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Effect of Oat to Flour Ratio on Stickiness of the Cookie Dough

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Abstract
Texture attributes, such as stickiness of grain-based food is important to consumers and manufacturers (McManuis, 2001). Descriptive method such as Texture Profile Analysis (TPA) is used in order to describe the textural properties of the cookie dough. By using TPA, the structure of the food can be emphasize. Mixture formulation of cookie dough based on five different cup ratios of oat to flour which are 1:1, 1:1.25, 1:1.5, 1:1.75 and 1:75. The ratio of 1:1.5 is the basic mixture formulation provided by the SME's cookies company. The calculated weight was rounded off to the nearest whole number. Example, for 1.8 cups of oat at ratio 1:1.5, the total weight required was 1.8 cups times 94 grams which equal to 169.2 grams. After rounded off to the nearest whole number, the weight required was 169 grams. Similar calculation method was used to calculate the weight of flour. For each ratio of oat to flour, the total cup required for every mixing process was 4.5 cups. As results, different ratio of oat to flour had a significant effect on the dough stickiness where cookie dough with ratio 1:1.75 flour have the highest stickiness value while cookie dough with ratio 1:1.25 have the lowest stickiness value. This is because the higher flour content contains higher starch which contribute to higher moisture content. Hence, the dough with more flour is more sticky. The current study indicated a high potential in developing fiber-rich cookies with large inclusion with composition of 1:1.25 of oats and flour respectively which produced a less sticky dough. Thus, the increasing of oat and flour content in the formulation show a significant effect on dough stickiness.

Keywords: Stickiness, Oat to flour ratio, Resting time

Introduction

As studied by Norimah et al. (2008), in Malaysia, there is an expanding consumption patterns of ready-made or convenience food such as biscuits, bread and cake among Malaysian adults. According to Malaysian Adult Nutrition Survey, in particular, biscuit and bread appeared in the list of top ten daily consumed food. The survey also concluded that 16.3 percent of the local population consumed an average of five pieces of biscuits daily which showed that biscuits are one of many popular food in Malaysia. Biscuits are among the well-known and highest consumed baked food in the world. This is because of their ready to eat nature, affordable, good nutritional quality, available in different flavours and longer shelf life. Oat-based cookies is a cookie that contains basic ingredients including butter, sugar, salt and additional ingredients which are oat, either rolled or instant oat, and a large inclusion such as shown in Figure 1. Large inclusions are the additional ingredients added into the dough including chocolate chips, almonds, raisins, cashew, and other type of nuts. The purpose of adding the large inclusion into the cookie dough is to produce the oat cookies with various flavour following the consumer preferences. Due to addition of oat and large inclusions, the texture of the cookie dough is different as compared to that of the basic cookie dough which not has oat and large inclusions inside. As the texture differ, the dough properties such as stickiness and cohesiveness will significantly affect the production process of the cookie. Thus, study on parameters affecting the properties of the cookie dough including ratio of oat to flour and resting time of cookie dough is unduly important. By ensuring and determining the suitable oat-based cookie dough with suitable stickiness, problem such as dough sticks on the machine surfaces may potentially be hindered.

In biscuit making, the main ingredients are flour, sugar and fat. The quality of the biscuit is governed by the nature and quantity of the ingredients used. Nevertheless, several authors have attempted to describe the effect of ingredients in a dough and formula balance on the final structure of the product (Chen and Hoseney, 1995).

Texture attributes, such as stickiness of grain-based food is important to consumers and manufacturers (McManuis, 2001). Texture evaluation is an important step in developing a new product or optimizing process variables (Meullenet et al, 1998). Descriptive method such as Texture Profile Analysis (TPA) is used in order to describe the textural properties of the cookie dough. By using TPA, the structure of the food can be emphasize.

Dough stickiness or adhesion can be defined as the adhesion of dough to the contact surface (Dobraszczyk, 1996; Hoseney and Smewing, 1999; Adhikari et al., 2001; Yildiz et al., 2012). Some authors described dough stickiness or adhesion as the combination of cohesion which is the stickiness between particles, and adhesion which is defined as the stickiness between particle and wall or surface stickiness (Adhikari et al., 2001). Dough stickiness emerged as one of the major problems in bakery and confectionary industries since decades ago. Today, modern bakery and confectionary industries apply dusting flour or oil method to reduce the dough stickiness. However, it is

significantly help in eliminating the problem. The negative effect due to the dough stickiness has long be proven to interrupt the production schedule and subsequently caused losses due to low quality of the final products (Grausgruber et al., 2003).
Parameters resulted in dough stickiness and enhanced the dough stickiness had been reported in many journals. According to a research by Grausgruber et al. (2003), there are several parameters that influenced the dough stickiness such as overmixing of dough, over addition of water and uncontrollable intrinsic factors of the flour.

