CHAPTER I. INTRODUCTION

1.1 Background

Nutritional deficiencies have been identified as a serious health problem worldwide, including protein malnutrition and microelement deficiencies. In 2022, the global prevalence of stunting was 22,3%, with approximately 148,1 million children under five affected worldwide. More than half of these cases were in Asia, totaling 76.6 million, while around 42% or 63.1 million children with stunting were in Africa (Kemenkes RI, 2018). Protein is one of the essential nutritional elements needed by the body. An adequate supply of protein is essential for maintaining the normal functioning of the human body (Coelho-Junior *et al.,* 2020). Malnutrition is a condition in which an individual fails to meet their nutritional needs, resulting in either reduced (malnutrition) or excessive (overnutrition) food intake, or nonspecific changes in nutritional status due to disease or treatment. Some examples of malnutrition include marasmus, kwashiorkor, and marasmus kwashiorkor (Putri, 2022).

Based on data from the Survey Kesehatan Indonesia (SKI) in 2023, the prevalence of stunting in children under five in Indonesia remains high, at 21.5%, indicating that approximately one in five children under five experience this issue. These stunting cases are most prevalent in the 2 to 3-year age group, indicating a critical period in child growth and development during this age range. Although the stunting rate has not changed significantly compared to the 2022 survey results, the long-term trend shows considerable improvement. In 2013, the prevalence of stunting was still 37.6%, indicating that this decline reflects the efforts of the government and various parties in reducing stunting rates through public health and nutrition programs.

However, further steps are still needed to achieve a more significant reduction target in the future. At the provincial level, West Sumatra also shows a relatively high stunting rate, with the percentage of cases reaching 23.6% (Badan Kebijakan Pembangunan Kesehatan, 2024). According to the threshold defined by De Onis & Blössner, (2003) percentages above 20% are categorized as high, indicating the need for more intensive interventions to address stunting in the region.

Malnutrition can lead to significant changes in the anatomy and physiology of the body, impacting daily activities. Malnutrition that occurs early in life can increase the risk of infection, morbidity, and mortality, along with decreased mental and cognitive development. Protein malnutrition affects the metabolism of several body proteins, resulting in impaired function in various parts of the body, including the skin, which serves as a protective barrier against the external environment. Inadequate protein nutrition can lead to wound healing retardation and bedsore damage (Mathus-Vliegen, 2004).

Under conditions of malnutrition, particularly protein deficiency, it also affects inflammatory cells; for instance, the function of macrophages can become impaired. Adequate nutritional status, especially sufficient protein intake, plays a crucial role in maintaining macrophage activity and proliferation. Proteins are essential components in the metabolic processes of immune cells, including macrophages, which are responsible for phagocytosis, regulating the immune response, and facilitating tissue repair (Murray and Wynn, 2011). Studies in animal models and humans have demonstrated that malnutrition enhances the migration of monocytes, neutrophils, and lymphocytes to the dermis, mediated by the increased expression of chemokines and adhesion molecules. Overall, excessive immune cell infiltration in malnourished skin

results from a combination of metabolic disturbances, inflammation, and changes in the tissue microenvironment that trigger an uncontrolled immune response (Osorio *et al.,* 2023; Piipponen *et al.,* 2020).

Malnutrition also affects skin tissue atrophy, particularly in the dermis. Collagen is a fibrous protein that plays a crucial role in maintaining skin strength, particularly in the dermis. Collagen is found in connective tissues such as skin, tendons, cartilage, and bones, making up 25-30% of total protein in mammals and making up 95% of skin organs (Evans *et al.,* 2021; Koizumi *et al.,* 2023). The most abundant collagen types in the skin are collagen types I and III (Ito *et al.,* 2018).

Protein malnutrition is reported to affect skin collagen status in humans and experimental animals. The synthesis and degradation of collagen types I and III are affected by protein deficiency (Oishi *et al.*, 2002). Type I collagen itself acts as an extracellular matrix protein that promotes cell proliferation, thereby directly affecting cell physiology and morphology (Cardoso *et al.,* 2014). Clinical features of the skin in patients with protein energy malnutrition also show dry, thin skin followed by the formation of wrinkles, thin hair, easy loss, breakage, and slow hair growth (Heilskov *et al.,* 2015) Therefore, improving the intake and supplementation of animal and vegetable protein diet is needed to overcome skin problems due to malnutrition.

Lima beans (*Phaseolus lunatus* L.), also known as Paga beans in West Sumatra, are one of the edible legumes in the Leguminosae Family and are considered the best source of dietary protein and essential plant-derived nutrients (Jayalaxmi *et al.,* 2016). It has long been consumed as a processed food in Indonesia, as it can adapt to tropical environments and is easily grown in the tropics (Diniyah *et al.,* 2020; Jayalaxmi *et al.,* 2016). Lima bean seeds are referred to as a food with high-quality

nutrition because the value of protein sources ranges from 14.24% to 24.92% with a balanced amino acid profile and rich in essential amino acids (Ibeabuchi et al., 2019). In addition, the proximate test of Lima beans in West Sumatra contains high complex carbohydrates which range from $40.65\% \pm 1.72$, protein of $38.57\% \pm 3.76$, fat of $4.66\% \pm 0.84$, fiber of $1.335\% \pm 0.33$, ash content of $8.51\% \pm 0.601$, and moisture content of $7.465\% \pm 0.388$ (Maliza *et al.,* 2024).

In addition to Lima beans, Patin fish (*Pangasius hypophthalmus*) is one of the food sources rich in nutrients that the Indonesian people widely utilize as processed food. Patin fish contains 17.51% protein, 6.57% fat, and 75.21% water (Puspita & Wiyono, 2014). The fat contained in Patin fish is predominantly unsaturated fatty acids. Patin fish contains omega-3, containing 2,544% and omega-6 containing 12.083% (Pandiangan, 2021). The composition of unsaturated fatty acids in Patin fish belly fat is dominated by oleic acid at 40.4% while saturated fatty acids in the form of palmitic acid amounted to 26.22% (Ayu *et al.,* 2019).

Thus, Lima beans and Patin fish can be used as protein sources that have great potential to prevent and overcome malnutrition problems at a reasonably affordable price. The high protein content and other nutrients are expected to help prevent and overcome damage to the skin layer caused by malnutrition. This study aims to investigate the effect of feeding Lima beans and Patin fish on malnourished rats, particularly analyzing its impact on skin histology, including the thickness of the epidermis and dermis, the number of fibroblast cells, collagen density in the skin, and the number of inflammatory cells.

1.2 Problem Formulation

1. Does the feeding of Lima bean and Patin fish flour affect the increase in epidermal and dermal tissue thickness in malnourished rats?

2. Does the feeding of Lima bean and Patin fish flour effect on the increase the number of fibroblast and the collagen fiber density in malnourished rats?

3. Does the feeding of Lima bean and Patin fish flour affect in the number of inflammatory cells in malnourished rats?

1.3 Research Objectives

1. To determine the effect of feeding Lima bean and Patin fish flour on the increase in epidermal and dermal tissue thickness in malnourished rats.

2. To determine the effect of feeding Lima bean and Patin fish flour on the increase in number of fibroblast and the collagen fiber density in malnourished rats.

3. To determine the effect of feeding Lima bean and Patin fish flour in the number of inflammatory cells in malnourished rats.

1.4 Benefit of Research

The fundamental contribution to the field of science from this research provides information and an overview of the mechanism of action of the nutritional recovery effect of Lima beans (*Phaseolus lunatus* L.) and Patin fish (*Pangasius hypopthalmus*) on growth in malnourished animals, as well as skin tissue repair.