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Optimization of the Design of an Ergonomic Multi-Function Oil Slicer

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ABSTRACT

The results of observations made by the research team at the corn emping home industry have its own uniqueness, namely corn that has been boiled then washed and fried, dried in the sun and fried which will become marning corn. In fact, it turns out that the frying of corn chips still uses manual tools, namely the slicing using an irek, so it takes a long time and cannot be optimal. Optimal in question is that the tool can be used in a number of fried foods, for example in marning corn chips, onion crackers, etc. by adjusting the speed. The purpose of designing an ergonomic tool in question is to design a tool that produces a work system using anthropometric measurements, while this research is focused on designing a multi-functional oil drainer with an ergonomic approach with results that are more effective, efficient, safe, comfortable and can increase productivity. The production this slicing machine uses a 0.50 hp electric motor with 1400 rpm rotation, the V-belt used is type A belt machine, no. 38 with a pulley component with a diameter of 2 inches for the sharft, the machine frame uses an angle iron profile frame with size of 40 mm x 40 mm x 3 mm capability of 5 kg marning corn chips.

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1. Introduction

The location of this research was carried out at the corn chip home industry in Pandanwangi village, Blimbing district, Malang City. The research was conducted in one part of the corn chip marning production, namely the frying section. By still using manual tools as a slicer, it causes less optimal time used. Optimal in question is to be efficient and effective with the resources you have, one of which is at the time of extraction (Yanto, 2017; Saptaputra et al., 2021). Based on the problems above, the aim of the research team is to devise a strategy for optimizing the oil slicer in an ergonomic corn chip marning fryer to make it more effective, efficient, safe, and comfortable to increase productivity for home industry business (Bitan et al., 2019; Kermavnar et al., 2021; Weisnera & Deusea, 2014). The production process is often associated with a series of activities to process or input an output or product result, information (output) that has added value. The design of this slicer is used by adjusting the speed, with an ergonomic approach and using anthropometric measurements (elbow height standing, hand reach forward, hand reach to the side, navel height, knee height when standing and index finger width).

2. Literature Review

The design department functions include mechanical design (electrical, mechanics, software, etc.,) and industrial design (aesthetics, ergonomics, user interface)(Manghisi et al., 2022; Radin Umar et al., 2019). Aspects that affect work design facilities are derived from various disciplines of existing expertise (Eldar & Fisher-Gewirtzman, 2019; Fusaro & Kang, 2021; Mououdi et al., 2018).

Ergonomics

Basically ergonomics is a branch of science that systematically utilizes information about human nature, abilities, and limitations to design a work system so that people can live and work in the system properly (Bortolini et al., 2021; del Rio Vilas et al., 2013; Mistarihi, 2020). In designing an ergonomic work system, there are five design principles that need to be considered, namely:

a. Making machines adapt to humans.
b. Minimize the percentage that is outside the design.
c. The work plan is to be more balanced, as well as to reduce physical use and things that are less procedural.
d. Emphasize the importance of communication. Using machines to enlarge human capabilities
e. Using machines to enlarge human capability.

Some main conclusion regarding the discipline of ergonomics are as follows (Das & Sengupta, 1996; Lotz et al., 2015; Maldonado-Macías et al., 2015):

a. The focus of ergonomics is closely related to human aspects in the planning of "man-made objects" and the work environment.
b. The ergonomics approach will be able to generate "functional effectiveness" and the pleasures of using the designed equipment, facilities and work environment.
c. The main aims and objectives of the ergonomics discipline approach are directed at efforts to improve human work performance such as increasing work speed, accuracy, work safety, reducing excessive energy, fatigue quickly and minimizing equipment damage.
d. A special approach in the discipline of ergonomics is the systematic application of all information related to human behavior in the design of equipment, facilities and the work environment used related to the anatomy (structure), physiology (work), and anthropometry (size) of the human body.

Designing work stations that are good and suitable for operators has been noticed by engineers in the industry. Many studies have been tested to get a good work station, one of which applies theprinciples of ergonomics and movement ergonomics divided into three types of discussion (Diban & Gontijo, 2015; Lohasiriwat & Chaiwong, 2020; Taifa & Desai, 2017).

a. The principle of movement economy associated with limbs.
b. The principle of the movement economy is linked to workplace settings.
c. The principle of motion economy associated with equipment design

Anthropometric

Anthropometric is defined as a science that specifically studies matters relating to measurements of the human body, which are used to determine differences (traits or characteristic) in individuals, groups and so on. I connection with the measurement of certain shapes and characteristics of the human body, anthropometry can also be interpreted as a science that is specifically related to the investigation of the human body which is used to determine differences in individuals and groups. The anthropometric data used to design this tool are as follows (Grajewski et al., 2013; Marano & Di Nicolantonio, 2015; Neves et al., 2015).

