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The Proximate Analysis and Sensory Evaluation of Super Seed Cookies

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ABSTRACT

This study aimed to determine the nutritional content and assess the consumers' acceptance of the sensory attributes of the Super Seed Cookies, which contained sacha inchi nuts, pumpkin seeds, almonds, and oats as added ingredients. The cookie was developed by a company named Mad About Cake. The cookie was analysed by measuring its proximate composition, such as moisture, ash, crude protein, crude fiber, crude fat, and carbohydrate content. This research also discovered the consumers' acceptance of the cookies by undergoing a 7-point hedonic sensory evaluation test among 30 semi-trained panelists. The proximate analysis results revealed that the Super Seed Cookies contained 4.06±0.07% of moisture, 1.80±0.04% of ash, 0.31±0.01% of protein, 3.16±0.00% of crude fiber, 7.67±0.00% of crude fat, and 83.00±0.00% of carbohydrates. In addition, the sensory evaluation results found that the consumers neither liked nor disliked all the sensory attributes of the cookies. In conclusion, improvement of the Super Seed Cookie's nutrient contents and sensory attributes is needed to make the cookies a healthy food product choice and meet the consumer's preferences before the cookies are commercialised to the market.

Keywords: almonds, cookies, oats, pumpkin seeds, sacha inchi nuts

INTRODUCTION

Nowadays, the availability of healthy foods around the world is increasing. It is because people are trying to maintain their health by monitoring their food intake since many researches have shown that daily dietary intake can influence an individual's health status. A diet can be assumed as healthy when it contains all types of nutrients that are required by the body in the appropriate amount, based on the Recommended Dietary Intake (RNI). The nutrients that should be in the diet are carbohydrates, protein, fat, fiber, water, minerals, and vitamins. According to the World Health Organization (WHO 2020), a healthy diet helps to protect against malnutrition and Non-Communicable Diseases (NCDs), such as diabetes, heart disease, stroke, and cancer. Fruits, vegetables, legumes such as beans, and nuts, and whole grains such as millet and oats are all components of a healthy diet (WHO 2020). However, the National Health Morbidity Survey 2019 found about 95% of Malaysian adults do not eat the recommended daily amount of fruits and vegetables (IHSR 2020). At the same time, the National Health Morbidity Survey 2017 showed that 2 in 3 adolescents in Malaysia ate inadequate fruits, while 23 in 25 Malaysian adolescents ate inadequate vegetables (IPH 2017). Besides, about 1 in 2 Malaysian adolescents ate inadequate amounts of legumes daily, and 1 in 3 of them consumed inadequate cereals and grains-related products daily. This problem may be a significant public health concern since the inadequate dietary intake of these foods can lead to an imbalanced diet, which may increase the risk of certain diseases, such as cardiovascular diseases, and cancers. Therefore, there is a need to have an alternative to increasing the daily dietary intake, especially involving grains, legumes, and fiber to ensure that Malaysians get sufficient nutrients, which can improve their health status. Sacha inchi nut (*Plukenetia volubilis*) has a high content of fatty acids (45–50%), protein (22–30%), and antioxidant properties (Kodahl & Sørensen 2021). Apart from that, oat is one of the

