

Development of Dabai Nutcracker

Mohamad Ghazali, A.N¹, Shamsudin, R^{1*}, Amir Jalil, M.S¹

¹Department of Process and Food Engineering, Engineering Faculty, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia.

*Corresponding author. Tel.: +603-89466366, Email: rosnahs@upm.edu.my

Abstract

Dabai fruit is one of the underutilized fruit originated from Sarawak which rich with nutritional values. The flesh can be eaten raw after soaking it in warm water. The nuts from the seeds can also be consumed as it tastes like peanuts. There are also recent findings indicates that the nutritional quality of Dabai oil or canarium oil is most likely to be similar to the composition of palm oil such as the palmitic acid, linoleic acid, and linolenic acid. Dabai nutcracker is designed to separate the kernel from the nut. The design is to help in solving the difficulties in cracking the nuts of Dabai fruits, difficulties in accessing the whole kernel when using ready stock nutcracker because the uniqueness of the shape and the shell is very hard to rupture. The main objective of this research is to design, develop and evaluate the performance of the device. The dimension of the tool is 351 mm (upper part length) x 250 mm (bottom part length) x 144.09 mm (height) x 100 mm (width). The performance capacity of this tool is 1.64 kg/hr and gives 97.27 % in overall efficiency.

Keywords: Dabai, Nutcracker, kernel

Introduction



Figure 1: Dabai fruit and nuts

Dabai fruit or *Canarium Odontophyllum* Miq. (Figure 1) is one of the mainstream underutilized products of Sarawak, Malaysia. Numerous research of Dabai fruits nutritional values has been carried out, in different region of Sarawak where a significant finding shows the existence of cancer agent properties lies in the fruit (Lim, 2012). Dabai is a seasonal organic product that is accessible just amid the periods of October to December.

Dabai is an organic product which belongs to *Burseraceae* family which comprises of 100 species conveyed all through tropical Africa, Asia, and the Pacific island. The organic product is oval fit as a fiddle, rich wellspring of protein, fat, sugars, and minerals (sodium, calcium, and iron). Dabai seed paste is used as cocoa butter substitute to produce dark chocolate. A study reported that the best formulation was selected after a few hedonic tests.

The formulation consisted of 50% chocolate, 45% Dabai seed paste, 35.25% sugar, 17% water, 2.5% butter and 0.25% citric acid. Besides, chocolate truffle with Dabai ganache can also be produced using Dabai puree. In future, the use Dabai or other local fruit as an additional ingredient in developing chocolate-based products can increase the variety of chocolate products in Malaysian market (Azlan, 2017).

Dabai fruit is a potential fruit with double set of benefits, which its lipids tend to produce a better blood lipid profile while the high content of phenolic compounds gives antioxidant effects. There are several products (mayonnaise, sauces, chips, pickles and soap) have been developed from this fruit for local markets. This fruit has also been used by local restaurants as ingredient in their dishes (Lim, 2012). Some industrialist and farmers take this issue as a small issue because they did not realize the potential of the nut's nutritional value that could possibly give their business or company a major profit. Therefore growing knowledge sharing has been done to the community of Dabai fruit producers and consumers to make them realize the importance of utilizing the Dabai fruit.

However, in order to retrieve the nut kernel from the shell they will stumble across the difficulty of cracking the shell. It is a challenge to crack the nut shell and access the nut kernel or the kernel without harming the nut kernel. The commercialized nutcrackers in the market are not suitable to be used in the small & medium industries as it is only designed for kitchen used. Other than that, past design of nutcrackers have complexity and do not provide good cracks and often damages the nut kernel or the kernel of the nut. Therefore, a specially designed nutcracker is needed for processing of dabai nut.

The invention of nutcracker has been evolving through times. Sticking to the same principal and concept of cracking nuts however, there are many design of nutcracker that available nowadays. There are also ways to crack a nut using magnetic methods where iron powder and magnetic fluids are used to separate the shells and kernel of a walnut (Berlage, 1984) . However in Malaysia, we can only find general nut cracker, walnut’s nutcracker and several other nutcracker designs specifically for certain type of nuts. There is no significant designed nutcracker for Dabai fruit nut. This is because Dabai fruit is not a major fruit consumed by people around the world compared to other type of nuts. Although this fruit is not known to most of the Malaysians, it has potential nutritional contents that would open the eyes of public. Therefore, this invention will help in obtaining the nut from its kernel as a whole for future development on its nutritional factor.