3. Methodology

In this study, ISO 9001:2015 clause 6.1 used as a requirement to find gaps from the company's actual conditions. The form in this research is based on ISO 31000:2018, which contains six points.

4. Results and Discussion

The making of this slicing machine has specifications, namely : with a tool height of 120 cm, a tool length of 70 cm, a tool width of 60 cm, there are two tubes, one slicing tube with a diameter of 45 cm and a height of 50 cm, the other is a tube containing oil with a diameter of 50 cm and a height of 70 cm, funnel height 50 cm, on/off button width 1.2 cm. Using an electric motor of 0.50 hp with a rotation of 1400 rpm, the V-Belt used is type A belt machine, no.38 with a pulley component with a diameter of 2 inches for the shaft, the machine frame used is an angle iron profile frame with a size of 40 mm x 40 mm x 3 mm with a capacity of 5 kg marning corn chips.

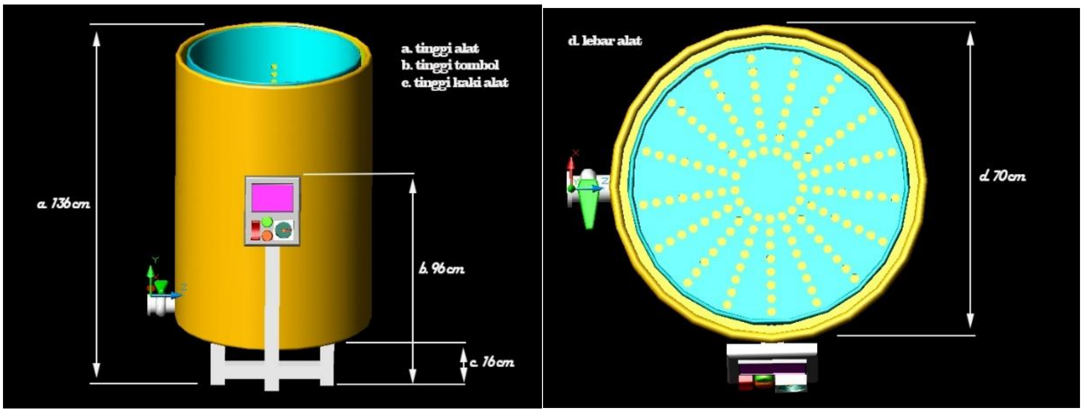

Figure 1. The corn chip marning slicer that will be made

The result of calculations in anthropometric measurement used to design this work facility are Shoulder height when standing with the 5% percentile of 136 is used to determine the height of the tool, extend the hand forward with the 50% percentile of 70 cm used for the width of the tool, elbow height when standing with a 5% percentile of 96 cm for the height of the operator button, and standing knee height with a 50% percentile of 48.5 cm is used to determine the height of the battery position. Used for the design of the work facilities as shown in the table below :

Table 1. Percentile calculation results

No.	Data type	Persentil		
		5%	50%	95%
1.	Shoulder height while standing	136		
2.	Forward reach		70	
3.	Elbow height while standing	96		
4.	Knee height while standing		48,5	

Table 2. Comparison of old and new tools

Comparison	Old Tool	New Tool
Oil drain standard time	6,02 min/kg	1.55 min/kg
Oil slice standard output	9.6 kg/hour	38,4 kg/hour
Operation process	Long	Fast

Quality	Unhygienic, less crunchy and less than optimal storage.	Hygienic, crisper, and long shelf life.
Operator	Requires a lot of effort and operator safety is not guaranteed.	The energy released is small, making it easier for the operator to work and safety is guaranteed.

5. Conclusion

Work facilities to determine draining time can be optimized with an ergonomic tool design process. The ergonomic design in question is the design of a tool that produces a work system using anthropometric measurements so that it can be safe and comfortable. The anthropometric measurements used are: elbow height when standing with the 50% percentile of 102.5 cm, forward hand reach with the 50% percentile of 51.8 cm, sideways hand reach with the 5% percentile of 52.9 cm, hand grip with the 5% percentile of 2.5 cm. Meanwhile, from the results of the analysis, the standard output of the old equipment was 9.6 kg / hour, while the new equipment obtained a standard output of 38.4 kg /hour. So that a productivity of 300% was obtained.

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