CHAPTER 1. INTRODUCTION

Honey is a natural product made by bees from flower nectar. Honey has many variations because different regions and flowers will develop a different composition of honey and thus, producing different flavor and aroma (D'Arcy, 1999). Honey has been used for its therapeutic effects. Honey has antioxidant, anti-inflammatory, antibacterial, antidiabetic, respiratory, gastrointestinal, cardiovascular, and nervous system protective effects (Samarghandian, Farkhondeh, & Samini, 2017). One of the most common beneficial effect of honey is that honey has a hypoglycaemic effect. Honey has a stimulatory effect on healthy β-cells of the pancreas and also hypoglycaemic effect on both healthy and diabetic patient (Bobiş, Dezmirean, & Moise, 2018). In general, the glycaemic index of floral honey (58) is lower glycaemic index (GI) than sucrose (60), because it mostly consists of fructose. Some honey has an even lower GI, such as German Floral Honey (<55). Honey also has lower calories compared to sucrose; 300 kcal/100g and 387 kcal/100g, respectively (Bobiş, Dezmirean, & Moise, 2018). GI is a percentage representing the amount of carbohydrates in food and beverages; low GI foods mean that the food is digested, absorbed and metabolized in a slow rate while high GI foods mean that the food is digested, absorbed, and metabolized in a fast rate (Augustin *et al.*, 2015). One of the strategies in the dietary management of diabetic person is that they should consume lower GI food rather than higher GI food since low GI diets can help to improve glycaemic control of a person (Ain & Khan, 2015). By substituting sugar with honey in the meal, the GI value and the calories of the meal should be decreased and it will be healthier to be consumed.

Some sweeteners were also used as an alternative to sugar like sugar alcohol, aspartame, saccharine, acesulfame-k, and other artificial sweeteners. However, there are some side effects caused by their consumption. Sugar alcohols have a laxative effect when consumed in excessive amount (Ain & Khan, 2015; Grembecka, 2015). Artificial sweeteners in general cause obesity, increased risk of diabetes

mellitus type 2, and might cause bone loss in later life because they contain phosphoric acid (Ain & Khan, 2015). Although there are regulations about the usage of the sugar alcohols and artificial sweeteners, alternative natural sweeteners are now sought to replace sugars, sugar alcohols, and artificial sweeteners since natural sweeteners are considered safer.

Stevia has been used in various baked products, such as muffins (Gao *et al.*, 2017), cookies (Ahmad *et al.*, 2017), cake, and biscuit (Hemada *et al.*, 2016). The results showed that the baked products using stevia have no significant difference with the baked products using sucrose, but has a lower score in terms of taste, although not significant. Despite having a sweet taste, stevia has a bitter aftertaste which affects the taste score of the final products (Gao *et al.*, 2017). It is also reported in Ahmad et al (2017) that stevia has no significant effect on decreasing postprandial glycemia and thus does not reduce the risk of diabetes. In comparison, honey as sugar substitute has been used in baked products like bread and cookies (Bornare & Khan, 2015). The results showed that cookies and bread made with honey would not have a significant difference with the control, and the taste is not significantly lower. In addition, the mouthfeel of the products is significantly higher than the control (Bornare & Khan, 2015; Orgera & Parada, N.D.). Since honey is more viscous than sucrose syrup, the amount used should be decreased to 75% of the amount of sugar used (Orgera & Parada, N.D.).

Diabetes Mellitus (DM) is a metabolic disorder with a common symptom of high blood sugar level (Bobiş, Dezmirean, & Moise, 2018). Four hundred and fifteen million people in 2015 are having DM and it is expected in 2040 that the number will increase to 642 million. There are 153.2 million diabetic populations in the West Pacific Region, which is around 37% of the total diabetic population; and 96 million of them are from South East Asia. The prevalence of diabetes in South East Asia has also increased from 4.1% in 1980 to 8.6% in 2014 (WHO Searo, 2016). For Indonesia itself, the number or diabetic patient has increased from 1.5% of the total population in 2013 to 2% of the total population in 2018 (Riskesdas, 2018). Despite diabetes being one of the biggest concerns in the world, one of the food trends for 2019

from Innova Market Insights as stated by Green (2018) is that snacking become a definitive occasion and no longer occasional. Snacks might be in the form of chips, street foods, desserts, confectioneries, and others; people have their definition of snacking. The problem with snacking emerges as the sweet snacks are included as part of snacking.

