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PROTECTION AND SUSTAINABILITY OF ANIMAL GENETIC RESOURCES FOR ENSURING THE PRODUCTION OF QUALITY DOMESTIC FOOD

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ABSTRACT

Rapid rise in population, economic growth and urbanization are important factors, which can affect the current and future quality of life and food security. An enormous pressure to streamline animal breeding and production have led to the rapid erosion of animal genetic diversity. The importance of animal genetic resource protection emerges from biological, economic, social, cultural and environmental needs of the country. Animal genetic resources contribute to the development of good food quality and food products, new medicines and manufactured goods, as well as other important goods and services. This will ensure that these resources will be fully used to respond to current food security and that they will continue to contribute to human development and well-being. The situation in protection of animal genetic resources in the Slovak Republic is not satisfactory, therefore, it is very important to pay attention to the management of certain breeds and to its conservation. Also, the legal base is needed to ensure the long-term maintaining of the endangered breeds.

Keywords: animal, genetic resources, sustainability, food, quality

INTRODUCTION

Animal genetic resources are the primary biological capital for livestock development. Their sustainable utilization, development and conservation are essential for agriculture and food production, rural development and environment. The values of these resources are poorly understood and their management has been neglected. This has resulted in substantial erosion of genetic diversity – a trend that is likely to accelerate with the rapid changes affecting the livestock sector in response to massive increases in demands for livestock products. The livestock development in the twentieth century is concentrated on a very small number of breeds worldwide, frequently without due consideration to the way in which local production environment affects animals' ability to survive, produce and reproduce.

Human population in 2050 is estimated to be 9.15 billion, with a range of 7.96 - 10.46 billion **(UNPD, 2008)**. Continuation of a rapid population growth could be an important impediment to achieving improvements in food security in some countries, even when world population, as a whole, ceases growing sometime during the present century. Another important factor determining demand for food is urbanization. By the end of 2008, more people now live in urban settings than in rural areas **(UNFPA, 2008)**. Urbanization has considerable impact on patterns of food consumption in general and on demand for livestock products in particular **(Delgado, 2005)**. A third factor that leads to increased demand for livestock products is income growth. Between 1950 and 2000, there was a growth rate of an annual global income of 2.1% per capita **(Maddison, 2003).**

Various natural conditions of the individual regions in Slovakia find their expression in the different conditions for plant and animal production. There are intensive lowland regions as well as extensive mountainous and sub-mountainous regions in Slovakia. In the lowland regions farms with combined plant and animal production prevail. On the contrary, farmers in regions with a lower proportion of arable land (mountainous and sub-mountainous regions) mainly deal with cattle, sheep or goat breeding. Since the rural regions of Slovakia are afflicted with high unemployment rates, a return to self-supplying poultry, sheep, goat, pig and rabbit husbandry has become evident.

The decrease in agricultural production is reflected in a decrease of employment. In Slovakia the consumption of milk and beef products has greatly decreased in comparison to the end of the 80^{ies} of the 20th century. Since this decrease was caused by a loss of the buying power of the population, it cannot be understood only as a result of natural regulation of the production by real demand under real market conditions.

Cattle

In cattle, from the purebred animals there are the Slovak Spotted and Slovak Pinzgau breeds, whose origin is from autochthonous Carpathian red and Carpathian grey extinct breeds. Despite decrease in numbers, the population of cattle is of great interest with respect to the food needs of people, as well as to its landscape influence. Since 1989 the numbers of cattle have tended to decrease. The highest proportion of animals belongs to crosses of the Slovak Spotted and Slovak Pinzgau cattle with the Holstein breed. Of purebred animals the Slovak Spotted cattle represents the most widespread breed. In the purebred form about 50 000 cows are being bred followed by the Holstein (35 000 cows) and the Slovak Pinzgau cattle (5 000 cows). Mainly with the Slovak Pinzgau breed a drastic decrease in the number of purebred animals can be observed.

It is necessary to emphasise that the state of cattle (livestock) not only in Slovakia but in a whole European Union is the stable basis of animal husbandry. This non-substitutable importance in the framework of agriculture consists not only in the multi-production nature (production of meat, milk, organic fertilizer) but also in the close interaction with plant production.

Sheep

Before 1989 wool production was the main commodity in sheep. After that date, as a consequence of transformation and a decrease of the market price of wool, sheep milk and meat production became essential. Lamb meat belongs to those commodities that can be capitalized not only on the European but on the world market as well. In the export of lambs Slovakia does not fulfil the European Union quotas in spite of the fact that lambs represent a commodity that might decrease the negative foreign trade balance of the Slovak Republic. With respect to the non-production aspects sheep grazing permanent grassland plays an irreplaceable role in the landscape formation. Between 1990 and 1999 the numbers of sheep in Slovakia decreased from 600 000 to 340 000 i.e. by 260 000 pieces, which is 43 %. Since 1999 a reverse tendency could be seen. This trend, accompanied by a slight improvement in the production and reproduction traits in sheep, has been a result of increased care and mainly of economic measures. The economically most important sheep breeds are autochthonous ones - the

Improved Valachian and Tsigai, which are widely used for meat and milk production.

