

Chapter 1

Introduction

1.1 Background

According to Finnegan et al., (2018), cheese is one of the world's most widely consumed dairy products whose popularity is constantly increasing over the decades. Align with this, a survey conducted by GrandViewResearch (2023) also showed that the marketability of cheese is projected to constantly increase with a Compound Annual Growth Rate (CAGR) reaching 5.5% until the year of 2030. This popularity is mainly caused by the evolution of cheese products which initially aimed to conserve the constituents of milk into an ingredient of *haute cuisine* with high nutritional value (Fox & McSweeney, 2017). Despite its popularity and nutritional value, the consumption of cheese products has been limited due to several factors including lactose intolerance, restriction of some beliefs, and lifestyle preferences (Sethi et al., 2016). In accordance, Labrie et al., (2016) also mentioned that the ability for people to digest lactose is decreasing as their age increases, making more individuals to be lactose intolerant in their elder state. Thus, the development of cheese alternatives made from plants is constantly expanding throughout the world.

In general, the development of cheese analogue frequently utilizes legumes such as soybean, peanuts, or peas as its main source of protein which acts as a base ingredient for cheese analogue. However, legume-based cheese has undesirable properties such as beanie flavor, and heat-stable anti-nutritional compounds (Mefleh et al., 2021). Due to this reason, an exploration of other plant-based sources for cheese analogue development is constantly investigated. One of the plant commodities that is popular in society is coconut milk, a derivative product of coconut palm (*Cocos nucifera* L.). According to Rahim (2025), coconut milk has been a staple ingredient in a lot of tropical and subtropical regions due to their creamy texture and unique flavor. Furthermore, it also stated that coconut milk possessed a beneficial nutritional value, making it extensively used in culinary

applications of vegan and dairy-free products. The total protein contained in coconut milk itself could reach up to 2.9%, followed by 0.02% of calcium, which is comparable to peas, a popular legume to be processed into legume-based cheese that contained 5.42% of protein and 0.02% of calcium (Mat et al., 2022; USDA, 2019). Therefore, coconut milk might be one of the suitable main ingredients for cheese analogue development.

Up to this day, the development of plant-based cheese from coconut milk has been explored by several researchers. However, there is still some research gap that exists and could be further explored. As an example, a previous study conducted by Ismail et al., (2021) was successful to produce a coconut milk cheese that was accepted by consumers. However, there is no physicochemical and proximate analysis provided towards the final product which leads to a missing information in regards to the coconut milk cheese nutritive value and health benefits. This research might fill those gaps of studies as coconut milk cheese would undergo proximate, physical, and sensorial analysis.

Furthermore, an exploration towards the optimum pH condition of the coconut milk cheese production would be conducted prior to the cheese analogue formulation, which has not been done in the previous studies. pH condition is an important factor in plant-based cheese development as it affects the final quality of cheese product in several aspects including salt absorption, enzyme activity, microbial growth, and the calcium distribution (Bansal & Veena, 2024). In this study, the formulation condition of coconut milk cheese analogue will be utilizing rice flour which acts as texture modifier, along with nutritional yeast and salt that could provide cheese-related sensorial properties in order to mimic the dairy cheese in general (Genet et al., 2023; Mazalana et al., 2024). Moreover, response surface methodology (RSM), a multivariate statistical method that able to interpret a mathematical model towards the effect of independent variable on the dependent variables, would also be implemented in this study to produce an optimized formulated coconut milk

cheese analogue based on its physicochemical and sensorial properties, as well as its nutritional value (Yolmeh & Jafari, 2017).

1.2 Objective

There were 3 main objectives of this study which elaborated below:

1. Exploring the most suitable acidic condition for coconut milk protein precipitation based on its physical and proximate properties.
2. Optimizing the coconut milk cheese analogue formulation with the variation of coconut protein, nutritional yeast, and rice flour based on its physicochemical, proximate, and sensory properties using response surface methodology (RSM).
3. Observing the effect of calcium fortification towards coconut milk cheese analogue based on its texture profile analysis, followed with a consumer acceptance evaluation towards the fortified coconut milk cheese analogue product.

1.3 Hypothesis

In this study, there were several expected phenomenon to occur which described below:

1. Acidic condition throughout the cheese analogue production would affect the percentage of yield recovery, physicochemical properties, and nutritional value of the precipitated protein from coconut milk
2. The concentration of coconut protein, rice flour, nutritional yeast, salt, and calcium added towards the cheese analogue would affect the physicochemical properties, nutritional value, and sensory qualities of coconut milk cheese analogue

1.4 Scope of Work

This study mainly explored the feasibility of cheese analogue development by utilizing coconut milk as the base ingredient with the incorporation of nutritional yeast, rice flour, and salt which were

varied during formula optimization. Moreover, this study was deeply focused into the coconut milk cheese analogue development starting from the protein precipitation, product formulation, calcium fortification, as well as consumer acceptance evaluation. Therefore, the final product developed from this study was not compared towards other cheese products including dairy-based cheese and plant-based cheese. In addition to that, coconut milk cheese analogue in this study was also developed without the presence of any specific type of cheese as its benchmark, thus it is comparable to cheese products in general terms.