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学位論文題目	Nutritional studies on improvement of phosphorus availability in chickens using buckwheat (ソバを活用したニワトリのリン利用性改善に関する栄養学的研究)
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論 文 内 容 の 要 旨

[Objectives] The primary objective of this study was to reveal the potentiality of using buckwheat as an alternative phytase source for chicken feed. The specific objectives were: I) to measure the chemical composition and phytase activity in different buckwheats in non-germinated and germinated form: an *in vitro* study, II) to investigate the efficacy of buckwheat phytase to improve phosphorus (P) availability in broilers and laying hens given non-phytate P deficient diets with buckwheat, and III) to identify the part of the digestive tract in chicken that involved in phytate degradation by buckwheat phytase.

[Materials and Methods] In first study, four different buckwheats: Shinano No. 1, Kitawase, Harunoibuki and Dattan were collected, and part of seed was germinated. For germination, seeds were soaked into water for 12 h and germinated at room temperature ($23\pm 2^{\circ}\text{C}$) for 36 h and oven dried at 50°C for 7 h. Both non-germinated (BU) and germinated (GBU) buckwheat seeds were ground, and analyzed for chemical composition, phytase activity and *in vitro* digestibility. Second study was conducted using 120 male broilers in eight dietary groups (8 d to 42 d of age): positive control (PC) diet formulated according to NRC recommendations, negative control (NC) formulated to contain 0.16% lower non-phytate P than that in the PC diet, and six other diets, formulated by replacing maize in the NC diet with Shinano No. 1 BU or GBU at 10%, 15% and 20% level. Growth performance, bone quality and P balance were measured. Third study was conducted using 56 laying hens in eight dietary groups (46 weeks to 51 week of age): PC diet formulated according to NRC recommendations, NC formulated to contain 0.16% lower non-phytate P than that in the PC diet, and six other diets, formulated by replacing maize in the NC diet with Shinano No. 1 BU or GBU at 10%, 15% and 20% level. Production performance, egg quality, and P balance were measured. In fourth study, phytase activity in the digesta in different parts of the digestive tract, and ileal nutrients digestibility was measured in broilers by using 80 male broilers in four dietary groups (29 d to 36 d of age): PC diet, NC diet (0.15% lower non-phytate P than in the PC diet), and NC diet containing 20% Shinano No. 1 BU or GBU at the expense of maize. At 36 d of age birds were sacrificed to collect digesta from crop, gizzard, jejunum and ileum.

[Results and Discussion] Results obtained in first study indicated that chemical composition and

phytase activity varied among different buckwheats, and germination influenced the composition as well as phytase activity. Moreover, *in vitro* digestibility of CP varied markedly among different buckwheats. Among the four examined buckwheats, Shinano No. 1 possessed highest phytase activity and phytate P digestibility in both non-germinated and germinated forms and seemed to be effective as a source of phytase in chicken diets. In second study it was observed that impaired growth performance and bone quality resulted by the deficiency of non-phytate P in NC diet were restored dose-dependently with the addition of Shinano No. 1 BU and GBU. Total P excretion decreased, and retention increased in BU and GBU added groups. It was calculated that 470 PU/kg diet of buckwheat phytase was equivalent to 0.10% non-phytate P. In third study it was found that deteriorated production performance and eggshell quality in laying hens given NC diet was ameliorated by the addition of BU and GBU. Moreover, total P retention increased as the total P excretion decreased in BU and GBU added groups. It was calculated that 340 PU/kg diet of buckwheat phytase was equivalent to 0.10% non-phytate P. Consequently, it indicated that laying hens has better efficiency of phytate utilization than broilers at least in case of buckwheat phytase. In fourth study it was observed that phytase activity either from BU or GBU was remained active mainly in the crop digesta and the activity decreased sharply as the digesta moved to the gizzard and then decreased gradually, indicated that crop is the main site of phytate degradation by buckwheat phytase. Moreover, dietary BU and GBU increased the ileal phytate P digestibility.

[Conclusion] In conclusion, the results obtained here indicated the possibility of improving the availability of P in chickens by using buckwheat phytase, which may possibly contribute to poultry sector academically and environmentally. Overall, this research findings will provide the imperative information to use buckwheat as an alternative phytase source for chicken feed.