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Coffee Roasting Machine Model Design 3Kg Capacity to Boost Craftsman Work Productivity

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Abstract: Coffee roasting machine innovation using a gas stove heating system. This machine still has a drawback, namely the previous roasting machine did not have optimal air circulation that was able to regulate the roasting tube room temperature, so users did not know the roasting tube room temperature. The design to be made has the advantage that it has an automatic shutdown control system. The capacity of this machine is also greater than the capacity of the previous engine, with a capacity of 3 kg. After the roasting process, the coffee can be removed from the roasting pan easily. For this reason, the planning of the roasting machine was administered through an ergonomic approach in one short case study with a pre- and post-test design group which was administered observationally on the roasting process manually and by employing a roasting machine. Ergonomic Roast Machine specifications are designed with a capacity of 5 Kg as follows: a). The roasting tube may be a chrome steel plate with a thickness of 1.2 mm with a length of 670 mm and a width of 310 mm, b). the facility of the electrical motor is 0.25HP with a rotation of 1400 rpm while the rotation of the drum roast is 50 rpm with a gearbox transmission, c). the size of the machine are 80 cm long, 75 cm wide and 90 cm high. Ergonomic test results show that the utilization of a roasting machine can increase the work productivity of roasted by 62.07%.

Keywords: Roasted Grated Coconut, Ergonomic Roast Machine, Work Productivity

1. Introduction

There is still a relatively long roasting time of 30-45 minutes for coffee that is uneven and irregular in each roasting process, according to experiments employing a gas-fueled roasting equipment and electric motor drive in Pujungan Village, Pupuan District, and Tabanan Regency. Most coffee roasting machines use an external heating system, which means that heat is provided from outside the pan. The roasting pan gets excessively hot and the heat is uneven with this approach because the pan comes into close contact with the gas stove fire. This results in the roasting of the coffee beans burning, which lowers the caliber of the coffee that is produced.

A cutting-edge coffee roasting apparatus uses a gas burner heating technology. This machine still has a problem in that the air circulation in the roasting machine might be enhanced to regulate the ambient temperature in the roasting tube. The user is therefore uninformed of the ambient temperature of the roasting tube. Additionally, the end result of the coffee roasting process on this machine is challenging to remove from the tube due to the less effective design of the coffee roaster. To overcome the aforementioned challenge, a coffee roaster that could correct the errors committed by the previous designer had to be built.

By taking an ergonomic approach to the stirring process, specifically by using a roasting machine model within the roasting process, there are a number of alternative solutions to the aforementioned problems that are anticipated to reduce workload, musculoskeletal complaints, and fatigue levels as well as shorten working hours and boost work productivity. A posture that regularly slows down over a long period of time is not physiological. Non-physiological work postures are frequently brought on by the features of job requirements, work tools, work stations, and labor.

Overall costs may be reduced in the manufacturing sector by planning the assembly process to reduce the need for raw materials and procedures [1]. Low job productivity is a result of increased heart rate during work and complaints after work [2]. The features of job demands, work equipment, work stations, and work posture that are incompatible with the abilities and limits of employees sometimes lead to work posture that is not physiological [2, 3] Years of non-physiological work posture might lead to workers developing bone abnormalities [3, 4].

2. Method

2.1. Research Design

This study is a one-short case study with a pre- and post-test design group that was carried out through observation of a coffee roaster's operational procedure [5, 6]. This is how the chart may be explained:

Figure 1. *Research Design.*

Information:
R = Random sample.
P0= the result of the pre-test experimental unit.
PI = the result of the post-test experimental unit.

2.2. Research Variable

The following factors will be assessed in this study: (1) workload, which will be determined by the heart rate of rice before and after work; (2) complaints of muscle and skeletal exhaustion before and after work; and (3) work productivity, which will be determined by comparing the work pulse (measured in beats per minute) with the weight of the products produced (in kilograms) while working (minutes). The information data of the beginning condition and therefore the end condition are measured, compared, and worked out before using the roasting machine and after using the roasting machine to determine the comparison.

2.3. Data Analysis

The roasting machine's design specifications are determined in accordance with the requirement for a 3 kg load capacity, after which an electrical motor, a shaft and stirrer tank, and an ergonomic machine holder structure are developed. Data on working time/length of labor, workload, subjective complaints, and work productivity are among the test data collected before and after the use of the roasting machine. These data can be descriptively examined to draw conclusions. The roasting machine's design specifications are determined in accordance with the requirement for a 3 kg load capacity, after which an electrical motor, a shaft and stirrer tank, and an ergonomic machine holder structure are developed. Data on working time/length of labor, workload, subjective complaints, and work productivity are among the test data collected before and after the use of the roasting machine. These data can be descriptively examined to draw conclusions.

