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RESEARCH ARTICLE

Development of Healthier Cookie Product by Utilizing Different Formulations of Durian Seed Flour

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ABSTRACT

The increasing fast food production led to decreased consumption of dietary fiber food and increased risk of obesity and cardiovascular disease. Hence, this study aimed to utilize durian seed flour in making a healthy cookie product and observe the effect of different durian seed flour formulation (0%, 25%, 50%) to the organoleptic properties of the cookies. The cookies were analysed through sensory analysis and further statistical analysis. The addition of different formulations of durian seed flour did not significantly affect the aroma, taste, aftertaste, and overall liking of the cookies, however, it did significantly affect the texture of the cookies. The formulated cookies made with the addition of durian seed flour had better overall organoleptic attributes especially in the texture attribute. Nevertheless, it is recommended to conduct chemical and rheological analysis for further characterization of the durian seed flour and its effect in the cookies for further studies.

Keywords*:* cookies; durian seed; durian seed flour; *Durio zibethinus*; sensory analysis

INTRODUCTION

Nowadays, food industries keep revolutionizing in order to keep up with the unceasing increase of human population in the world. This led to a skyrocketing production of fast food and in turn decreased the consumption of whole food. The declining consumption of whole food products subsequently decreased the amount of dietary fiber that people required to consume daily. Moreover, it has been studied that fast food consumption has been linked with increased risk of obesity and cardiovascular disease due to the high content of simple sugar and saturated fat within fast food (O'Keefe, 2018). According to a study by McRae (2017), high dietary fiber intake reduces the total serum and low density lipoprotein cholesterol concentration which plays a cruising role in reducing the risk of cardiovascular disease. In the study, it was also found that increased dietary fiber intake reduced the cholesterol and fatty acid absorption which reduced the LDL cholesterol, reduced glucose absorption and insulin secretion which lowered the blood pressure, as well as reduced inflammation effect. These three reduction properties of high dietary fiber intake minimized the risk and severity of cardiovascular diseases (McRae, 2017). Another study led by O'Keefe (2018) suggested that low dietary fiber intake could lead to obesity, colon cancer, and cardiovascular diseases. The study explained that fiber has a significant effect on the colonic microbiota in regards to colonic health and colon cancer risk. A high fiber diet will stimulate the growth and modify the function of the gastrointestinal microbes to focus on saccharolytic fermentation, in which this fermentation will stimulate further growth of the beneficial microbes and suppress the growth of pathogens. Furthermore, a high fiber diet will also promote

immunomodulatory and anti-inflammatory effects, and genetic-epigenetic modulation with anti-proliferative effects which could considerably reduce the risk of cancer (O'Keefe, 2018).

Despite being one of the most consumed foods in the world, cookies are considered as a high calorie product that when consumed in such high amounts, might just increase the risk of cardiovascular disease the same way as fast food does (Bier et al., 2014). Cookies are generally composed of high amounts of fat and sugar contents, a weak gluten flour, low level of water, and leaveners (i.e. sodium bicarbonate) that will be mixed together and baked (Hui, 2006). In effort to make cookies relatively healthier, its fat and sugar content need to be reduced. For example, the flour used may be substituted with a healthier flour such as durian seed flour, the sugar and butter may be reduced by adding inulin and soy lecithin instead. Soy lecithin has emulsifying properties that has function somewhat similar to butter, moreover, it has a rather good antioxidant properties (Judde et al., 2003). Meanwhile, according to a study by Kalyani et al. (2010), inulin is a type of non-structural storage carbohydrate that consist of a polydisperse mixture of molecules including glucosyl moiety and fructosyl moiety. The study also described that inulin has similar basic functions as fat and sugar. As inulin is dissolved and mixed thoroughly with water, inulin forms a particle gel network that represents itself as a white creamy structure that has a little spreadable nature, and these properties could be used to replace fat up to 100% (Kalyani et al., 2010). Furthermore, the gel has a three dimensional network consisting of insoluble sub-micron crystalline inulin particles that is capable of immobilizing large amounts of water molecules. Hence, inulin can also be used to replace sugar in food. It was also mentioned that further function of inulin to baked products such as cookies include moisture retention, fiber and prebiotic source (Kalyani et al., 2010). Another study also found that inulin could replace sugar and gives off lesser calories, however, it has a sweetness level of about 10% of sucrose (Shoaib et al., 2016) which may require the addition of another sweetener (i.e. artificial sweetener) to adjust.