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top 10 superfoods in the world, which is high in protein, dietary fiber, lipids, vitamins, minerals, and antioxidants (Kim *et al.* 2021). Beta-glucan is a type of dietary fiber in oats that has cholesterol-lowering and antidiabetic effects (Paudel *et al.* 2021). According to the study conducted by Paudel *et al.* (2021) eating beta-glucan-rich oats or oat-based products in the daily diet can lower blood pressure and the lipid profile in people with mild hypercholesterolemia. Besides, almond (*Prunus dulcis*) belongs to the Rosaceae family and is a good source of protein, monosaturated fatty acids, dietary fiber, vitamin E, riboflavin, and essential minerals such as manganese, magnesium, copper, and phosphorus (Barreca *et al.* 2020). In a study done by Kamil and Chen (2012), they found that a standard 28 g serving of almonds provides 36.4% of α-tocopherol and 36% of manganese, 19.5% of magnesium, 16.0% of copper, 13.4% of phosphorus, 13.2% of fiber, 13.5% of riboflavin, and 12.1% of protein. However, in another study done by Barreca *et al.* (2020), they found that approximately 50% of an almond's weight is made up of fat, which is mostly Monounsaturated Fatty Acid (MUFA). The high content of MUFA can reduce the Low-Density Lipoprotein Cholesterol (LDL-c), which can help to improve cardiovascular health. Other than that, pumpkin seeds (*Cucurbita sp.*) from the *Cucurbitaceae* family have become a popular functional food due to their nutrient content and health-promoting properties. The pumpkin seeds can promote anthelmintic, antidiabetic, antidepressant, antioxidant, antitumor, and cytoprotective properties (Dotto & Chacha 2020). It is rich in fibers, protein, Polyunsaturated Fatty Acids (PUFA), minerals, phytosterol, carotenoids, and tocopherols (Syed 2019). The mineral contents of pumpkin seeds are iron, zinc, calcium, magnesium, manganese, copper, and sodium. Moreover, pumpkin seed is also a good source of phenolic compounds, which can act as antioxidants (Dotto & Chacha 2020; Amin *et al.* 2019; Koh *et al.* 2018). In addition, the cookie is a type of snack, which has a sale value of 2.34 billion Malaysian Ringgit in 2021 in Malaysia (Statista Research Department 2023). Many manufacturers have begun to add nutritious ingredients to the cookies and market the cookies as functional foods (Brown 585). For example, to reduce fat content in cookies, beta-glucan can be used to replace shortening in the batter. To improve the nutritional profile of cookies, dietary fiber, vitamin E, and omega-3 fatty acids can be used as additives in cookie preparation (Brown 585).

The aim of this study is to determine the nutrient contents of the developed cookie, which is known as Super Seed Cookies that are made from sacha inchi nuts, oats, almonds, and pumpkin seeds. The nutritional content of the cookies should be known and labeled on the packaging of the food product so that the customer can refer to the label, and it may help the customer to make a good choice whenever they want to look for foods that contain more nutrients. Besides, this study also wants to assess the consumers' acceptance of the sensory attributes of Super Seed Cookies. The results of the consumers' acceptance can be used as a reference to improve the sensory attributes of the cookies.

METHODS

Design, location, and time

The design of this research was experimental, which involved proximate analysis and 7-point hedonic sensory evaluation. The proximate analysis was conducted at the Food Analysis Laboratory, while the hedonic sensory evaluation test was conducted in the Food Sensory Laboratory at Universiti Teknologi MARA, Puncak Alam campus. The experiment was conducted from June to July 2023. Ethical approval was obtained from the Faculty Ethics Review Committee (ref. no: REC/06/2023 (MR/397).

Materials and tools

The ingredients used in the preparation of Super Seed Cookies were 432 g of butter, 500 g of brown sugar, 4 eggs, 528 g of oats, 588 g of wheat flour, 1 tablespoon of baking soda, 1 tablespoon of baking powder, 120 g of almonds, 200 g of raisins, 50 g of pumpkin seeds, and 30 g of Sacha Inchi seeds.

Catalyst tablets, Sulphuric Acid (H_2SO_4), hydrogen peroxide, deionized water, methyl red solution, bromocresol green solution, concentrated boric acid solution, Sodium Hydroxide Solution (NaOH), 1% of Hydrochloric Acid (HCl), celite 545, n- Octanol, acetone, desiccator, air oven, aluminium dish with lid, muffle furnace, electric hotplate with thermostatic

control, Silica crucible: diameter 3.5 cm, depth 4 cm, desiccators with silica gel desiccant, beakers, analytical balance, Kdejahl digestion unit, Kdejahl distillation apparatus, burette, conical flask, digestion tube, Fibertec hot extraction unit, Fibertec cold extraction unit, boiling stone were used to conduct proximate analysis.

