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Design of a snack seasoning mixing machine for culinary partners

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ABSTRACT

To improve customer satisfaction, this study discusses the design of a snack seasoning mixing machine to improve the efficiency and consistency of the mixing process in the food industry. The main problems faced by businesses are uneven seasoning distribution and long production times when the process is performed manually. The methods used included identifying user needs, mechanical and electrical design, material selection, and prototype development using an electric motor as the main drive and mixing shaft in a stainless steel container. Testing was conducted to determine the machine's performance in mixing seasonings. The results showed that the machine was able to mix seasonings within 2-3 minutes with stable operation, low power consumption, and produced a more homogeneous mixture compared to the manual process. In addition, the machine is easy to operate and maintain, making it suitable for application in small- and medium-sized businesses. The conclusion of this study is that the designed snack seasoning mixer has good performance, is capable of improving production quality and efficiency, and has the potential to be further developed to increase its capacity and durability.

Keywords: mixer; snacks; design; efficiency; seasoning

1. INTRODUCTION

The snack food industry is growing rapidly, requiring more efficient and consistent production processes to maintain the product quality. One of the critical stages in snack production is the seasoning mixing process, as seasonings affect the taste, aroma, and consumer appeal. Many micro and medium-sized entrepreneurs still use manual methods for mixing seasonings, which leads to uneven distribution of seasonings, increased production time, and dependence on operators. This situation has an impact on reduced production efficiency and the risk of inconsistent quality in each product batch. Therefore, an automatic and stable spice mixing tool that produces a more uniform mixture is required.

Research on the development of mixing machines has been conducted over the past ten years, including the development of simple electric motor-based mixers and mixing systems using rotating shafts designed to improve the homogeneity of the mixture. Previous studies have shown that the use of electric motors with the appropriate torque can increase the mixing effectiveness and significantly reduce the processing time. However, most of these studies have focused on large industrial scales; therefore, more affordable technological adaptations for micro and small businesses are needed. Based on these needs, this study aims to design and manufacture a simple, efficient, and easy-to-operate spice mixer suitable for use by culinary MSMEs. Through mechanical design, material selection, and machine performance evaluation, it is hoped that the resulting product can improve production efficiency and achieve consistently high-quality mixing results.

2. LITERATURE REVIEW

2.1. The Process of Mixing Seasonings in the Snack Industry

The spice mixing process is an important stage in snack production because it determines the uniformity of taste, aroma, and quality of the final product. Uneven mixing can cause differences in taste in each part of the product, thereby reducing consumer satisfaction. The mixing process in the food industry involves mass transfer and material flow, which are influenced by mechanical forces and turbulence inside the mixing vessel.

In practice, manual mixing methods are still widely use manual mixing MSMEs, but they have limitations, such as longer processing times and inconsistent mixing results. Research shows that the use of mixing machines can improve the homogeneity of mixtures and speed up production time compared with manual methods. Therefore, the application of mixing machines is a solution to improve the efficiency and quality of snack products.

2.2. Mixing Machines and Drive Systems

The mixer operates on the principle of rotating a shaft equipped with mixing blades to generate a flow of ingredients within the container. The rotation of the shaft creates shear forces and turbulence that aid the mixing process, ensuring that the seasonings are distributed evenly. The performance of the mixer is greatly influenced by the design of the mixing blades, the rotational speed, and the capacity of the ingredients being mixed. Mixer drive systems generally use electric motors because they are energy efficient and easy to operate. For SME applications, low to medium power electric motors are considered effective in producing the torque required for the mixing process. Selecting the right motor can maintain rotation stability and increase machine reliability during the production process.

2.3. Mixer Machine Materials and Previous Research

The selection of mixer materials must take into account mechanical strength and hygiene aspects, especially for food industry applications. Materials that come into direct contact with food must be corrosion resistant, non-reactive chemically, and easy to clean. Stainless steel is the most commonly used material because it meets these requirements and is safe for food products. Previous studies have shown that small-scale mixing machines can increase production time efficiency and produce more homogeneous mixtures compared to manual methods. Rahman et al. stated that a simple but precise mixing machine

design can provide optimal performance with relatively low power consumption, making it suitable for application in micro and medium enterprises.

3. METHOD

This research method includes the stages of identifying user needs, designing mechanical and electrical components, selecting materials and their sizes, prototyping, and testing machine performance. Needs identification was carried out by observing the spice mixing process at MSMEs with a production capacity of 1–2 kg per batch. Based on this data, the initial specifications of the machine were determined, including the dimensions of the container, motor capacity, and stirring mechanism.

The design stage begins with the selection of the main materials. The mixing container uses a 6 kg capacity stainless steel barrel with a diameter of ±26 cm and a height of ±25 cm so that it can hold 1–2 kg of snack ingredients per process. The mixer works on the principle of rotating the container (drum) as a mixing medium, without using an active stirring shaft. The cylindrical drum is mounted on a frame in a slightly tilted position and can rotate on a horizontal axis. Inside the drum are fins or stirring blades that are permanently attached to the inner wall of the drum. The drive motor used is a 50 Watt electric motor with a rotation speed of 100-300 rpm, selected to produce sufficient torque for the mixing load. The main frame is made of hollow iron, while the motor mount uses 3 mm thick iron plate for stability during operation. The electrical components use 1.5 mm NYA cable, an on/off switch, and standard safety connectors.

