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ENHANCING ANTIOXIDANT CONTENT IN WATERMELON ICE CREAM BY USING RIND OF *Citrullus lanatus*

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ABSTRAK
Citrullus lanatus also known as watermelon that normally consumed raw. Apart from benefits of its flesh, less people know that watermelon rind (WMR) also contains some nutrients. Looking at it potential and benefits to health, a research has been conducted to produce ice cream from the WMR. This study was assigned to determine the presence of antioxidant activity, nutrition content and the acceptance level of respondents towards ice cream made from WMR. As for quantitative instrument, hedonic scale was used in the questionnaire distributed to 30 randomly selected respondents. Descriptive analysis was used to analyse the data collected using SPSS version 23.0. Gas Chromatography-mass spectrometry were used to determine amount of antioxidant, fat, protein, carbohydrate and total energy content of WMR ice cream. Results showed that the presence of antioxidant is at 9.91%, while the amount of fat, protein, carbohydrate and total energy are at 1.5g/100g, 2.7g/100g, 7.7g/100g and 55kcal/100g respectively. It was also indicated that the respondents accepted this ice cream at high level with mean value 4.28. In conclusion, the WMR ice cream is nutritious, highly accepted by respondents and has commercial value.

Keywords*: ice cream, Hedonic scale, watermelon rind, antioxidant*

INTRODUCTION

The health-conscious public demands high-quality and low calorie products that are low in fat and sugar. However, altering amount of ingredient to reduce caloric content may compromise texture, mouthfeel, flavor and appearance (Pong et al., 1991; Khalil, 1998 in Hanan and Ahmed, 2013). Ice cream is frequently considered as a 'fun food,' which is undeserving consideration, and even was considered as a 'junk' food. These depreciatory statements have affected industrial development virtually from its inception. In reality, ice cream is a relatively well-balanced, wholesome, easily digestible, and delicious food. It is because ice cream is a nutritious element of the diet that is frequently used as a meal component for hospital patients. The energy value and nutrient content of ice cream depends upon the food value of the products from which it is made (Deosarkar et al., 2016).

Watermelon (*Citrullus lanatus*) is a tropical fruit widely consumed around the world and particularly among Malaysians. It botanically considered as a fruit, belongs to the family Cucurbitaceae (Edwards et al., 2003). Its first harvest was documented 5000 years ago in Egypt that later spread to other part of the world. Presently, China is the top producer followed by Turkey, United States, Iran and Republics of Korea (Zohary and Hopf, 2000; Lucier and Lin, 2001; Naz et al., 2013). Watermelon is a valued source of natural antioxidants with special reference to lycopene, ascorbic acid and citruline. These functional ingredients act as protection against chronic health problems like cancer insurgence and cardiovascular disorders (Zhang and Hamauzu, 2004; Omoni and Aluko, 2005; Fenko et al., 2009). The skin of watermelon usually thrown away, which is included in the category of solid waste. Watermelon
rind is rich in the amino acid L-citrulline, which can also help dilate your blood vessels and improve blood circulation.

BACKGROUND OF STUDY

Watermelon Citrullus lanatus, is a large, oval, round or oblong tropical fruit (Koocheki et al., 2007). The skin is smooth, with dark green rind or sometimes pale green stripes that turn yellowish green when ripe. It is a very rich source of vitamins and also serves as a good source of phytochemicals (Perkins-Veazie and Collins, 2004). The therapeutic effect of watermelon has been reported and has been ascribed to antioxidant compounds (Leong and Shui, 2002; Lewinsohn et al., 2005). The citrulline in watermelon rinds (WMR) gives it antioxidant effects that protect you from free-radical damage. Additionally, citrulline converts to arginine, an amino acid vital to the heart, circulatory system and immune system. These researchers speculate that watermelon rind might relax blood vessels as cancer and cardiovascular diseases (Rimando and Perkins-Veazie, 2005).

