CRAVING FOR CHOCOLATE BUNS?

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Abstract

Commercial sweet buns are selected by consumers based on several factors such as its convenience, shelf life and taste. The commercial sweet buns are usually filled with different types of paste. The ingredients and nutrient contents of the commercial sweet buns are usually well known to other people through the printed information on the packaging. However, detailed and scientific comparison on the nutritional composition of the buns are seldom carried out. In this study, the nutritional composition of five types of different flavours of commercial sweet buns such as chocolate, kaya, red bean, coconut and potato bun is analysed with a mathematical technique named as Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). The analysis of this study has identified the type of bun that has the most nutrient contents which are good for health and has the least of non-benefit nutrient contents that are bad for health. The result could be served as a reference for people who is conscious on nutrition and health.

Keyword: Bun, Chocolate, Mathematical Analysis, Nutrition

Introduction

The health benefits of eating breakfast are huge. Having a breakfast at the beginning of the day can bring energy to our body. With a healthy body that is not hungry, our mind can perform better. The choice of breakfast for Malaysian are vast. It ranges from tasty coconut milk rice (nasi lemak) or Indian pancake (roti canai) to various traditional snacks (nyonya kuih or Malay kuih). Apart from that, bun or bread is one of the Malaysian favourite breakfast choices. They are usually sold in many convenient stores and they have longer shelf life than rice or traditional snacks. Thus, they become a popular food that could be easily consumed by children and adults from all walks of life.

Norizan et al. (2018) obtained the nutritional composition of five types of sweet buns that are commonly sold in Malaysia from proximate analysis, mineral analysis, fatty acids analysis and Vitamin C analysis. The five types of sweet buns are chocolate bun, kaya bun, red bean bun, coconut bun and potato bun. In this study, further analysis has been done based on the nutritional composition of these five types of sweet buns. The objective of this study is to identify the type of bun that has the most nutrient contents that are good for health and has the least non-benefit nutrient contents that are bad for health. A mathematical analysis known as TOPSIS is used in order to achieve the objective of the study.

Methodology

A mathematical technique named as Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is used in this study to identify the type of bun having the most nutrient contents that are good for health and at the same time having the least non-benefit nutrient contents. It is a multicriteria decision-making approach created by Hwang and Yoon (1981). TOPSIS is a mathematical analysis where multiple criteria (nutrient contents) are to be

evaluated in order to choose the best alternative (the type of sweet bun) from a set of alternatives (different types of sweet buns). The fundamental principle of TOPSIS is to choose the best alternative that is closest to the ideal solution as well as furthest from the negative-ideal solution. The ideal solution is associated with all the benefit criteria while the negative-ideal solution is associated with all the non-benefit criteria.

There are two categories of criteria in TOPSIS analysis, namely benefit criteria and non-benefit criteria. In this study, the benefit criteria refer to the nutrient contents that are good for health while the non-benefit criteria refer to the nutrient contents that are bad for health.

Twenty nutrient contents in the sweet buns are analysed in this study, that are saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), cholesterol, Vitamin C, protein, carbohydrate, total dietary fibre, ash, Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium, Manganese and moisture. These nutrient contents are being considered as the criteria in the analysis of TOPSIS. It is essential to differentiate which nutrient contents are benefit criteria and which nutrient contents are non-benefit criteria. This is to ensure the best alternative (the type of sweet bun) that is chosen from the TOPSIS analysis has the most benefit criteria (good nutrient contents) and at the same time has the least non-benefit criteria (nutrient contents that are bad for health).

In this study, the analysis on the nutritional composition of the sweet buns is first presented and the following section is the TOPSIS analysis.

Results and Discussion

Analysis on the nutritional composition of the sweet buns

(a) Protein and carbohydrate

Carbohydrate that is found in the sweet buns is a source of energy for our body. Protein is also found in the sweet buns. It is important in cell growth, maintenance and repair. It can also serve as an energy source. As both protein and carbohydrate are essential for our body growth, they are categorized as benefit criteria in TOPSIS analysis.

(b) Fats

There are certain fats that are vital for healthy body functioning while there are some fats considered as bad for health that should be avoided. SFA, MUFA, PUFA and cholesterol are the fats found in the sweet buns.

Curb et al. (2000) reported that there are apparently beneficial effects of diets with high content of monounsaturated fatty acids (MUFA). A diet with high content of MUFA helps to reduce the level of 'bad' low-density lipoproteins (LDL) and triglycerides in the blood without decreasing the level of 'good' high-density lipoprotein (HDL). LDL is often called 'bad' cholesterol as it is associated with an increased risk of cardiovascular disease. Therefore, MUFA is categorized as benefit criteria in TOPSIS analysis.