3. Results and Discussion

3.1. Manually Coffee Roaster Process

On average, it takes 3 hours to make a coffee roaster, from preparation to finish. Except on vacations or other important holidays, or if there is no order, coffee roaster craftsman often work 6-7 hours per day, including lunch breaks, seven days a week. From 9:00 am until 5:00 pm, they are at work. Although labor is strongly impacted by the working weather during a pleasant working location, so it's not chilly or too hot, employees are always exposed to heated ambient temperatures due to the influence of warmth radiation from the furnace and solar heat radiation. For Indonesians, a comfortable temperature is between 24 and 26°C [7]. It is thus anticipated that the current ambient temperature would result in a greater burden for the employees producing coffee roasters. The roasted grated maker's operating position involves bending while crouching or standing.

The position is a non-physiological work posture that is used for a considerable amount of overtime and is administered over a reasonably long period of time, which is bad for your health [2]. The features of job requirements, work instruments, workstations, and work postures that are not in conformity with the skills and limits of employees can lead to non-physiological work postures [2, 3]. Years of non-physiological work posture can result in employees' bones developing abnormally [3] as well as causing workers' subjective disorders [8, 9].

Likewise, the striated muscular system will undoubtedly be disturbed by the job posture that comes together with coffee roaster producers who are always in an abnormal position. Without taking any breaks throughout the 7-8 hours of labor each day, weariness will inevitably set in, leading to an increase in burden. It is characterized by an increase in working pulse and striated muscular system abnormalities.

If the force is only used up to 20% of the maximum strength, the contraction will endure for a few times in a static working posture that requires 50% of the maximum force. Any person may exercise dynamically for 4 minutes or less if they do so at a pace that meets their aerobic capacity before resting [3]. In a 2009 study on work models that supported ergonomics, Roles et al. discovered that the work model was capable of reducing tiredness by up to 17.71%. According to Torik, et al. [10], designing an ergonomic work system can lessen the severity of worker weariness. To prevent a forced attitude that surpasses the physiological capacity of the body, craftsmen's working posture should be developed in physiological postures such as when sitting and standing (Kroemer and Grandjean, 2009). This is ergonomically prepared to lessen workers' musculoskeletal issues.

3.2. Coffee Roaster Design Model

The roasting machine is constructed using an ergonomic design strategy so that the strain of the job and work capacity

should be matched in order to achieve good work performance. According to Tarwaka [11], the tension associated with work tasks shouldn't be too low or overwhelming because both would lead to stress.

Figure 2. *The Result Coffee Roaster.*

The pulley, which shares a shaft with the electrical motor in this equipment for roasting coconuts, rotates when the electrical motor is turned on. Due to their connection by a v-belt, the pulley within the speed reducer will rotate as a result of the pulley inside the main pulley. Due to the fact that the speed reducer has two gears, the electrical motor's rotational speed will be lowered (reduced) inside of it. Additionally, a set of gears and chains will communicate the rotation to the roaster's cylindrical axis. The shredded coconut-filled horizontal cylinder (roast holder) spins slowly while being heated by an LPG gas source that is funneled via perforations in the heating pipe at the bottom of the cylinder. The following are the outcomes of the planned parameters for a 5 kg roasting machine: a). A chrome steel plate with a 1.2 mm thickness, measuring 670 mm in length and 310 mm in width, may be used as the roasting tube. b). the drum roast rotates at 50 rpm with a gearbox transmission, while the electrical motor has a 0.25 HP capacity and rotates at 1400 rpm. c). The machine is 80 cm in length, 75 cm in width, and 90 cm in height.

3.3. The Result of Ergonomics Test Using Coffee Roaster

3.3.1. Subjective Complaint

Due to the craftsman's slumped position while working and being exposed to heat from the surroundings due to radiation from the stove, there is an increase in musculoskeletal symptoms and fatigue-related issues. It's possible that a work position that involves repeated, prolonged bending is not physiological. Muscle problems develop as a result of strain on the muscles from ongoing workloads without rest [4].

According to measurements made using a Nordic body map questionnaire on 10 artisans before and after labor, there is typically a difference between musculoskeletal problems before and after work of 28.90 and 16.70. Prior to and following therapy, there was a 42.21% decrease in the mean difference between musculoskeletal problems. This reduction was significant (p 0.05). This is consistent with the findings of a study conducted by Habib and Hojeij [12] on 504 randomly selected bakery employees in Lebanon, which revealed that 23% of them reported having upper extremity pains.