Table 1: Botanical classification of watermelon

Kingdom	Plantae – Plant
Subkingdom	Tracheobionta - Vascular plants
Superdivision	Spermatophyta - Seed plants
Division	Magnoliophyta - Flowering plants
Class	Magnoliosida – Dicotyledons
Order	Cucurbit ales
Family	Cucurbitaceae
Genus	Citrullus
Species	Citrullus lanatus

Usually, the seller of watermelon juice will not use the rind and continue to throw it away. This is includes the green scraps that usually end up in the compost bin. The rind, which is the green skin that keeps all that water-logged delicious fruit safe, is completely edible. In recent times, there have been challenges in agro-wastes management due to yearly increase in production in perishable fruits which does not commensurate with consumer utilization (Apsara and Pushpalatha, 2002; Souad et. al., 2012). Hence more wholesome fruit are discarded indiscriminately in the environment. This development makes reuse and value addition of agro- waste a viable methodology capable of reducing their environmental impact. As stated by Souad, A.M., Jamal, P. and Olorunnisola, K. S (2012), watermelon waste materials remained one of the important food grade agro-wastes generated by most hospitality industries in Southeast Asia and particularly in Malaysia.

Nutritionally, every aspect of the fruit of watermelon has value, including the rind and the seeds (Erhirhie and Ekene, 2013). Citrullus lanatus contains about 6% sugar and 92% water by weight. As with many other fruits, it is a source of vitamin C. The composition of dried seed without shell per 100 g include: water 5.1 g, energy 2340 kJ (557 kcal), protein 28.3 g, fat 47.4 g, carbohydrate 15.3 g, Calcium 54 mg, Phosphorous 755 mg, iron 7.3 mg, thiamin 0.19 mg, riboflavin 0.15 mg, niacin 3.55 mg and folate 58 μg. The seed being an excellent source of energy and contains no hydrocyanic acid, making it suitable as livestock feed. The seed oil contains glycosides of linoleic, oleic, palmitic and stearic acids. The fruit flesh contains bitter cucurbitacins (Schippers, 2002). Additionally, watermelon is rich source of β-carotene acts as an antioxidant and precursor of vitamin A

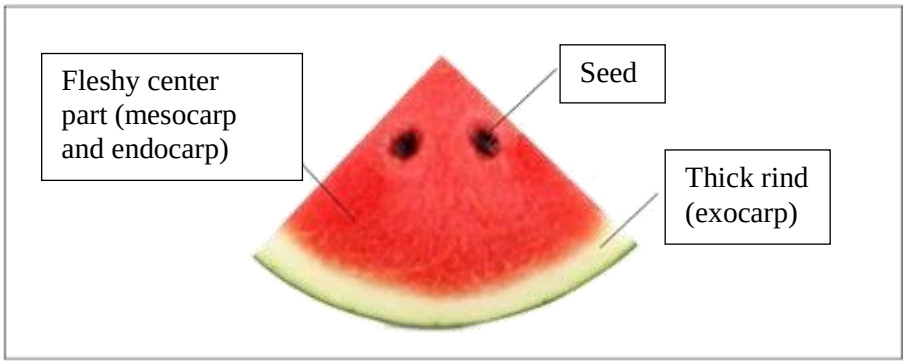

Figure 1: Watermelon cut

Most people understand that only the fruit of the watermelon have its own nutrition but less people know actually the skin also have more nutrition. The rind contains impressive concentrations of most nutrients like phenolic antioxidants, flavonoids and lycopene (Ambreen et. al., 2014). However, reports of juice made from watermelon rind (WMR) waste is scarce showing that watermelon wastes from restaurants, food and beverages processing lines are scantly being reused. WMR is one of the major solid wastes generated by several restaurants, cottage fruit juice producers and food industries in Malaysia. Unfortunately, more than 90% of the rind is discarded indiscriminately into the environment thereby constituting environmental challenges. This waste rind is not presently being utilized for any value added processes due to limited research activities focusing on the possible conversion of the waste to other valuable products thereby making it available for dumping as solid waste (Souad et. al., 2014). This novel use of WMR will among other things reduce the amount of the waste discarded, create more income for farmers, food processors and more importantly reduce environmental impacts of the waste. Therefore, the main focus of this research paper is to successfully document the antioxdant activity, nutrition content and sensory characteristics of ice cream made from WMR.

