Design and Development of Bird’s Eye Chili Stalk Separator Machine

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Abstract. Chili-based products are increasingly in demand. Realizing this demand, many companies are taking the opportunity to run a chili processing business including turning it into a grind chili and instant chili paste in bottle packaging. The processing of this product goes through several stages, including the process of separating the chilies from the stalks, the cleaning process, grinding the chilies, and ending with the packing work. The main problem is during the process of separating the chilies from the stalks as it is still traditionally practiced by manually separating the stalks from the chilies by workers. It takes a lot of workforce and takes a long time to complete in large quantities. The researchers have carried out a prototype study by designing and building a machine that has been tested and has the ability to separate the chilies from the stalks. The sample of this research was the Sri Azwani Company which had successfully passed the screening by a panel of selected evaluators to obtain the PPRN grant award. The company had encountered problems during the process of separating the bird’s eye chilies from the stalks because it took a while to process 30kg-50kg of chilies for a mass production to produce 530-550 bottles at a time. The machine has a cylindrical main chamber that rotates according to the pre-determined resolution. The machine can process a maximum of 75kg-100kg per day of operation and it will impact the industry in terms of increased production volume, time savings, and cost.

1. Introduction

Nowadays, many consumers prefer the ready-made and ready-to-use chili products at any time for use in cooking or even as a snack. This is due to time constraints and cost saving. Sri Azwani is a 100% local company under the SME Micro category which carries out the business of producing or processing bird’s eye chilies for a ready-to-use instant grind chili / chili paste in bottle packaging. The process of making these products goes through several stages starting with the work of manually separating the chilies from the stalks, cleaning, grinding which ends with the packing process [1].

One of the most complex and time-consuming work processes is separating the bird eye’s chili from its stalk. This process traditionally uses manpower to manually remove the stalks from the chilies before they are gathered together for the next process. The downside is that this process takes a long time and a lot of workforce. It greatly affects the productivity of the company's production [2-3].

To help the company to accelerate the process of separating the chilies from the stalks, a creative and innovative idea was created to assist the company [4-8]. This machine known as the Bird’s Eye Chili Stalk Separator Machine (Mesin Pemisah Tangkai Cili Padi) is able to automatically separate
the chilies from the stalks in large quantities and takes faster time compared to using the manual method [6].

In order to build this machine, a preliminary study on the process of manually removing the chili stalks was conducted directly with the industry to gain accurate information (see Figure 1). After obtaining the necessary information from the industry, the next step was to develop a prototype machine model for the purpose of testing the process of cutting / removing the stalks (see Figure 2). Continuous improvements of the prototype models were carried out in order to achieve the best results based on industry requirements [9]. The actual machine was built based on the test results of the developed prototype model by meeting the determined objectives and scope of the project [1, 5-8].

The researchers had expected that this machine to be able to overcome the problem of cutting / separating the chili stalks by a minimum of 75kg in a day's operation compared to the traditional methods of 1-2 kg per hour and thus helping to increase the quantity and quality of the industry production. In addition, with this machine, the industry would be able to deliberate in diversifying their chili-based products as this difficult process (removing the chili stalks) has been overcome. Figure 3 shows the initial suggestion of machine design.
1.1 Project Scope

i. The only types of chilies that can be processed are the capsicum frutescens Linn or small chilies such as bird’s eye chilies and cabai rawit.

ii. Processable chilies for the removal of the stalks are those with a minimum diameter of 5mm, while the stalks have a maximum diameter of 3mm. The chilies are medium-sized, not small in size and not as big as the peppers. This machine is recommended for Cili Padi Bara and Cili Padi Pondan / cabai rawit.

iii. The machine to be produced has the capacity to dispense chili stalks within an estimated 15kg of operation, within an estimated 1 hour of operation.

iv. The machine cannot operate continuously for a long duration of time. Estimated machine rest time is 15 - 20 minutes after each time completed operation to ensure the machine’s life expectancy.

v. The machine weight would not exceed 200kg for easy mobility but it would be heavy enough to ensure the stability of the machine when in operation.

