



## The Potential of Pumpkin (*Cucurbita Moschata Duschene*) as Commercial Crop in Malaysia

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**Abstract** – Awareness of recommendations for fruit and vegetable consumption has increased substantially over the last 20 years. In addition, fruits and vegetables such as pumpkin (*Cucurbita moschata Duchesne*) are good sources of many important nutrients, including potassium, vitamin C, folate, fibre, and numerous phytochemicals. Malaysia produces pumpkin its own, with considerably large areas of production comparable to its high global demand. However, in reality, there is a limitation in the commercial production as the local pumpkin is very much dependent on the market demand as the utilization has been limited to the consumption of fresh product. Thus, the objective of the study first initiative to provide the information about the pumpkin and second to investigate the opportunities on commercialized local pumpkin in Malaysia as by products despite various nutritious it is also listed as prophetic foods. The scientific research that covered a broad range of in vitro to in vivo studies on the by-products potentials of these fruits is also discussed in detail. The current review is an update for researchers to have a better understanding of the pumpkin, which simultaneously can provide awareness to enhance their commercial value and promote their utilization. Malaysia have potential to growth pumpkin instead of continuously importing. The daily consumption of pumpkins may provide various health benefits to human. Future investigation is needed to explore the potential of pumpkin as by products in order to increase its competitiveness and self-sufficiency.

**Keywords:** *Pumpkin, Local Prophetic Foods, Production, Commercialized.*

### Introduction

Malaysian cash crops are mainly grown in small farms of one to ten acres. A common cash crop grown by these farms is pumpkin. They mainly grow two pumpkin species, which are *Cucurbita moschata* and *Cucurbita moschata Duchesne* (Margaret et al., 2016; Shazila et al., 2014); the latter is the most planted cultivar (FAMA, 2014). Due to their short growing period of only two to three months, Malaysia encourages pumpkin cultivation (Anim Hosnan, 2011). The fruit's wax-covered skin enables it to be stored for as long as six months postharvesting. Meanwhile, the current price of pumpkin (*Cucurbita moschata Duchesne*) in the Malaysian market is around RM1.50 to RM2.00 per kilogram. A pumpkin could reach about 3 to 5 kilograms (Agro Mumpung, 2014). In Malaysia, pumpkins have also been considered for export purposes. Thus, pumpkin is important to the agricultural sector since it contributes to the national income and export. Despite the declining number of pumpkin production, the demand is increasing, driven primarily by the sizable population, a significant rise on per-capita income, awareness, and a growing interest for healthier food products (Muhammad and Masdek, 2018). Over the last 20 years, recommendation awareness for fruit and vegetable consumption has significantly risen (CDC, 2011). Fruits and vegetables are rich sources of such important nutrients as potassium, vitamin C, fibre, and various phytochemicals. Specifically,

pumpkins contain numerous substances with healthy effects (Shazila et al., 2014). They potentially provide a number of health functions, including anti-diabetic, anti-carcinogenic, and anti-microbial potentials. Additionally, consuming pumpkins may prevent the formation of kidney stones and reduce the effects of blood clotting. However, there is a limitation in commercial pumpkin production; it is dependent on market demand as it is mainly consumed fresh (Margaret et al., 2016; Shazila et al., 2014). Since there are many studies reporting on the fruit's nutrition contents (Dinu et al., 2016; Iwo et al., 2014; Adams et al., 2011) and health effects (Nishimura et al., 2014; Rakcejeva et al., 2011), this study aims to, first, provide information about the pumpkin, and, second, to investigate the opportunities in commercializing pumpkin in Malaysia. In addition to its abundant nutrition, pumpkin is also listed as a type of prophetic food. Both of these factors indicate the potential for pumpkin to be commercialized in Malaysia. The importance of the study is to give a better understanding of the pumpkin itself, which simultaneously can provide awareness to enhance its commercial value and promote its utilization. This paper begins with an introduction and literature review. The third section explains the methodology of the research. The fourth section explains the research findings. The final section concludes the study.

### **Pumpkin**

The pumpkin (*Cucurbita*) is a cultivar of the squash plant. It is round in shape and has slightly ribbed skin. Its colour ranges from deep yellow to orange. Inside the shell are seeds and pulp. The fruit is thought to come from North America. The oldest pumpkin seeds were found in Mexico, dating between 7000 and 5500 BC (The Pumpkin Patch, 2015). Pumpkins were then brought to Argentina and Chile, before eventually spreading to Europe and Asia. Regardless of altitude, they are cultivated in almost all parts of the world (Yadav et al., 2010).

