

CHAPTER I

INTRODUCTION

1.1 Introduction

In the past decade, there has been growing interest in functional foods for health enhancement. Among these, nutraceuticals a category of food ingredients that lie between nutrients and medicines have gained significant attention due to their potential benefits. Examples include antioxidants, omega-3 fatty acids or n-3 polyunsaturated fatty acids (n-3 PUFAs), and other bioactive compounds (Tiwari & Takhistov, 2012). However, nutraceuticals face several challenges, including unpleasant taste and aroma, low stability, potential interactions with other ingredients, and limited bioavailability. To overcome these limitations, advanced drug delivery systems, such as nanotechnology, have emerged as promising solutions to enhance the bioavailability and efficacy of nutraceuticals.

Korat chicken is a crossbreed between male Thai indigenous chickens (Lueng Hang Khao) and female Suranaree University of Technology (SUT) breeder line. Korat chicken has a firmer and chewer texture and contains less fat and high protein and collagen. Korat chicken is a slow-growing chicken, it took 9 to 12 wks of age to reach market weight of 1.2 to 1.8 kg. Korat chicken will be generating as the functional meat such as adding the value of meat by n-3 PUFA supplementation. Previous studies demonstrated that dietary inclusion of 4-4.5% tuna oil for three to six wks before slaughtering, effectively enriched Korat chicken meat with n-3 PUFAs (Hang et al., 2018; Khosinklang et al., 2023).

Despite its potential, n-3 PUFAs are highly susceptible to lipid oxidation, which negatively impacts feed quality and meat stability (Sanguansri et al., 2013). Encapsulation technology has shown promise in addressing these issues by protecting n-3 PUFAs from oxidation and improving their stability. However, current research primarily focuses on quantifying n-3 PUFA content in meat rather than optimizing the efficiency of its utilization, which is crucial for scaling up production. The accumulation of n-3 PUFAs into

skeletal muscle be noticed from their metabolism. Briefly, n-3 PUFAs were absorbed and form as chylomicrons before directly transferred to hepatocyte (Niot et al., 2009) also known as “hepatic first-pass metabolism” (Poonia et al., 2016), and then lipoproteins were synthesized to carry fatty acid to another organ (Niot et al., 2009). Studies suggest that significant enrichment occurs in the liver, adhering fat, and skin followed by breast and thigh meat (Keegan et al., 2020). Higher dietary supplementation is required to achieve the desired n-3 PUFA levels in meat, but this often leads to losses through accumulation in non-target organs.

Nanotechnology offers a promising solution to enhance the precision and efficiency of n-3 PUFAs delivery. Lipid-based carriers, such as nanostructured lipid carriers, are particularly suitable for encapsulating oils like soybean, linseed, or fish oil (Saedi et al., 2018). These carriers can be engineered to withstand gastrointestinal conditions, evade phagocytosis (Zhang et al., 2011). Moreover, this technology could modify its surface to go to target organs such as skeletal muscle (Yeh et al., 2014). So, this technology might become an opportunity for enhance precision of utilization of the bioactive compound to add value of meat production.

The process of nanoparticle transport through enterocyte cells involves complex pathways, including transcytosis, which protects nanoparticles from degradation before entering the bloodstream. Beyond studying the mechanisms of nanoparticle absorption, understanding cellular responses to these nanoparticles is equally critical. Such insights are vital for the further development and optimization of nanoparticle systems tailored for Korat chicken.

This research aims to enhance n-3 PUFA accumulation in Korat chicken meat by developing nanoparticles with targeting ligands to minimize fatty acid deposition in non-target organs. The study seeks to refine nanoparticle synthesis methods and deepen the understanding of physiological mechanisms underlying nanoparticle transfer in enterocyte cells, thereby identifying the most suitable nanocarriers for functional meat production.

1.2 Research objectives

1.2.1 To study the physicochemical characteristic and biocharacteristic of different synthesis methods of nanoparticles and glucose transporter-targeted nanoparticles.

1.2.2 To prove the ability of nanoparticles and glucose transporter-targeted nanoparticles on transportation of n-3 PUFAs into Korat chicken.

1.2.3 To study the nanoparticles transportation of Korat chicken on absorption n-3 PUFA nanocarriers by proteomics.

1.3 Research hypotheses

1.3.1 The different of nanoparticles and glucose transporter-targeted nanoparticles synthesized process influence on physicochemical characteristic and biocharacteristic of lipid based nanocarriers.

1.3.2 The nanoparticles and glucose transporter-targeted nanoparticles affect to fatty acid profile in important organ of Korat chicken.

1.3.3 Korat chickens supplemented with different n-3 PUFAs will exhibit different protein expression patterns in response to nanoparticles in the thigh muscle.

1.4 Scope of the study

In the present study, we focus on apply the process of nanoparticle synthesize to enhance utilization of n-3 PUFA source by determining suitable lipid based nanocarriers type on physicochemical characteristic, study the efficiency of lipid based nanocarriers and adding their function on ability to transfer n-3 PUFAs through the chicken meat and study the protein mechanism of Korat chicken thigh muscle cell, which relate with assignment n-3 PUFA source in nanoparticle form by proteomic technique. Chicken will be raised in open house so that housing climate and other factors cannot be controlled on condition that somehow it may influence on chicken health and experimental result.

1.5 Expected benefits

This study will contribute to improving the efficiency of n-3 PUFA delivery in Korat chicken meat through nanoparticle-based technology. The findings will enhance the precision of nutrient utilization, reducing non-target organ deposition and improving the functional value of poultry meat. Additionally, this research will

provide insights into the mechanisms of nanoparticle absorption and transportation, supporting the development of advanced nanocarrier systems for poultry nutrition and functional food production.

1.6 References

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