Goats

Goat breeding is a marginal branch of animal production. Most animals can be found in the hands of small keepers mainly under more difficult agro-ecological conditions i.e. in the poorer sub-mountainous and mountainous regions. The population of Slovakia does not show demand for goat meat, milk and the respective products. This is mainly connected with the cooking habits, the low offer as well as the high price. In Slovakia local breeds are bred like the White Shorthaired and Brown Shorthaired. The latter, however, has merged with the population of the Alpine goat. The White Shorthaired goats are predominant among the goat population of Slovakia. Goats represent the livestock sector of minor importance, mainly farmed for milk. The performance testing involves few flocks of the White Shorthaired goats; the numbers have been gradually decreasing since the beginning of the millennium. Selection is done under the umbrella of the Sheep and Goat Breeders' Association and the Breeding Services of the Slovak Republic. Breeding is aimed at improvement of milk, prolificacy and exterior.

State of utilization of genetic resources

Pursuant to Act No. 194 of 1998 and the Regulation of the Ministry of Agriculture of 2000 on performance testing, heredity testing, health testing, exterior evaluation of farm animals, establishment and management of herd book, breed registry, record-keeping and verification of the origin of farm animals, the following traits are monitored in charge of performance testing in farm animal species (table 1). A herd, year and, season significantly affected all milk traits, as was reported in all studies dealing with environmental effects in milk producing livestock **(Ortiz et al., 2012).**

Table 1 The results of milk performance testing in the year 2016 (the average value per lactation - for all lactations; http://pssr.sk/org/publ/2017/ov/rocenka/rocenka.pdf, http://pssr.sk/org/publ/2017/hd/rocenka/mp_16/rocenka.pdf)

Evaluated parameters	Slovak spotted breed*	Slovak Pinzgau breed*	Tsigaja**	Improved** Valachian	Shorthaired goat*
Total number of lactations	33 667	1369	3284	4139	197
Number of standard lactations	25 808	934	2166	3422	195
Number of lactation days	295	293	150	150	150
Milk, kg	6664	4768	115.81	111.05	638.8
Fat, %	3.98	3.93	6.93	7.30	3.46
Fat, kg	258	187	8.21	8.73	22.2
Protein, %	3.40	3.40	5.79	5.65	2.79
Protein, kg	221	162	6.89	6,76	17.9
Lactose, %	-	-	4.71	4.68	4.46
Lactose, kg	-	-	5.69	5.61	28.5

*pedigree breeding; ** farms regardless of performance testing

In **cattle**, monitoring is carried out on milk production traits (milk yield, production and content of fat and protein, especially in dairy and dual purpose cattle), beef production and carcass traits (beef cattle), growth traits (weight of calves and young cattle, daily gain etc.) and other traits, like milkability, duration of lactation, number of somatic cells in milk, length of production period, parturition course, ratio of still-born calves or exterior traits. These data represent a basis for genetic evaluation and breeding value estimation (for individual traits or aggregate selection indices) using modern genetic and statistical analyses and taking into account all accessible information on the animals.

Slovak Pinzgau, a traditional cattle breed of mountainous areas of Slovakia and Slovak Spotted cattle, which belongs to the group of Simmental breeds, are dual purpose breeds, which have a long tradition in Slovakia. Investigation of milk production parameters showed that Slovak Spotted breed had greater average milk production (6664 kg of milk) with the average concentration of milk constituents (fat + protein concentration) 7.38%, compared to Slovak Pinzgau breed with the average milk production in pedigree breeding 4768 kg and the average value of milk constituents 7.33%. When we compared these parameters with milk production from Holstein, Friesian and Jersey purebred cows (**Coffey et al., 2016**), the highest milk production was recorded in Slovak spotted cattle compared to Holstein (5217 kg), Slovak Pinzgau cattle (4768 kg), Friesian (4591 kg) and Jersey (4230 kg). On the other hand, milk constituents were highest for Jersey (9.38%) compared to Frieisian (7.91%), Holstein (7.75%), Slovak spotted (7.38%) and Pinzgau (7.33%) cattle.

Performance testing in sheep includes fertility traits, lamb growth intensity and milk production traits. In meat sheep, fattening and slaughter value are tested. At present, genetic evaluation of sheep using animal model is being developed. Genetic evaluation of milk performance (animal model – test-day model) is being introduced into routine practice. Genetic evaluation of other traits is under preparation.

In sheep, milk yield and quality varies depending on genetics as well as on the impact of numerous environmental factors **(Petrović et al., 2000).** Also, ewe milk composition fluctuates in the wide range according to the genetic differences among breeds as well as inside the breeds **(Haenlein, 2004).** Breeds and genotypes can influence the quality of produced milk and its composition **(Bencini, 2001).** Milk yield can vary more than 10-fold between and inside the breeds **(Haenlein, 2004**). We can state that in our study the average milk yield during lactation period was higher in Tsigaja (115.81 kg) than in Improved Valachian sheep (111.05 kg), what was lower in comparison with Lacaune breed (255.82 kg). There were also insignificant differences in the content of milk constituents. This is in accordance with the results of **Oravcova et al. (2015),** who found out that the average milk yield during lactation period was higher in Lacaune compared to Improved Valachian and Tsigaja sheep breeds. Goat performance testing includes reproduction and milk production traits.