Data collection

Proximate analysis. Proximate composition was determined according to standard procedures of AOAC International. In particular, moisture content was determined by heating 5–6 g of the sample at 105°C in an oven until constant weight measurements (AOAC 1984). Ash was determined by using the dry ashing method, in which the sample was placed in a muffle furnace at 550°C overnight (AOAC 1984). The nitrogen content of the sample was determined by using the Kjeldahl method (AOAC 1984). The crude protein content was calculated by using the conversion factor 6.25. The crude fiber was determined by using Wijkstrom fast method, in which the sample needed to undergo cold extraction, hot extraction, cold extraction, drying, and ashing process. Crude fat was determined by using the Nutritionist Pro Software and the data from the USDA databases. The carbohydrate content of the cookies was determined by subtracting 100% from the percentage of moisture, ash, crude protein, crude fat, and crude fiber.

Sensory evaluation. 30 semi-trained panelists from the Health Science Faculty were selected to evaluate the sensory attributes of the cookies. The selection of semi-trained panelists based on the inclusion and exclusion criteria for the sensory evaluation test. The inclusion criteria were healthy individuals and ages between 19–30 years old, and the exclusion criteria were smokers, individuals with hyposmia, and individuals with ageusia. The Mc Oaty Raisin Oat Cookies, and HM Cookies were used to compare the sensory attributes of the Super Seed Cookies. Besides, plain water was needed to rinse the mouth between each sample test.

The 7-point Hedonic Scale was used to measure whether the consumer liked or disliked the Super Seed Cookies. Each panelist was randomly served three different cookies: the Super Seed Cookies, the Mc Oaty Raisin Oat Cookies, and the HM Cookies. The panelists needed to rinse their mouths with water before trying each sample. After testing the samples, the panelists recorded their scores on the 7-point hedonic sensory evaluation scale based on their preferences.

Data analysis

The sensory evaluation data was analyzed by using Statistical Package for Social Sciences (SPSS) version 27.0. Analysis of variance (ANOVA) and descriptive statistics were used to investigate the significant differences in the acceptances between 3 types of different cookie brands. Besides, the Spiderweb chart is also used to compare the sensory attributes data between the three samples.

RESULTS AND DISCUSSION

The results of the proximate analysis of Super Seed Cookies are summarised in Table 1. The moisture content of the cookies was 4.06±0.07%, which was low moisture content. The low moisture content in the cookies contributes to the crunchiness of the cookies (Carter *et al.* 2015). If the moisture content of the cookies is high, it can reduce the cookie's crunchiness and lead to sogginess. According to the Food Data Central of USDA, soft oatmeal cookies with raisins had 8.85% of water content. Besides, cookies with low moisture content normally have a longer shelf life (Varghese *et al.* 2023). Apart from that, another factor that can contribute to the cookies' moisture is the ingredients used in making the cookies. The ingredients that contributed to the moisture of the Super Seed Cookies were brown sugar, raisins, butter, and eggs. Brown sugar had a higher moisture content (0.15%) than refined

Table 1. Proximate composition of super seed cookies

Proximate composition	(Mean±SD)*
Moisture content (%)	4.06±0.07
Ash content (%)	1.80±0.04
Crude Protein (%)	0.31±0.01
Crude fiber (%)	3.16±0.00
Fat (%)	7.67±0.00
Carbohydrate (%)	83.00±0.00

*Data in duplicates; SD: Standard Deviation

sugar (0.1%) and minimally refined brown sugar (0.11%) (Azlan *et al.* 2020). The high moisture content of brown sugar is due to the presence of molasses, which is a type of syrup. Besides, dark raisins are also high in moisture. It contained about 15.46 g of water per 100 g of raisins (Olmo-Cunillera *et al.* 2019). Other than that, butter is a type of fat, which contributes to the tenderness, moistness, and smooth mouthfeel of baked goods (Lauterbach & Albrecht 1994). According to Food Data Central of USDA, butter contained about 16.2 g of water per 100 g of butter.

