

## 博士論文の内容の要旨

|         |   |
|---------|---|
| 氏名      | SANGKAEW MANISA   |
| 学位名     | 博士（農学）  |
| 学位授与年月日 | 2021年3月20日  |
| 論文題目    | Studies on improvement of feeding value of shrimp by-product meal for laying hens using dried-persimmon by-product<br>(干柿副産物を活用した採卵鶏用エビ副産物ミールの飼料価値改善に関する研究) |

(博士論文の内容の要旨)

**1) Introduction:** As a consequence of the westernization of feed habits, especially in Japan and other Asian countries, the demand for livestock products has increased and as a result in plaguing chronic feed shortages. With the rapid development of poultry industry, especially in Thailand, the author's home country, feed supply security has become a concerning issue, especially a shortage of soybean meal for feed. However, expanding agricultural land to increase the self-sufficiency rate is deemed undesirable because this would lead to a decrease in rainforests and hence global warming. Recently, feed made from wastes has been receiving attention. In Thailand, a great amount of shrimp by-product meal (SM) is generating due to the great amount of shrimp processing. SM is a promising alternative protein due to its high protein content but has the disadvantage of being difficult to be digested due to its high chitin content. To improve the feeding value of this by-product, it has been reported that formic acid treatment, which reduced chitin levels in SM, effectively improved the digestibility of SM in chickens, but this method is not environmentally friendly due to generating acidic wastewater. As an eco-friendly alternative, the degradation of chitin in SM by waste products having chitinase, an enzyme that degrades chitin, may be the preferred method. Therefore, this study focused on the high chitinase activity of persimmon peel (PP), a by-product of dried persimmon processing, and investigated the improvement in feeding values of dietary SM using PP, and thus the following subjects were studied.

**2) Chemical properties of PP and the *in vitro* digestibility of SM diets containing PP:** PP was mainly composed of nitrogen-free extract (74% of the total composition) and contained 2.8% of tannin, which is an inhibitory factor on protein digestion. As expected, the chitinase activity of PP was high, reached a maximum at pH 4.5, and relatively high activity was also observed even in pH 3 to 8, including in the buffer containing 10 mg pepsin/mL. Additionally, a significant reduction in the *in vitro* digestibility of dry matter (DM) and crude protein (CP) induced by SM could be increased with increasing levels of PP, reached a maximum at 8% and 6%, respectively. On the contrary, the *in vitro* chitin digestibility increased in a dose-dependent manner as the PP level increased and did not decrease even at 10% PP. As observed above, it was clarified that PP could improve the *in vitro* digestibility of DM, CP, and chitin in SM diets when the addition rate was up to 6%. To confirm these effects, further *in vivo* study was conducted.

**3) Laying performance and egg quality:** It has previously been reported that the detrimental effect of tannin is alleviated by the binding of which to digestive enzymes, resulting from an increased pancreatic enzyme secretion, and thus the supplemental levels of PP at 6% or more were examined in this study. It was observed that feed intake, egg productivity, and nitrogen retention were reduced by feeding SM, but these reduced parameters were recovered by the addition of PP to SM diets. This recovery effect of PP may be resulted from not only increased feed intake but also improved digestibility. In addition, no reduction trend was observed in laying performance even with the supplemental rate of 8% PP, indicating that the digestion inhibitors in PP, probably tannin, seemed to be less effective *in vivo* than *in vitro*. Additionally,

PP could enhance the quality of eggs, such as Haugh unit values and antioxidant properties. Moreover, it is plausible that PP reduces unfavorable intestinal bacteria because the levels of ammonia excretion decreased by the supplementation of PP in diets. Taking the above findings, it was clarified that PP could alleviate the negative effects of dietary SM on laying performance and improve egg quality, as long as the level of supplementary PP in diets is less than 8%.

**4) Digestibility and intestinal bacterial counts:** In this study, the effects of PP on *in vivo* digestibility and chitinase activity, tannin content, and the populations of *Escherichia coli* in each part of the gastrointestinal (GI) tract were investigated in laying hens given SM diets. The findings clarified that the addition of PP to diets could improve *in vivo* digestibility of SM in laying hens, and this improvement may be involved with chitinase in PP. Besides, the addition of PP to diets increased chitinase activity in each intestinal content, excepting the ileal and cecal contents, but the enhancement of chitinase activity by PP chitinase was not remarkable, because the activity of PP chitinase was much lower than that of the intrinsic one in the gizzard content. This indicates that PP could increase SM digestion, but the contribution of limited activity of chitinase in PP to SM digestion is not unclear. Additionally, PP is expected to reduce intestinal ammonia-producing bacteria, such as *E. coli*, due to its reducing effect of ammonia excretion as observed in the previous *in vivo* study. In this study, it was found that PP effectively reduced *E. coli* count in all parts of the GI tract, and tannin in PP may be the main factor of this reduction because tannin level increased toward the distal part of the digestive tract. On the other hand, chitinase in PP may have little involvement in this reduction, because *E. coli* count was also decreased in ileum and cecum, where little activity of PP chitinase was observed. Consequently, it is suggested that dietary PP can potentially serve as a digestion promoter for chitin-rich SM diets and improve the intestinal environment of laying hens.

**5) Conclusion:** The results obtained in this study indicate the possibility of improving the feeding value of SM for poultry by adding PP, and by combining SM and PP, it is possible to create a new potential protein feed for poultry, which may possibly contribute to poultry sector, academically and environmentally.