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Development of Small Scale Mould Stick Machine for Fish Cracker Production

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Abstract

The usage of mould stick machines can be implemented to replace the manual hand kneading, rolling, shaping and cutting dough for fish cracker with machine. The conventional method used manual hand kneading, rolling and shaping the dough of fish cracker. This method takes time, need more manpower and reduce the quality of production. Therefore, invention of machine helps producer to increase the production quantity and quality with minimize manpower. Besides that, this modern method may also help the producer to achieve the standard in term of hygiene, safety and quality of these snacks. There are three common types of fish cracker mould stick machines used in market such as rolling machine, conveyor machine and blowers machine. Therefore, this study aims to discuss on the development and usage of mould stick machine for the fish cracker in improving its production in future.

1. Introduction

Fish cracker was well-known fish product at east coast Malaysia which also called as keropok lekor by community (Wan Ibrahim et al., 2011). Fish cracker composed of fish meat, starch, salt, and preservative. There are several processes to produce fish cracker such as fish meat mincing, mixing ingredient, kneading the dough, boiling, cooling and cutting and dried. Most of the traditional manufacturing practices for production of fish cracker were questionable in term of nutrition composition, hygiene, and contamination. In the production of fish cracker, most producers are still using traditional manufacturing practices with low competitiveness and poor efficiency. Since the standard processing procedure can be employed in order to maintain the quality while meeting consumer demands for safety, quality and nutritional value of these foods (Samsudin et al., 2012).

Omar et al. (2011) mentioned the practice was low competitiveness and poor efficiency which need to standardize the procedure and improve the method in production. Therefore, there are several researches have been done to investigate and improve the production of fish cracker (Siaw et al., 1985; Kyaw et al., 2001; Kaewmanee et al., 2015; Mohd Zaidi & Mohd Syahidan, 2015). They review the processes and the ingredient compositions in order to improve the quality of fish cracker production. Mohamed et al. (2008) review the sago flour physicochemical and thermorheological which shows the texture and physical output of mixing the others flavor ingredient. Omar et al. (2011) mentioned the higher fish content rather than flour produce more delicious. Chong and Swee (1997) stated the gelatinization temperature ranges will reduce by increasing the fish content. On other hand, some researches undergo in investigation on microbiological quality of fish snack during processing (Mahmud et al., 2009; Nor Khaizura et al., 2009). Nor Amaiza (2003) discussed on freezing process of keropok ekor by using cryomechanical freezing method.

Traditionally, fish snack is precooked by boiling in water. Study by Mohd Zaidi and Mohd Syahidan (2015) review that the boiling methods in processing keropok lekor and suggest new design of boiler to improve keropok lekor production. On other hand, Mohd Adib (2009) using the pneumatic system in order to develop cutting machine to improve quantity of production to meet costumer's demand. However, the study on extruder machines to produce fish-based snack discussed by Law (2009a) to replace the conventional way in kneading, rolling and shaping process. Even there are several researchers and producers involve in developments of machines in order to improve the quantity and quality of fish snack product (Samsudin et

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al., 2012), the implementation of modern method in fish snack production is still considered intermediate (Omar & Ismail, 2012).

2. Production Process of Fish Cracker

There are seven processes for fish cracker production which are fish meat deboned and minced, ingredient mixed, dough's kneading, boiling, cooling, cutting process and drying process. The conventional method used manual procedure which required more manpower at each process (Wan Nur Nai'mah, 2015). However, when technology development take place, all the processes carried out using the machines to faster the process and increase the production quantity and quality with less manpower. The deboned machine used to deboned raw fish and mincing machine used to minced fish meat before mixing it with others ingredient such as flour, salt and preservative. Next, the critical part is kneading the dough and rolling it to form stick like shape/ sausage like shape before boiling it. The boiled fish sausage (keropok lekor) need to be cooled down and stored before cutting and drying process. MARDI had developed a set of machines from the beginning process to the end. A three tunnel extruder machine had been developed to improve the keropok lekor quantity and quality production for small scale industry (Samsudin et al., 2012).

3. Mould Stick Machines

Mould stick machine is a machine used to mould or shaped the raw dough's food into sausage like shape. This machine used in producing the keropok lekor and a process used to produce round shape of fish cracker. There are three types of mould stick machines to produce the stick form fish sausages which are rolling machine, conveyor machine and blowers machine (Samsudin et al., 2012). Table 1 shows those machines descriptions and differences in term of functions, mechanism, physical properties, manpower's, and output productions.

