

# Chapter 1: Introduction

## 1.1 Background

The consumption of legumes has been reported to exert a lot of potential health benefits, primarily offered by their nutritional concentrations and properties (Martín-Cabrejas, 2019). Soybean is one of the types of legumes mostly consumed globally as an important protein source in a healthy diet due to its polysaccharides (i.e., starch and dietary fiber) content and high essential amino acids, bioactive peptides, folic acid, and isoflavones contents (Dukariya *et al.*, 2020; O’Keefe *et al.*, 2015; Rizzo & Baroni, 2018). Soybean and its derivative products offer a lot of benefits for the human body, namely through their anti-cancer, anti-oxidant, anti-diabetic, anti-obesity, and anti-inflammatory effects—which altogether aid in the prevention of chronic diseases related to age (e.g., obesity, cardiovascular disease (CVD), impaired immune function, type 2 diabetes, deficiency-related illnesses, and certain types of cancer) (Chatterjee *et al.*, 2018; Dukariya *et al.*, 2020; Hassan, 2013; Martín-Cabrejas, 2019; Messina, 2014). In addition, the consumption of legumes has been reported to be associated with a lower risk of mortality from all causes (Li *et al.*, 2017). According to the health claim established by Food and Drug Administration (FDA) of the U.S. in 1999, soy protein intake of  $\geq 25$  g/day have been regarded as the daily recommendation.

Historically, soybean is originated from Asia (Rizzo & Baroni, 2018). The growth of soybean demand is anticipated to rise approaching global meat consumption with the elevating trend of plant-based diet, as fuelled by Asia at a regional level. This is particularly due to the increasing awareness of the detrimental effects of meat consumption on ecosystems, biodiversity, and human health (e.g., associated with higher rates of CVD, obesity, cancer,

and diabetes) (Machovina *et al.*, 2015). This demand will particularly be led by China, given that the country accounted for almost two thirds of global soybean demand growth in the last decade (Chatham House, 2016, in Voora *et al.*, 2020). Soybean has been known as one of the protein sources favored by Indonesian society (Ningrum *et al.*, 2018). In a 1% of population growth in Indonesia, the demand for soybean will elevate in the amount of 10.6% (Adetama, 2011, in Ningrum *et al.*, 2018). Thus, the consumption of soybean will also increase with the increase in population (Harsono *et al.*, 2021; Hasan *et al.*, 2015). Soy intake assessment is therefore necessary to understand the frequencies and amounts of macro- and/or micronutrients from soy consumed by the Indonesian population and to predict the corresponding health benefits.

The available methods to conduct a dietary assessment include diet history, dietary food record, 24-hour recall, and food frequency questionnaire (FFQ) (Shim *et al.*, 2014). Among these methods, semi-quantitative food frequency questionnaire (SQ-FFQ) has been described as one of the most prominent dietary assessment tools to examine the frequency of food consumption during a specific time (Gibson, 2005). The main difference that underlies dietary assessment using FFQ and SQ-FFQ is that the latter also include the assessment of serving size aside from the assessment of frequency of food and beverage consumption. FFQ is typically developed differently for each country due to the variety of food items, the variety of food composition database, and the variety of food processing in each country. Aside from its usability in assessing the frequency of food consumption, FFQ can also be used to predict disease risk. It has also been commonly utilized in large-scale epidemiological studies to assess dietary exposure and its association with diseases.

Previously Rice *et al.* (2001) demonstrated the utilization of soy FFQ to assess dietary isoflavone intake in Japanese-American population. In another study, Frankenfeld *et al.* (2002) have demonstrated the development and utilization of soy FFQ to discover the association between soy consumption and plasma isoflavone concentrations in adults in United States (U.S.). Svendsen *et al.* (2018) and Yan *et al.* (2022) have also revealed the utilization of FFQ to estimate food intake in participants possessing CVD risk. These studies exhibited the benefits of utilizing soy FFQ in clinical and epidemiological settings. Previous studies have reported a number of limitations in the usage of FFQ for research, especially regarding the generalizability of the study, the lack of comprehensive database to obtain nutrient data, and the lack of gold standard method to validate the FFQ as a dietary assessment tool—notably in a quantitative parameter. Although there are a lot of soy products available in Indonesia, unlike other countries, soy FFQ or SQ-FFQ has not been specifically developed in Indonesia based on available scientific literatures. Therefore, the aim of this study is to assess daily soy-based products intake and daily soy protein intake using a soy SQ-FFQ in Indonesian adults.

## **1.2 Objective**

The objectives of this study include:

1. To assess the distribution of soy-based products majorly consumed by Indonesian adults.
2. To assess daily soy-based products intake and daily soy protein intake as well as to compare the daily soy protein intake against the daily soy protein intake recommendation ( $\geq 25$  g/day) using a soy SQ-FFQ in Indonesian adults.

3. To assess the difference between daily soy protein intake data obtained from soy SQ-FFQ and 24-hour recall.

### **1.3 Research Scope**

The scope of work of this study include:

1. Development of soy SQ-FFQ through literature review (from Indonesian food database screening), market survey, and 24-hour recall.
2. Pre-testing the developed soy SQ-FFQ to 20 Indonesian adult participants.
3. Assessing daily soy-based products intake and daily soy protein intake using the developed and pre-tested soy SQ-FFQ to Indonesian adult participants.
4. Assessing the difference between daily soy protein intake data obtained from soy SQ-FFQ and 24-hour recall.

### **1.4 Research Question**

The research question of this study include:

1. How is the distribution of soy-based products majorly consumed by Indonesian adults?
2. How much amount of the actual daily soy-based products and daily soy protein consumed by Indonesian adults assessed using a soy SQ-FFQ in compliance with the daily soy protein intake recommendation of  $\geq 25$  g/day?
3. How is the difference between daily soy protein intake data obtained from soy SQ-FFQ and 24-hour recall?

## 1.5 Hypotheses

Based on the elaboration above, the hypotheses formulated in this study are:

1. For objective 1:

H<sub>0</sub>: Tempeh and tofu are not the most majorly consumed soy-based products by Indonesian adults.

H<sub>1</sub>: Tempeh and tofu are the most majorly consumed soy-based products by Indonesian adults.

2. For objective 2:

H<sub>0</sub>: Daily soy protein intake of Indonesian adults assessed using a soy SQ-FFQ do not meet the recommended daily soy protein intake of  $\geq 25$  g/day.

H<sub>1</sub>: Daily soy protein intake of Indonesian adults assessed using a soy SQ-FFQ meet the recommended daily soy protein intake of  $\geq 25$  g/day.

3. For objective 3:

H<sub>0</sub>: There is no significant difference between daily soy protein intake data obtained from soy SQ-FFQ and 24-hour recall.

H<sub>1</sub>: There is a significant difference between daily soy protein intake data obtained from soy SQ-FFQ and 24-hour recall.