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Availability of Malaysia traditional food process mechanization produced by MARDI

H. Azman[a] and A.W. Ruwaida

Engineering Research Center, Malaysian Agricultural Research and Development Institute (MARDI), 43400 Serdang, Selangor Darul Ehsan, Malaysia.

Abstract

Mechanization and automation is a technology that is capable of being the driver of the country's agro-food sector development. The use of this technology in agro-food sector capable of producing a constant supply of high quality, consistency, reduce production costs, improve production rates and save the labour cost. The importance of mechanization and automation were outlined in the strategic direction of the National Agro-Food Policy 2011-2020, namely to establish the direction of research and development (R&D), innovation and use of technology. MARDI through Engineering Research Centre has developed mechanization and automation technologies that can be used by the country's agro-food sector. R&D undertaken are in the fields of post-harvest and food processing mechanization; farm mechanization; and precision farming. The main research thrust of post-harvest and food processing mechanization is to provide solutions to issues that matters to the mechanization of small and medium industries (SMIs) food companies. In addition it also aims to provide solution to the post-harvest handling and storage of agricultural commodities by developing more efficient and effective mechanization system. This paper will be highlighting process mechanization of Malaysia's selected traditional food.

Keywords: traditional food, mechanization and automation, high quality, consistency, reduce production costs, improve production rates and save the labor cost

INTRODUCTION

The vision of the country in the agro-food sector is to make this sector as one of the country's economic growth engine. Farmers and food producers need to modernize the country's agro-food and conducting business in an effort to make it more productive and competitive. They have to adopt new technology, using the best practices and agro-food products that meet international standards.

MARDI has taken proactive steps in reaching the goal of extending the technologies related to mechanization and automation in the agro-food sector in the country. Mechanization and automation are among the key technologies in the development and progress of the country's agro-food sector today. This technology is able to reduce production costs, resulting in consistently high quality products and to increase the production rate. Agro-food mechanization technology is one of the ways to overcome the problem of labor shortage. The use of the latest technology via mechanization and automation will be enhanced and expanded to increase the productivity of the agro-food industry.

According to the national agro-food policy, the national agro-food industry has contributed a total of RM22.5 billion (USD7.3 billion) or 6.3% of the gross domestic product (GDP) in 2011 and, from 2011 to 2020 as a continuation of the policies formulated to address the food safety issues and also consider new challenges in global environmental

[a] E-mail: hazman@mardi.gov.my

emergency. National Agro-Food Policy (2011-2020) formulated with the following objectives (National Agro-Food Policy):

1. To ensure adequate supply of food and safe to eat.
2. Make the agro-food industry as competitive industries and sustainable.
3. Increase the level of income entrepreneurs.

FOOD PROCESS MECHANIZATION

The Cambridge Dictionary defines mechanization as the process of starting to use machines to do something that was previously done by hand. Another well described definition, mechanization is defined as the art of using machineries to hasten production, accomplish task and reduce fatigue and human labour in order to produce better quality goods and services (Folaranmi, 2014). Thus, food process mechanization can be described as the process whereby equipment's and machineries are utilized to boost food production by offering efficient, higher capacity production and delivering better quality of food products.

The core area of research in food and post-harvest processing mechanization is to provide solutions to mechanization issues across the chain of agricultural production systems associated with processing and manufacturing activity to develop value-added services to the food sector. Special focus is given to food industries especially the small-medium enterprises (SMEs) as mechanization will help them for larger scale production, hence opening opportunity for bigger market. Appropriate mechanization and automation is introduced to the food processing system. In addition, it is also looking into solution to the problem of post-harvest handling and storage of agricultural commodities whereby mechanization system makes it more effective and efficient.

MARDI's commitment in helping to develop the food industry, particularly to SMEs should be increased in order to maintain Malaysia's position in the food sector. The use of machinery and equipment is an important element in the modernization of local food processing industry. Lack of skilled labour, minimum control requirements, consistent quality and high salaries also cause food manufacturers to switch to the use of appropriate mechanization. Malaysia needs mechanization of food production is to meet the following factors;

a) Improve productivity.
b) Production of food hygienic conditions.
c) Improving food quality and consistency: quality and food safety is a priority in the food processing industry. This is due to increasing consumer demand for high quality food.
d) Addressing the needs of skilled labour in the production of food.
e) To fulfil the market demand.

MARDI is committed in helping to expand the food industry for the SMEs to preserve the sovereignty of the nation's food security. Generally, most of the mechanization designs have been protected by Intellectual Properties Rights (IPR) in the Patent or Industrial Design categories, and is registered under Intellectual Property Corporation of Malaysia of Malaysia (MyIPO). Mechanization and automation technologies that have been developed by MARDI through Postharvest and Food Processing Mechanization Program will be presented in the following section (MAHA, 2014).