METHODOLOGY

Fruit waste collection

Fresh watermelon wastes (rind only); WMR with similar physical characteristics were collected from local juice processing restaurants located at Merlimau, Melaka area. The WMR are collected between 9 am and 12 noon in order to maintain their natural content before being stored immediately after collection at 4OC to avoid any chemical deterioration before processing day.

WMR ice cream preparation

The outer most skin of the exocarp of WMR were peeled with a peeler. Then, 250 g of the rind were cut into small pieces. Next, pieces of the collected rind of Citrullus lanatus were extracted using slow juicer at room temperature. Finally, the liquids were collected in a beaker. The ingredients were weighed according to the standard recipe. Then, pour some ice into the large mixing bowl then add some rock salt to make sure the ice will not melt easily. Beat all the mixture together until it becomes smooth and fluffy and, pour the mixture into the container to leave freeze with temperature 0 to -18 degree Celsius from 6 to 8 hours.

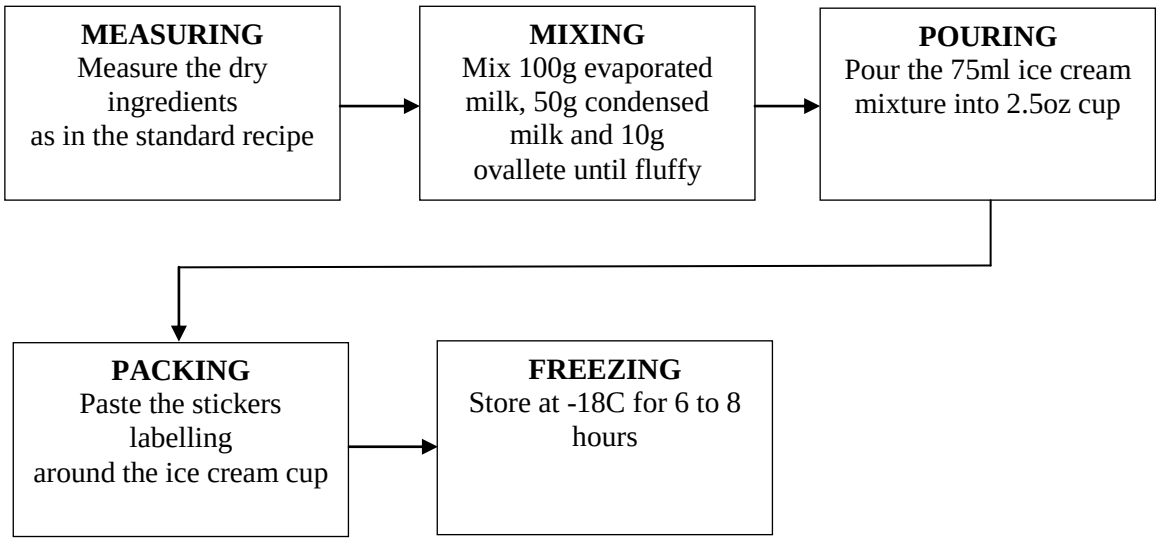

Figure 2: WMR ice cream preparation method

Sensory evaluation

WMR ice cream sample for organoleptic evaluation were prepared aseptically in clean transparent disposable closed containers and served fresh on the test day. Thirty untrained member panel (twenty five men and three women) were selected from the polytechnic community. Evaluated sensory characteristics (taste, smell, sweetness and colour) of the samples using a 5-point hedonic scale ranging from dislike extremely (1) to like extremely (5) (John et al., 2007 in Souad et al., 2012). During product testing, panel members were allowed to clean their mouth at intervals.