Pumpkins in Malaysia are of the *Cucurbita moschata* and *Cucurbita moschata duchesne* species (Margaret et al., 2016). Among the locals, they are known as *labu manis* and *labu loceng*. The former is cultivated in almost every state, while the latter is primarily grown in Kedah (Shazila et al., 2014) and Sarawak (Margaret et al., 2016). Their size and colour vary; young fruits are green, while older ones are pale yellow. The flesh's thickness is about three centimetres, and it tastes sweet. Due to its size, it is more demanded relative to other species. These physical features drive farmers and wholesalers to prioritize the production and sales of the crop (Zaharah et al., 2006).

### **Soil and Cultivation**

Pumpkin is easy to grow. It can be harvested after two to three months of planting, and can be stored for as long as six months (Margaret et al., 2016). Malaysia's climate enables year-round production and exportation of pumpkin. The major pumpkin-producing states are Kelantan, Terengganu, and Johor (MARDI, 2014). According to Zaharah et al. (2006), pumpkin plantations in Malaysia cover an area of around 138 hectares, most of which is in Kelantan (79.6 hectares), Terengganu (59.6 hectares), and Johor (93.5 hectares). According to Anim Hosnan (2016), a hectare of pumpkin comprises around 2,600 of trees. Pumpkins are preferably cultivated in low-lying areas with a spacing of 1.2 m x 2.4 m. Low-lying areas such as river bottom sites are preferred because of their fertility and drainage. Though pumpkins can be grown without irrigation, research has shown the benefits of supplemental irrigation when rainfall is limited (Anthony, 2009).

Natural Resources Conservation Service (2006) reported that fertility recommendations for pumpkins are not based on soil, but rather are based primarily on crop yield potential, with adjustments made for soil organic matter content. This will lead to an increase in crop yield. Table 1 shows the total production of pumpkin in Malaysia for the year 2011 to 2015. In 2011 and 2012, pumpkin production fell sharply by 19.3 percent. Meanwhile, in 2014 and 2015, domestic production of the fruit had reduced by 42.4 percent. The decline in production is due to several major factors, such as higher production costs, restricted access to capital, and incidence of pests and diseases in pumpkin cultivation (Anim Hosnan, 2011; DOA, 2016; Margaret et al., 2016). However, in 2016, the harvest areas increased to 1,261 hectares, with a total production of 16,494 tons (Department of Agriculture Malaysia, 2016).

Table 1: Total Production (Tonnes) of Pumpkin in Malaysia for Year 2011 – 2015  
Source: DOA (2016)

Item/Year	2011	2012	2013	2014	2015	Total
Pumpkin (Tonnes)	21,534.40	17,382.50	111,144.30	44,525.70	25,651.70	22,023,860.00

### Challenges

Among the plant's diseases is pigmented downy (*Pseudomonas cubensis*), which attacks the leaves, leading to yellowish veins. It can be controlled by applying *Metalaxyl* or carbendazim. In addition, pumpkin also suffers from a dermal disease (*Erysiphe chiorancerum*), which invade the lower part of the leaf, causing it to be yellow and shredded. The disease can be avoided with by spraying chemical toxins such as carbendazim or *tridermorph*. Besides that, burned seedlings and damping-off are caused by three types of fungus (*Phytophthora spp*, *Rhizoctonia spp* or *Phytium spp*). Burned seedling can be controlled by using herbicides such as mancozeb or *melataxyl*. Meanwhile, anthracnose disease is common in pumpkins. It is caused by the fungus (*Collectotricum lindemunthiamun*), and it can be controlled by administering *Maneb*, *Zineb*, *Chlorothalonil*, *carbendazim* or *mancozeb* (Anim Hosnan, 2011). Pumpkin must be controlled from diseases to promote their growth.

### Nutritional Value and Benefits

Pumpkin has several health benefits and nutrition contents. Pumpkins are rich in fibre, vitamins, minerals, and other beneficial compounds (Djutin 1991). They are trailing or climbing herbs that grow annually or perennially. They comprise 25 species, and some of them, such as *Cucurbita maxima*, *Cucurbita moschata* and *Cucurbita pepo*, are economically important (Mayor et al. 2007). As shown in Table 2, pumpkins are a fine source of such essential nutrients as potassium, folate, and vitamin C (CDC, 2011). Furthermore, pumpkins also contain polysaccharides, proteins and peptides, para-amino benzoic acid, phenolic compounds, terpenoids, and sterols (Kuhlmann et al., 1999).

