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Design and Fabrication of Automatic Laddu Shaper Machine

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Abstract: The laddu shaper machine is primarily utilised in cottage and small-scale industries. A feed hopper, screw conveyor, roller, motor, and collecting tray are some of its various parts. People frequently order a lot of sweets from the vendor and anticipate receiving them as soon as feasible. The vendor must add more staff in order to finish the order in the allotted time and also maintain the quality of the product. To cope up with demands to be fulfilled in a shorter time span, automation can come in handy. The effort to automate laddu production is discussed in the paper. By enhancing production rate and quality, the project seeks to decrease labour costs while boosting profits. Additionally, it adheres to safety standards for the materials required to build the machine, reducing material waste caused by manual handling. The material used is food grade material to keep the machine hygienic and corrosion-free. The purpose of this machine is to make proper and highly nutrients content laddu in proper round shape.
Keywords: laddu shaper machine, laddu making, shaper machine, laddu maker, laddu maker

I. INTRODUCTION

During festivals, there is an increase in the demand for sweet products, and many times, due to limited production, only a few customers are satisfied, so there is a need for automating the process of sweet product manufacturing plants. Automating the process will undoubtedly increase the productivity of these plants, as productivity is directly related to how efficiently the input resources are used. They are used to convert them into marketable end products. Another factor influenced by automation of the sweet products manufacturing plant is quality.

Quality assurance methods used in the food industry have traditionally involved human visual inspection and are tedious. So it is necessary for the food industry to employ automatic methods for quality assurance and quality control. In fact, this aspect of food manufacturing has received the most attention in terms of automation. Furthermore, automation increases profit, which not only increases shareholder value but also allows management to invest strategically in improving product quality and productivity, both of which contribute directly to profitability.

To reduce labour requirements and thus labour costs, achieve uniformity of shape and size of the product, increase productivity i.e. large scale production in very short time, reduce gap between order time and delivery time, create a setup that should be within budget for small scale organisations.

II. MATERIALS AND METHODS

The main goal of this project is to create an automated laddu producing machine. The materials are the most important aspect in creating a product. Materials that are needed are chosen and screened.

A. *Feed Hooper*

The combination is fed at regular intervals and is regularly fed to a machine. The feeding material in this project is flour mixed with a sugar solution, almonds, and ghee.

B. *Screw Conveyor*

A screw conveyor is a mechanical conveyor that uses a helical screw blade that rotates. This aids in the movement of liquid or granular particles. It can be driven by a motor with the flow of material tilted upward. When space permits, this method of elevating and transporting is very cost effective. The capacity of a particular unit reduces significantly as the angle of inclination increases. The conveyor's rotating component is also known as an auger. Screw conveyors are employed in this equipment to transport dough from the feeder to the processing section.

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C. Belt and Pulley

The device aids in the transmission of power via a wire or belt. A belt runs along the groove of a pulley in a belt and pulley system to transfer power from one pulley to another or from the pulley directly to the application that requires power. A belt and pulley system is used in this machine to transfer power from the motor to the conveying and rotating unit.