The heart-healthy omega-3 fatty acids are commonly found in fish oil and certain nuts while the omega-6 fatty acids are found in vegetable oils (Asif, 2011; Kris-Etherton et al., 2003). These two acids are the major types in the polyunsaturated fatty acids (PUFA). It is recommended that our diets should include these fatty acids as these are recognized as essential nutrients in the human diet (Meyer et al., 2003). Thus, PUFA is also categorized as benefit criteria in TOPSIS analysis.

Saturated fatty acids (SFA) are known to increase the risk of cardiovascular disease. Cardiovascular disease affects heart and blood vessels that is leading to the serious disorders such as high blood pressure, high blood cholesterol, heart attack and stroke. Cardiovascular disease is a major cause of death in many countries. Khor (2001) predicted that seven out of every ten deaths in the developing countries are caused by non-communicable diseases including cardiovascular diseases by 2020. Besides, high levels of cholesterol in the

bloodstream can cause a build-up of plaque in the arteries (Ma, 2004). The plaque in the arteries can cause arteries to be thicker and thus block blood flow to the heart. As a result, heart attack can occur. Therefore, both SFA and cholesterol are non-benefit criteria in TOPSIS analysis.

(c) Minerals and vitamin

Micronutrients are made up by vitamins and minerals. The minerals and vitamin that are found in the sweet buns are Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium, Manganese and Vitamin C.

Vitamin C is beneficial for our body in the formation of collagen. Collagen is an essential structural protein that strengthens bones and blood vessels. It is also necessary for tissue repair, wound healing and body growth (Hark & Deen, 2007).

The benefits of the minerals (Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium and Manganese) that are found in the sweet buns are summarized in the **Table 1** (Freeland-Graves et al., 2016; Hark & Deen, 2007; Watts, 1990).

Table 1 Benefits of minerals for human health

Minerals	Daily requirement	Benefits for health
Sodium	Men: 1600 mg Women: 1600 mg	It is vital in maintaining the normal pH of blood, controlling the amount of water in the body and helping muscular contraction.
Calcium	Men: 700 mg Women: 700 mg	It is the main mineral needed in forming bones and teeth. The symptoms of calcium deficiency include bone pain, muscle cramps, needles in hands, feet and osteoporosis.
Magnesium	Men: 300 mg Women: 270 mg	It helps formation of bones and teeth. It also helps body to process fat and protein.
Potassium	Men: 3500 mg Women: 3500 mg	It helps controlling the amount of water and maintaining the acid-alkali balance in our body. It also plays a role in lowering and controlling blood pressure.
Phosphorus	Men: 550 mg Women: 550 mg	It is essential for bones and teeth. It is also a part of our DNA (deoxyribonucleic acid), enzymes and ATP (Adenosine tri-phosphate) that stores energy needed by all cells.
Iron	Men: 8.7 mg Women: 14.8 mg	It is a component of haemoglobin and has a major role in transporting oxygen around the body. It also helps the release of energy from glucose and fatty acids in the intestine.
Zinc	Men: 9.5 mg Women: 7 mg	It is needed for the breakdown of carbohydrates, fats and proteins. It is also essential in the functioning of immune system and wound healing. It is also necessary to maintain normal levels of male sex hormone (testosterone) in the blood.
Copper	Men: 1.2 mg Women: 1.2 mg	It plays a role in the production of pigment in eyes, hair and skin. It protects body cells from chemical damage since it is an antioxidant. It is essential for the development of heart, bones and teeth.
Selenium	Men: 75 µg Women: 60 µg	It is an antioxidant and a part of an enzyme that protects cells from free radicals damaging our body.

		It also plays a role in normal functioning of the immune system and the thyroid gland.
Manganese	Men: 2.5 - 7 mg Women: 2.5 - 7 mg	Deficiency of manganese includes metabolic syndrome, diabetes, poor birth outcomes and a risk of getting cancer.

Due to the beneficial effects of micronutrients to our body, the minerals and vitamin that are found in the sweet buns (Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium, Manganese and Vitamin C) are categorized as benefit criteria in TOPSIS analysis.

(d) Total dietary fibre, ash and moisture

Fibre, ash and moisture are three of the nutritional composition of the buns. The total dietary fibre is important for maintaining a healthy digestive system. Food that is high in dietary fibre improves the body's blood-sugar response as it slows down the release of insulin into the bloodstream. A fibre-rich food also increases the feeling of fullness and thus can help controlling weight gain.

Bun is made of flour. A flour with higher ash content contains more bran, outer endosperm and germ. On contrary, a highly refined flour has lower ash content. A grain is considered as a whole grain if it contains three edible parts, which are bran, endosperm and germ. A refined grain has one or more missing parts from the bran, endosperm and germ. For instance, white flour is a refined grain because it has only endosperm. Serra-Majem and Bautista-Castano (2015) stated that lower gains in weight and abdominal fat are associated to the reduction of the white bread consumption, but not whole grain bread consumption. Therefore, a higher ash content in a bun is an indicator that the bun is made of flour with less refined. Hence, ash content in a food is beneficial to our health.

