CHAPTER I
INTRODUCTION

1.1 Background of the Study

In recent years, the food industry has shown increasing concern for sustainability, nutrition, and the efficient use of agricultural by-products. One such by-product is tofu pulp, also known as *okara*, which is generated in large quantities during the production of tofu or soymilk. It is reported that China, Japan, Korea, and Singapore alone produce approximately 2.8, 0.8, 0.3, and 0.01 million metric tons of tofu pulp annually. On average, one metric ton of soybeans can produce about two metric tons of tofu pulp. In Indonesia, tofu production results in an estimated 1.1 to 1.2 million tons of fresh tofu pulp each year, which is mostly used as animal feed or processed into *tempe gembus* in smaller amounts. However, due to its high moisture content, tofu pulp is highly perishable and prone to spoilage, potentially causing environmental issues if not properly managed. Therefore, there is an urgent need to explore alternative uses for tofu dreg through food innovation to enhance sustainability and reduce waste in the tofu industry (Ginting et al., 2024). To realize this potential, it is important to understand the characteristics and nutritional content of tofu pulp.

Tofu pulp is the solid residue that contains unextracted parts of the soybean, including the husk. Despite being categorized as waste, tofu pulp retains high nutritional value, including protein, fat, fiber, calcium, iron, and copper. It also contains isoflavones and phenolic compounds, which have antioxidants properties (Ginting et al., 2024). These nutritional and functional properties make tofu pulp a promising ingredient for developing value-added food products that are both healthy and sustainable, such as cookies or breakfast cereals.

Building on its nutritional potential, tofu pulp can be further processed into a more stable and versatile form — tofu pulp flour. Because not all of the soybean protein is extracted during tofu production, a considerable portion

remains in the pulp. When dried, tofu pulp becomes more stable due to its lower moisture content, allowing for a longer shelf life and broader applicability. This dried form, known as tofu pulp flour, is produced by drying and grinding the pulp into a fine powder. Besides its high protein content, tofu pulp flour is also rich in dietary fiber, making it a functional ingredient in the development of various food products such as cakes, biscuits, and crackers (Yuliarti et al., 2024).

In addition to these nutritional and processing benefits, the decision to develop cookies was also driven by both scientific and personal motivation. Scientifically, cookies have a dense and compact dough structure, making them suitable for incorporating high-fiber ingredients such as tofu pulp. Research shows that dietary fiber increases dough hardness and decreases extensibility, which may disrupt gluten networks in products like bread, but aligns well with cookie formulations that require minimal gluten development (Sabanis & Tzia, 2019). Personally, cookies are one of my favorite types of food to make at home because they are relatively simple to prepare and allow for creative formulation. Moreover, the dense texture of cookies makes them ideal for incorporating tofu pulp, as it helps balance out the rough texture and mild flavor of the ingredient, making the final product more acceptable to consumers. Therefore, cookies are a convenient choice for transforming tofu pulp into nutritious snack while also supporting food waste reduction and small-scale or home-based production.

Given its nutritional richness and processability, tofu pulp flour presents an excellent opportunity for creating innovative food products. One such application is its incorporation into cookies formulations, which can offer a healthier alternative when made with nutrient-dense ingredients. Combining tofu pulp flour with other nutrient-rich ingredients such as oat, quinoa, and barley flour can result in a high-fiber, protein-enriched cookies that supports a balanced diet. As these ingredients are naturally gluten-free and wheat free, the product also caters to consumers seeking allergen-friendly or gluten-free snack alternatives. This product not only diversifies tofu pulp utilization but

also aligns with the growing consumer demand for functional, plant-based foods.

To support the development of sustainable and nutritious foods, it is crucial to diversify grain use beyond the commonly consumed wheat, rice, and maize. Overreliance on these three staples has contributed to less diverse diets and more vulnerable food systems. Integrating a wider variety of grains—such as oat, quinoa, and barley—into food products enhances nutritional value by adding essential fibers, proteins, and micronutrients, while also promoting agricultural biodiversity. When used in combination with tofu pulp flour, these grains offer a more balanced and health-promoting alternative to conventional refined flour products. Additionally, utilizing these underused grains contributes to global food sustainability and resilience (Milani et al., 2024).

By processing tofu pulp into dry flour and combining it with whole grain flours such as oat, barley, and quinoa, it is possible to develop value-added products like cookies based on sustainable food principles. This process involves steaming, drying, grinding, mixing ingredients, and baking—methods that are relatively simple and efficient. In addition to reducing food waste, such formulations support grain diversification and meet the demand for fiber-rich, plant-based snacks. Therefore, developing cookies made from tofu pulp flour and whole grains represents a practical step toward a healthier and more sustainable food system.

1.2 Objectives of the Study

The objectives of this study are following below:

1. To explore the potential of tofu pulp flour as a sustainable and nutritious ingredient in cookie production by analyzing its fiber, protein, and moisture content, as well as its benefits in reducing food waste.
2. To develop and optimize a cookie bites formulation that incorporates tofu pulp flour together with whole grains such as oats, quinoa, and barley, focusing on achieving a desirable balance of taste, texture, nutrition, and baking performance.

3. To promote the valorization of tofu by-products by demonstrating the practical use of tofu pulp in functional food applications, while assessing its potential to support sustainable and value-added food innovation.