The trends in meat and milk consumption in developing and developed countries are shown in table 2, together with estimates for 2015–2050 (**FAO 2006, Steinfeld *et al.*, 2006)**. Differences in the consumption of animal products are much greater than in total food availability, particularly between regions. Food demand for livestock products will nearly double in sub-Saharan Africa and South Asia, from some 200 kcal per person per day in 2000 to around 400 kcal per person per day in 2050. On the other hand, in most OECD (Organization for Economic Cooperation and Development) countries that already have high calorie intakes of animal products (1000 kcal per person per day or more), consumption levels will barely change, while levels in South America and countries of the Former Soviet Union will increase to OECD levels **(Van Vuuren *et al.*, 2009)**.

Global plan of action

Animal genetic resources and their sustainable utilization, development and conservation are essential for agriculture and food production, rural development and environment. In recognition of the need to develop an effective framework for managing these resources and deal with the threat of their genetic erosion in September 2007 brought together representatives of 109 countries at the First International Technical Conference in Interlaken (Switzerland). The Conference adopted the Global Plan of Action, which sets out 23 strategic priorities defining sense approach to the management of animal genetic resources. The Conference also adopted the Interlaken Declaration, which confirms the commitment of countries to implement the Global Plan of Action at the national level and ensure the use of livestock biodiversity in support of food security and their availability for future generations.

Ratification of the Convention on the Biodiversity was confirmed by the Slovak Republic also in 1994, to protect biodiversity, to guarantee sustainable use of its components including also animal genetic resources. The importance of the protection of animal genetic resources emerges from biological, economic, landscaping and cultural needs of each country that are realized using national gene banks (NGB). NGB should guarantee monitoring, collection and preservation of samples from genetic resources (spermatozoa, oocytes, embryos, somatic cells, tissues, DNA etc.) under original condition, deeply frozen or lyophilized; their storage, molecular-genetic characterization of samples, research comparison of the genetic biodiversity, management of information system about stored samples and their use for original breed restoration. At the time when Slovak agriculture and mainly the animal production permanently year-by-year achieves decrease in the farm animal population, it is necessary to be aware of the fact that the farm animal breeding has not only production function, but also non-production functions, which provide cultural country cultivation and countryside development.

Table 2 Meat and milk consumption (http://pssr.sk/org/publ/2017/hd/rocenka/mp_16/rocenka.pdf)

Country	Year	Annual *per capita* consumption		Total consumption	
		meat (kg)	milk (kg)	meat (Mt)	milk (Mt)
Developing	1980	14	34	47	114
	1990	18	38	73	152
	2002	28	44	137	222
	2015	32	55	184	323
	2030	38	67	252	452
	2050	44	78	326	585
Developed	1980	73	195	86	228
	1990	80	200	100	251
	2002	78	202	102	265
	2015	83	203	112	273
	2030	89	209	121	284
	2050	94	216	126	295

In the last fifty years, there was not only a significant decrease in the animal number in the Slovak Republic, but in some original species autochthonous breeds completely disappeared. The development of 15 breeds in the Slovak Republic, using the data on purebred animals registered in herd books, was analysed in years 2005, 2010 and 2015 (**Tomka *et al.*, 2016)**. These data are part of the animal genetic resource monitoring, which is performed in cooperation with the Breeding Services of the Slovak Republic and with authorized breeder organizations of respective breed. Twelve breeds were classified as being endangered in 2015, from which 6 were classified as critically endangered. The possible extinction of these breeds would also mean irrecoverable loss of the genetic variability and so the loss of unique gene and allele combinations, that would be very useful in the future, e.g. for the generation of new livestock genotypes. However, the real extent of genetic erosion is very difficult to measure using current data. Therefore, this challenging target demands better coverage, understanding and utilization of genomic and environmental data, the development of optimized ways to integrate these data with social and other sciences and policy analysis to enable more flexible, evidence-based models to underpin conservation of farm animal genetic resources.

The cryobank (within the programme of biodiversity preservation) conserves available semen and embryos of cattle and horse breeds. The aim is to extend the sources of gametes and embryos also for other farm animals. Cryopreservation and storage of semen and embryos represents the basis of animal genetic resources under *ex situ* conditions. It is obvious that in future special attention should be paid to establishing a gene bank of tissues, blood derivatives and DNA samples of farm animal genetic resources (**Chrenek *et al.*, 2017**).

CONCLUSION

Further development and maintenance of the national gene bank is important to guarantee long-term conservation of farm animal genetic diversity, for future breeding or research purposes. Animal genetic resources may contribute to the development of good food quality and food products, new medicines and manufactured goods, and other important goods and services. This will ensure that these resources will be fully used to respond to current food security and that they will continue to contribute to human development and well-being.

The approaches to animal genetic resources must apparently better consider the potential of indigenous livestock breeds and realistic ways of improving this livestock in the context of environmental and socio-economic demands as well as within the available resources.

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