Sweet snacks are high in sugar content and might result in diabetes. One of the most popular sweet snacks nowadays is macaron (Wu, 2018). It can be seen from Figure 1 that macaron consists of two parts, which are the shells and the fillings. The fillings widely ranged from jams, chocolate, buttercream, to anything spreadable on the shell. As macaron shell consists of only meringue and almond flour, macaron's meringue becomes an essential part of the macaron as it contributes to the overall texture of the macaron shell itself. In addition, meringue contributes to 30% of sugar content of macaron.

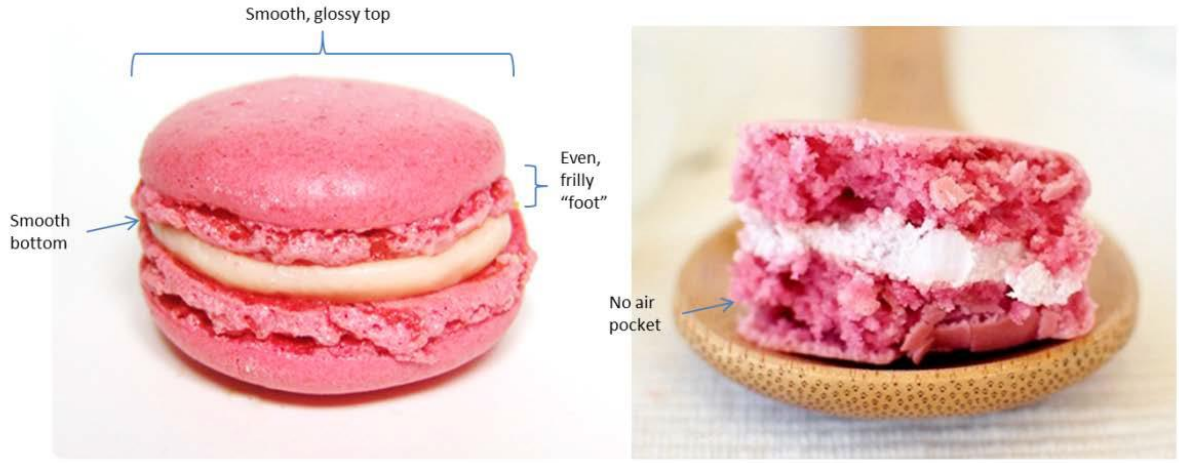

Figure 1. Anatomy of a macaron. Adapted from "Optimizing sugar ratios for macaron taste and structure," by A. Wu, N.D., *Writing with Food Science, 2*, 1-12.

Meringue, whatever the types are, contains more than 50% of sugar and therefore it is not a good choice of snacks for people with diabetes. The consumption of meringue and other snacks derived from it might increase the risk of diabetes, but there is a way to reduce the risk; sugar reduction. One way to fight diabetes is through diet; it is suggested that the amount of sugar in food and beverages should be reduced to prevent people from getting diabetes (Kaldor, Magnusson, & Colagiuri, 2015; WHO Emro,

N.D.). Honey, which has hypoglycaemic effect and considered as best alternative for sugar (Ain & Khan, 2015), has been used in various baked products to replace sucrose but has never been used the process of making macaron shell. Meanwhile, honey is high in viscosity compared to the other alternative sweeteners and able to add viscosity to the meringue to increase its stability. Therefore, the objectives of this research are to test the effect of honey substitution in Italian meringue towards the moisture, texture, and physical measurement of the macaron shell and to choose the most preferred formulation based on the sensorial preferences of the macaron shell.

The benefit of this research is that it can contribute as a foundation for the application of honey meringue in baked products, especially macaron. In addition, people can be informed that there are alternatives for sugar in their food, such as honey.

The hypotheses for this research are that macaron shell with honey substitution will have more moisture and softer as the amount of honey increases. The physical measurement of honey-substituted macaron shell will have a shorter diameter, thicker, and heavier the more honey incorporated into the macaron shell. The most preferred concentration of honey incorporated into the macaron shell will be 25% honey macaron.

The scope of work in this research includes meringue formulation, macaron shell making and baking, physical measurement in terms of diameter, height, and weight, texture analysis by moisture content analysis and texture analyser, sensory test in form of hedonic test, and data analysis in form of ANOVA with Tukey post-hoc test and t-test with assumption of unequal variance.