Besides, the ash content of the cookies was 1.80±0.04%. Ash refers to the inorganic residue remaining after the complete oxidation of organic materials of food and it represents the mineral content of the foods (Nielsen 2003). In another study conducted by Desai & Bodhankar (2023) which analyzed gluten-free water chestnut flour cookies fortified with almond flour, the ash content of the cookies was 1.119%. Besides, based on the USDA database, the ash content of soft oatmeal cookies with raisins was 1.44%. Thus, the ash content of Super Seed Cookies was higher than the two cookies mentioned before, which indicated Super Seed Cookies contained more minerals than the two cookies. According to the USDA database, the ingredients that contributed to the ash content of Super Seed Cookies were pumpkin seed (4.77%), almond (3.16%), butter (2.1%), raisin (1.9%), oat (1.8%), wheat flour (1.6%), and egg (0.85%). The high value of ash content in pumpkin seeds is due to its mineral content, which is iron, zinc, calcium, magnesium, manganese, copper, and sodium (Syed 2019).

Other than that, the crude protein content of the cookies was 0.31±0.01%. The value of crude protein in Super Seed Cookies was considered as low. According to the research conducted by Megeri *et al.* (2022) protein content of multigrain cookies made from a combination of whole wheat flour, finger millet flour, and oats flour ranged between 11.5–13.8%. In another research conducted by Salazar *et al.* (2018) the crude protein content found in oatmeal cookies that used sucrose as the sugar was 9.75%±0.07. Besides, according to the USDA database, soft oatmeal cookies with raisins contain 5.79% of crude protein. Based on the comparison of crude protein content with other cookies of previous studies, the Super Seed Cookies contained a low percentage of crude protein. Even though the ingredients such as almonds, oats, sacha inchi nuts, eggs, and pumpkin seeds used in making Super Seed Cookies were known as good sources of protein, the crude protein content of the cookies was still low. Small amounts of sacha inchi nuts (30 g), pumpkin seeds (50 g), and almonds (120 g) used in making the cookies might be the reason for the low crude protein content. Another factor that might contribute to the low crude protein content was due to heat effect during the baking process. According to the study conducted by Runyon *et al.* (2015) heat treatment on oat led to a reduction in the amount of soluble proteins, which was approximately 50%. He explained that the reduced amount of soluble protein in oat during heat treatment might be due to the denaturation of soluble protein.

The percentage of the crude fiber content of the cookies was 3.16%. The fiber content of Super Seed Cookies was nearly the same as the fiber content of soft oatmeal cookies with raisins recorded on the USDA database (3.3%). The ingredients that might contribute to the fiber content of the Super Seed Cookies were oats, sacha inchi nuts, pumpkin seeds, and brown sugar. According to the studies on the nutritional compositions of sacha inchi seeds conducted by Kyaw *et al.* (2019), the fiber content of sacha inchi seeds was 8.63%, which was high. In other studies, the fiber content of sacha inchi seeds was found between the range of 6.61–11.30% (Goyal *et al.* 2022; Muangrat *et al.* 2018). However, a study conducted by Muangrat *et al.* (2018) found that the drying process of sacha inchi nut decreased its fiber content. Apart from that, another ingredient that contributed to the fiber content of the cookies was oat, which was known as a good source of β-glucan, a type of soluble dietary fiber (Sang & Chu 2017). Based on the USDA database, oats contained about 12% of total fiber. In the study conducted by Devi *et al.* (2018), the fiber content in pumpkin seeds was 4.59%. Research conducted by Azlan *et al.* (2020) found that brown sugar had higher fiber content than refined sugar, which was 2.38%.