III. MODELLLING OF LADDU SHAPER MACHINE

A. 3D Isometric View

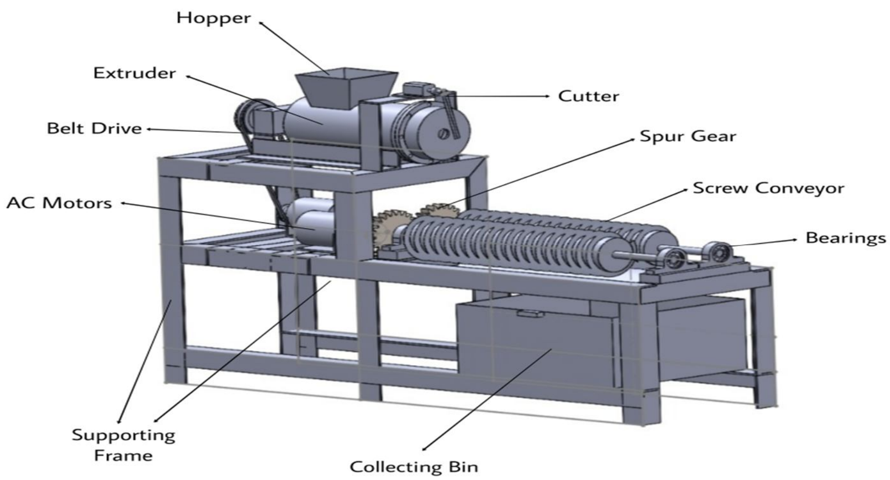

Fig. 1. 3D Isometric View

B. 2D View

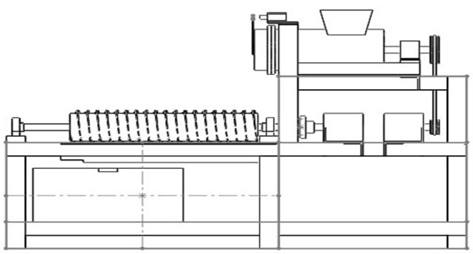

Fig. 2. Front View

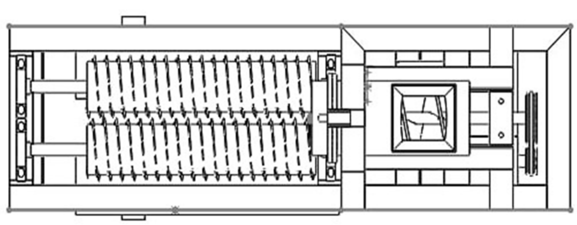

Fig. 3. Top View

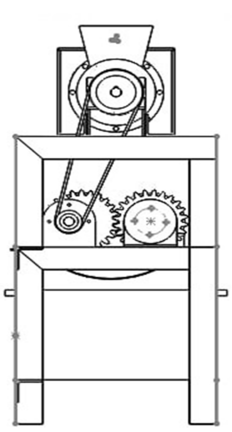

Fig. 4. Left View

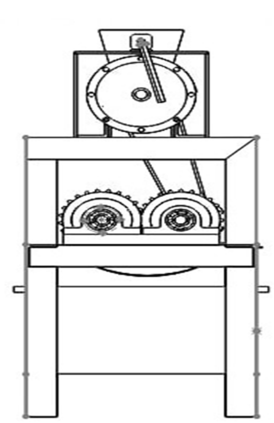

Fig. 5 Right View

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IV. WORKING

A motor connected to a feed screw compress and pushes the material to the proper consistency for further processing. This component is critical because it moves the material forward with proper compression and speed. Because the material should not dry out in the hopper, accurate compression and speed are critical criteria. The hopper is connected to the feeder casing, which is the feed screw barrel. The barrel's capacity is kept at its maximum to maintain the moisture level of the feeding material. If it is too large, the feeding material will dry out, compromising the substance's consistency. If it is too low, feeding it repeatedly will be a laborious task. The cutter cuts the material at predetermined intervals with appropriate force. The motor provides the necessary cutting force and torque. The cutter is powered by an electric motor with optimal horse power for cutting. The cutter's speed should be kept constant so that the cutting process does not damage the cutter or the material extruded from the feeder. The raw material is pressed and continuously fed by the feeder in the desired shape through screw conveyor, and the cutter cuts it at regular intervals based on the amount necessary. Now, cylindrical-looking things must be rolled into spherical uniform balls of the desired diameter. This is accomplished by moulding a component of our arrangement. It transfers the item from the cutter to our shaping setup. For shaping the Laddu, two lead screws are needed. A lead screw is sometimes referred to as a power screw or a translating screw. In this arrangement, the laddu gets round and the butter in the laddu does not escape, causing the laddu to grow softer and our goal to be met. Laddu quality and quantity will improve.

V. CALCULATION

TABLE I
CALCULATION OF LADDU SHAPER MACHINE

S.NO	COMPONENTS	DESIGN CONSIDERATION	RESULT
1	CALCULATION OF HOPPER	Volume of Hopper	V=1500 cm^3
		Height of Hopper	h=150 mm
2	CALCULATION OF SCREW CONVEYOR	Velocity of Feed	v=51 mm/s
		Capacity of Screw Conveyor	Q=10 rpm
		Power required for driving the shaft	N=0.190 kW
		Torque on screw shaft	M=185.25 Nm
		Load Propulsion Speed	v=0.017 m/s
		Load per metre Length of conveyor	q=653.6 no unit
		Axial Thrust on Screw	P=1800 N
3	CALCULATION OF CUTTER MOTOR	Yield strength of dough	σ_y = 600kPa
		Tensile strength of the dough	σ = 780kPa
		Shear strength of dough	τ = 468 kPa
		Shear Force of dough	F= 588 N
		Torque of the cutter motor	τ = 97 Nm
		Power required	P= 88.2 W
4	CALCULATION OF BEARING	Journal Bearing	□ = 256.014
		Coefficient of Friction	µ = 3.001 x 10-10
5	CALCULATION OF BEAM	BEAM 1	
		Maximum Bending Moment	M_b = 981.6 Nmm
		Thickness of the Beam	t = 6 mm

