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Design and Construction of the Semi-Automatic Sliced Ginger Machine

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***Abstract*—**The purpose of study was to design and construction the semi-automatic sliced ginger machine for reduce production times in sheet and slice ginger procedure furthermore, reduced amount of labor of slides and cutting method. Take consider into clean and safety of workers and consumers. The principle of machines, used 1 horsepower motor, rotation speed of sliced blade 967 rpm, the diameter of sliced dish 310 mm, consists of 2 blades for sheet cutting ginger and the power from motor which transfer to rotate the sliced blade roller, rotation speed 440 rpm. The slice cutter roller was sliced ginger from sheet ginger to line ginger. The conveyer could adjustment level of motors, used to the beginning area that sheet ginger was transference to the roller for sheet and sliced cutting in next process. The cover of sliced cutting had channel for 1 tuber of ginger. The semi-automatic sliced ginger machine could produced sheet ginger 81.8 kg/h (6.2 times of labor) and line ginger 17.9 kg/h (2.5 times of labor) compare with, labor work could produced sheet ginger 13.2 kg/h and line ginger 7.1 kg/h, and when timekeeper, the total times of semi auto machine 30.86 kg/h and labor 4.6 kg/h, there for the semi auto machine was 6.7 times of labor. The semi-automatic sliced ginger machine convenient, easy for use and maintain, in addition to reduce fatigue of body and seriousness from works; must be used high skill, and protection accident in slicing procedure. Beside, machine could used with other vegetables for example potato, carrot .etc

***Keywords*—**Sliced Machine, Sliced Ginger, Line Ginger

I. Introduction

GINGER was importance economic agriculture plants of Thailand which has been exported since 2518, the production of dry ginger and fresh ginger in 2551, 39,136.55 ton and increased up 30 percent from previous year, particularly in Japan, ginger was very popularly. The quality of Thai ginger was higher than competitor for example china. This reason, the export order were increased in 2551, freezing ginger 15,378.07 ton, value 261.81 million bath and export other product of ginger for example, fresh ginger, dry ginger 23,758.48 ton, value 603.92 million bath. The production of ginger into the industry was necessary. A large amount of export ginger was processed products and ginger products. Pickled ginger was highest. The ginger factories were distribution in every part of Thailand and expansion production each place that employment in countryside and effect with economics. [1]

In order to carry out this work, it was necessary to study the sliced ginger procedure from seller in Complex market, Hatyai, Songkhla, Thailand. We found higher requirement, but now a day makers could produce 9000 kg/month, value 675,000 bath [2] that were not enough for requirement of customers. The productions were mainly used labors and complex procedures: 1 basket of sheet ginger 14-15 kg, after that sliced. Sheet ginger 1 kg/6 min and Sliced ginger 1kg/12min. Then, sliced ginger must to sharp blade or sharp knife, for instance cutting blade, sliced blade .etc, that were easy to make accident and spend a long time to produced, when would like to increased volumes, so must to increased labors and used times for make in each time. Customers were requirement to line ginger average thickness parameter 2 mm and length around 60 mm but almost the length was rarely considered depend on customer requirement, which special order, for example the Pickled ginger factory export to Japan that had short and long sliced ginger mixing together sometime, relationship with size, for instance the thickness parameter average 2 mm and length around 20 mm. In special order cases, the value were different 5 baths when sliced, then soak 1 time with bleach. Next to, cleaning 2 times with clean water for get rid off bleach form ginger and flavor, and soak with alum water get strong and white. Then, cleaned 2 times with clean water; each time was soak around 5 min. After that, get into packaged bag or container for sale. The procedure of production, the raw materials that young and eldest ginger, the first step is scraped the peel of ginger, then sheet ginger cutting and arrangement layers that easy for cutting.

The previous process; sheet cutting, arrangement layers, and cutting that spend times and complex. This reasons, the production of ginger was not answer to customers. Accordingly, should to improve new procedure by used conveyor in arrangement layer part, then cutting, which decreased complex of works and times, follow the new procedure must to use machine for helping.

Thereby, we had idea to construction the semi-automatic sliced ginger machine for replacement labors that reduced times of production sliced ginger process and labors for efficiency of method. Considerable cleanness and safety of worker and customer caused increased production punctually with requirement of customers.