The manufacturing process includes cutting the frame according to the design, installing the motor on the mount, assembling the shaft and agitator blades, and installing the electrical components. The container is perforated at the top for shaft installation, with a hole diameter of 12–14 mm to match the shaft size. All mechanical connections are reinforced using M8–M10 bolts, while electrical connections are given additional insulation for safety.

4. RESULT AND DISCUSSION

4.1. Engine Performance Test Results

The spice mixing process is one of the most crucial stages in the snack food production system, particularly in maintaining the consistency of the flavour, aroma, and quality of the final product. Consistency in mixing is necessary so that each product unit has relatively the same sensory characteristics, thereby meeting quality standards and consumer preferences (Puspitasari et al., 2021). Inconsistent mixing has the potential to cause variations in product flavour, which can ultimately reduce consumer acceptance. Scientifically, the mixing process is influenced by the phenomenon of material flow, mass transfer between particles, and mechanical forces in the form of shear and turbulence that occur during the stirring process (Emzain et al., 2023).

In small and medium industries, particularly micro, small and medium enterprises MSMEs, the process of mixing spices is still largely done manually using human labour and simple equipment (Siswati & Alfiansyah, 2020). This situation limits control over the speed, direction and pattern of mixing, resulting in a relatively longer mixing process and a less homogeneous mixture. Community service research discussing the application of appropriate technology in MSMEs shows that manual mixing has a major weakness in the low mechanical force applied during the mixing process, so that the distribution of seasonings in food products in particle form, such as crisps, is often uneven and affects the inconsistency of the final product quality (Salho & Hamzah, 2024).

In addition to mechanical factors, the characteristics of the seasoning and the product being mixed also affect the quality of the mixture(Lestari et al., 2026). The composition of the seasoning, particle size, and physical properties of the product determine the success rate of seasoning distribution on the surface of the snack product. Research on seasoning formulations in food products has shown that differences in seasoning composition can affect sensory characteristics, such as taste and aroma, making a homogeneous mixing process a key requirement for producing consistent product quality (Pujiyanto et al., 2024).

Therefore, a well-controlled mixing process is necessary to ensure that the seasoning is evenly distributed and optimally adhered to the product surface.

4.2. Engine Performance Test Results

A mixing machine is a mechanical device designed to mix two or more materials to achieve a homogeneous mixture through the aid of specific mechanical movements (Anggraini et al., 2024). The working principle of a mixing machine is based on the rotation of a shaft equipped with mixing blades inside a mixing container, where the rotation produces material flow, shear force, and turbulence that play a role in moving and distributing the seasoning evenly on the surface of the product (Iznilillah et al., 2022). The effectiveness of the mixing process is greatly influenced by the design of the mixing blades, the shape of the container, and the flow pattern of the materials formed during the process, as these factors determine the intensity of mixing and the degree of homogeneity of the mixture produced.

The performance of mixing machines also depends heavily on operational parameters, such as shaft rotation speed and mixing capacity (Emzain et al., 2023). Too low a rotation speed can result in suboptimal mixing, while too high a speed can potentially damage the texture of snack products. Therefore, it is necessary to select an appropriate rotation speed to achieve a balance between mixing homogeneity and product physical quality. Research shows that mixing machines designed with the right technical parameters can improve the homogeneity of the mixture and speed up the production process compared to manual mixing methods (Affandi, 2020).

The drive system in mixing machines generally uses electric motors because they have relatively high energy efficiency, are easy to operate, and are reliable for continuous use (Dewi et al., 2022). Electric motors serve as the main power source that drives the mixing shaft through a pulley and belt transmission system to adjust the rotation speed according to the mixing process requirements. The use of electric motors with appropriate power has proven to be effective for SME-scale applications because they can increase productivity, reduce operator workload, and produce a more consistent and controlled mixing process, as shown in research on small-scale processing machine drive systems that emphasises the importance of transmission mechanism efficiency and motor rotation stability.

4.3. Comparison with Previous Research

Several studies over the past ten years have shown that small-scale industrial mixers are generally designed using electric motors with a power of around 50 watts for a mixing capacity of 1–2 kg. This approach was chosen to suit the production needs of MSMEs, which prioritise energy efficiency and ease of operation (Cahyono & Yulianto, 2018). However, mixing efficiency is not only determined by the power of the motor, but also by the configuration of the mechanical system and the characteristics of the agitator used in the mixing machine.