Crowned as the king of fruit, durian is one of the most popular fruits consumed in Indonesia and most Southeast Asian countries. However, only one-third of durian is edible, whereas other components such as the seeds (20-25%) are mostly disposed of and contributes to food waste (Amid et al., 2012). The seeds are a good source of antioxidant compounds, proteins, dietary fiber, and carbohydrates (Ho & Bhat, 2015). The relatively high total polyphenol content acts as the source of antioxidants within the durian seeds (Ji & Chang, 2013). The durian seeds have many potential of being useful such as being converted into a flour. Amin & Arshad (2009) conducted a study to characterize the composition of whole durian seed flour (WDS) and dehulled durian seed (DDS) flour. In the study, it was found that WDS flour contained 6.5% moisture, 6.0% protein, 3.1% ash, 0.4% fat, 10.1% crude fibre and 73.9% carbohydrate, whereas the DDS flour contained 6.6% moisture, 7.6% protein, 3.8% ash, 0.4% fat, 4.8% crude fiber and 76.8% carbohydrate. When the durian seed flour (DSF) was compared with wheat flour, the study found out that DSF contained a relatively lower fat content (approx. 3.5-5.5 times), higher dietary fiber content (approx. 2-10 times), and about half the amount of protein than in wheat flour which may limit its uses. The study also found that DSF could withstand high temperature processes and remain stable (Amin & Arshad, 2009). In another study, Ho & Bhat (2015) found that DSF contained smaller starch size compared to rice flour, and was capable of becoming a starch source as well as a hydrocolloid source. Moreover, the phytosterol within DSF could act as a cholesterol substitutor (Hisham et al., 2012), and decrease the concentration of plasma cholesterol by reducing the intake of cholesterol (Quílez et al., 2003). Hence, the objective of this study was to convert durian seed waste into durian seed flour and utilize it to make a healthier product together with inulin. The study also investigated the effect of different formulations of durian seed flour on the organoleptic quality of the cookies.

MATERIALS AND METHODS

Materials

The ingredients used to make the cookies were durian seed flour, all purpose flour, unsalted butter, inulin, coconut sugar, brown sugar, skimmed milk, salt, espresso powder, vanilla extract, soy lecithin, dark chocolate, emplex and baking powder.

These ingredients were commercially prepared except for durian seed flour. Durian seeds were retrieved from local durian seller waste instead and were processed manually to produce the durian seed flour.

Methods

Durian seed flour production

After retrieving, the durian seeds were brought back to the lab to be sorted, cleaned and washed. Subsequently, they were pressure cooked for about 30 minutes and were followed by a dehulling process to remove the outer layer and cutting process. The durian seeds were then dried inside a food grade incubator (oven) at a temperature of about 80-90℃for about 3 hours and were followed by a milling process. After the milling process, the durian seed flour was sifted using a 60 mesh flour sieve/sifter and stored at room temperature with moisture absorber.

Cookie formulation

The design of the experiment was to use different formulations of durian seed flours to substitute all purpose flour during the production of the cookies. There were three formulations in this experiment where; F0 was the control consisting of 0% durian seed flour & 100% all purpose flour, F1 consisted of 25% durian seed flour & 75% all purpose flour, and F2 consisted of 50% durian seed flour & 50% all purpose flour.

Cookie production

The butter was first melted either through heating or microwaving. The other ingredients except inulin were then added, according to each formulation, into the melted butter and well mixed with a spatula. The mixing process was followed with the addition of inulin and water, and was continuously mixed with either spatula or hand until a cookie dough was obtained. The cookie dough was then topped with chopped dark chocolate, wrapped with a plastic wrap and chilled for approximately 1 hours inside a refrigeration. The dough was rolled and shaped or moulded, then placed on a tray to be baked at 180°C for 15 minutes using an oven. After baking, the cookie was cooled down and was analysed.