Table 2: Nutrients Composition in Pumpkin  
Source: USDA; De Escalada Pla et al., (2005) and Yadav et al. (2010)

Constituent(s)	Amount
Water (g/100 g)	89
Protein (g/100 g)	4.0
Fat (g/100 g)	0.2
Carbohydrate (g/100 g)	2.0
Fibre (g/100 g)	2.4
Ca (mg/100 g)	475
P (mg/100 g)	175
Fe (g/100 g)	0.8
b-Carotene (mg/100 g)	1.0
Thiamin (mg/100 g)	0.08
Riboflavin (mg/100 g)	0.06
Niacin (mg/100 g)	0.3
Ascorbic acid (mg/100 g)	80
Al (mg/g dry weight)	9.21
Co (mg/g dry weight)	0.29
Cr (mg/g dry weight)	2.84
Cu (mg/g dry weight)	15.4
K (mg/g dry weight)	5.70
Mg (mg/g dry weight)	5.60
Na (mg/g dry weight)	6.90
Zn (mg/g dry weight)	113

Pumpkin consumption could lead to the reduction of prostate cancer risk, joint swelling, and face wrinkling, in addition to stimulating the functions of kidneys. Moreover, pumpkin is also listed as a type of prophetic food, as it was consumed regularly by Prophet Muhammad (*pbuh*). This habit is indicated by the following Quranic verse and Hadith:

*“And We caused a plant of yaqteen (pumpkin) to grow over him.”*

(As-Saffat 37:146)

*"I accompanied Allah's Apostle to that meal. He served the Prophet with bread and soup made with pumpkin and dried meat. I saw the Prophet taking the pieces of pumpkin from the dish." Anas added, "Since that day I have continued to like pumpkin."*

(Hadith No.305, Vol.3, Book 34, Sahih Bukhari)

Pumpkin is considered as beneficial to health because it contains various biologically active components such as polysaccharides, *para*-amino benzoic acid, fixed oils, sterols, proteins, and peptides. The fruit is a good source of carotenoids and gamma-aminobutyric acid. Pumpkin seeds are valued for their high protein content and useful amounts of the essential fatty acid and linoleic acid (Yadav et al., 2010). Besides that, pumpkin also offer health benefits such as sharper eyesight, aid weight loss, reduce cholesterol, reduce cancer risk, protect the skin, and boost the immune system (Klein, 2014). Thus, pumpkin is a promising raw material for commercialization.

Numerous studies have been conducted on pumpkin (Hashim et al., 2014; Kampuse et al., 2015; Derossi et al., 2011). It has commercialization potential (Margaret et al., 2016), and can be consumed fresh, boiled, steamed, or as processed food items such as soup and curry in Thailand (Pongjanta et al. 2006), and in such cuisine as *masak lemak labu*, *labu sira*, and *pengat labu* in Malaysia (Norshazila et al., 2014). Some downstream products of the fruit are dried white seeds called *kuaci* and candied pumpkins (Norshazila et al., 2014). However, the availability of processed pumpkin products is low, since the market demands fresh pumpkins. Hence, pumpkin has commercialization potential (Nurhuda et al., 2013) since it is widely planted all over Malaysia (Anim Hosnim, 2015; Shazila et al., 2014; Margaret et al., 2016) and one of the prophetic food items.

### **Innovation of Pumpkin as By-products**

Innovation has been the focus of many studies throughout the years, and its definition and concept differ by background and context. In this study, innovation means any novel ideas that lead to economic advantages. These novel ideas can then be spread to create benefits for both self and society (Utterback, 2004). Pumpkins are usually consumed fresh or used as soup and puree thickeners (Pongjanta et al. 2006; Konopacka et al., 2010; Norshazila et al., 2014). Dry pumpkin powder, meanwhile, is used as natural food colouring, as well as additional flavour and thickener in a variety of food. Processed pumpkin (*Cucurbita moschata Duchesne*) products have a potential to be commercialized since pumpkin is widely planted all over Malaysia (Margaret et al., 2016). There is a limited amount of study that looks into processed pumpkin products. Therefore, this study will look into the potential of local pumpkin commercialization in Malaysia based on product innovation. Since pumpkin planting in Malaysia is mainly for domestic consumption and export (Anim Hosnan, 2010), there is a potential to commercialize its processed products. Moreover, additional values such as halal certificate, packaging, and innovation can be included to increase consumer demand. The literature has listed some processed pumpkin products in the form of powder, snacks, seeds, animal feed, and pharmaceutical products.

