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GENETIC DIVERSITY OF PINZGAU CATTLE BREED: A SYSTEMATIC REVIEW

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Abstract

The present work aims to review the most important aspects regard to genomic characterization of Pinzgau cattle breed. In Romania, this cattle breed is part of the country´s genetic and cultural heritage and faces the impact of bottleneck and the lack of diversity due to a significant decline in population. Natural populations´ genetic structure is influenced by a limited gene flow that occurs when the geographic distances between them increase. In our country, the Food and Agriculture Organization of the United Nations (FAO) maintained the status of ' endangered-maintained ' cattle breed in 2000 considered to be threatened with extinction. This paper wants to highlight the fact that the conservation of this breed is a national priority and also, reviews the most relevant information in the literature on the genetic diversity of this cattle breed.

Key words: *cattle breeds, genetic diversity, Pinzgau cattle.*

INTRODUCTION

The Pinzgau breed is named after its origin area, near Salzburg, Austria, and is a mountain cattle breed.

The breed originated from local mountain breeds in the 19th century and evolved in three directions: traction, milk and meat. In Romania, the Red Pinzgau breed has been established since the second half of the nineteenth century, after the absorption of crosses made between the local cattle breeds Grey Steppe, Mocanita and Pizgau of Austria. Also, "Cow of Dorna" or "Black Pinzgau" was created by the crossing of local cattle with specific mountain breeds: Pinzgauer, Mölltal, Zillertal etc. (Popa et al., 2012).

Over the last few decades, the biodiversity of cattle has decreased dramatically. The genetic degradation observed was mainly due to the specialization of livestock production in favor of cosmopolitan and high quality breeds, so, the control of the genetic diversity of cattle has therefore become an important concern in the management of livestock breeding programmes (Kukučková et al., 2017).

The Pinzgau breed, currently, meets in more than 25 countries around the world. Special color mottled red-brown spots on the side of the body and white line became the character of the breed.

In Romania, the Pinzgau breed is meets in three areas: the NW of Moldova, the SW of Transylvania and the W of Transylvania-Apuseni. Transylvanian Pinzgau breed has a strong constitution, lively temperament, docile disposition, average precocity, high endurance, good adaptation ability, resistance to disease and environment (Kadlecik et al., 2004).

Dorna cow is less than 1-2 cm tall than Red Pinzgauer, the rectangular body is more pronounced, the bones and muscles are better developed and the background is black (Fisteag, 1958).

According to FAO reports, the Pinzgau breed is threatened with extinction, entering the category of endangered cattle. FAO studies often draw attention to the numerical decline of different species, the classification of different breeds, taking into account the number of individuals for each breed, the ratio of females to males, and their inclusion in active

conservation or maintenance programs by companies or research institutions, as one of the following categories: extinct, critical, endangered, critical-maintained, endangered-maintained, not at risk (Scherf, 2000).
Due to its rusticity, resistance to a particular hilly and mountainous climate, with a remarkable successful longevity and survival, the expression of its genetic characteristics distinct from other breeds, Pinzgau must be considered a component of national genetic resources.
The main objective of this study was to provide a thorough insight into the genomic characterisation of the Pinzgau cattle breed (especially the Romanian Pinzgau breed) through the use of high-performance molecular information.

MATERIALS AND METHODS

In order to reach the objectives of this study, 13 bibliographic sources from the specialized literature were consulted. The main issues addressed refer to the morphological and productive evaluation of the Pinzgau breed, especially in our country, as well as information regarding the genetic diversity of this breed, which is currently in danger of extinction.
The research methods used in this study were the observation, analysis and graphical interpretation of data from the specialized literature regarding numerical evolution, morpho-productive characteristics and genetic analysis of the Pinzgau cattle breed.

RESULTS AND DISCUSSIONS

1. The morphological and productive characteristics of the Pinzgau cattle breed

The Pinzgau breed was first developed between 1690 and 1740 by the crossing of local red bulls with the Bern type of Switzerland, after 1740, the resulting animals were used for breeding in the true breed and is located in the mountain areas of Romania at an altitude of over 1000 m. This breed is originates in Austria, Salzburg, Tyrol, alpine and subalpine areas (Maciuc, 2006).
In 1820, Pinzgau breed were exported to countries such as Romania, Yugoslavia, the Czech Republic and Slovakia. Throughout South Africa, Canada, the USA and Australia, even under the harshest weather conditions, Pinzgau thrived (Kadlecik, 2004).
An extensive study on the morphological and production characteristics of Pinzgau cattle, from the Apuseni Mountains area and from the Hațeg and Petroșani Depression was carried out between 1956-1962 by Dincă et al., whose synthesis is presented below. The average body weight of the cows was 382.3 kg, the cows in the area of the valleys had 392 kg body weight, and those in the mountain area and in the premontane area 371 kg.
Figure 1 shows the weight of the Pinzgau (females) breed, for 2014, in comparison with the cows from the breeds: Brown, Romanian Black Spotted, Romanian Spotted and other beef cattle breeds, undefined.

