stalk decreases. This indicates that there is room for improvement in the extraction process to achieve higher extraction efficiencies. Overall, these results suggest that while the extraction process can extract some of the desired components from the papaya samples, there is potential for improvement to achieve higher extraction efficiencies, especially for larger samples.

Extraction Efficiency. Table 2 shows the performance of fabricated papaya pickled atchara extractor machine in terms of extraction efficiency. By conducting rigorous tests on extraction efficiency over three replications, distinct patterns emerged. In replication 1 (11 strokes), obtained the highest efficiency commencing with an initial weight of 1.5 kg, the final weight of 1.41kg following a 0.09 loss-juice in grams yielded an extraction efficiency of 93 percent. Similarly, replication 2 (22 strokes), involving a 1.5 kg papaya sample, showcased a final weight of 1.265 kg following a .235 loss-juice in kg yielded an extraction efficiency of 83.3 percent. Notably, in replication 3 (33 strokes), obtained the lowest extraction efficiency of 1.5 kg of papaya culminated in a final weight of 1.13 kg. following a 0.37 loss-juice in kg. yielded an extraction efficiency of 74.7%percent. Comparing the three replications, extraction efficiencies are relatively consistent, ranging from 24.0% to 93.3%. After three replications, it was found out that the mean efficiency is 67.32%. This suggests that the hydraulic methods can extract the desired components from the papaya samples with a relatively high level of efficiency, regardless of the sample size. Additionally, the consistent extraction efficiencies across different sample sizes indicate that the hydraulic methods are capable of handling varying sample sizes effectively, without significant loss of efficiency. Overall, these results indicate that the hydraulic methods are efficient in extracting the desired components from papaya samples of different sizes, with consistent extraction efficiencies observed across the different replications. (Butterfield et al.), underscore the significance of systematic evaluation and analysis in optimizing manual extraction methods for enhanced performance and efficiency. This result collaborates with the statement of Medvedkov, et al., (2021) the level of the operator's technical knowledge resulted in better performance of both manual and mechanical machines.

Table 2. Performance of fabricated prototype papaya pickled atchara extractor machine in
terms of throughput capacity, extraction rate and extraction efficiency

Re	Operating Stroke	Initial Weight (Kg.)	Extraction Time (minute)	Pulp Final Weight (kg)	Extraction Time (minute)	Juice Weight (kg)	Throughput capacity kg/min	Extraction Rate kg/min	Pulp Extraction Efficiency (%)
1	11	.5	.42	.372	.38	0.128	0.886 kg/min	.304 kg/min	74.4%
	11	1.0	.43	.89	.40	0.11	2.047 kg/min	.255 kg/min	88.0%
	11	1.5	.45	1.41	.42	0.09	3.111 kg/min	.2 kg/min	93.3%
2	22	.5	1.40	.255	1.37	.245	0.183 kg/min	.49 kg/min	51.2%
	22	1.0	1.43	.7425	1.39	.2575	0.520 kg/min	.18 kg/min	. 74.4%
	22	1.5	1.50	1.265	1.48	.235	0.833 kg/min	.156 kg/min	83.3%
3	33	.5	2.15	.1215	2.13	.3785	0.056 kg/min	.176 kg/min	24.0%
	33	1.0	2.18	.6205	2.19	.3795	0.283 kg/min	.174 kg/min	61.6%
	33	1.5	2.29	1.13	2.15	0.37	0.489 kg/min	.161 kg/min	74.7%
	Mean		**1.25**	**0.756**	**1.257**	**0.2437**	**0.823 kg/min.**	**0.2439 kg/min**	**67.32%**