Materials and methods

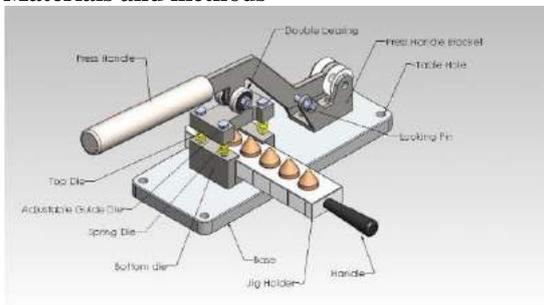


Figure 2: Dabai nutcracker

Figure 2 shows the Dabai Nutcracker that had been developed by using SOLIDWORKS software. The dimension of the tool is 250 mm (bottom part length) / 351 mm (top part length) x 100 mm (width) x 144.09 mm (height). The operation of the tool is carried manually with the use of a single manpower. The nutcracker is invented with a Jig holder with five mould spaces design to hold nuts vertically to ease cracking process and produce greater results. The mould is designed to hold nuts at 90 degrees angle. It comes in three different sizes based on the diameter of the dabai nuts. It is designed with a plastic handle to ensure user friendly. Double bearing is used to avoid the friction to the top die as it can cause damage to the operator. It also is being used to improve the accuracy of cracking when the top die is pushed down. The press handles acts as the pusher of the top die during cracking process. The base of the tool acts as the main holder for the entire component. The material of this part is made from lightweight hard material. The nuts are load to the jig holder accordingly to its size, and then the mention jig holder is slotted in through the bottom die, where the bottom die acts as the path for the jig holder. After

the jig is slotted in, the first nuts is cracked when it reach under the top die. To ensure the cracking process to run smoothly and give greater result, the adjustable guide die is adjusted according to the nut height. After adjusting, then the press handle is pushed down, where it slowly touches the top die. When the press handle touch the top die, the force will moves the top die in downward direction until it reach the nut on the jig. The nut is then cracked open with good opening so that the kernel inside can be retrieve easily because the shell of the nut is not scattered or crush and mix with the kernel.

Performance test of the tools

Performance test is done to identify the defects of the tools for further improvement based on the production capacity and/or other related parameters. Before the performance test is done, the tools need to be fabricated and assembles completely. The loading orientation of the nuts is set to be longitudinal as it produces more effective cracks and easier access to the kernel without crushing the kernel. The loading orientation is decided. to be longitudinal based on preliminary studies which shows the best set of orientation of the nuts to be cracked. The samples of Dabai nuts are selected randomly and 3 experimental replications were carried out with time recorded using a stopwatch. An average production capacity for each category of size of Dabai nuts is calculated. The production capacity can be determined by using the equation (1) below:

$$\text{Product capacity} = \frac{\text{number of dabai nuts fully cracked (kg)}}{\text{time taken to fully cracked nuts (hr)}} \quad (1)$$

The performance efficiency of the Dabai Nutcracker is evaluated based on the capability of the tools to fully cracked open nuts. The justification of the cracking process is based on the circumstances of the kernel from the shell. The efficiency of the tools also is determined. The efficiency of the Dabai Nutcracker can be calculated using the equation below. Three samples weight of 100 g of nuts is used for each sampling. Fully cracked nuts are weigh after cracking process is done. Not fully nuts also is weigh after cracking process is done. All the results is tabulated in Table 4.14. Calculation of Tools Efficiency is based on equation (2) below:

$$\text{Efficiency} = \frac{\text{weight of nuts fully cracked}}{\text{total of sample weight}} \times 100\% \quad (2)$$

Results and discussion

Table 1: Performance Capacity of Dabai nutcracker

	Number of Dabai fully cracked (g)	Time required (s)	Rate (g/s)	Rate (kg/hr)
Manual	100	385	0.26	0.94
Dabai nutcracker	100	220	0.45	1.64

From the data obtained and calculation using equation (1) the capacity of the tool is 1.64 kg/hr. There is 1.75 times increase in production capacity by using Dabai Nutcracker. This shows that this tool helps in increasing the productivity.

