INTRODUCTION

1.1. Background of the Research

Indonesia is facing triple burden malnutrition, where undernutrition, overnutrition, and micronutrient deficiency exist (Rah, Melse-Boonstra, Agustina, van Zutphen & Kraemer, 2021). Micronutrient deficiency has become a significant problem, especially in children and pregnant women. Micronutrients, including vitamins and minerals, are needed in a small proportion, yet are important to reach optimal health, maintain physiological functions and metabolisms (Ernawati et al., 2021). Deficiency of micronutrients increases the risk of infectious diseases, maternal and children mortality; also decreases intelligence and work productivity (Prasetyo et al., 2018). According to Zerfu & Ayele (2013), more than 20 million infants were born in low birth weight, and 3.6 million deaths of neonatus were reported, which were related to undernutrition. The deficiency of many vitamins and minerals commonly occurs among pregnant women, especially vitamins A, B2, B6, B9, B12, C, E, iron, and zinc, which occurs due to the lack of meats, fruits, and vegetables consumption during pregnancy (Zerfu & Ayele, 2013). Previous studies also stated that almost 60% of children in Indonesia have a high risk of nutrient deficiency, especially in iron and vitamin D. In addition, it was stated by Indonesia Basic Health Survey (Riskesdas) that micronutrient deficiency is the cause of stunting that might possibly occur in Indonesia (Ernawati et al., 2021).

Due to the emergence of micronutrient deficiency, many intervention programs have been developed, including food fortification, which is a method to add micronutrients into food and beverages to prevent and reduce nutrient inadequacy (Dewi & Mahmudiono, 2021). For example, a research conducted in Philippines on fortified oat drinks among anemic young children had shown a reduction in the prevalence of anemia by 68%, while the vitamin A and iron levels were significantly improved; it indicated that food fortification program was effective to overcome anemia in young children (Angeles-Agdeppa, Kurilich, Harjani & Capanzana, 2012).

In food fortification programs, the amount of nutrients fortified to the foods has to be sufficient to meet the nutritional intervention program targets, and to give impact to the diets nutritionally. The effectiveness of the programs depends on the stability of the nutrients added, including quality and taste as well (Bechoff, Taleon, Carvalho, Carvalho & Boy, 2017). However, micronutrients in food products can be diminished or severely lost during manufacturing process, including the preparation, heat thermal processing, and storage. Exposure of labile micronutrients to moisture, heat, oxygen, water, light, catalyst, other nutrients, time, or acid and alkaline as physical and chemical factors affects the stability of the micronutrients (Ayelign, Urga & Retta, 2012).

It is interesting to fortify the nutrients into enjoyable food, such as snacks. In recent years, the demand for snack foods, including cookies, has increased, reaching 6.7% (Sofyan & Mercilia,

2018). Cookies, as one of the snack foods, could carry a high amount of nutrients with high stability, simple manufacture, yet long shelf life. However, cookies are usually considered unhealthy due to its high fat and sugar content, but low in protein, vitamins, minerals, and fibers (Ishera, Mahendran & Roshana, 2021). As a convenient, ready-to-eat, and one of the most common bakery products consumed, cookies might be able to help the economy and people's health development, opening more improvement in its ingredients and nutritional value to a healthier choice, including by fortifying the cookie with micronutrients (Kulthe, Lande & Thorat, 2017).

A study by Herawati, Simanjuntak, Syamsir, Lioe & Briawan (2015) on micronutrient fortified sweet potato cookies showed that more than 60% of vitamin C, vitamin A, and iron was retained after the process of mixing and baking of the cookies. The vitamin C content decreased up to 35% during processing due to mixing and baking (Herawati et al., 2015). Vitamin C retention depends on the method of cooking which may be retained up to 91.1% (Lee, Choi, Jeong, Lee & Sung, 2018). In addition, the presence of iron in cookies also accelerate the degradation of vitamin C due to the reduction properties of vitamin C (Herawati et al., 2015). Both iron and vitamin C are essential nutrients in pregnancy to prevent anemia, support fetus growth, and maintain the immune system ("Iron: foods, functions, how much do you need & more", 2021). Therefore, it is necessary to assess the iron and vitamin C stability of the fortified cookies product.

In current study, cookies were fortified with the micronutrient premix designed for pregnant women supplementation, which contained vitamin A, B1, B2, B3, B5, B6, B9, B12, C, D, E, sodium, calcium, phosphorus, iron, zinc, iodine, and selenium. The concentration of the premix was varied to assess the micronutrient stability, in meeting the nutritional requirements with the best sensory acceptance since the concentration of micronutrient may affect sensory acceptance. Mahmood, Butt, Anjum & Nawaz (2008) in their study on fortified cookies mentioned that micronutrient loss decreased as the concentration of vitamin A fortified increased. Furthermore, cookies with the highest vitamin A fortificant concentration were found to be the most liked in terms of sensorial properties (Mahmood, Butt, Anjum & Nawaz, 2008). It is known that previous studies evaluated the different concentration levels of vitamin A fortification on cookies and did not analyze the different premix concentration, especially vitamin C and iron. There was a lack of studies focusing on the analysis of different micronutrients concentrations in the form of premix added and its effects on several cookies parameters, including physicochemical and sensory properties, knowing that premix concentration might influence the outcome of the fortified products. Therefore, the objective of this study was to evaluate the effect of different concentrations of micronutrient premix on micronutrient stability, physicochemical and sensory acceptance of fortified cookies.

1.2. Objectives

The objectives of this research are:

1. To assess the effect of different premix concentrations added on the micronutrient stability (before and after baking) of fortified cookies, focusing on vitamin C and iron
2. To assess the effect of different premix concentrations added on the physicochemical properties (color, texture, moisture content, thickness, diameter, and spread factor) of fortified cookies
3. To assess the effect of different premix concentrations added on the sensory acceptance of fortified cookies
4. To analyze the proximate composition of the fortified cookies

1.3. Scope of the Project

The scope of the project mainly was focused on:

1. The sample preparation using different premix concentration in basic cookies recipe
2. The analysis of physicochemical properties, micronutrient stability, sensory acceptance, and proximate composition of the different sample
3. The statistical analysis of the data obtained using SPSS

1.4. Hypothesis

The hypothesis for this study are as follows:

1. The $\mathbf{H_0}$ is the different concentrations of premix added will not affect the stability of vitamin C and iron of the fortified cookies, while the $\mathbf{H_1}$ is the different concentrations of premix added will affect the stability of vitamin C and iron of the fortified cookies
2. The $\mathbf{H_0}$ is the different concentrations of premix added will not affect the physicochemical properties of the fortified cookies, while the $\mathbf{H_1}$ is the different concentrations of premix added will affect the physicochemical properties of the fortified cookies
3. The $\mathbf{H_0}$ is the different concentrations of premix added will not affect the sensory acceptance of the fortified cookies, while the $\mathbf{H_1}$ is the different concentrations of premix added will affect the sensory acceptance of the fortified cookies
4. The proximate composition of the fortified cookies will fulfill the requirement from Indonesian government

1.5. Research Significance

This research could give insight about micronutrient stability, physicochemical properties, and sensory acceptance of fortified cookies. Thus, this research would be beneficial for future study about fortified cookies as a snack for pregnant women in Indonesia fulfill their micronutrient requirement.