### **Powder and Bread**

Pumpkin powder is produced from mature pumpkin (*Cucurbita moschata Duchesne*). Pongjanta et al. (2003) revealed that pumpkin powder is produced by first extracting and drying the pumpkin, which is then followed by grounding it with a pin mill and sifting it through an 80-mesh sieve. The powder is cheap to produce, has good quality, and can be used as a beta-carotene supplement in food products. Moreover, Pongjanta et al. (2004) indicated that the use of 10-20% pumpkin powder in

place of wheat flour in Thai desserts improves their yellow colour and beta-carotene content. The desserts are accepted by consumers. Beta-carotene present in pumpkin is converted to vitamin A in the body and plays a crucial role in the prevention of chronic diseases during adult life due to their antioxidant abilities (Usha et al., 2010). Meanwhile, introducing pumpkin powder in wheat bread increases the loaf volume and organoleptic acceptability of wheat bread produced using flour samples with comparatively poor bread making properties (Pongjanta et al. 2006).

In addition, they reported that wheat flour could be substituted by 20% of pumpkin powder for butter cake and chiffon cake, and 10% substitution for sandwich bread, sweet bread and cookies. Adding pumpkin powder progressively gives an initial rise, followed by a decrease, in loaf volume. Other studies found that adding pumpkin powder to wheat bread increases its quality and nutritional value (Pongjanta et al. 2006; Rakcejeva et al., 2011). Consuming it is beneficial for most people living in urban areas, where vitamin A deficiency is common (Chakravarthy, 2000). Young children with vitamin A deficiency are usually more susceptible to severe infection, particularly dehydrating diarrhea, complications from measles, and respiratory infection (Usha et al., 2010). One way to increase vitamin A intake of infants is to incorporate high carotenoid food in their diet (Normah and Pongjata, 2000). Norfezah et al. (2013) proposed the expansion of snack food using pumpkin powder as additives. Thus, the extant literature shows that pumpkin powder and bread are beneficial to health. There is a significant potential to commercialize processed pumpkin products in Malaysia. In addition to the local and international markets, these products can be another potential source of income for pumpkin farmers.

### **Snacks**

Pumpkins (*Cucurbita moschata Duchesne*) grown for their seed for use as a snack product appear to be a growing market (Clinton et al., 2015). Recently, greater attention has been placed on the emerging market of ready-to-eat (RTE) snacks such as dried and seasoned pumpkin seeds (Brennan et al. 2013). Pumpkin products tend to taste naturally sweet and desirable, and the addition of pumpkins into food increases its beta-carotene. Continuous growth in the snack market has motivated producers to introduce new products using a variety of ingredients in order to improve appearance and nutritional values of their products (Norfezah et al., 2013). Convenience, appearance, value, texture, and taste are some factors driving consumer interest in snack foods (Diane, 2010).

The majority of snack products contain large proportions of wheat, rice, corn, oat, and other grain products. Sometimes, vegetable powder is also included, though this practice is uncommon. Pumpkin is abundant in beta-carotene and contains significant pectin and sugar levels (Norfezah et al., 2013). Products that include pumpkins become sweeter due to the sugar, while pectin contributes a number of health benefits. The utilization of pumpkin has been limited to the consumption of fresh products as a vegetable, or thickeners in soups and purees (Konopacka et al., 2010). Dry pumpkin powder is also used to add colour, flavour, and thickness in a range of foods. A potential avenue for the development of pumpkin-based products is the snack market. Pumpkin is fully usable not only for human, but also animals.

### **Animal Feed**

Agricultural residuals are usually utilized to counter animal feed shortage, while at the same time reduce waste. Agricultural residuals, or waste, are produced following the harvesting of crops. For pumpkins, their agricultural residuals are usually the by-products that remain after the collection of pumpkin seeds. These residuals are a good source of carbohydrate and can be used as animal feed, thereby reducing the accumulation of waste and accordingly pollution (Pirmohammadi et al., 2006). Another study proposed the possibility of pumpkins as a rich source of crude protein for the poultry industry (Wafar et al., 2017). Pumpkin has since been used as an alternative feed ingredient in poultry production (Matthew et al., 2017). As a supplement to regular feed, raw pumpkin can be fed to hens to help maintain egg production during the winter months (Jacob et al., 2013).