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Table 1: Types of mould stick machines and descriptions

Machine type	Rolling machine	Type of conveyor machine	Extruder machine
Function	Stick mould process	Stick mould process	Stick mould process
Mechanisms	Roll the dough by manual but keep it in standard shape	Autoroll the dough between two up and down conveyor	Press and blow the dough by extrusion process.
Structure	Roller, continuous AC motor operation, controller	Conveyor belt and roller, continuous AD/AC motor operation, controller	Teflon drill in extruder machine, tunnel, dough container, controller
Size/dimensions	Depend on production	Depend on production	Depend on production
Manpower	More than 2	1 is enough	1 is enough
Output shape	Standardize shape and size	Standardize shape and size	Standardize shape and size but different texture from manual kneading and rolling
Output size	Depend on the roll size	Depend on the conveyor size	Depend on shape of output tunnel
Capacity	Depend on manpower capacity and roll length	Depend on the conveyor length	100kg/hour/tunnel
Power supply	1HP	1HP	3HP

4. Design and Structure of Rolling Machine

The rolling machine comprise of four compartments which is machine stand and roller, motor operation, controller and table or pan. One needs to consider the roller size, capacity, power supply requirements, motor types, weight, dimension and material used before design and build the roller machines. However, most machines in food industrial used stainless steel to avoid corrosion and food contamination. The other consideration usually depends on the capacity of input and output needs by producer. Figure 1a shows the mini roller which need 220-240 VAC and 1 HP power supply and can produce about 5 units per minute. Figure 1b and 1c show the others product for roller machines which different design and dimension. Mini roller dimension is 30"x36"x16" with roller dimension is 20"x8", while larger one dimension is about 48"x24"x37" with roller dimension is 6'x3". However, the size can be custom-made depend on the producer's demand and manpower availability. The Figure 2a shows the machine mechanism. Figure 2b shows the rollers roll and help to mould the dough between two rollers.

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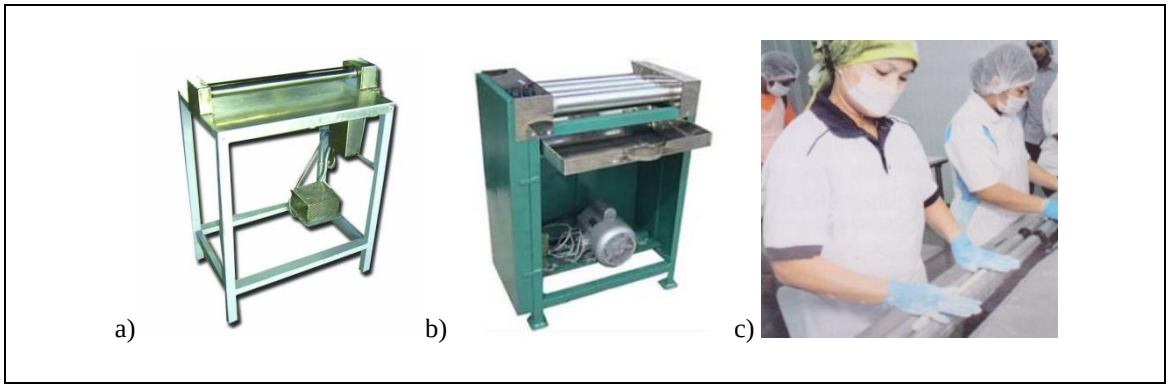

Figure 1: Roller machines (Samsudin et al. (2012)