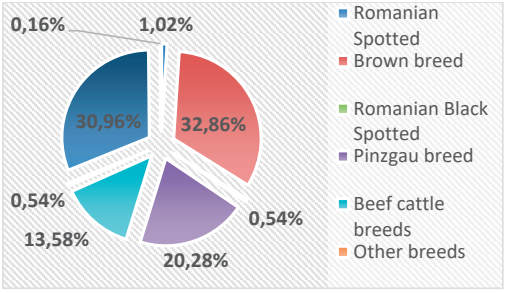

Figure 1. The share of Pinzgau cattle breed from the total of cows in Romania, registered in the herd book (2014)

In Romania, as mentioned by FAO-1993, the Pinzgauer cattle included 1092 females registered in the national herd book. However, the recorded population trend was considered to be decreasing. According to Figure 1, in 2014, the Pinzgau breed represented 20.28% of the total number of cattle from the bovine species, in the territory of our country.
For 2015, the situation regarding the weight of the Pinzgau breed from the total number of cattle in Romania is presented in Figure 2.

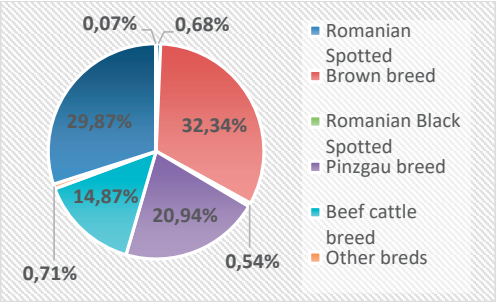

Figure 2. The share of Pinzgau cattle breed from the total f cows in Romania, registered in the herd book (2015)

According to Figure 2, in 2015, the Pinzgau breed represented 20.94% of the total number of cattle from the bovine species, in the territory of our country, a higher percentage by 0.66 compared to the previous year.

Regarding the exterior, the conformation and the constitution, in general, the cattle of this breed present a pleasant, attractive and harmonious exterior, having a characteristic conformation to the breeds with intermediate production skills (Georgescu et al., 1998).

The body development is relatively variable, depending on the area of spread and the local geoclimatic conditions (Table 1).

Within the breed there is a variety known as Dorna Cow or Black Pinzgau. It is a special type of breed, widespread in the area of the same name, especially around the localities of Vatra Dornei, Câmpulung Moldovenesc and Gura Humorului.

The researchers conducted by Acatincăi in 2004, show that there are morphological differences between the cattle of the Pinzgau breed, found in the northwest of Moldova, the Apuseni Mountains or the Dorna Depression.

The phenotypic performances in the direction of milk production are different, with limits between 1900-3500 kg and 3.62- 4% fat. As for the herds from the official production control, they have a very sinuous evolution (Table 2).

Table 1. The main morphological characteristics of the Pinzgau breed

Characteristic (cm)	NW Moldovei (cattle)	Apuseni Mountains (cattle)	Cows	Bulls	Dorna Cow
Waist	126.3	129.4	128.6	134	125
Length of the trunk	151.2	155.0	153.1	163.1	151
Thoracic depth	67.4	67.9	67.5	74.3	64
Thoracic perimeter	178.8	179.3	179.1	199.7	176
Body weight	469.2	482.8	471.1	662.9	444

**Acatincăi, 2004*

Table 2. Number of lactation, average milk production and fat content

Pinzgau cattle breed			
Lactation	I	IV	VII
Average milk production (kg)	2849.79	3313.89	3300
Fat content of milk (%)	3.77	3.75	3.73

*Official Control of Production, during 2014-2015

Regarding the evolution of milk production according to the lactation rank, it has a linear character.

Imported animals of the Pinzgau breed have produced a lower yield of milk under the conditions of processing in Romania than in Austria. The protein, fat and lactose content of milk was also lower (Gîlcă & Gîlcă, 2012).

