Studies of the Control of *Salmonella* Contamination in Oil Meal and Oil Meal Production Environments

Abstract of Doctoral Thesis

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Salmonella contamination has long been a problem for oil meal, which is used as a vegetable protein source in compound animal feed. Although the *Salmonella* contamination rate in oil meal has been declining in recent years, cases of contamination continue to arise sporadically. Given that the *Salmonella* contamination rate of oil meal production environments remains high, outbreaks of oil meal contamination are likely to be the result of secondary contamination from production facilities. Therefore, in this study, in addition to evaluating *Salmonella* detection methods suited for oil meal manufacturing plants, we investigated methods to control *Salmonella* in the actual production process and in processing environments with the goal of reducing *Salmonella* contamination in finished oil meal and oil meal production environments.

First, we evaluated the delayed secondary enrichment (DSE) method, which relies on efficient isolation for detection of *Salmonella* in oil meal production environments. The DSE method exhibited high detection sensitivity in samples such as the base materials for oil meal, which contain low numbers of bacterial contaminants. In addition, in many samples, the DSE method was able to detect *Salmonella* strains with O-antigen that could not be detected using the official method for detecting *Salmonella* in animal feed. The above results demonstrate that the DSE method is an effective detection method for epidemiological investigations in feed manufacturing facilities.

Next, we assessed the state of *Salmonella* contamination and evaluated methods for controlling *Salmonella* contamination in production environments. A comparison of disinfectants used to clean factory floors revealed surfactants whose main active ingredient is polyoxyethylenealkylether to be superior in terms of disinfection efficacy, safety, and cost performance. We also found that the contamination rate could be substantially reduced by combining the three measures of disinfecting the soles of shoes, applying smooth floor coatings, and disinfecting factory floors.

Further, we assessed the state of *Salmonella* contamination and evaluated methods for controlling contamination in oil meal production lines. *Salmonella* was detected in areas of the production line that tend to accumulate large amounts of residue, suggesting that *Salmonella* survives

for extended periods of time in residue. Accordingly, the contamination rate of oil meal was significantly reduced ($p < 0.05$) by removing and discarding residue from the production line after the heating stage and removing and discarding fines, which were found to have high contamination rates, from the process rather than adding them to the meal as is done conventionally.

Finally, we assessed a rapid, easy method for detecting *Salmonella* that would be suitable for outgoing freight inspections. We were able to detect *Salmonella* in as little as 8.5 h by combining MP medium with QuickGene-mini80 and QUALIBAX™ system.

In this study, detection and control methods were evaluated in actual oil meal production plants and production lines. As such, they can be applied in many animal feed and food-production plants that handle powders.