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II. Experimental

The procedure of design and construction of semi-automatic sliced ginger compose of

A. Design and estimate of elementary of machines

The principal of semi-automatic sliced ginger that we primary studies of sliced ginger from bring about to design and estimate method. [3–14].

B. Construction element of semi-automatic sliced ginger

1) The structure of machine composes 3 parts; frame, conveyor and sliced blade roller. Frame size 250x300x990 mm by contact with conveyor along with length for absorbent weights of machine part that was shown in Fig.1, The wide side of machine contact with sliced part that was shown in Fig. 2, and a part of sliced blade roller size 250x260x145 mm, the height around 300 mm that was shown in Fig. 3.

Fig. 1 The frame

Fig. 2 The conveyor

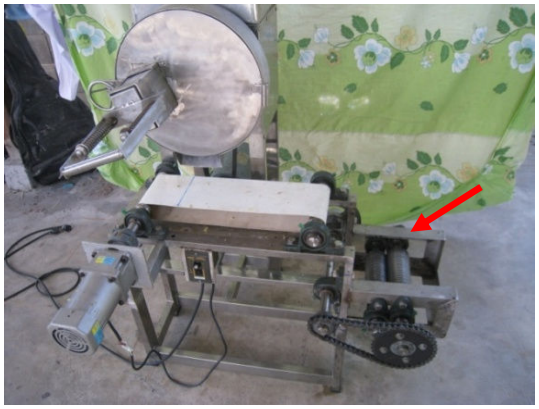

Fig. 3 The sliced cutting roller

2) A part of sheet ginger cutting separate into element; the cover of sliced dish, size 320x4 mm that protection ginger get off from ginger channel that was shown in Fig. 4. Sliced dish, size 310x4 mm that hold by shaft for transference power to dish for produce sheet ginger and the dish have adherent to sliced blade that was shown in Fig. 5. Transmission shaft, size 25.4x320 mm, that transferred power to dish for sheet cutting. This part, motor transfer engine to pulley and drive shaft by shaft and blade hold by sliced dish for sheet cutting that was shown in Fig.6. In the channel has pushing ginger to position that appropriated for sheet cutting used compression force of spring. After that, sheet ginger move to conveyor for transfer to sliced cutting part that was shown in Fig.7. and the cover of sliced dish, size 310x4 mm that was shown in Fig. 8.

Fig. 4 The cover of sliced dish

Fig. 5 The Sliced dish

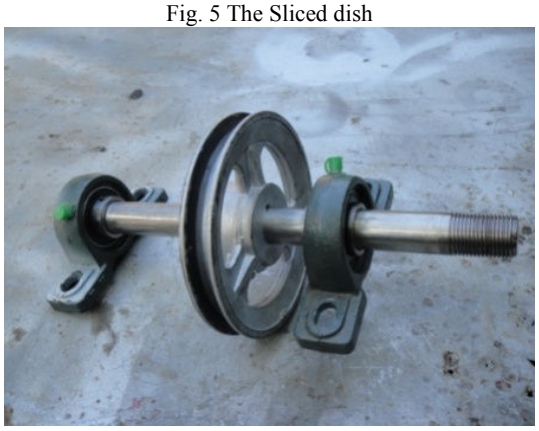

Fig. 6 The transmission shaft

Fig. 7 The in channel has pushing ginger

Fig. 8 The cover of sliced dish

3) The conveyor part compose of motor drive and transmission gear rotation speed 1: 5 rpm and transfer power to transmission shaft by used to coupling that have bearing to support with shaft that was shown in Fig. 9. The conveyor was 2tG50/EW type, size 140x100x2 mm compose of transmission shaft. Conveyor for transfer ginger to sheet and sliced procedure that was shown in Fig. 10 and 11.

Fig. 9 The motor drive

Fig. 10 The conveyor

Fig. 11 The transmission shaft conveyor

4) The sliced cutting set compose of 2 pieces of cutting roller for cut to line ginger was used to stainless steel ∅ 56.5 mm the grooving to slot depth 6.5 mm length 100 mm, amount 15 slots that was shown in Fig.12. The sliced cutting part was using engine to pulley and shaft. In front of

shaft have chain drive gear, size 25 inch amount 15 teeth for transmission roller set. chain drive gear, size 5.5 inch amount 35 tooth compose of transmission shaft and in front of have roller that have 2 gears hold for transfer engine shown in Fig.13.