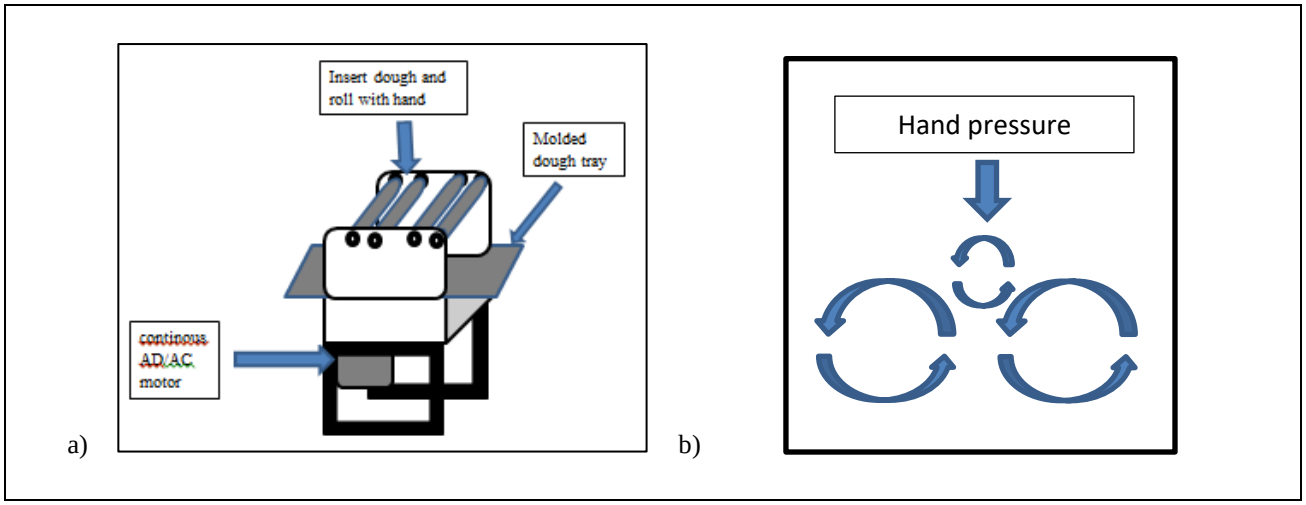

Figure 2: Design and process involving in roller machines

5. Design and Structure for Type of Conveyor Machine

Conveyor is a machine that usually used to transport a product from a place to next stage of the process (Vanamane & Mane, 2012,). It was popular in improving the food production which helps to minimize time, standardize the production size and increase production to meet customers' demands. There are many types of conveyor used in industrial. However, the belt conveyor is the most popular in food production. There are several designs and parameters considered to design and build the conveyor machines such as system for continuous flow, flexibility, material flow system, ratio of the dead weight, belt dimension, capacity, speed, roller diameter, belt power and tensions, idler spacing, pulley diameter, motor, shaft design and control part (Vanamane & Mane, 2012,). In keropok lekor production industry, the engineer had come out with conveyor type dough shaping into stick shape or sausage-like shape. The conveyor type machine had been design to increase the volume production and reduce the manpower.

Figure 3 shows the conveyor roller machine for keropok lekor. There are two set of belt conveyors used to roll the dough which the bottom layer function as the table and the top layer is function as human hand to roll the dough and to shape it into sausage-like. The control system for this machine is semi-automatic. This machine was developed by using stainless steel material. Machine in Figure 3a can produce about 10-20 units per minute with dimension is about 23"x30"x40" and other supplier come out with another conveyor type as showed in Figure 3b with larger dimension which is 53"x25"x19". Figure 4 show the steps and the machine's function.

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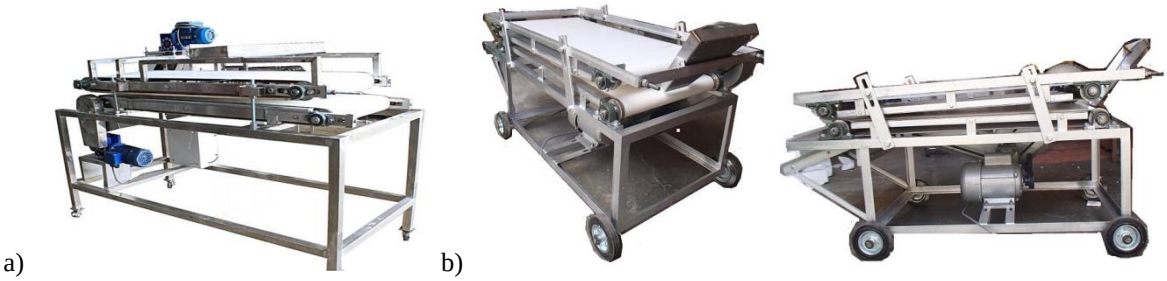

a) b)

Figure 3: Type of conveyor machines (Utusan (2015) & RC Machinery Sdn. Bhd. (2009))