***Murtabak* Machine**

Murtabak machine (Figure 1) is a continuous murtabak cooker. It consists of a conveyor system, which carries aluminum tray-filled *murtabak* through four separate cooking units. The speed of the conveyor system and the temperature in each cooking chamber can be adjusted according to the required processing parameters. This machine is capable of cooking up to 120 pieces *murtabak* within one hour. This innovation addressed the problems in the provision of *roti canai* skin that requires skill, cooking limiting

production capacity, as well as uncontrolled heating can result in a product that is cooked unevenly.

Fully Automatic Satay Skewing Machine

Satay skewing machine (Figure 2) is suitable for entrepreneurs that need to produce satay more than 10,000 a day. The production capacity of this machine is 1,500 skewed satay/hour. Sate skewing operation is carried out continuously. The machine is built from stainless steel and other food grade material. Other than meeting the standard of food-grade machinery, the design is in such a way that it facilitates cleaning process after use and ensure cleanliness and hygiene of sate production. This machine is capable of reducing the time for manual operation and produce a cleaner and one consistent quality. Machine operator will arrange the pieces of marinated meat that have been prepared with spices into the machine mould. Next the skewering operation will be performed by this machine automatically and continuously. The main components of this machine are: -

1. Mould for filling the marinated meat (5 grooves in each mould)
2. Chain drive system for mould
3. The control system , i.e., "Programmable Logic Control -PLC"
4. The mechanism for automatically sorting the bamboo skewers and a pusher system
5. The sensor to determine the location of each of the components of the machine in the right position
6. Machine control box

Figure 1. Murtabak machine.

Figure 2. Automatic satay skewing machine.

Semi-Automatic Satay Skewing Machine

The machine (Figure 3) is suitable for use in smaller production capacity of less than 5,000 satay sticks a day. Only one operator is required to handle this machine. The uniqueness is its simple operation whereby pieces of meat are placed onto a mould, and sate skewers are laid in the dedicated grooves. Skewing is done by simply pressing a switch on the machine; hence skewers are pushed and penetrated the meat held in the mould. Then skewed satay is released from the mould and removed by the operator, hence the process cycle continues. Mini satay skewing machine was developed using stainless steel and other food grade material that ensure easy cleaning and hygienic production. The machine specification is shown in Table 1.

Table 1. Semi-Automatic Satay Skewing Machine.

Capacity	: 300-350 satay/hour
Operator	: 1 person
Structure	: Food Grade (Stainless Steel AISI 304)
Mold	: Teflon
Control System	: Pneumatic press with switch
Air Compressor	: 2.5 hp, 1 phase

Satay Grilling Machine

Satay grilling process traditionally requires special skills and open areas. By using this technology (Figure 4), roasting skewers can be done in an enclosed area such as hotels,

supermarkets, shopping malls and fast food restaurants. The development of this machine is able to overcome the high cost of coal compared with electricity consumption where it is two times cheaper. This machine is portable and continuous, quality roasting skewers evenly, easy to clean and low running costs. The main feature of this machine is the one meter grilling unit fitted with 3 infrared heaters and a pair of screws to convey and rotates the product across the griller. This machine can also be used for grilling of other skewed products. The specification of the machine is shown in Table 2.

Table 2. Satay Grilling Machine.

Capacity	: 800-1000 satay/hour
Operator	: 1 person
Structure	: Food Grade (Stainless Steel AISI 304)
Heating medium	: 3 infrared heaters (4.0 kW) or coal
Control system	: PLC

Figure 3. Semi-automatic satay skewing machine.

Figure 4. Satay grilling machine.

Kuih Ros Machine

The traditional method of producing *kuih ros* is by using a single mould at a time. This is time consuming and laborious, producing about 150-200 pieces per hour. The mechanical system was developed to process *kuih ros* using automatic forming and frying technique consisting of 18-25 moulds attached to the machine (Figure 5). By this method, 1,200-1,500 pieces per hour of the products can be produced by a single operator. The forming process took only 20-30 seconds where all moulds are simultaneously dip into the batter. The frying process is carried out in 180^{o}C oil for 2 minutes. The most suitable size of the mould is 60mm in diameter, but other sizes also applicable that suits the need of the user.

***Rempeyek* Machine**

Traditionally *rempeyek* was prepared using small moulding plate. The raw materials such as batter, peanut and anchovies were placed manually and fried in frying pan. The product has to be prepared individually and took 3-4 minutes to make it ready to be packed. Modern processing system was developed to process *rempeyek* using automatic forming and frying machine (Figure 6). About 12-15 kg *rempeyek* can be produced per hour using single machine operator. The machine allows the filling process of the batter to be carried out within 3-5 seconds onto 12-24 mould plates by a touch of a button, and ensures equal amount of batter and peanuts/anchovies distributed. The mould plates then dipped into the fryer at 180^{o}C cooking temperature. There are 2 mould sizes available i.e. 42mm and 62mm in diameter, depending on the needs of the user.