Higher moisture retention in bread indicates the quality and directly correlated to shelf life of the bread (Bhise & Kaur, 2014). Hence, the total dietary fibre, ash and moisture that are found in the sweet buns are categorized as benefit criteria in TOPSIS analysis.

TOPSIS analysis

In this study, nutritional composition of five types of commercial sweet buns (chocolate, kaya, red bean, coconut and potato bun) was analysed using TOPSIS analysis. The objective is to identify the type of bun that is the best alternative, having the most good nutrient contents and has the least of non-benefit nutrient contents.

There are two main components in TOPSIS analysis, namely alternatives and criteria. The alternative refers to the five types of sweet buns. On the other hand, the criteria refer to the 20 nutrient contents in the sweet buns. These nutrient contents are divided into two categories, that are benefit criteria and non-benefit criteria. It is found that monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), Vitamin C, protein, carbohydrate, Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium, Manganese, total dietary fibre, ash and moisture are categorized as benefit criteria. On the other hand, saturated fatty acids (SFA) and cholesterol are categorized as non-benefit criteria.

Table 2 summarized the nutritional composition of the sweet buns obtained by Norizan et al. (2018). In this study, TOPSIS analysis was performed on the data that are presented in the **Table 2**.

Table 2 Nutritional composition of five types of sweet buns

	Chocolate	Coconut	Kaya	Potato	Red Bean
Moisture (g/100g)	29.9	29.37	30.4	29.65	29.9
Potein (g/100g)	8.7	7.22	7.13	9.15	7.93
Carbohydrate (g/100g)	47.43	51.05	54.73	46.93	52.4
Total Dietary Fibre (g/100g)	4.95	4.43	3.93	4.65	4.7
Ash (g/100g)	1.6	1.05	0.9	1.3	1.1
Sodium (mg/100g)	241.58	197.53	170.33	274.2	169.13
Calcium (mg/100g)	137.4	65.27	61.9	45.15	79.97
Magnesium (mg/100g)	24.3	21.42	17.2	16.92	21.67
Potassium (mg/100g)	141.75	105.87	80.47	140.57	130.2
Phosphorus (mg/100g)	78.78	64.9	58.8	89.1	70.63
Iron (mg/100g)	1.98	1.00	0.67	0.92	1.07
Zinc (mg/100g)	0.9	0.83	0.73	0.95	0.93
Copper (mg/100g)	0.18	0.15	0.13	0.10	0.13
Selenium (µg/100g)	2.75	2.85	1.97	3.38	2.80
Manganese (µg/100g)	0.5	0.47	0.33	0.28	0.43
SFA (g/100g)	4.8	4.85	1.7	4.63	3.30
MUFA (g/100g)	2.13	1.52	0.8	3.05	2.37
PUFA (g/100g)	0.48	0.48	0.4	0.85	0.83
Cholesterol (g/100g)	0.00	0.53	2.83	13.7	0.00
Vitamin C (mg/100g)	4.25	3.48	2.07	2.85	2.9

In order to perform the TOPSIS analysis, the data in the Table 2 is converted into an evaluation matrix, $\boldsymbol{X} = (x_{ij})_{5\times20}$, of size 5×20 where the rows of the matrix represent 5 types of sweet buns (alternatives in TOPSIS) and the columns of the matrix represent 20 nutrient contents (criteria in TOPSIS). The matrix $\boldsymbol{X}$ is then normalised to form the matrix $\mathbf{Z} = (z_{ij})_{5\times20}$ where each element in the matrix $\mathbf{Z}$ is obtained by using the equation (1).

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{5} x_{ij}^2}} \text{ , where } i = 1, 2, \dots, 5 \text{ and } j = 1, 2, \dots, 20. \quad (1)$$

The weighted normalised decision matrix $\mathbf{T}= (t_{ij})_{5\times20}$ is then formed where each element in the matrix $\mathbf{T}$ is obtained by using the equation (2).

$$t_{ij} = w_j z_{ij}, \text{ where } \sum_{j=1}^{20} w_j = 1. \quad (2)$$

In this study, the analysis was carried out using equal weighting for all criteria.
A numerical value named as relative closeness to the ideal solution, s_{iw}, is evaluated for each of five alternatives. The best alternative is identified if it has the highest value of s_{iw}. The values of s_{iw} are obtained using the equation (3).

