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Significance of Genetic Diversity in Farm Animal Production

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Abstract

Genetic diversity (GD) refers to the variety of genes within a species. In order to preserve GD within a species, different populations must be sustained. GD allows livestock species for adaptation to changes in environmental conditions over time and is, consequently, essential to species survival. Unfortunately, GD in livestockis threatened by various reasons such as intensive artificial selection programs in animal production systems (genomic selection), mating schemes (inbreeding) and global warming along with inappropriate management strategies and policies. Moreover, recent molecular genetic approaches provide more and more powerful tools for unravelling the molecular basis of phenotypic diversity in genomes of farm animals.Future plans concerning GD must contain the sustainable application, development and conservation of domesticated animal genetic resources requires information on the diversity of both national and international resources, therefore referring to global information.

Keywords: Genetic diversity, Genetic resources, Livestock breeding, Environmental conditions

INTRODUCTION

Animal domestication is one of the most important events in human history. Different livestock breeds have been formed by centuries of natural selection and human who has selected farm animals to fit considerable environmental conditions and his needs. Livestock keeping is an important livelihood activity for hundreds of millions of people around the world. In consideration of the first domesticated farm animal as a source of food, there have been more than 35 species of birds and mammals that have been domesticated for use in agriculture and food production, and there are more than 8000 recognized breeds [1, 2].

Diversity in animal genetic resources (AnGR) or in livestock species provides opportunity for breeders to develop new and improved farm animals with desirable traits such as higher meat and milk yields, a number of progeny and disease resistance along with adapting livestock production to future challenges. In other words, the genetic diversity (GD) found in domestic breeds allows farmers to develop traits with new characteristics in response to changes in environment, diseases or market conditions [3].

Taking advantages of associated sciences and technologies in agriculture, on account of farm animal production, the required question is to be asked is whether there would be adequate food around the world in near century. This paper will indicate the significance of GD in livestock populations in terms of decrease in the loss of GD, therefore, sustaining the genetic conservation in populations.

What is the significance of genetic diversity?

Genetic diversity (GD) is a base for all higher levels biodiversity which is the estimation of the variety of organisms and their surrounding ecosystems. Furthermore, it refers to the variety of genes within a species providing major benefits for sustainable development of livestock production [4]. A gene pool is the total sets of alleles found in a population and always dynamic in populations, meaning that it tends to consistently change over the time. Unique genetic variants are lost when populations of species decrease in size or genes are responsible for expressing certain phenotypes become extinct.

The existence of large amount of genetic variation is the basis for the survival and development of animal populations. Obviously, the source of the variation is due to considerable allelic diversity and heterozygosity over the genome [5].

One of the important reasons is to preserve GD within a species, different populations must be sustained since it allows livestock species for adaptation to changes in environmental conditions over time and is, consequently, essential to species survival. There are many reasons why genetic diversity improves a species chance of survival but the most important for organisms is resistance to pathogens and parasites [6].

Besides, genetic variation allows natural selection and more importantly new alleles are introduced in a specific population. By having different genetic combinations, individuals in the population exhibit different traits which tends or not to their benefit in regard to social and environmental interactions. For instance, while some individuals might be able to stand for or tolerate an increased load of pollutants or a crucial stress factor(s) in their surrounding environment, others with different alleles might suffer from infertility or even die under the exact same environmental conditions. In other words, certain alleles in population are preferred over others as a result of altering the allelic frequency towards to the favorable allele. This process is called natural selection, which gives rise to the loss of genetic diversity (GD) in certain habitats [5, 7].

Nonetheless, over the time, the environment constantly alters and ultimately the preferred trait may become disfavored at a certain point of the time. New traits must then be present in population for adaptation to the new environmental conditions due to mutation(s) generating a gene pool in population. The natural selection would remove all minor or inferior species unless there were genetic

variations in a population. On the other hand, it should be noted that once the environment changes, major species will have no chance to survive in their habitats since it cannot adapt to new or unpredictable ongoing environmental conditions.

GD also reduces the occurrence of undesirable inherited traits. In a small, isolated populations, individuals may be forced to breed with close relatives thus, generating uniform genetic makeup of the individuals (i.e. inbreeding).

Why should the loss of genetic diversity be prevented?

In order to obtain an effective management, farm animal genetic resources (FAnGR) requires comprehensive knowledge of the breeds with characteristics along with data on population size and structure, geographical distribution, the production environment, and within- and between-breed genetic diversity [8]. Unfortunately, GD in livestock breeds has been threatened by various reasons such as intensive artificial selection programs in animal production systems (genomic selection), mating schemes (inbreeding) and global warming and as well as inappropriate management strategies and policies.

The loss of GD is difficult to observe or measure, which results in reducing the species ability to function its role in genetics along with the surrounding ecosystems. The worst part of the loss of GD is to bring about the loss of favorable traits in populations. The restricted diversity might knock out options and opportunities for exploiting food resources, productions, and all related industries and sectors.

Components needed for sustainability

The factors effect sustainable management of FAnGR as follows: Avoidance of inbreeding, maintaining alternative (appearance of a multiple breed liveability), and sufficient numbers of breeds to secure between-breed diversity, optimal selection and intensivity on traits, and eventually interaction between environment (production systems) and genotypes. Furthrmore, it should be taken account into certain breeds for developing branded food products, conservation of historical or culturally important breeds and sufficient conservation to secure maintenance of important genes for future use [9]. Changing gene and genetic variation through selection and crossbreeding has been the basis for improving livestock populations in animal husbandry and artificial selection ultimately depends on a reservoir of genetic variation in a population [10]. Thus, genetic variation (genetic diversity) must be conserved for food security for future.

CONCLUSIONS

The goal of conservation genetics is to maintain genetic diversity at many levels and to provide tools for population monitoring and assessment that can be used for conservation planning [11]. Unfortunately, livestock production systems in present have always required genetic improvement and selection for desired traits meeting breeders income levels and consumer needs. This will cause to gradually reduce the genetic variance as loci become fixed. To prevent from inbreeding, alternatively, outbreeding mating between breeds may be applied to increase and sustain the diversity [9].

In addition, recent molecular genetic approaches provide more and more powerful tools for unravelling the molecular basis of phenotypic diversity in genomes of farm animals. Utilization of molecular markers along with their analytical tools and techniques are quite in common genetic diversity studies which provide information about the relationship between breeds and the domestication process. Especially, microsatellites, mitochondrial DNA(mtDNA) or Y-chromosomal markers and single nucleotide polymorphism (SNP) markers and their high throughout technologies are quite in common for conservation studies and researches [3]. Probably, in near future, more molecular markers would be developed throughout the genomes, applying for utilization in postgenomicera.

Future plans concerning GD must contain the sustainable application, development and conservation of domesticated animal genetic resources requires information on the diversity of both national and international resources, therefore referring to global information.

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