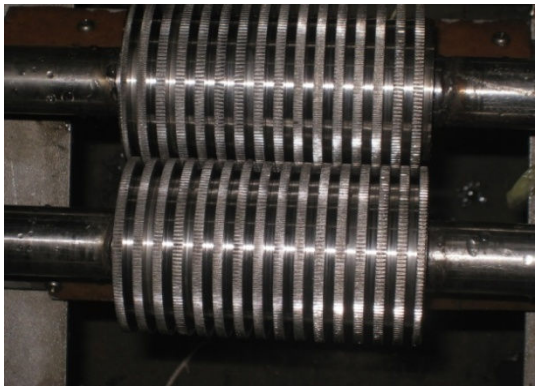

Fig. 12 The roller for cutting line ginger

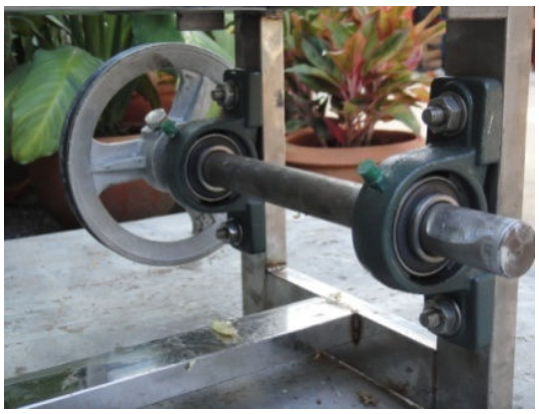

Fig. 13 The pulley and shaft

III. Equipment and Experiment

The experiment of semi-automatic ginger composed of raw materials, tool and equipment and experiment method that summarized as follows.

A. Raw materials in procedure

Experimental were used 5 head of ginger 4-6 month, weight around 200-300 g, length around 70-110 mm that was shown in Fig. 14.

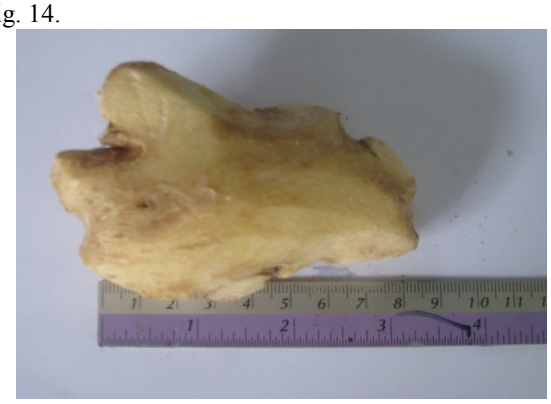

Fig. 14 The peel scrapes ginger

B. Tool and equipment

1) Semi-automatic sliced ginger
2) Ginger
3) Blade for get rid off peel
4) Sliced blade
5) Stop watch
6) Vernier caliper
7) Weight scale
8) Basin
9) Table of recorded results

IV. Result and Discussion

Design and construct of the semi-automatic sliced ginger, the procedure of experiment consist of sheet cutting, sliced cutting by get off peel of ginger and compare the works from machine with 1 labor that detailed and results as follows.

A. Experimental

Of experiment, labor who works with sliced ginger. At sheet and sliced cutting process found, 5 head of ginger, length around 70-110 mm brought to weight scale that had 300 g. Next to, get rid off the peel of ginger, then sheet cutting 1 head/times that check timer by stop watch until finish procedure and brought ginger to weight scale for calculate % by weight of good and worse. We recorded result 5 times. After that, brought sheet ginger to cutting roller, checked timer and weight measured of product, then calculated %weight, and recorded 5 times.