Table 1. *Measurement Results of Musculoskeletal Disorder.*

Descriptions	Everage difference musculoskeletal disorder		t	p
	Mean	Standard Deviation		
Manual roasting process	28,90	3,31	6,578	0,00
Machine roasting process	16,70	4,30		

3.3.2. Work Load

The average resting pulse of craftsmen within the manual work process (before using the roasting machine) is 69.84 (±2.31) bpm and therefore the average working pulse is 105.96 (±1.46) bpm and therefore the increase in work pulse is 37.53 (±2.98) bpm or 54.48%. The typical resting pulse of craftsmen after employing a roasting machine is 68.43 (±1.71) bpm and therefore the average working pulse is 97.08 (±2.00) bpm and a rise in work pulse is 27.24 (±1.64) bpm or 39.00 %.

The average working pulse of the serundeng maker before treatment was 105.96 (±1.46) beats/minute including the category of medium workload [13]. This workload is caused by workers working continuously without rest amid a hot work environment because of heat radiation from the furnace and solar heat radiation also as heat radiation through the kitchen wall causing the workload to extend.

Table 2. *Resting Pulse, Pulse Working and Work Pulse.*

Descriptions	Manual roasting process		Machine roasting process		t	p
	Mean	SD	Mean	SD		
Resting Pulse	69.84	2.31	68.43	11.71	-1,53	0,16
Pulse Working	105.96	1.46	97.08	2.00	10.51	0.00
Work Pulse	37.53	2.80	27.24	1.64	15.55	0.00

SD: Standard Deviation

3.3.3. Work Productivity

The work productivity of craftsmen within the coffee roaster process is recorded supported the ratio of output to input at a specific unit of time. The output produced is that the

amount of coffee roaster (kilograms) produced by the crafted during working hours, while the input is that the working pulse of the crafted. The results of the calculation of productivity after using the roasting machine is 152.69±3.37 while before using the roasting machine it's 94.21±3.09 or a rise of 62.07%. This increase in productivity is because of a decrease in workload and an ergonomic work postur in order that fatigue and musculoskeletal complaints are reduced and production is increased. to extend productivity, consistent with [13], it's necessary to vary the work system to scale back the extent of worker fatigue, in order that working time is shorter and production can increase. Torik, et al. [10] also stated that the planning of an ergonomic work system can reduce the extent of worker fatigue.

Table 3. *Work Productivity of Craftsmen in The Coffee Roaster Process.*

Descriptions	n	Mini-mum	Maxi-mum	Mean	Standard Deviation
Manual roasting process	10	149	151	152.69	3.370
Machine roasting process	10	91	102	94.21	3.091

Ergonomics intervention recommendations to extend work productivity also are widely stated by ergonomics researchers, like in Priambadi's research [14] through improving working conditions for a smelting gamelan craftsmen can increase work productivity by 26.67% and Bawa Susana's research (2014) with ergonomics interventions can increase work productivity 54.88%. Setiawan's research [15] through the work a station design can increase work productivity by 20.29%

4. Conclusion

Based on the discussion that has been administered, the subsequent conclusions can be:

1) The working posture of coffee roaster craftsmen by sitting hunched over causes a rise in musculoskeletal complaints and fatigue complaints because of the craftsman's bending work posture amid exposure to environmental heat because of radiation from the stove/stove. The working posture that bends over and over for an extended time may be a work posture that's not physiological.
2) The results of the planning of the coffee roaster machine with a capacity specification of 3 Kg are as follows: a). The roasting tube may be a chrome steel plate with a thickness of 1.2 mm with a length of 670 mm and a width of 310 mm, b). the facility of the electrical motor is 0.25HP with a rotation of 1400 rpm while the rotation of the drum roast is 50 rpm with a gearbox transmission, c). the size of the machine are 80 cm long, 75 cm wide and 90 cm high.
3) The results of testing the work productivity of craftsmen through an ergonomic approach are obtained that: a). the typical resting pulse of coffee roaster craftsmen before using the roasting machine was 69.84 (±2.31) bpm and therefore the average working pulse was 105.96 (±1.46) bpm and therefore the increase in working pulse was 37.53 (±2.98) bpm or 54.48%. the typical resting pulse of coffee roaster craftsmen after employing a roasting machine is 68.43 (±1.71) bpm and therefore the average working pulse is 97.08 (±2.00) bpm and a rise in work pulse is 27.24 (±1.64) bpm or 39.00 %; b). the typical difference between musculoskeletal disorders before work and after work before employing a roasting machine is 28.90 (±3.31) and therefore the average difference between striated muscle disorders before work and after work after employing a roasting machine is 16.70 (±4.30). The decrease within the mean of striated muscle disorders before using the roasting machine and after using the roasting machine was significant ($p < 0.05$) or 42.21%; and c). The results of calculating the work productivity of craftsmen before using the roasting machine is 94.21±3.09 and a rise after using the roasting machine is 152.69±3.37 or a rise of 62.07%.

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