Materials and methods

a) Sample preparation

Basic mixture formulation used in this research are provided by one of the SME's cookies company who has experience for more than 10 years in producing oat-based cookies. The basic mixture formulation of the cookie dough in cup measurement and weight for one cup of ingredient is shown in Table 2. This mixture formulation is for one time mixing process. For example, by using ratio of 1:1.25 of oats to flour, two cups of oat and 2.5 cups of flour were required in mixing process which makes up a total weight for oat and flour of 188 and 285 grams, respectively.

Table 1: Basic mixture formulation of the cookie dough

Ingredients	Quantity	Weight percup (g)
Oat	2 cups	94
Flour	2.5 cups	114
Brown sugar	0.75 cup	164
Castor sugar	0.5 cup	232
Chocolate chip	0.75 cup	178
Cashew nut	0.25 cup	140
Almond slice	0.5 cup	96
Egg	1 piece	-
Butter	250 gram	-
Soda bicarbonate	3 gram	-
Baking powder	8 gram	-

Since the basic mixture formulation were provided in cup measurement (Table 1) for most of the important ingredients including oat and flour, the ratio of oat to flour were calculated based on the cup measurement throughout the research. Prior to the experiments, samples were prepared at different ratio of oat to flour, while other ingredients were remained constant.
Mixture formulation of cookie dough based on five different cup ratios are shown in Table 2. The ratio of 1:1.5 is the basic mixture formulation provided by the SME's cookies company. The calculated weight was rounded off to the nearest whole number. Example, for 1.8 cups of oat at ratio 1:1.5, the total weight required was 1.8 cups times 94 grams which equal to 169.2 grams. After rounded off to the nearest whole number, the weight required was 169 grams. Similar calculation method was used to calculate the weight of flour. For each ratio of oat to flour, the total cup required for every mixing process was 4.5 cups.

Table 2: Mixture formulation of cookie dough for different ratio of oat to flour

Measurement	Ratio Oat to Flour	Oat	Flour	Total
Cup	1 : 1	2.25	2.25	4.50
	1: 1.25	2.00	2.50	4.50
	1: 1.5	1.80	2.70	4.50
	1: 1.75	1.64	2.86	4.50
	1: 2	1.50	3.00	4.50
Weight (g)	1 : 1	212	257	469
	1: 1.25	188	285	471
	1: 1.5	169	308	477
	1: 1.75	154	326	480
	1: 2	141	342	483

The dough was prepared using a domestic mixer (Mixer HR 1565, Philips, Malaysia). First, butter, castor and brown sugars were placed inside the mixing bowl and mixed using the mixer. The mixing time and speed were kept constant at 11 minutes and 6 rpm, respectively. Then, egg was added into the mixture and was mixed for another 2 minutes at 6 rpm. The mixing product was a soft white-yellowish batter.
At the same time, the remaining ingredients were mixed manually by hand in other bowl following proper ratio as shown in Table 1. The batter was mixed with the remaining ingredients for 2 minutes until the mixture was well-mixed (Figure 1). The mixing process were repeated for all ratio of oat to flour.

Figure 1: Cookie dough

Prior to testing, the well-mixed cookie dough was divided into five equal parts. The dough were rested at five different resting times which were 10, 20, 30, 40 and 50 minutes. Samples were tested in different days. Therefore, the dough were rested inside incubator at controlled room temperature (approximately 27°C with 85 to 90 percent relative humidity. The mixing process and testing apparatus are located near to each other. This is important to minimize inaccuracy in data collection due to changes of temperature and relative humidity caused by distanced location.

b) Experimental design

Experiments were conducted in two phases. The first phase involved the determination of stickiness, cohesiveness, and moisture content properties of different cookie dough mixture formulation based on the oat to flour ratio and resting time. Texture and moisture analyzer were used in the first phase. The second phase focusing on the stickiness properties of cookie dough on different material surfaces including teflon, silicone, stainless steel, and parchment paper. For the second phase, only good and poor samples, obtained in the first phase based on the properties, were tested.

c) Experimental procedure (Texture Analyzer)

The value of adhesiveness and stickiness were studied by using the texture analyzer (TA.XT PLUS, Stable Micro Systems, Surrey, U.K.) with a 75 mm diameter cylinder probe (P/75P) under the following setting: Pre-Test Speed: 0.5 mm/s, Test Speed: 0.5 mm/s, Post-Test Speed: 10.0 mm/s, Return Distance: 5 mm, Applied Force: 5 g, Contact Time: 0.1s,Trigger Type: Auto – 5 g (Chen and Hoseney, 1995). The measurement was performed on triplicate samples from each condition and three measurements were performed on each replicate.

