Romanian Gene Bank: Perspectives and Aspects for Farm Animal Genetic Resources Conservation

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Abstract

Many European countries set up gene banks for farm animal genetic resources (FAnGR). This paper describes the current status of animal genetic resources cryobanking and the perspectives for in vitro conservation of endangered livestock breeds and populations. Conservation efforts in Romania are done by the National Agency for Animal Husbandry `Prof. dr. G.K. Constantinescu`, which implements activities to aid the farm animal genetic resources conservation and to develop a gene bank. Following the examples provided by other European countries, some improvements in FAnGR management are needed, focusing on aspects and approaches such as genetic and genomic studies, assisted reproduction techniques (ART’s) and by strengthening collaboration with RD institutions and universities from Romania. The aim of the paper is to give a general overview on current the situation of ex situ conservation efforts of FAnGR in Romania.

Keywords: animal genetic resources, cryopreservation, gene bank, genetic tools.

1. Introduction

The animal production sector is currently facing challenges such as the increasing demand for animal products (meat and milk) and the threats of rapidly loosing genetic diversity. According to FAO [1], the milk and meat produced worldwide will double by 2030, compared to the year 2000. Within the last 15 years, 300 breeds have gone extinct, out of a total of 6000 identified. A significant number of indigenous unimproved breeds are at risk of becoming extinct, given their lower levels of production or due to the extensive use of uncontrolled crossbreeding, with exotic specialized breeds [1-3].

According to the Romanian strategy for a sustainable management of farm animal genetic resources, the following species and breeds of native or other origin are listed as being at risk, having an endangered (cattle: Romanian Grey Steppe; sheep: Corkscrew Walachian, Palas Meat sheep, Palas Milk sheep, Rusetu Tsigai, Polwarth, Stavropol Merino, Caucasus Merino, Australian Merino, Romney March, Coopwarth; pig: Romanian Saddleback, Red Magalitsa, Hampshire; horse: Hutsul, Nonius, Furioso-North-Star, Gidran; poultry: Gat Golas de Transilvania) or an extinct status (cattle: Romanian Grey Steppe varieties Bucsana, Transilvaneana, Ialomiteana, etc., Walachian (Mocanitsa Mountain) and its varieties, Red Danish, Polish, Latvian, Lithuanian, Red Poll, Jersey, Shorthorn, Santa Gertrud; sheep: Karnabat, Ascanian Merino, Ile de France, Ostfriesian, Southdown, Texel, Border Leicester, Romanov, Finish Landrace, Perendale, Drysdale, Awasi; pig: Stocli, Palatin, Strei, Banat White, Black Dobrogea Pig; horse: Romanian local breed Moldavian, Mountain, Ialomitsan etc.) [4]. Conservation efforts remain a priority for all European states, given that the indigenous breeds

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posses valuable production traits such as undemanding feeding management, resilience to climatic stress, resistance to parasites and diseases. The local breeds, given their attributes, are a valuable and unique source of gene reserves, for improving fitness traits of other breeds and also for the consolidation of new genotypes [5]. According to the Convention on Biological Diversity, the vast majority of the European countries defined own programmes for conservation of the animal genetic resources diversity (FAnGR), based on both in situ and ex situ conservation strategies [1, 6]. Ex situ conservation methods are used mainly for gene banks development, using primarily semen, oocytes, embryos, DNA, somatic cells or other tissue cryopreservation, supporting also in situ conservation strategies throughout the use of reproductive technologies (ARTs) implementation.

The aim of the paper is to give a general overview on current the situation of ex situ conservation efforts of FAnGR in Romania.

2. Materials and methods

The article is presenting in detail an assessment of the Romanian National Agency for Animal Husbandry `Prof. dr. G.K. Constantinescu` (NAAH), regarding the current situation of the gene bank developed and the efforts and activities implemented by the agency in FAnGR sector. The breeds involved in the conservation efforts and their current number are being presented, alongside with the future plans and strategies.

3. Results and discussion

The gene bank for farm animal genetic resources

The Ministry of Agriculture and Rural Development, throughout the Department for Farm Animal Genetic Resources Conservation of the NAAH, is implementing efforts and activities according to the current European programmes for FAnGR, aiming to characterize phenotypically and genetically the endangered breeds and populations from Romania, in order to aid the better utilization of the genetic resources. The gene bank of the NAAH consists out of semen and embryos, of various farm species and endangered breeds.

The bovine collection consists out of 10,266 doses of semen, sampled from individuals belonging to 9 breeds, namely: Romanian Grey Steppe, Aberdeen Angus, Romanian Buffalo, Brown Cattle, Holstein Friesian, Simmental, Pinzgau, Romanian Black Spotted Cattle, and Red Spotted Cattle (figure 1).

Also efforts for cattle embryo cryopreservation was initiated for 3 breeds, following collaborations with RD institutions (Romanian Spotted, Grey Steppe, Holstein), 19 embryos being produced and stored.

Throughout collaborations with RD entities, this has lead to sheep and goats genetic resources conservation efforts. The sheep collection consists out of 1,400 doses of semen from 7 breeds, as follows: Tsurcana - Ratsca, Suffolk, Teleorman Black Head Tsigai, Palas Merino, Palas Prolific, White Tsigai and Frisian breeds (figure 2). The goats’ semen collection consists out of 2,950 doses, from 6 breeds, namely: Alpine, Saanen, Saanen x Carpatina, Boer, Carpatina and Angora (figure 3).