As a good source of protein, fluted pumpkin seeds play an important role in the world of food production both for humans and animals (Kuku et al., 2014). The use of crop by-products from the

food industry in animal feeding is a way of reusing resources with a high feeding potential (Tatiana et al., 2016). Umesiobi (2009) reported that the carcass quality and haematological parameters of the livestock and poultry fed rations appropriately fortified with organic compounds, such as the pumpkin seed meal (PSM), enhance their growth and reproductive performance. Furthermore, extracts from pumpkin seed and *Sorghum bicolor* are used to improve the haematological parameters in domestic rabbits (Adedapo et al., 2002). Since Malaysia is planning to expand the agriculture livestock (ETP, 2010), the commercialization of pumpkin by-products for animal feed is necessary. Thus, innovation towards animal feeding from pumpkin by-products must be explored to realize the fruit's potential.

### ***Pumpkin Seeds***

Pumpkin seeds are rich in phytoestrogens, healthy fatty acids, protein, and vitamins A and E. They are also beneficial for health, and may reduce swelling (Tracey, n.d). The seeds are alkalizing, and their sweet taste made them included in a variety of food items. In addition, they are easily digested by the body. Pumpkin seeds are green in colour, and they are coated by white shells. Studies have revealed some health benefits of the seeds, including lowering diabetes risk, weight, cholesterol level, and boosting mood.

They are rich in omega-3 fatty acids and potentially lower blood pressure level. According to Sojak and Glowacki (2010), the food-processing, pharmaceutical, and feed industries have become interested in pumpkin fruit and pumpkin-derived products in the past few years because of the nutritional and health protective value of the proteins and oil from the seeds as well as the polysaccharides from the fruit.

Native Americans were the first to consider the therapeutic and nutritious value of pumpkins and their seeds. They used the seeds to treat parasites, and this practice is recorded throughout their history. During the 1800s and 1900s, the United States began using pumpkin and its seeds to manage parasites. In addition, they were used to treat kidney problems and gastric illness. The fruit was then spread to Europe and other parts of the world by travellers. Presently, Mexico, India, the United States, and China are the largest pumpkin producers globally, and the fruit and its seeds are ever-present in numerous delicacies (Quora, n.d).

### ***Food Supplement***

Pumpkin-based supplemental food may have an anti-inflammatory function, which is beneficial for arthritis (Yadav et al., 2010). Pumpkin seed oil may reduce blood pressure level (Zuhair et al., 2000). They found that the interaction of pumpkin seed oil and some hypotensive drugs has a potential effect on hypertensive animals. Consuming pumpkin seeds-based supplements may also reduce the probability of crystal formation, subsequently leading to reduced risk of bladder stone formation (Svjetlana et al., 2016).

At a daily dose of 60 mg per kg of body weight, pumpkin seeds or orthophosphate supplementation could potentially reduce the occurrence of bladders tones. It could be used to supplement cereal flours in bakery products, soups, sauces, instant noodle and also as a natural colouring supplement for food (Noor Aziah and Komathi, 2009; Noor Aziah et al., 2011). Bread made from wheat flour supplemented by pumpkin flour had good nutritional value and sensory characteristics (See et al., 2007).

According to Dannenhoffer et al (2001), pumpkins can also potentially lower depression levels, as the seeds contain a substance called L-tryptophan, which increases the level of serotonin in the brain and other potential functional benefit is the reduction of blood coagulation. Children suffering from diarrhoea benefit from the consumption of a dietetic formula comprising pumpkin, chicken, rice, and vegetable oils (Sotelo and Perez, 2003). The epidermal uses of pumpkins are also aplenty; they can be used as body masque, massage oil and lotion, and facial masque.

## Conclusion

The first purpose of this review paper is to provide a comprehensive overview of pumpkin in Malaysia, including its total production, current market price, pumpkin cultivation, incidence of pests and diseases, yield area, and so on. To achieve the second objective of this study, the commercialization opportunities for pumpkin-based products has been reviewed. Innovation of processed pumpkin products such as powder and bread, snacks, animal feed, food supplement, and pumpkin seed was explored to present new market opportunities for the fruit. It is clear that pumpkins can be diversified through such innovations. Notwithstanding the above shortcomings, Malaysia has the potential to grow pumpkin and be independent from imports. Continuous research and innovation, particularly on processed and by-products, must be made. It is important to carry out research in the pumpkin sector so that the quality and quantity of the pumpkin can be improved to meet consumer demand. Nowadays, consumers demand more healthy products. Thus, the government should play a significant role in improving the pumpkin market with the purpose of satisfying customers' demands. In addition, there are many government agencies such as MARDI, FAMA, and SME Corp that can provide help and encourage entrepreneurs of pumpkin by-products in the aspects of quality and development product, marketing, financing, and advisory services. Moreover, the daily consumption of pumpkins may provide various health benefits. Thus, future investigation is needed to explore the potential of pumpkin-based products and by-products in order to increase its competitiveness and self-sufficiency.

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