Figure 2: Texture Analyzer

Results and discussion

Stickiness value of the cookie dough

Stickiness value obtained by the Texture Analyzer for different ratio of oat to flour and resting time were tabulated in Table 3.

Table 3: Stickiness value on different oat to flour ratio

Resting time (min)	Ratio 1:1	Ratio 1:1.25	Ratio 1:1.5	Ratio 1:1.75	Ratio 1:2
10	-144.5	-146.1	-135.2	-129.3	-131.1
20	-125.3	-143.2	-114.6	-27.4	-46.6
30	-129.0	-169.5	-113.3	-17.5	-38.4
40	-142.2	-164.7	-114.4	-22.6	-63.3
50	-137.0	-186.3	-134.0	-54.2	-81.0

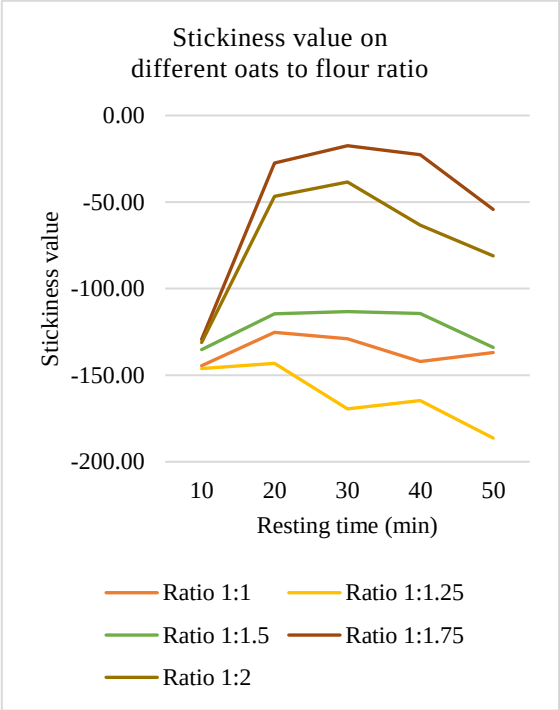

Figure 3: Graph stickiness value on different oat to flour ratio vs resting time

In order to enhace the cookie's quality, it is crucial to understand the function of the ingredients such as dietary fiber in the cookie. Based on Figure 3, it shows that the different ratio of oat to flour had a significant effect on the dough stickiness where cookie dough with ratio 1:1.75 have the highest stickiness value while cookie dough with ratio 1:1.25 have the lowest stickiness value.

Preliminary research using different ratio of oat to flour with different resting time showed that the best cookie dough with 2 and 2.5 cups of oat and flour, which indicated the lowest stickiness among the mixed cookies.

Based on Figure 3, the dough stickiness can be grouped into 3, where ratio 1:1.75 and 1:1.2 as high stickiness, ratio 1:1.15 as moderate stickiness and ratio 1:1 and 1:1.25 as less stickiness.

This is due to the starch content from the flour, where the higher flour used in the dough means that there are higher starch content. The starch is is hydrophilic which caused the dough to absorb moisture easily. Thus, the higher the flour content,

the higher the stickiness of the cookie dough due to the higher moisture content.

Dough stickiness value are evaluated to examine the adhesion force of the cookie dough. Dough with higher stickiness value indicates higher adhesive forces while the low stickiness value indicate lower adhesive value (Avramenko, 2017). Hence, the result as shown in Figure 3 shows that the formulation of different oat to flour ratio vs resting time.

Conclusion:

There are many parameters that influence the determination of stickiness value of the cookie dough with different composition. In food industry, one of the major issues in finding out the dough stickiness is that there is no standardized standard for measurement of the stickiness value. The current study indicated a high potential in developing fibre-rich cookies with large inclusion with composition of 1:1.25 of oats and flour respectively. The increasing of oat and flour content in the formulation show a significant effect on dough stickiness.

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