Sensory analysis

The sensory analysis was conducted using an acceptance test (Lawless & Heymann, 2010) and the parameters analysed were aroma, taste, aftertaste, texture, and overall liking. The test used a 9-point hedonic scale ranging from 1 - 9 where 1 is “dislike extremely” and 9 is “like extremely”, and was carried out in a monadic sequence. The samples were coded and the panelists were “blinded”, and the sensory test was repeated in which the judges were blind to the replication.

Statistical analysis

The data obtained from the sensory analysis were analysed statistically using One Way ANOVA (Lawless & Heymann, 2010) followed by a post hoc analysis consisting of LSD & Tukey HSD test, and a comparison of mean values from each attribute of each sample using a bar plot (Meilgaard et al., 2007).

RESULTS AND DISCUSSION

There are three formulations of the cookies in which the first formulation contained 0% DSF, the second formulation contained 25% DSF, and the third formulation contained 50% DSF. A sensory analysis was conducted to compare the three formulations. The sensory analysis was replicated or conducted in a repeat in which the panelists were blinded to the replication. According to a study by Lawless & Heymann (2010), replication in sensory analysis was uncommon in acceptance testing, however, there were many benefits to consider replication. The study described that replication could provide additional information, increase the discrimination ability of the panelist towards the product especially in a 9-point hedonic scale, may reduce bias answer from the panelists, and may reduce effects of serving order that could also give bias result.

Table 1. The statistical significance of different attributes based on the first and second sensory analysis.

Attributes	*F-value*[1]	*F-value*[2]	*F-critical*	*P-value*[1] (□ = 0.005)	*P-value*[2] (□ = 0.005)
Aroma	1.847	0.349	3.01	0.162	0.706
Taste	0.665	0.476	3.01	0.516	0.623
Aftertaste	0.115	1.303	3.01	0.891	0.276
Texture	7.871	13.236	3.01	0.001	0.000
Overall Liking	0.345	1.734	3.01	0.709	0.181

[1]The data are based on the first sensorial analysis.
[2]The data are based on the second sensorial analysis.

The data obtained from One Way ANOVA test were analysed as seen in **Table 1.** The F-values were compared with the F-critical values, whereas the P-values were compared with the significance level (□ = 0.005) (Lawless & Heymann, 2010). Based on **Table 1.**, the cookie samples did not have any significant difference in terms of aroma, taste, aftertaste, and overall liking. The texture of the cookie samples were significantly different from each other. Similar to the first trial, in the second trial, only the texture of the cookies were significantly different from each sample, whilst the other attributes were not. This means that the formulation of durian seed flour only affected the texture of the cookies, however it did not affect the other attributes. The aroma, taste, and aftertaste of the formulated (25% and 50% DSF) cookies were not significantly different to the control indicating that it had the same aroma, taste, and aftertaste of a regular chocolate chip cookie, without any aroma, taste, and aftertaste of a durian flesh nor durian seed. According to a study by Nathanael et al. (2016), these criterias were linked with the mucus naturally secreted by the durian seed, where its incomplete removal during the DSF production process may affect those criterias.

Table 2. The statistical significance of different samples in terms of the textural attribute based on the first and second sensory analysis.

Post-Hoc Test	Samples[1] (Code)			Samples[2] (Code)		
	915	**170**	**658**	**273**	**574**	**428**
Tukey HSD	5.26^{b}	6.74^{a}	6.54^{a}	5.45^{a}	7.22^{b}	6.75^{b}
LSD	5.26^{b}	6.74^{a}	6.54^{a}	5.45^{a}	7.22^{b}	6.75^{b}

Note : Different superscript letters indicate significant differences ($p \leq 0.05$) between samples.
[1]The data are based on the first sensorial analysis.
[2]The data are based on the second sensorial analysis.

The data for the texture attribute obtained from the post hoc test (Tukey HSD & LSD) test were analysed as seen in **Table 2.** Sample 915 was significantly different from sample 170 and sample 658. Meanwhile, sample 170 and sample 658 were not significantly different from each other. This means that the control sample (0% DSF) was significantly different from the other samples,

whereas sample 170 (25% DSF) and sample 658 (50% DSF) were not significantly different from each other. Similar to the first trial, in the second trial, the control sample 273 was significantly different from the other samples, while sample 574 (25% DSF) and sample 428 (50% DSF) were not significantly different from each other.