Based on the data obtained from Nutritionist Pro Software and the USDA database, the crude fat content in the Super Seed Cookies was 7.67%. Almonds contributed to the highest content of fat, which was 2.16%, followed by oats (1.39%), butter (1.32%), pumpkin seeds (1.03%), eggs

(0.74%), sacha inchi seeds (0.56%), wheat flour (0.41%), and raisins (0.03%). Even though almond is high in fat, it contains high MUFA, and PUFA, which is good for health (Kalita *et al.* 2018). MUFA and PUFA in almonds help to reduce the LDL levels and maintain and increase the High-Density Lipoprotein (HDL) cholesterols levels (Kalita *et al.* 2018; Phung *et al.* 2009; Tey *et al.* 2015). Besides, oats, a type of cereal, are also high in unsaturated fats, which contain 34–37% of oleic acids and 36–39% of linoleic acids (Biel *et al.* 2020). Butter, an essential ingredient in baking, contained high saturated fatty acids, which was 2.4 grams of saturated fatty acids that can be obtained in one teaspoon of butter (USDA 2000). Apart from that, a study conducted by Kim *et al.* (2012) found that the major fatty acids in pumpkin seeds were palmitic acids, oleic acids, linoleic acids, and stearic acids. Besides, egg yolk is the part of the egg which contains high fat. The fatty acids found in egg yolk were oleic acids (about 40%), palmitic acids (about 30%), and linoleic acids (about 13%) (Xiao *et al.* 2020). In addition, Arachidonic Acid (AA) and Docosahexaenoic Acid (DHA), known as omega-3 also can be found in egg yolk. Oleic acid is a monounsaturated fatty acid, while linoleic acid, arachidonic acid, and docosahexaenoic acid are polyunsaturated fatty acids.

The carbohydrate content in Super Seed Cookies was 83.00%. Based on the USDA food database, soft oatmeal cookies with raisins contained 69.6% of carbohydrates, lower than the carbohydrate content in Super Seed Cookies. The difference in carbohydrate content might be due to a few factors, such as different types and quantities of ingredients used in making the cookies. The ingredients that contributed to the high carbohydrate content of Super Seed Cookies were wheat flour, brown sugar, and oat. Research conducted by Kumari and Sindhu (2019) found that carbohydrate content in cookies made from a combination of refined wheat flour and germinated pumpkin seed flour was within the range of 45.04% to 60.04%. The result of the study showed that the germinated pumpkin seed flour contributed to a lower carbohydrate content in the cookies. Wheat flour contributed to a high carbohydrate percentage because it contains starch, a type of complex carbohydrate. According to the USDA database, the carbohydrate content in 100 g of wheat flour is about 72 g, while 69.8 g in 100 g of oats. In addition, brown sugar also contributed to the high carbohydrate percentage of Super Seed Cookies, as it primarily contained sucrose, a type of simple sugar.

Sensory characteristics of cookies. The summary of colour, aroma, taste, crunchiness, and overall acceptability of the cookies is shown in Table 2 and Figure 1. HM cookies had the highest score in color, aroma, taste, crunchiness, and overall acceptability, while the Super Seed Cookies had the lowest score for all attributes. The HM cookies had the highest score for color due to the appearance of red cherry in the cookies, which made the cookies look attractive. In comparison, MC Oaty Crunch and Super Seed Cookies contained raisins instead of cherries.

Apart from that, in terms of taste, the Super Seed Cookies had the lowest score, while the HM cookies had the highest score. The difference in taste score might be due to some different ingredients used in making the cookies. Chocolate chip and cherry, which were contained in the HM cookies, made the cookies taste sweet, while the sacha inchi seed, almond, and pumpkin seed, which were contained in the Super Seed Cookies, made the cookies taste nutty. A study that was conducted by Espinosa-Páez *et al.* (2021) also showed that panellists preferred cookies with

Table 2. Comparing the mean score per attribute with the standard deviation between the cookie samples (n=30)