Research conducted by Sulistyo & Yudo (2019) states that the efficiency of the mixing process is greatly influenced by the geometry of the agitator and the rotational speed of the shaft. Proper agitator design can improve material flow and accelerate the achievement of homogeneous mixing conditions even when using relatively low motor power. This is in line with research on machine design in the agro-industrial sector, which shows that optimising mechanical design can improve machine performance without significantly increasing power consumption (Liana & Denjayanti, 2022; Pramesti et al., 2023).

The results of this study indicate that the mixer design attached to the shaft is capable of providing mixing efficiency comparable to other machines that use more powerful motors. A comparison with previous studies reinforces the finding that the design configuration of the agitator, transmission system, and rotational speed have a dominant influence on mixing performance (Anggraini et al., 2024; Febriani, 2021; Lestari et al., 2026). Thus, the mixing machine designed in this study is considered suitable and effective for application on an SME scale, particularly in efforts to increase production efficiency without excessively increasing electricity consumption.

4.4. General Discussion

Based on the results of research and comparison with previous studies, it can be concluded that the current trend in the development of small-scale mixing machines is no longer focused on increasing motor power, but rather on optimising mechanical design and mixing systems. Several studies mention that the use of an electric motor with a power of around 50 watts is sufficient for a mixing capacity of 1–2 kg, as long as it is supported by the right agitator design and transmission system. This approach is very relevant to the needs of MSMEs that require energy-efficient machines that still have optimal performance.

Salho & Hamzah (2024), emphasise that mixer geometry and rotation speed are the main factors affecting mixing efficiency. This is supported by other studies that emphasise the importance of mechanical design in improving the performance of food processing machines. Puspitasari et al. (2021) show that machines with optimally designed mechanical systems are capable of achieving good working capacity without a significant increase in input power, thus confirming that the design of the structure and working mechanism of a machine plays an important role in operational efficiency.

In addition, the application of appropriate technology in the MSME sector is also an important consideration in the design of mixing machines. Community service research discussing the application of machine drive systems for MSMEs emphasizes that machines must be easy to operate, energy-efficient, and suitable for field conditions (Pramesti et al., 2023). Thus, the results of this study indicate that the designed mixing machine fulfills the principles of appropriate technology, as it is capable of providing good mixing performance with low power consumption and is suitable for application in the MSME-scale snack food industry. See Table 1, Figure 1, and Figure 2 for details.

Table 1. Mixing Time Based on Material Capacity

Kapasitas Bahan (kg)	Waktu Pengadukan (menit)	Homogenitas Campuran (%)
1,0	2,0	96,0
1,5	2,5	95,0
2,0	3,0	94,0

Figure 1. Inventor Design of Spice Mixing Machine

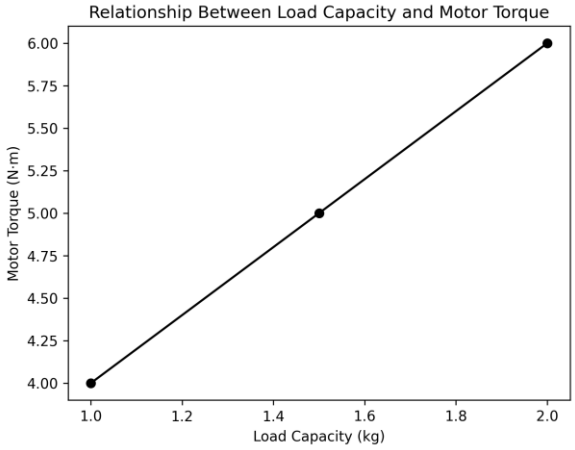

Figure 2. Graph showing the relationship between load and motor torque

5. CONCLUSION

In this study, a snack seasoning mixer was successfully designed and tested to improve the efficiency and consistency of the mixing process compared with manual methods. From the test results, the machine can mix seasonings evenly in 2-3 minutes for a capacity of 1-2 kg of ingredients, with a homogeneity level above 90%. The mechanical design, which uses a 50 Watt motor, a 26 cm diameter shaft, and fins or mixing blades permanently attached to the inner wall of the drum, has proven to be effective in producing a flow pattern that supports even seasoning distribution. The advantages of this machine include low power consumption, ease of operation, relatively affordable manufacturing costs, and stable rotation during mixing. However, there are several drawbacks, such as the lack of a speed control system, limited container capacity, and absence of a cover system to improve safety. Based on these findings, further development can focus on adding a microcontroller-based speed control feature, increasing container capacity, selecting more hygienic materials such as stainless steel, and conducting further testing on the machine durability in long-term use. These suggestions are expected to form the basis for developing a more optimal product that meets the needs of culinary MSMEs.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Authors' Contributions

JTA conceptualizedoof the study, developed the research framework, coordinated data collection, and prepared the initial manuscript draft. AR refine the theoretical foundation and validate the measurement instrument of analysis to ensure methodological rigor. MSP and AS contributed to the literature review, strengthened the discussion by integrating relevant empirical studies, and revised the manuscript forclarity coherence.

Disclosure Statement

The Authors declare that they have no conflict of interest

Data Availability Statement

The data presented in this study are available upon request from the corresponding author for privacy.

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