Improvement of Intestinal Environments to Facilitate Reintroduction of Japanese Rock Ptarmigans

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[Abstract]

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Japanese rock ptarmigans exclusively inhabit the timberline region of the Japanese alpine zone. Recently, the ptarmigan population has been declining and the species is currently listed as vulnerable in the Japanese Red Data Book. The Ministry of the Environment has promoted various conservation strategies, including *in situ* cage protections and artificial propagation in zoos. However, for the production of birds than can be successfully returned to their habitats, it is essential to create wild intestinal flora in chicks to enable digestion of indigestible plants and their toxic compounds. Furthermore, it has been reported that the protozoan parasite *Eimeria* spp. highly infect Japanese rock ptarmigans and thus, it is thought that tolerance against *Eimeria* parasites is needed in artificially propagated birds. First, the pathogenicity of *Eimeria* spp. infecting ptarmigans, *E. uekii* and *E. raichoi*, was clarified, namely diarrhea, depression, growth reduction and death. Based on our analyses, low dose inoculation in chicks could be effective to raise the immunity against *Eimeria* spp. infection. Chicken embryos were found to be capable of being utilized to produce the parasites for vaccination. Second, we successfully developed a filtration technology to remove *Eimeria* parasites from feces of wild rock ptarmigans in order to reduce the risk of parasite infection by safely transplanting the wild intestinal flora into artificially propagated birds. Furthermore, some useful bacteria, including newly identified species that could be effective for digestion of Alpine plants and resolution of toxic compounds, were isolated and successfully cultured. At least, one species of bacteria was found to be capable of reducing the pathogenicity of *Eimeria* spp. in the birds. Finally, primary and secondary metabolites in the Alpine plants were analyzed to produce appropriate artificial feeds for the rock ptarmigans. Based on the analysis, including the amount of daily intake, we were able to suggest breeding improvements for the birds and propose suitable feeding formulations. These findings can contribute to the generation of artificially propagated chicks that can be released into the wild for conservation strategies. The new strategy described herein, including understanding intestinal environments of wild animals and their composition, can improve conservation of endangered species worldwide.

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