

CHAPTER VI

OVERALL CONCLUSION AND PERSPECTIVE

6.1 Overall conclusion

This study investigated the development and application of lipid-based nanoparticles to enhance the utilization of n-3 polyunsaturated fatty acids (PUFAs) in slow-growing Korat chickens, emphasizing formulation, dietary effects, and molecular mechanisms.

In terms of formulation and stability, targeted lipid nanoparticles were developed using tuna and algal oils, exhibiting improved stability, reduced lipid oxidation, and effective delivery of n-3 PUFAs to chicken muscles. This approach offers a promising strategy to enhance nutrient bioavailability in poultry diets.

For dietary application and health impacts, lipid nanoparticles successfully enriched chicken meat with n-3 PUFAs without adverse effects on growth performance, carcass traits, or overall health. Although unencapsulated tuna oil showed slightly higher enrichment efficiency, the nanoparticle method holds potential for further optimization to support safe and functional meat production.

Regarding molecular responses and metabolic insights, proteomic analysis revealed distinct cellular responses to lipid nanoparticles compared to unencapsulated oil. Nanoparticles promoted aerobic energy metabolism, reduced oxidative stress, and optimized muscle function, while unencapsulated oil stimulated broader metabolic pathways, emphasizing structural repair and immune modulation.

Lipid-based nanoparticles represent a promising tool for enhancing n-3 PUFA delivery, improving metabolic responses, and producing functional poultry meat. However, further research is needed to refine nanoparticle synthesis, understand their cellular uptake mechanisms, and ensure safety for human consumption. These findings establish a foundation for innovation in animal nutrition and meat science.

6.2 Perspective

This research highlights the potential of lipid-based nanoparticles to transform n-3 PUFA utilization in poultry, with implications for formulation, dietary applications, and molecular mechanisms. Each study provides valuable insights and raises important directions for future exploration.

Lipid nanoparticles demonstrated improved physicochemical stability and effective fatty acid delivery. Future research should focus on optimizing synthesis processes, including particle size, dispersion, and storage stability. It is also essential to evaluate the compatibility of diverse lipid sources with nanoparticle formulations and investigate the long-term impacts of nanoparticles on animal health and meat quality.

In the context of dietary application and health impacts, nanoparticles effectively enriched chicken meat with n-3 PUFAs without compromising health, though further optimization is needed. Refining the synthesis process to minimize high-temperature effects during preparation is critical. Additionally, alternative encapsulation techniques that maximize PUFA bioavailability should be explored, along with cost-effectiveness analyses and safety evaluations for consumer products.

Finally, proteomic analysis highlighted the distinct cellular mechanisms activated by nanoparticles, particularly in molecular responses and metabolic insights. These mechanisms focus on enhanced oxidative metabolism and muscle function. Future studies should investigate the mechanisms of nanoparticle uptake and transportation within the body, explore their molecular interactions with muscle cells particularly in oxidative stress adaptation and calcium homeostasis and examine the effects of lipid oxidation by-products to refine nanoparticle formulations further.