B. Analyzed the experiment

Comparison the sheet and line ginger cutting from labor with the semi-automatic sliced ginger machine that found the machine was quickly than labor works. The result of this experiment, the machine could be produce sheet cutting 81.8 kg/h and sliced cutting 17.9 kg/h. In contrast, labor produced sheet cutting 13.2 kg/h and sliced cutting 7.1 kg/h. Because of, when employee worked at the period of time, worker was fatigued and stress. But the machine could continuously works. The result of comparison the abilities of employee with semi-automatic sliced ginger machine that was shown in table. I.

TABLE I
THE RESULT OF COMPARISON THE ABILITIES OF EMPLOYEE WITH SEMI-AUTOMATIC SLICED GINGER MACHINE

Behaviors	Weight (g)	Capacity of Approximately					
		Sheet Cutting		Sliced Cutting		Sheet and Sliced Cutting	
		Time (s)	Kilogram /hr.	Time (s)	Kilogram /hr.	Time (s)	Kilogram /hr.
Semi-automatic sliced ginger	300	13.2	81.8	60.2	17.9	35	30.86
Labor	300	82	13.2	152.8	7.1	235	4.6

The result of experiment found have worse ginger 8% from machine shown in Fig. 15 but no worse in labor works shown in Fig. 16.

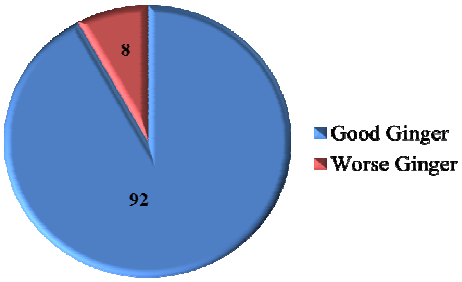

Fig. 15 The good and worse ginger from the sliced cutting machine

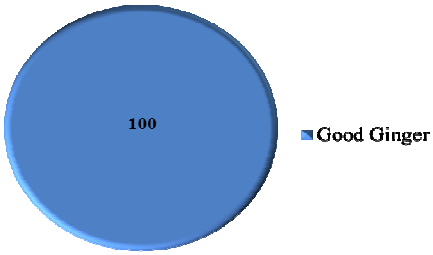

Fig. 16 The good ginger from the sliced cutting labor

The ability of semi-automatic sliced machine was quickly than labor works 6.7 times and continuously works better than labor. Nevertheless, sheet and sliced cutting ginger with machine had a little bit waste from the method which could rework by labor.

Therefor, the semi-automatic sliced ginger machine had production rate more than labor works and did not have incomplete waste of ginger that was shown in Fig.17 (a). Moreover, when comparison sliced ginger from machine with labor that was similar that was shown in Fig. 17 (b). But the sliced cutting process had a little bit waste of ginger that was shown in Fig.18 (a). But, had a few of worse ginger that could rework by machine shown in Fig.18 (b).


(a) Ginger with a sheet machine (b) Ginger with a sheet labor
Fig. 17 Ginger is a characteristic of sheet


(a) Worse ginger for machine (b) Good ginger for machine
Fig. 18 Ginger is a characteristic of slide

When efficient of machine testing, then we brought other vegetable for example, potato, carrot, and banana .etc. to sheet and sliced cutting that was smooth line, beautiful and development for cutting other fruits. Furthermore, improvement efficient of machine by constructed more channel and increase sliced blade that will increasing production rate.

C. Analyzed of economic

The summary of our research that illustrated the process of sheet and sliced cutting had labor cost 6 baht/kg. Eliminate the output of procedure, labor works 8 h/day could sheet and sliced cutting 36.8 k/day, low labor cost 220.8 baht/kg. The semi-automatic sliced ginger machine work times 8 h, could sheet and sliced cutting 246.88 kg/day, value of product 1,481.28 bath/day that was negative electric, overhead, wage of labor and depreciation of machine that the times will to break-even point of machine 64 days, when comparing incomes from sheet and sliced cutting by labor with machine that shown the income of machine was 6 times of labor work or 6 labors work. Moreover, the semi-automatic sliced ginger machine, reduced time in sheet and sliced process, reduced charges, reduced labors, solve the fatigue of work, and illness from labor work.