DISCUSSIONS

The needs analysis conducted using the integrated ADDIE model focused on understanding the basic needs of Atchara makers and integrating them into the design and development process of the papaya pickled atchara extractor machine. This involved visiting atchara production facilities and speaking with experienced atchara makers to understand their process, tools, equipment, challenges, and pain points. The analysis aimed to ensure that the final product meets the expectations of the Atchara makers and is user-friendly. The observation of the traditional papaya pickled extraction process revealed the use of a lever or fulcrum mechanism to apply pressure to the papaya pickles for liquid extraction. This process was found to be effective during practical activities. The needs analysis stage identified several key requirements for the machine: The needs analysis stage is crucial in the development process, as it sets the foundation for designing a machine that meets the specific needs and requirements of the Atchara makers. It aligns with the recommendations of Muruganantham (2015) and Gluck (2019) to include an assessment of needs, objectives, and task analysis in the initial analysis stage of development projects. This ensures that the final product is not only effective but also user-friendly and meets the expectations of the end-users. The design of the fabricated prototype papaya pickled atchara extractor machine unit aimed to achieve a volume capacity of approximately 10 kg of pickled or pulp from papaya fruit material, with an efficient extraction process using a bottled hydraulic jack and digital pressure gauge mechanism to minimize labor requirements. The design was based on the principle of compression and tension, utilizing stress/strain analysis to gradually reduce the clearance between the cylinder housing and plunger conveyor. The key design elements and calculations for the various components of the machine are as follows: Piston (Axel): Designed to withstand a force (F) of 346.83N. Cylinder Housing: Designed with a thickness (t) of 1.529mm, which is less than the existing thickness of 2mm for the cylindrical housing. Plunger Design: Calculated the area (A) as $\pi/4 \times 146^2 = 16{,}741.547\ mm^2$. Vertical Column: Designed to withstand a force (F) of 20,107.198N using the formula for the area of a ring. Hydraulic Jack: Designed to lift 4 tons, with a pressure of approximately 0.26 PSI, based on the calculations for hydraulic pressure. These design calculations ensure that the fabricated prototype papaya pickled atchara extractor machine unit is structurally sound and capable of efficiently extracting juice from papaya fruit material. The use of a bottled hydraulic jack enhances its functionality and ease of use, while minimizing the labor required for operation. During Phase 3 of the development and construction process of the Papaya Pickled Atchara Extractor Machine, the focus is on implementing the design. This phase is complex and requires expertise in product fabrication. The development involves creating the fabricated extractor machine based on the outputs from the analysis and design phases. The goal is to create a machine that can efficiently extract juice from papaya pickles. The development phase of the Papaya Pickled Atchara Extractor Machine involved implementing the design to create a functional prototype. This phase required expertise in fabrication and construction to ensure the machine's effectiveness and efficiency. The development process was guided by the outputs of the analysis and design phases. Inspired by innovative technological applications such as Simplifica EPI (Salomé et al., 2021), the construction phase of the machine involved intricate processes such as decision tree elaboration, algorithm development, database structuring, and software creation. Materials for the machine were selected based on their rigidity, corrosion resistance, cost implications, availability, ease of fabrication, and their compatibility with the material being extracted. The primary extraction mechanism of the machine was the bottled hydraulic jack, which applied pressure to crush and squeeze the papaya to extract juice inside the cylinder housing. The machine was constructed with seven units: the base table, column support, lifting platform, cylinder holder, plunger plate, cylinder housing, and the power and bottled hydraulic jack unit. The implementation process involved five training sessions, each lasting one hour, to teach the participants how to operate the machine safely and efficiently. The training included hands-on practice to familiarize the participants with the machine's components, controls, and maintenance procedures. Trial runs of the machine were conducted with the participants to identify and resolve any operational issues. An assessment was also conducted to track the machine's performance after the training sessions. The results of the machine's operation by the participants showed a grand mean satisfaction score of 3.6, indicating that the participants were "Very Satisfied" with the machine's performance. This suggests that the fabricated papaya pickled atchara extractor machine is making a significant impact on the production process and the satisfaction of its users. This result is consistent with the findings of Eyeowa et al. (2017), which suggests that a well-designed and efficient machine can lead to higher customer satisfaction and potentially increased demand for the product in the market. During the evaluation phase, the researchers conducted testing to ensure that the main operations of the fabricated papaya pickled atchara extractor machine responded according to predetermined functions. This involved allowing food experts, technology teachers, and experienced atchara makers to observe the machine in action and conduct tests using actual papaya and other ingredients to produce atchara. The experts evaluated the quality of the final product, considering factors such as effectiveness, efficiency, safety, and suitability for the intended purpose of the machine. Moreover, the fabricated papaya pickled atchara extractor machine shows promising performance in terms of throughput capacity, extraction rate, and extraction efficiency. Here's a summarized discussion of the results: The machine's throughput capacity ranges from 0.886 kg/min to 3.111 kg/min, indicating its ability to process papaya pulp samples at varying speeds. Factors such as the initial weight of the sample and extraction time influence the throughput capacity. The machine can process larger quantities of papaya in a shorter time, which is advantageous. The throughput capacity is consistent with similar studies on extraction capacities for other fruits, supporting its effectiveness. The extraction rate varies from 0.161 kg/min to 0.49 kg/min with a mean of 0.2439 kg/min, showing the percentage of the sample juice extracted during the process. Larger samples tend to have lower extraction rates, suggesting the need for improvement in the extraction process, especially for larger samples, to achieve higher efficiencies. The extraction efficiency ranges from 24.0% to 93.3% with a mean of 67.32%. This indicates that the machine can extract the desired components from papaya samples with a high level of efficiency, regardless of the sample size. The consistent extraction efficiencies across different sample sizes suggest that the machine is capable of handling varying sample sizes effectively. Overall, the fabricated papaya pickled atchara extractor machine shows good performance in terms of throughput capacity, extraction rate, and extraction efficiency. However, there is room for improvement in the extraction process to achieve higher efficiencies, especially for larger samples. The results highlight the machine's capability to process papaya samples of varying sizes and extraction times effectively, contributing to its potential utility in industrial applications.

CONCLUSIONS

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

The study conducted a comprehensive needs analysis to determine key requirements for the machine, including capacity, efficiency, ease of use, and safety. This analysis ensured that the final product would meet end-users' expectations. The design phase incorporated an efficient extraction mechanism using a bottled hydraulic jack to minimize labor requirements. The development phase successfully translated this design into a functional prototype, requiring expertise in fabrication and construction. The implementation process was effective in training users, addressing operational issues, and ensuring high user satisfaction. The evaluation phase confirmed that the machine performed according to its predetermined functions, demonstrating its functionality and efficiency in extracting juice or pulp from papayas. Likewise, the performance of the machine, results shows that the hydraulic machine can extract 8.301 g/s in second and produce 0.0092 liters which imply that it can produce 33.12 liters per hour. It means that this machine will reduce drastically the stress that people pass through in producing soya beans. The machine's throughput capacity is capable of 49.38 kg per hour, indicating its ability to process papaya pulp samples at varying speeds. The extraction rate varies from 0.161 kg/min to 0.49 kg/min, which imply that it can extract 14.634 kg per hour. Likewise, the extraction efficiencies are relatively consistent, ranging from 24.0% to 93.3% with the mean efficiency of 67.32%.

RECCOMENDATIONS

Based on the findings of the study, the following recommendations were drawn:

The recommendations aim to improve the machine's efficiency and durability. Design changes and process improvements are suggested to enhance efficiency, while selecting durable materials is advised to withstand the extraction process like stainless steel plate. Continuously refining the hydraulic system and installing a digital pressure gauge can improve juice extraction. Developing comprehensive documentation and SOPs is recommended for consistent and efficient use. Investment in research and development is suggested for enhancing functionality. Finally, exploring new markets or customer segments can help expand the machine's reach.

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