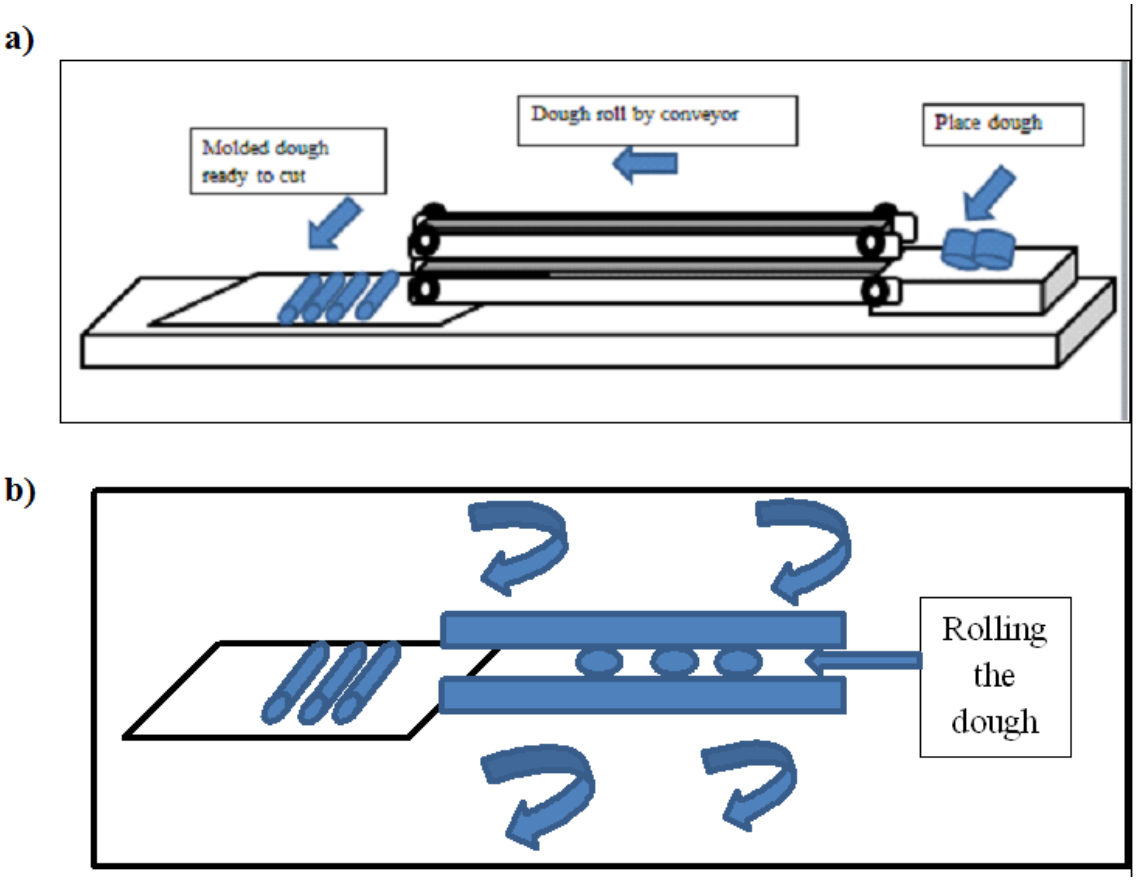

Figure 4: Design and process involving in type of conveyor machines

6. Design and Structure of Extruder Machine

Extrusion process refers to combination of several unit operations including mixing, cooking, kneading, shearing, shaping and forming (Fellows, 2000). The extruder machine was design by many manufacturer and engineer to increase and improve keropok lekor production (Law, 2009b; Muhammad Khairy, 2017). This process involve extruder barrel to place the dough and screw to press and convey the dough from the barrel towards the end of the barrel (Fellows, 2000). The end of the barrel become as restricted opening that cause the pressure in the barrel to force the dough to merge and expends to the final shapes and also known as “die”. Therefore, the extruder machine in Figure 5 undergo extrusion process which press the keropok lekor dough put into first part of the machines called as dough container. Moving teflon drill (screw) in the extruder machine (barrel) will press the dough out through the modified tunnel (die) with circle shape hole. Then the moulded dough is transferred to the cutting process by using the conveyor mechanisms (Figure 5c). The cutter will cut the moulded dough according to the producer requirement. The frequency of cutter and conveyor speed can be decided and controlled by using controller. In additional, the floor container for flour sower is placed in between the tunnel and cutter machines to avoid the dough stick to the conveyor. Figure 5a shows an extruder with dimension 28”x15”x8” with power requirement 5.6 kW. Figure 6 shows the design and structure of extruder machine in keropok lekor food industry.