2. Genomic uniqueness of the Pinzgau cattle breed

The genome of many breeds of cattle was studied by researchers and the research results have been published over time in numerous articles. The research was centred on the analysis of genetic markers correlated with the characteristics of the productions, in the case of cattle breeds threatened with extinction (as is the case with the Pinzgau breed), this was useful for the understanding of the importance of the survival of genetic capital relevant to animal origin, the degree of uniformity of the breed and, corroborated by several other important molecular markers, their place of development and domestication. The genetic structure of natural populations is determined

by the minimal gene flow that happens as the spatial differences between them increase. Genetic segregation of the breeds decreased the variation at the molecular stage, which can be controlled by growing homozygosity (Felius et al., 2014).

Investigating Pinzgauer populations in Austria, Bavaria, Germany, Erhardt (1996) discovered a new K-casein variant (K-CN G) with a frequency of 0.003 by isoelectric focusing in polyacrylamide gels and by alkaline polyacrylamide gel electrophoresis. K-CN G was not present in milk samples of Limpurger, another endangered breed.

A. Caroli et al. analized in the original Pinzgauer cattle, milk protein genetic variation and casein haplotype structure. A total of 485 dairy specimens from Original Pinzgauer from Austria (n = 275) and Germany (n = 210) were isoelectrofocused to evaluate the genetic variation influencing the protein amino acid charge in dairy proteins αS1-casein, β-casein, π-casein, α-lactalbumin and β-lactoglobulin. A rather elevated genetic variation influencing the amino acid charge of dairy proteins characterizes the Original Pinzgauer breed, with a total of 15 alleles, 12 of which were discovered at a frequency > 0.05. With 4 alleles identified, the most polymorphic protein was β-casein. CSN1S1*B, CSN2*A2, CSN1S2*A, CSN3*A, LGB*A, and LAA*B were the predominant allles. A comparatively high frequency of CSN1S2*B (0.202 in the entire information set)

was discovered, primarily occurring within the haplotype C-A2-B-A (in the order CSN1S1-CSN2-CSN1S2-CSN3), which appears to be unique to the original Pinzgauer, potentially due to the survival of an ancient haplotype or *Bos indicus* introgression.

A specific white spotting phenotype, termed finching or line-backed spotting, is known for all Pinzgauer cattle and occurs occasionally in Tux-Zillertaler cattle, two Austrian breeds. The so-called Pinzgauer spotting is inherited as an autosomal incompletely dominant trait. Based on 777k SNP data, a genome-wide association study using 27 white spotted and 16 solid-colored Tux-Zillertaler cattle revealed a strong signal at the Kit locus on chromosome 6. Haplotype analyzes described the Kit coding region's critical interval of 122 kb downstream. Whole-genome sequencing of a Pinzgauer cattle and comparison with 338 control genomes disclosed a complicated structural version composed of a deletion of 9.4-kb and a reversed duplication of 1.5 kb fused from chromosome 4 to a 310-kb duplicated section. A diagnostic PCR for this structural variant (Kitpinz) was created for the simple genotyping of carriers and confirmed the presence of the variant allele in all Pinzgauer and most white spotted Tux-Zillertaler cattle. The introgression of the Kitpinz variant confirms admixture and the reported historical relationship with Austrian Tux-Zillertaler of these short-headed breeds and suggests a mutation event that occurs before breed formation (Kuttel et. al., 2019).

Ivan Pavlík et. al. (2014) researched genetic variation in the Pinzgau breed in Austria and Slovakia. A total of 12,442 individuals were used in the sample reflecting the reference population and have been studied four sub-populations. The mean inbreeding coefficient (five generations taken into account) was 0.0186, 0.0242, 0.0151 and 0.0126 for Austrian dairy products (AD), Austrian beef (AB), Slovak dairy products (SD) and Slovak beef (SB) respectively. The effective size of the population varied from 122.5 (AD) to 809.4 (SB).

Genetic evaluation represents an important tool in breeding and cattle selection, Romanian Pinzgau being a part of active breeds adapted to local conditions with local origin. Currently, in Romania, Pinzgauer cattle breed is included in a genetic program of conservation.

CONCLUSIONS

Pinzgau cattle breed represents a valuable genetic reserve for livestock of Romania. This is more strategically necessary than ever to maintain as much livestock variety as possible and to ensure a prompt and timely response to the needs of future generations.

The Romanian Pinzgau must be regarded as a part of national genetic wealth, owing to its rusticity, tolerance to the unique hilly and mountainous climate, with a remarkable endurance, an indication of its genetic distinction from other breeds.

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