2. Project Implementation/methodology

The following is a summary of the processes for each phase of the project implementation by timeline shown in Figure 4:

![Figure 3. Initial Suggestion of Machine Design](image)

![Figure 4. Implementation Phase Block Figure](image)
2.1 Testing and Improvement of Prototype A
For prototype A as shows in Figure 5, testing was performed and the result showed that the machine could not function properly. The designed cylinder was unable to maintain the vertical position of the bird’s eye chilies on the wall of the cylinder causing the inability of the chilies to last. This situation caused the blade of the cutter to be unable to cut the chili stalks.

Results from the test suggested that the design of cylinders with vertical or horizontal-shaped walls was not appropriate to achieve the objectives of the project. Test results were found to be 100% unsuccessful. The results of the study sample did not meet the characteristics required by the company.

Figure 5. Prototype A

2.2 Prototype B Testing and Improvement
For prototype B as shows in Figure 6, testing was conducted and the result showed that the machine was able to work properly. The specially designed cylinder had successfully and was able to maintain the position of the chilies vertically on the wall of the cylinder causing the chilies to last longer. This led to the knife blade cutting the chili stalks.

Test results found that the cylindrical design with a perforated-sheet wall with a hole diameter of 5mm - 6mm was ideal for trapping the chilies stalks. Hence, the prototype B design managed to achieve the objectives of this project. The test results were 100% successful in meeting the objectives of the project. The results of the research project were successful in meeting with the required characteristics of the company. However, the samples tested were *capsicum frutescens* or small chilies, bird’s eye chilies, and *cabai rawit* only which were similar type of chilies used by the *Sri Azwani* company in their chili bottle production.

Figure 6. Prototype B
3. Results and Discussions
The samples used for the project underwent the stalk-cutting process which were carried out in 2 stages: for fresh samples less than 24 hours old as well as samples that had been kept in cold storage for 48 hours. Both the test results were successful and the results were presented to the Sri Azwani company manager for verification purposes (see Figure 7). Here are the test sample results using a final machine from Prototype B (see Figure 8).

![Figure 7. Final product of the test samples](image1)

![Figure 8. Final product of the machine](image2)

3.1 Operations of the Machine
Below are the steps for operating the machine in its respective order:

i. Samples or chilies are inserted into the cylinder in a minimum capacity of 1kg to a maximum of 15kg and the machine door is then closed and locked.

ii. Turn on the power supply phase 1 and turn the power switch on the control box.

iii. The RPM rotation speed of the cylinder can be set by turning the knob on the control box.

iv. Press the START pedal on the wall of the machine.

v. The cylinder on the machine rotates and the cylinder speed can still be controlled even when rotating by adjusting the key knob on the control box (the slowest rotation is best for maximum yield quality).

vi. Wait 40 minutes or earlier depending on the speed of the rotation.

vii. Do a quality check on the chilies every 20 minutes.

viii. The machine will automatically stop when the machine door is opened and will not start until the machine door is closed (as a safety measure).

ix. Emergency switch isolator is also provided. It can be used any time during an emergency.
3.2 Advantages of the Machine

i. The machine is able to separate the chilies from the stalks and isolate it automatically.
ii. The machine can operate at a maximum load of 15kg at a time and only takes a maximum of 1 hour to separate the stalks for the entire 15kg load.
iii. Maximum of 5 hours of work per day followed by a deadline and no load for 15 minutes per hour.
iv. The machine operates using a one-phase supply power.
v. The machine is only 2 x 1 square meters with a height of 1.5 meters.
vi. The cylinder wall is made of stainless-steel perforated sheet making it rust-free and very suitable for the food processing industry.
vii. Capable of processing chilies with a minimum diameter of 5mm, while the stalks have a maximum diameter of 3mm.
viii. Designed specifically for processing Cili Padi Bara and Cili Padi Pondan.
ix. The machine is easy to move as it has 4 wheels.
xi. Equipped with some safety switches and isolators as safety measures.
xii. Attractive end packs add value to the aesthetic value of the machine.

4. Conclusions

Based on the results of the implemented study and the analysis of the prototypes and the samples, the researchers believe that the machine’s performance can be further improved with more future further studies in an effort to address the limitations of the machine.

The findings of this research will definitely help to enhance the productivity of the industry and at the same time have a positive impact on the production of the companies’ chili products. The result of this study suggested that the researchers have successfully created a machine capable of meeting all of the objectives set out in this study. It is hoped that it will also enhance the productivity of chili-based companies by local entrepreneurs in Malaysia.

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