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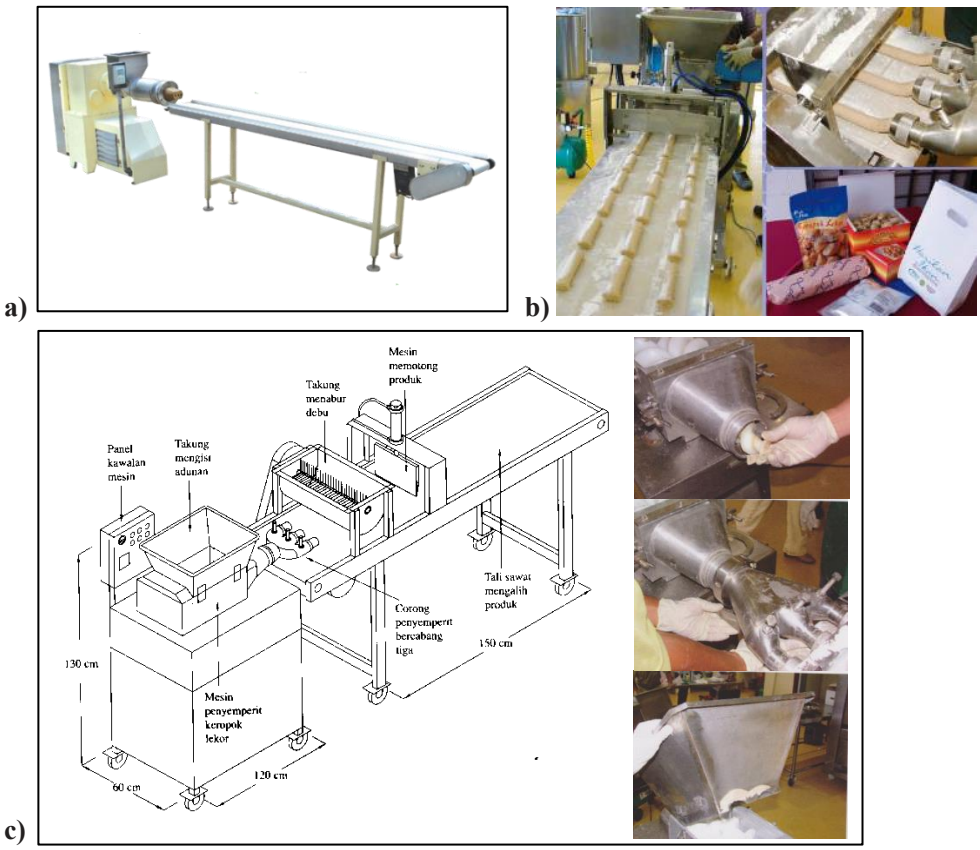

Figure 5: Extruder machines (Samsudin et al. (2012))

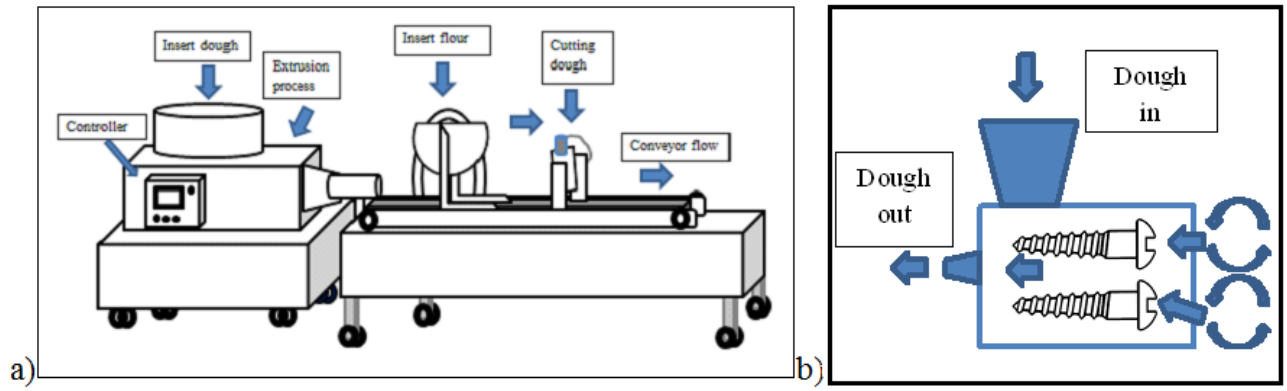

Figure 6: Design and process involving in extruder machines

7. Conclusion

There are several researches had been done and several types of machine had been used to improve the production of fish cracker. Mould stick machine is one of the machines that improve the shaping method for fish cracker. There are three types of mould stick machines commonly used such as rolling machine, conveyor machine and blowers machine. The usage of machines in fish cracker production is believed to help in improving the quantity and quality of fish cracker production to meet customer's satisfaction and market demand.

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