The development of the animal resources gene bank will be further consolidated through the activities of the NAAH specialists, using the modern facilities and two state of the art equipped laboratories, for implementing genomic studies and semen collection, evaluation, preparation, storage, AI as well as ART's.

Perspectives and aspects for FAnGR

Value of farm animal genetic resources

In order to be able to design and implement proper management strategies FAnGR, it is required to have solid data on the stats and the potential of the local breeds [7]. Furthermore, the exact animal population size and structure, the geographical distribution and the populations of same breed in other countries are population genetic tools concurring to define the status of a breed [8]. The value of a breed is given by its genetic distinctiveness, adaptive traits, utility value for food and agriculture and also the historical or cultural background [8-10]. The genetic factors related to FAnGR refer to Mendelian segregation, crossbreeding strategies, inbreeding, genetic modifications, generation interval [11]. Furthermore, molecular information is being
increasingly used to assist breed conservation programmes and to improve livestock conservation chances, by applying gene based selection and marker assisted selection techniques [8, 9]. Genetic relationships among the individuals can be used to assign them to clusters and performing “tree” diagram analyses [2]. There is a major necessity for applying molecular tools to characterize and assess the genetic diversity of farm animal resources in Romania, especially for gene banking. Based on molecular characterization, target traits can be set up for animal genetic improvement throughout proper experimental techniques for animal population breeds and species. The laboratory of genetics of the NAAH can prove useful in contributing to animal genetic resources molecular characterization by implementing genomic studies.

![Figure 1. Gene bank situation of bovine breeds semen samples cryopreserved](image1)

![Figure 2. Gene bank situation of sheep breeds semen samples cryopreserved](image2)

![Figure 3. Gene bank situation of goat breeds semen samples cryopreserved](image3)
Ex situ conservation implementation
Ex situ conservation of farm animal refers to zoos, captive breeding and gene banks. Ex situ collection should be established for all indigenous breeds, aiming to gather as much genetic diversity, as possible. Both in situ and ex situ strategies are complementary methods for biodiversity conservation [2, 12]. ARTs, mainly referring here to AI, embryo transfer and cloning, have contributed and will continue to contribute to the efficiency and effectiveness of conservation programmes [1, 13]. Cryopreservation methods are widely used for gene banking on different types of genetic material such as: semen, oocytes, embryos (recovered in vivo or in vitro produced through IVF, embryonic cells, somatic cells [1, 2, 3, 9, 14, 15], even if further progress in cryopreservation methods is still a challenge for some farm species. Also DNA samples can be stored in gene banks. Current practice in ex situ conservation, also in Romania is largely limited to cryoconservation of semen, presenting the highest feasibility for farm animal species, and also of oocytes and embryos from ruminant species. Preservation of somatic cells and DNA has to be considered as feasible technique in the future [16]. Nowadays, NAAH deals mainly with the cryoconservation methods of gametes and embryos, activities being in an incipient stage. However, conservation methods should be extended to other practices as well. The laboratory of genetics of the NAAH can contribute to setting-up valuable DNA collection into the gene bank from various breeds and populations, and also the agency’s laboratory from Targu-Mures can provide gene banking of equine breeds, broadening therefore the animal resources conservation efforts to new species and breeds.

System integration data
For integrating the information at European level, the samples collected and stored have to be integrated into a international database, compiling to the specific requirements for each record or data-set (referring to the number of samples per breed, the number of donors per material type stored, gene bank documentation systems etc), in an appropriate specific format. Moreover, special tools are required for providing access, transfer, integration and harmonization of gene bank data available [15-19]. Software such as CryoWEB, which is a web based software for the documentation of long term cryopreserved animal genetic material collections are already in use as national gene bank information system in various countries such as Netherlands, Slovakia, Slovenia, Austria, Switzerland, Iceland, Georgia, Estonia, Finland, Germany and Greece [17]. Germany uses the TGRDEU database, a tool for an international network of information systems on animal genetic resources and through the National Focal Point, data is available for the FAO’s global database DAD-IS and, at European level, for EAAP’s database [16]. Romania still needs to find out solutions to improve system integration data in farm animal resources, even if some changes and advances have been made.

Animal genetic resources conservation
According to FAO data base found in country reports on capacities in animal genetic resources management, institutional assessment at national level regarding research, knowledge, awareness of topic, infrastructure/capacities, participation of local/regional level, law, political programmes and degree of implementation are showing scores that improvement is still needed [8]. The institutions capacity related scientific research and technology to continuously produce scientific knowledge and technologies requires progress [20]. Stakeholder involvement in the development of animal genetic resources for setting up the breeding goals and performance recording, individual identification, data recording and genetic evaluation refer to a matter between governments, breeders, researchers and NGOs [8, 15]. At country level collaboration between institutions has to be improved for increasing the animal resources conservation efficacy and implementation.

4. Conclusions
The National Agency for Animal Husbandry “Prof. dr. G.K. Constantinescu” efforts concur to enhance and preserve the national animal genetic heritage, through gene banking and implementing the governmental strategies for FAnGR. For the gene bank development, new tools related to genomic large-scale studies, reproductive technologies and bioinformatics need to be used, along with the agencies laboratories and state of the art facilities, alongside with the improvement of the collaboration between the institutions and
actors involved in this field (policy makers, breeders and their associations, RD institutions and universities etc).

References