Sample	Color	Aroma	Taste	Crunchiness	Overall acceptability
Super seed cookies	5.03±1.13	4.20±1.50$^{\alpha}$	4.50±1.87$^{\alpha}$	5.23±1.41$^{\alpha}$	4.63±1.30$^{\alpha}$
Mc Oaty Crunch	5.47±1.14	4.53±1.33$^{\alpha}$	4.87±1.28$^{\alpha}$	5.27±1.26$^{\alpha}$	5.13±1.17$^{\alpha}$
HM Cookies	5.67±1.18	5.40±1.50$^{\alpha}$	6.00±1.44$^{\alpha}$	6.20±0.89$^{\alpha}$	6.03±1.10$^{\alpha}$

*Mean score per attribute with standard deviation are indicated as (±)

**Significance levels are indicated as α=($p<0.05$). P-value was calculated via analysis of variance test (ANOVA)

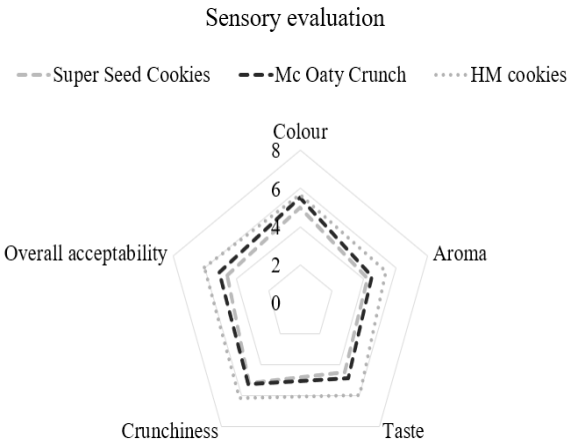

Figure 1. Spiderweb chart for the sensory data of the Super Seed Cookies, Mc Oaty Crunch Cookies and HM Cookies

cocoa flavours. Another factor contributing to the lowest taste score for Super Seed Cookies was the aftertaste of the cookies, which came from sacha inchi nuts. Besides, the food's aroma is closely related to the taste of the food. The food's aroma would influence the taste of the food. The HM cookies had the highest score, while the Super Seed Cookies had the lowest score for the aroma attribute. The lowest aroma score in Super Seed Cookies might be due to the nutty and earthy aroma, which came from sacha inchi nuts and pumpkin seeds. However, a study conducted by Alshehry (2020) showed that the panellists preferred the cookie's flavour with high percentage content of pumpkin seed. The highest aroma score in HM Cookies might be due to the cocoa aroma, which came from chocolate chips. The crunchiness score for Super Seed Cookies and Mc Oaty Crunch were nearly identical, while the crunchiness score for HM cookies was the highest. The cookies' crunchiness is related to the sugar types used in making the cookies. The Super Seed Cookies and Mc Oaty Crunch were nearly identical because they are made from brown sugar, while the HM cookie is made from white sugar. Since brown sugar contains more moisture than white sugar, it causes the cookies made from brown sugar less crunchy than the cookies made from white sugar. Since the HM cookies had the highest score for all attributes, it is good to make the HM cookies the benchmark to improve the quality of the Super Seed Cookies in the future.

CONCLUSION

This research aimed to determine the moisture, ash, crude protein, crude fiber, and crude fat and carbohydrate content of the Super Seed Cookies and also to determine the consumer acceptance of the cookies. Based on the proximate analysis and sensory evaluation results, it can be concluded that the Super Seed Cookies contained 4.06% of moisture, 1.80% of ash, 0.31% of crude protein, 3.16% of crude fiber, 7.67% of crude fat and 83% of carbohydrates, and consumer was neither like nor dislike all the sensory attributes of the cookies. The results indicate improvement of the Super Seed Cookie's sensory attributes is needed before the cookies are commercialized to meet the consumer's preferences. The recommendation for future research was to analyze the cookies' calories, water activity, and trace elements.

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DECLARATION OF CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

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