$$s_{iw} = \frac{\sqrt{\sum_{j=1}^{20}(t_{ij}-t_{wj})^2}}{\sqrt{\sum_{j=1}^{20}(t_{ij}-t_{bj})^2} + \sqrt{\sum_{j=1}^{20}(t_{ij}-t_{wj})^2}}, \text{ where } i = 1, 2, \dots, 5, \quad (3)$$

and $\{t_{bj}|j = 1, 2, \dots, 20\}$

$= \{\langle min(t_{ij}|i = 1, 2, \dots, 5)|j \in J_-\rangle, \langle max(t_{ij}|i = 1, 2, \dots, 5)|j \in J_+\rangle\}$,

$\{t_{wj}|j = 1, 2, \dots, 20\}$

$= \{\langle max(t_{ij}|i = 1, 2, \dots, 5)|j \in J_-\rangle, \langle min(t_{ij}|i = 1, 2, \dots, 5)|j \in J_+\rangle\}$,

J_- = non-benefit criteria,

J_+ = benefit criteria.

The values of s_{iw} are in the range of 0 to 1. The best alternative is identified if it has the highest value of s_{iw}, that is a value closest to 1.

Table 3 summarizes the values of s_{iw} for five types of sweet buns from the TOPSIS analysis. It is found that chocolate bun has the highest value of s_{iw} among the five types of buns ($s_{iw} = 0.738$) and the value is closest to 1. Thus, the analysis has identified chocolate bun as the best alternative in TOPSIS analysis, that is the type of bun that has the most good nutrient contents and has the least non-benefit nutrient contents.

Table 3 The values of the relative closeness to the ideal solution

Sweet buns	Relative closeness to the ideal solution, s_{iw}
Chocolate	0.738
Coconut	0.551
Kaya	0.439
Potato	0.372
Red Bean	0.640

The result of this study does not imply other type of sweet buns which do not have good nutrient contents. All sweet buns are edible and buns are the source of energy and nutrition for every human being. The advantage of this mathematical analysis is to provide ranking on the sweet buns according to the respective value of s_{iw}. Chocolate bun has the highest value of s_{iw} (0.738) and it follows by red bean bun (0.640). The coconut bun has the third highest value of s_{iw} (0.551) while the kaya bun is ranked at forth with a value of 0.439. The potato bun has the lowest value of s_{iw} (0.372). Hence, the ranking in ascending order is chocolate bun, red bean bun, coconut bun, kaya bun and potato bun.

In our society, all types of buns are favoured by people from all walks of life. People seldom make a detailed and scientific comparison on the nutritional composition of the buns. From this study, it was found that chocolate bun is the most nutritious bun among the five types of commercial sweet buns studied. The benefit of chocolate is huge. Chocolate contains several compounds that possess antioxidant properties (Waterhouse et al., 1996). Antioxidants can neutralize free radicals and prevent oxidative stress. The result in Allgrove et al. (2011) shows that regular dark chocolate intake is associated with reduced oxidative-stress markers. Oxidative stress refers to an imbalance of free radicals and antioxidants in the body and it can lead to cell and tissues damage in the body. Oxidative stress also plays a major role in human aging process (Salmon et al., 2010). Hence, consuming commercial chocolate products indeed bring benefit to the health of human being.

Conclusion

A complete range of nutrients are needed for our body to function well. The nutrients are divided into two main categories, namely macronutrients and micronutrients. Macronutrients are the foundation of any diet and it is needed in large quantities daily. Protein, carbohydrate and fat are belonging to the category of macronutrients. Micronutrients are made up by vitamins and minerals.

Sweet buns that are commonly sold in either small convenient stores or big hypermarkets are highly liked by all groups of people whether they are young or old. In this study, the nutritional composition of five types of commercial sweet buns (chocolate bun, kaya bun, red bean bun, coconut bun and potato bun) are investigated. It is found that these sweet buns contain essential nutrients that are needed by our body. The nutritional composition of the sweet buns consists of macronutrients (protein, carbohydrate, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids and cholesterol) and micronutrients (Sodium, Calcium, Magnesium, Potassium, Phosphorus, Iron, Zinc, Copper, Selenium, Manganese and Vitamin C). In addition, fibre, ash and moisture are also part of the nutritional composition of the buns. Among these twenty-nutritional compositions of the buns, saturated fatty acids and cholesterol are categorized as non-benefit nutrient contents while the rest are categorized as benefit nutrient contents.

A mathematical technique named as TOPSIS is used to identify the type of bun that has the most good nutrient contents and has the least non-benefit nutrient contents. The TOPSIS analysis shows that the chocolate bun is identified to be the best alternative. The result produced from this scientific and mathematical analysis in this study could be served as an additional positive information to many chocolate buns lovers, on top of the known facts that chocolate indeed has many health benefits to human body.

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Conflict of interests

Authors declare no conflict of interest.

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