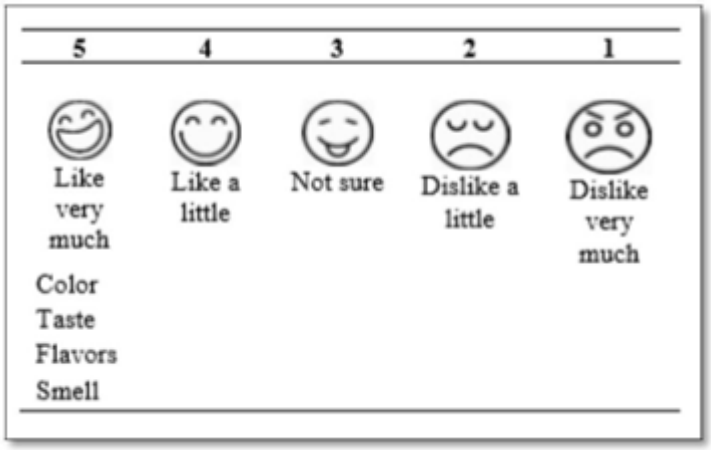

Figure 3: Questionnaire using Hedonic Scale in determining respondents' acceptance towards WMR ice cream

Statistical analysis Sensory characteristics data of the WMR juice were analysed using SPSS version 22. Mean values were detemined by referring to the mean value range interpretation (Sekaran, 1992) in the following Table 2.

Table 2: Mean interpretation

Mean score	Interpretation	Level
1.00 until 2.49	Low	Weak
2.50 until 3.49	Medium	Medium
3.50 until 5.00	High	Good

Nutrition content

Nutrition content of the WMR juice was conducted using the Gas Chromatography – Mass Spectrophotometry (GC-MS). Tested parameters were moisture, crude ash, total fat content, crude protein content, total carbohydrate, energy content, total sugar and antioxidant activity. 250ml of WMR ice cream sample was used to perform the tests.

Figure 4: Gas Chromatography – mass spectrometry

FINDINGS & DISCUSSION

Antioxidant and nutrition content oh WMR ice cream

From the analysis conducted, results in Table3 indicated that there is a presence of antioxidant activity by 9.91% in the WMR ice cream. The moisture content of green melon juice is 87.4g/100g, while crude ash is 0.8g/100g. The total fat and crude protein content are 1.5g/100g and 2.7g/100g respectively. There are 7.7g/100g amount of carbohydrate presence in the sample and each 100ml WMR ice cream providing 55kcal of energy.

Table 3: Antioxidant and nutrition analysis result of WMR ice cream

Test Parameter	Unit	Result
Antioxidant activity	%	9.91
Moisture	g/100g	87.4
Crude ash	g/100g	0.8
Total fat content	g/100g	1.5
Crude protein content	g/100g	2.7
Total carbohydrate	g/100g	7.7
Energy content	kcal/100g	55

Acceptance level of respondents towards WMR ice cream

Analysis in Table 4 showed that the respondents highly accepted the WMR ice cream with overall mean value 4.17. Respondents strongly agree that the juice has good colour, texture, smell and flavour with mean value 4.03, 4.23, 4.00 and 4.43 respectively. Table 4 indicates the mean score for each attribute evaluated

Table 4: Acceptance level of respondents towards WMR ice cream

Attributes	Mean	Level	Interpretation
Colour	4.03	Good	High
Texture	4.23	Good	High
Smell	4.00	Good	High
Flavour	4.43	Good	High
Overall mean	4.17	Good	High

CONCLUSION

Watermelon rind (WMR) usually treated as garbage. It is one of the factors contribute to the increasing number of municipal solid waste of food materials that were lost during preparation and consumption phase. However, it is undeniable that this research study has proven the presence of valuable nutrients and antioxidant activity in WMR ice cream and it has been highly accepted by respondents.

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