		Bending stress of the Beam	σ_b = 0.409 N/mm^2
		Design Checking of the Beam	Thus, $\sigma > \sigma_b$, The Beam Design is safe to construct
		BEAM 2	
		Maximum Bending Moment	M_b = 16600 Nmm
		Thickness of the Beam	t = 16mm
		Bending stress of the Beam	σ_b = 0.465 N/mm^2
		Design Checking of the Beam	Thus, $\sigma > \sigma_b$, The Beam Design is safe to construct
6	CALCULATION OF COLUMN	Determination of Long or Short Column	k= 1.55mm Column is Long Column
		Load on the column	P_{cr} = 1275 N
		Actual Load on the column	P_{actual} = 36.81 N
		Design Checking for the column	$P_{cr} > P_{actual}$ Thus, The Design of the Column is safe to construct.

VI. RESULTS & DISCUSSION

A. Proposed Method

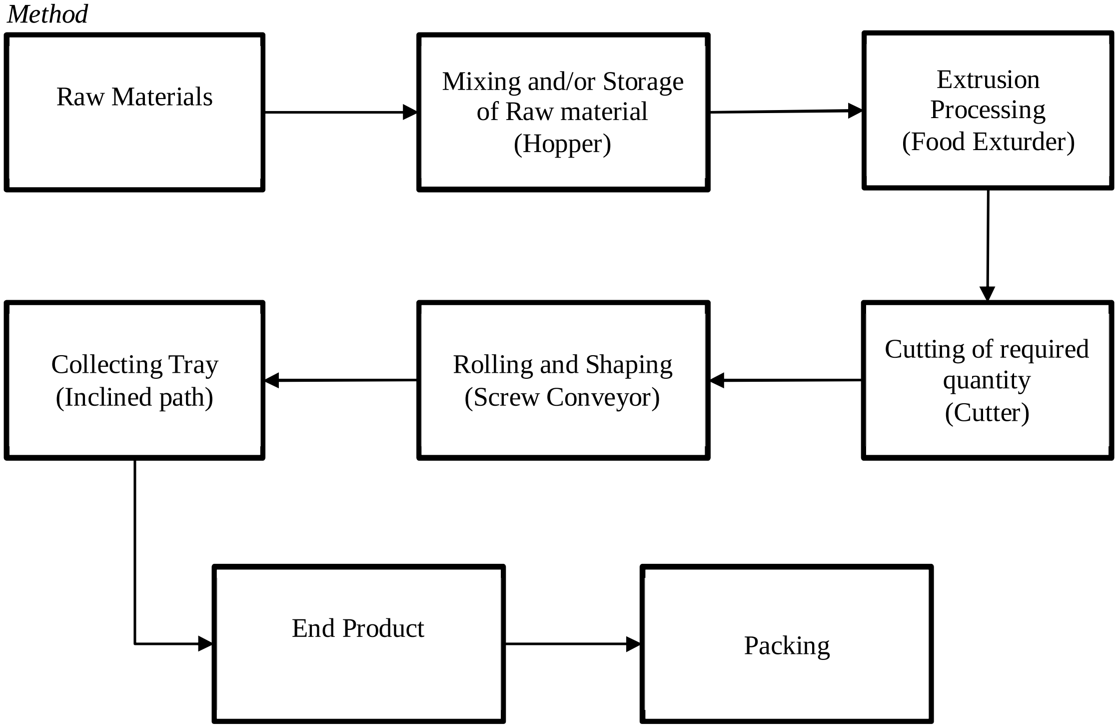

Fig. 6. Block Diagram

Preparation of raw material for the making of the millet balls, to shape the millet balls, the required raw material is roasted millet powder, ghee. Feeding of the raw material to the extruder via Feed hopper made of stainless steel material. The extruder extrudes the mixer as a tube shaped batter and it is cut using a cutting mechanism The extruded balls is shaped using the food grade screw conveyor. The sphere shaped millet balls is collected using the stainless steel collecting tray placed in the inclined manner and send to packing.

B. Proposed Outcome

Material wastage due to manual handling will be reduced. Food grade materials are used to keep the machine hygiene and corrosion free. Persevere the demand in short span of time. Increased the efficiency by reducing the labour and time. Proper size of the millet ball will be maintained.

VII. CONCLUSION

The automated laddu machine was evaluated and tested. This equipment increases manufacturing efficiency for small-scale industries. The equipment also saves time and labour while producing hygienic laddus. The product's capacity can be modified by readily scaling the product for desired capacity, allowing it to be utilised for small to big scale production as required by the seller. Because the cost of the machine is lower, it is more affordable to small vendors, who are the primary objectives for manufacturing the machine. By broadening customer needs, the machine lays the groundwork for the future development of universal special purpose machines in the food industry.

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