4. Application of breeding programmes, basic and applied research in livestock breeding, genetic resources

Hello everyone, I welcome you to another lecture from the Conservation and Sustainable Use of Animal Genetic module, the topic of which is: Application of breeding programmes, primary and applied research in livestock breeding and genetic resources.
In the first part of the presentation, we will focus on breeding programs.
Breeding programs represent the long-term goals and means of breeding. They are mainly a synthesis of theoretical knowledge and practical experience, which are combined in order to ensure the production of economically significant properties in the best or most efficient animals in the population. Breeding programs mainly include selection methods and mating programs.
In order to achieve long-term breeding goals, it is necessary to adjust or adapt livestock animals to local conditions and the production environment through appropriate breeding programs. This adaptation takes place through genetic adaptation, and it mainly includes adaptation to the natural conditions of the environment or the requirements for the sale of economic production. Factors that influence the genetic adaptation of individuals to the local environment are economic, ecological and local traditions of breeding and processing farming products. It follows from the necessity of breeding to adapt to local conditions that the aim of breeding is not to maximize the genetic potential of individuals but to optimize genetic potential of individual. This is because it is often impossible to improve the production environment where the animals are kept.
Optimising breeding programs aims to increase production efficiency and improve product quality. This improvement can be achieved through planning: appropriate definition of the breeding goal, selection of suitable populations, accurate estimation of population parameters, correct determination of economic coefficients and last but not minor, appropriate creation of mating plans. Because, for example, in pig breeding, but not only there, but the production of the final product is also realised in production farms, while breeding programs are implemented in breeding farms. This results in a significant step, such as the rapid transfer of breeding progress from the area of breeding to the area of production. The effort of this step is to make the time delay in the transfer of breeding progress as short as possible.
The basic types of breeding programs include the selection program, which uses an additive component of genetic variability. The selection program, as the name implies, works mainly with selection and estimation or prediction of breeding value, heritability coefficient and genetic gain. Breeding programs that use the additive component of genetic variability are purebred breeding, a special type of purebred breeding is inbreeding, as well as line breeding and Grading up crossing.
Another primary type of breeding program is the hybridization program, which mainly uses the non-additive component of genetic variability. The hybridization program primarily works with the complementarity of alleles and total heterosis effects, including the individual heterosis, positional and nonlinear effects. Among hybridization programs, we include breeding methods using a non-additive component of genetic variability. Among these breeding methods, we have, firstly, utility crossing methods without selection for special combinational continuity and breeding methods using the effects of the heterosis effect with selection for special combinational continuity. Among the forms of crossing methods without selection for special combination continuity, we include simple utility crossing without further use of hybrids in breeding, as well as rotational crossing and interspecies crossing. Among the methods of breeding that use the effects of the heterosis effect with selection for special combinational continuity, we include cross-line breeding, crossing of inbred lines and repeated selection for combinational continuity.
Factors that increase the utility of production properties in selected populations can be divided similarly to the phenotypic value into genetic and non-genetic factors. Genetic factors include knowledge of the current population, knowledge of the genetic parameters of the current population, correct choice of breeding measures, breeding program, performance control, heredity

control, testing and many others. Furthermore, the genetic factors include the choice of section criteria and the intensity of selection, and last but not least, the knowledge of the gene flow and, subsequently, the selection of a suitable breeding method. Among the non-genetic factors that influence the rate of progress in productivity is the incorporation of suitable genotypes into a given environment. It is mainly about the correct selection of the genotype for the given climatic conditions, the specific method of stabilization, or the given technology. In addition, non-genetic factors include animal nutrition, level of breeders and level of service.

Livestock breeding perspectives focus on the economics of agricultural products and the creation of active health. Active health includes, for example, the detection of genetic diseases, the increase of genetically determined resistance to diseases and others. The breeding perspective of farm animals also provides for the breeding of secondary traits such as longevity, length of productive life, exterior, etc., determination of the genetic basis and genetically determined differences in the feed utilization or evaluation of animals, which will lead to a more accurate estimation of the breeding value and population testing.

In this second part of the lecture, we will focus on the difference between primary and applied research in breeding. Under primary research, we should imagine studying physiological processes and their influence using gene manipulation, chromosome mapping, or chromosome cloning. On the contrary, we should imagine applied research as the study and characteristics of a specific production environment and the characteristics of each populations (in specific environmental conditions). Applied research, for example, deals with how it is possible to apply genetic factors of breeding progress suitably in specific environmental conditions.

In the last part of the presentations, we will focus on definitions of genetic resources.

Currently, 250 livestock breeds are endangered in Europe alone. In the Czech Republic, for example, in cattle, they are the Czech Rd and the Czech spotted cattle. In pigs, the Přeštice black-spotted. In sheep, the Šumava sheep and the Wallachian sheep. In horses, the gene sources include the Starokladrub horse, the Silesian Norik and the Hucul horse.

The importance of preserving endangered breeds lies in the maintenance of the cultural and historical wealth of the nation, in addition to the fact that these breeds are a reserve of specific, as yet underappreciated genes from the point of view of the so-called overcoming of selection limits, which include, for example, the preservation of an essential source of genetic variability, not anticipating future breeding goals, resistance to new, as yet unknown diseases, or resistance to new environmental conditions. Another reason for preserving the genes of endangered breeds is the possibility of production under unfavourable, often specific environmental conditions and, last but not least, a better understanding of the processes of domestication, evolution and natural or artificial selection.

The conservation possibilities of genetic resources are either In Situ or Ex Situ. By the term In Situ, we understand the breeding of live animals in small populations at the place of origin. This possibility of preservation enables the adaptability of individuals to possible changes in environmental conditions. On the contrary, by the term Ex Situ, we mean the conservation of frozen semen, for example, for possible gradian up crossing in the event of the extinction of living populations and the preservation of frozen embryos. In addition, this option allows the protection/conservation of the original population far from the place of origin.

As mentioned at the beginning of the lecture, breeding is optimizing a given population for given environmental conditions. Even the populations included in the genetic resources are subject to the breeding process. Due to that, these populations must be constantly adapted to changing environmental conditions. Our breeding procedures include the selection of parents next generations. Selection methods for populations included in genetic resources include individual selection, where we select individuals best adapted to local environmental conditions. Second is family selection, when we select entire families based on the chosen selection criteria; combined selection is when the best individuals from the best families are selected. And finally, family selection, when the best individuals of each family are selected.

Breeding process in small populations can be summarized in the following steps:

Determination of the breeding goal.
Selection of suitable selection criteria.
Optimization of the selection program, control of performance and health, evaluation of monitored properties, selection and breeding, monitoring and control of population development and, in the last step, expansion of genetic material.
In this presentation, we introduced the basic principles of the application of breeding programs, further stated the differences between primary and applied research in livestock breeding and defined breeding procedures in endangered populations included in genetic resources. Thank you for your attention, and I look forward to meeting you at the following presentations.