***Kuih Karas* Machine**

This machine (Figure 7) has been developed to mechanize the process of forming *kuih karas*. It consists of two frying stations and manned by two operators. *Kuih karas* machine offers consistency of product formed and eliminates fatigue of manual labour. The thickness

of the product depends on the settings of the machine. The machine production rate is two times higher than traditional processing methods.

Figure 5. *Kuih Ros* machine.

Figure 6. *Rempeyek* machine.

Figure 7. *Kuih karas* machine.

Keropok Lekor **Forming Machine**

Keropok Lekor forming machine (Figure 8) have been successfully developed and used by *keropok lekor* producers. This machine ensures the quality, cleanliness and uniformity of the product in addition to the reduction of man power. The machine consists of a hopper, a screw extruder, conveyor and pneumatic cutters. The desired size of *keropok lekor* is defined by the cutting control system that controls the timer and conveyor speed. The machine specification as shown in Table 3.

Table 3. *Keropok lekor* formingMachine.

Capacity	: 1000 pieces/hour (product length of 75mm)
Operator	: 3 person
Structure	: Food Grade (Stainless Steel AISI 304)
Conveyor	: Variable speed, PTFE (Teflon) belt
Cutter	: Automatic cutter with timer controlled
Power	: Single phase, 240 AC

Figure 8. *Keropok lekor* forming Machine.

Figure 9. Lemang oven.

Figure 10. Kuih roti jala forming machine.

Lemang **Oven**

Traditionally, *lemang* are cooked in bamboo stems but MARDI has developed a modern method using stainless steel cylinder, consisting of the inner and outer shell that can either be cooked using electric or gas ovens at 170°C for 90 minutes (Figure 9). *Lemang* is best served within 10 hour after cooking but can be packed and stored in chilled form to extend the storage life of about one week, then reheated before serving. Wrapping cylinder dimensions and number of cylinders in each oven can be made according to the specifications required by entrepreneurs. Currently, there are five models available to meet

the needs of users for the production of commercial or domestic application. Oven with capacity of 4-cylinders or 7-cylinders is targeted for home/domestic use. Medium capacity oven (12-cylinders) suitable for use at kiosk or night market, while the oven with a capacity of 25-cylinders is suitable for use in the central kitchen for franchise market. The oven production capacity varies from 4-25 *lemang*/hour, depending on the model of the *lemang* oven.

***Kuih Roti Jala* Forming Machine**

Roti jala is one of Malaysia's favorite foods and have been classified as one of the heritage foods (Kosmo, 2012). It is often served during Hari Raya or during the fasting month. The process of making traditional *roti jala* is complicated, especially for large quantities. Traditionally, the process of forming *roti jala* requires a skilled workforce and the quality of products produced inconsistent. The machine developed (Figure 10) addresses these issues. It has two important components that are the depositing tank and electric powered heating pan. The depositing tank rotation movement driven by a motor gives out the *jala* or net pattern on the heating pan. This machine is able to form 120-200 pieces *roti jala* in an hour. The switching heating pan movement is pneumatically driven, allows continuous forming of *roti jala*.

***Kuih Peneram* Handtool**

Kuih Peneram hand tool is designed with focus to increase production capacity , quality consistency of product, hygienic practices, low cost, lightweight and easy to carry, easy cleaning and easy to use. The hand tool also incorporated features that can reduce excess dough during ring forming process. The tool is able to punch 5 pieces *kuih peneram* at one go, and capable to produce 2,600 pieces in an hour. The formed ring size is 40 mm outer diameter and 10 mm inner diameter.

Figure 11. *Kuih peneram* hand tool.

Figure 12. Spring loaded kuih cincin mould.

Spring Loaded *Kuih Cincin* Mould

Historically, these products were produced by hands, using the fingers to form the 6 holes, hence the name *kuih cincin*. Nowadays, most processors are using the brass or stainless steel mould. However, this is a laborious method as the dough sticks to the mould and has to be knocked off every 5 to 6 pieces produced. This has slowed down the operation and also quite frequently damaged the mould. This innovation is practical, easy to use, simple and inexpensive solution to the highlighted problems. The tool offers enhancement of smooth operations of the stamping process, hence reduce the needs for skilled labour. This tool is capable of stamping up to 50-75 pieces of cake ring in a minute, which is 3-4 times faster than using the conventional mould made of brass.

CONCLUSIONS

The following conclusions can be drawn from the study:

- MARDI will pursue excellence in R&D in the field of mechanization and automation to help the development and progress of the country's agro-food sector.
- The process of modernization of technology, increase agricultural production and improve the productivity of the country's food processing industry will be further strengthened in the future.

- High-impact R&D projects that deem appropriate to the current demand of farmers and food industry SMIs, will also be addressed in the future in order to advance the country's agro-food sector.
- This effort need to be carried out to meet the increasing demand for food due to growing population of the future.
- The farming and food SMEs community should also gear up to face the ever growing demand of food supply and transformation of food industry by embracing relevant technologies that will bring them to the future.

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