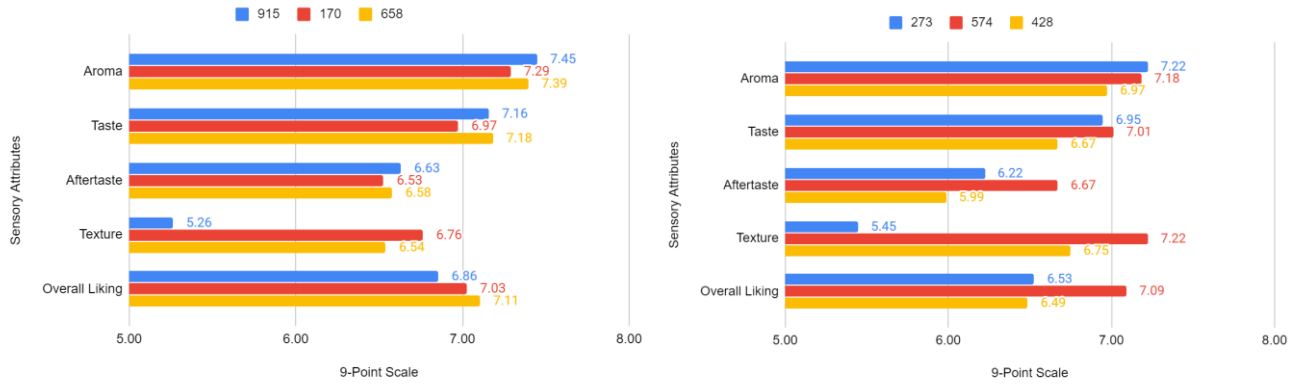

Figure 1. The mean scores for each attribute from each sample compared in a bar plot from the first sensory analysis (left) and the second sensory analysis (right).

The mean scores for each attribute from each sample were compared as seen in **Figure 1.** All the samples had similar scores on each attribute except for texture, where the control had the highest aroma score, 25% DSF sample had the highest texture score, and 50% DSF sample had the highest taste, aftertaste, and overall liking score. The 25% DSF and 50% DSF formulation had similar degree of acceptance on each attribute, although the 50% DSF formulation was more preferred by the panelists. Meanwhile, in the second trial, all samples also had similar scores except for texture, where the control had the highest aroma score, the 25% DSF sample had the highest taste, aftertaste, texture, and overall liking score. Here, the 25% formulation was more preferred by the panelists. However, it was noted that the cookies with DSF formulations had a more bitter aftertaste and a grainier texture than the control. The texture of the formulated (25% and 50% DSF) cookies were better than the control or the regular cookie. Therefore, it could be concluded that the cookie formulations consisting of 25% and 50% DSF were more preferred by the panelists due to higher degree of acceptance on most of the attributes.

The results obtained from the statistical analysis corresponded with the result obtained from the other study conducted by Verawati & Yanto (2019). Verawati & Yanto (2019) conducted a study of substituting wheat flour with durian seed four to develop a biscuit. The study also showed that different formulations of DSF did not significantly affect the taste and aroma of the biscuit, however, it did significantly affect the texture of the biscuit. The study also revealed that the biscuit with DSF formulation had better organoleptic properties than a regular biscuit. Another study conducted by Nathaniel et al. (2016), studied the effect of substituting wheat flour with DSF in bread production. The study revealed that different formulations of DSF did not significantly affect the taste and overall liking of the bread, however, it did significantly affect the aroma and texture. In that study, higher addition of DSF gave a higher aroma of durian seed that decreased the acceptance level of the panelist, meanwhile, higher addition of DSF made the bread had harder texture, however it did not significantly affect the panelists' acceptance level. The study also revealed that the panelists preferred bread without any DSF formulation. The differences between that study and this experiment may be caused by the durian seed flavor, in which this experiment did not have.

CONCLUSION

Incorporating durian seed flour into cookies is feasible to create a healthier product. Based on the sensory analysis, the addition of durian seed flour did not significantly affect the aroma, taste, aftertaste, and the overall liking of the cookies,

however, it did affect the texture attribute. In overall, the addition of durian seed flour increased the acceptability of the cookies in many different aspects, both the organoleptic aspects as well as health aspect. It is recommended to conduct chemical and rheological analysis for further characterization of both durian seed flour and its effect in the cookies.

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