V. Conclusions and Recommendation

A. Conclusion

1) Experimental of semi-automatic sliced machine have abilities to sheet cutting 81.8 kg/h and sliced cutting 17.9 kg/h. sheet ginger 6.2 times and sliced ginger 2.5 times compare with labor worker that could produced sheet cutting around 13.2 kg/h and sliced cutting around 7.1 kg/h, and when estimated total times worker comparison between machine and labor that machine could produce more than labor 6.7 times but the shape and quality maybe less than labor work, but labor have limit problem from fatigue and stress of body.
2) The semi-automatic sliced ginger machine could sheet and sliced cutting many kind of vegetable and fruit for example; potato, carrot, and banana .etc.
3) The benefit of machine, that reduces fatigue and stress from works that was use highly abilities.
4) The semi-automatic sliced ginger machine has easy and comfortable processes were used, and easy to maintain.
5) The semi-automatic sliced ginger machine could refund money in 64 days.

B. Recommendation

1) Blade set was thickness, should to design and selection the material that could made, the blade has thin and sharp but cover strength properties.
2) Sliced blade cutting should to design the roller, that sharp and increased roller for change cutting set, and tooth various sizes, including Turning of the roller to be pulled sharp for quick sliced.
3) The channel that input ginger should adjust the size of channel to bigger and longer blade , increase ability of machine to cut longer ginger, and could adjust shape of channel support the shape of ginger and others raw material.
4) Ought to, modifies design of machine to modern, reduced times of work and increased sufficiency of machine.
5) Evaluating of seller, we investigated the weak point of production, consist of bigger sliced ginger and smooth sliced. Not only ginger was used, but also others vegetable and fruit. In case, the semi-automatic sliced ginger machine could support the requirement of seller and customer, prices 70,000-80,000 bath.

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REFERENCES

[1] Regional Offices of Agricultural Economics Department of Agricultural Extension, 2008, Online: http://fic.nfi.or.th/th/thaifood/product52-condiment.asp, (13 November 2010)
[2] facilitated from vendor in complex market, Hatyai, Songkhla, Interview, (9 October 2010)
[3] W. Anan, *Design of Machine Elements* (Book style). Bangkok, CA: O.S. Printing House, 1992, pp. 1–380.
[4] P. Manukit, *The mechanical design and conception* (Book style). Bangkok, CA: Duangkamol Samai, 2005, pp. 15–38.
[5] A. Warit and T. Chan, *Design of mechanical No.1* (Book style). Bangkok, CA: SE-ED Ucation, 2006, pp. 68–124.
[6] K. Chana, *Strength of Material* (Book style). Bangkok, CA: Chouy Printing, 1993, pp. 23–56.
[7] S. Banlang and K. Prasert, *Metal Table* (Book style). Bangkok, CA: King Mongkut's University of Technology North Bangkok, 2006, pp. 1–361.
[8] Ch. Jaknarin, R.Surasit, J.Jatuporn and B.Worapong "Development built organic fertilizer pellets (Published Conference Proceedings style)," in *Proc. IE network 2010 Conf. Industrial Engineering*, Ubon Ratchathani Thailand, 2010.
[9] R. Wanida, D.Prachot, S.Panyapol and M.Ratchapol "Design and Development of the Machine Prototype Aided Sugar Tanot Manufacturing (Published Conference Proceedings style)," in *Proc. IE network 2010 Conf. Industrial Engineering*, Ubon Ratchathani Thailand, 2010.
[10] R. Wanida, G.Somsak, L.Chaiwat J.Pornpan and Th.Chalisa"Process Improvement for Mooncake Manufacturing (Published Conference Proceedings style)," in *Proc. IE network 2010 Conf. Industrial Engineering*, Ubon Ratchathani Thailand, 2010.
[11] K. Natapol, P.Panupong, W.Thanasit and M.Sunean "Knife Cut the Pineapple in Glasses Shredder Blade Rotates in the Horizontal Direction" in Department of Agriculture and Food, The agro-industry, Mae Jo University.
[12] S. Matee, and Ch.Thana "Development of Sliced Betel Nut" in Department of Mechanical Technology. King Mongkut's University of Technology.
[13] S. Aneak, "Build Banana Tree Shredder" in Rajamangala University of Technology Lanna.
[14] P. Teerapong, "Design and Construction of Grass Slide." in Department of Agriculture. King Mongkut's Institute of Technology Ladkrabang.