Table 2: Efficiency of Dabai nutcracker

Sample	Sample weight (g)	Weight (g)		Efficiency (%)
		Fully cracked open nuts	Not fully cracked	
1	100	96.4	3.6	96.4
2	100	100	0.0	100
3	100	95.4	4.6	95.4
Average				97.27

Three sets of 100 g samples are being used in the test of determining the efficiency of the Dabai Nutcracker. From the result obtained above, the efficiency for the Dabai Nutcracker is 97.27 % which is consider being high and successfully meets the requirements of the project design.

Conclusions

The aim of this project has been accomplished with the fabrication of the Dabai Nutcracker. This tool will helps in the cracking Dabai nuts by removing the shell more delicately and retrieving the kernel in a whole without crushing it into mixture of shell and kernel where it will make the separation process more difficult.

Acknowledgement

The authors express their gratitude to the Universiti Putra Malaysia for providing financial and technical support to conduct this research work.

References

- Abd Manaf, A. (2011). No Title. Retrieved October 24, 2017, from http://ww1.utusan.com.my/pix/2011/1020/Utusan_Malaysia/Sabah_&_Sarawak/wb_01.1.jpg
- Azlan, A. (2017). Dabai (*Canarium odontophyllum*), Fruit with Functional Oil. In A. Azlan & A. Ismail (Eds.), *Functional Foods Wonder Of The World Evidence-Based Functional Foods In Health & Disease* (p. 380). UPM Press.
- Azlan, A., Prasad, K. N., Khoo, H. E., Abdul-Aziz, N., Mohamad, A., Ismail, A., & Amom, Z. (2010). Comparison of fatty acids, vitamin E and physicochemical properties of *Canarium odontophyllum* Miq. (dabai), olive and palm oils. *Journal of Food Composition and Analysis*, 23(8), 772–776. <https://doi.org/10.1016/j.jfca.2010.03.026>
- Berlage, A. G. (1984). *Using Magnetic Methods*, 1, 1–3.
- Brooke, P. (n.d.). The dabai story: experience in commercializing an underutilized fruit.
- Brooke, P., & Yuon, L. C. (1980). Dabai Planting Material and Propagation Technique *Pearlycia Brooke and Lau Cheng Yuon*.
- Burge, D. S. (2009). Pugh Matrix (PM). *The Systems Engineering Tool Box*, 1–15.
- Gallegos, R. K. B., Suministrado, D. C., Amongo, R. M. C., & Madlangbayan, M. S. (2013). Some physical and mechanical properties of pili (*Canarium ovatum* Engl. cv. Katutubo) nut as a function of nut moisture content. *Philippine Agricultural Scientist*, 96(1), 66–74.
- Hun, C., Dan, P., & Daniel, N. (2014). Pembangunan produk berasaskan buah dabai (Product development from dabai fruit), 5(5), 51–61.
- Lim, T. K. (2012). *Canarium odontophyllum*, 624–629. https://doi.org/10.1007/978-90-481-8661-7_86
- Shakirin, F. H., Azlan, A., Ismail, A., Amom, Z., & Yuon, L. C. (2012). Antiatherosclerotic effect of canarium odontophyllum Miq. Fruit parts in rabbits fed high cholesterol diet. *Evidence-Based Complementary and Alternative Medicine*, 2012. <https://doi.org/10.1155/2012/838604>
- Shakirin, F. H., Prasad, K. N., Ismail, A., Yuon, L. C., & Azlan, A. (2010). Antioxidant capacity of underutilized Malaysian *Canarium odontophyllum* (dabai) Miq. fruit. *Journal of Food Composition and Analysis*, 23(8), 777–781. <https://doi.org/10.1016/j.jfca.2010.04.008>
- Tan, C. X., & Azrina, A. (2016). Nutritional, Phytochemical and Pharmacological Properties of *Canarium odontophyllum* Miq. (Dabai) Fruit. *PJSRR Pertanika Journal of Scholarly Research Reviews*, 2(1), 80–94