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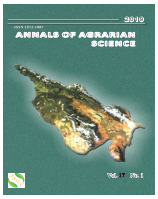

Genetic and Farming Features of the Kakhetian Pig Gene Pool and Epizootic Characteristics of Helminthiases of This Breed

L. Ujmajuridze, R. Mitichashvili, Sh. Potskhveria, Ts. Kiliptari

The Scientific-research Center of Agriculture of the Ministry of Environmental Protection and Agriculture of Georgia 6, Marshal Gelovani Str., Georgia, 0159, Tbilisi

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A B S T R A C T

The work reflects the genetic and economic potential of Georgian aboriginal Kakhetian pig. Based on the genetic systems of erythrocytical antigens, blood serum proteins, a number and morphology of chromosomes, the parameters of the skull structure (craniology) and the phenotypic features, it can be strongly suggested that the Kakhetian pig descended from the Caucasian population of European wild boar- Sus chrofa attila - through selective breeding in a process of the direct domestication. The results of our research including an amazing phenotypic similarity of the Kakhetian pig with its wild ancestor highly support the above suggestion. The Kakhetian pig farm was established with the purpose to reproduce this breed and provide both small family household farms and relatively large farms of the villages adjacent to fruitful forests located on the southern slopes of the Caucasus ridge, with piglets of the above breed. The first results of the Kakhetian pig breed recovery activities are presented in our research. In 2015-2017, the first slaughtering of Kakhetian pigs was carried out, which was followed by the drying of raw meat. The products of Georgian Hamon are already available on some Georgian markets. The conducted research has revealed four most prevalent pig helminthoses in Georgia. The study has shown that the Kakhetian pigs were less infected by helminthes when compared to the hybrid pigs, which can be suggestive of their relatively high resistance potential to these intestinal parasites.

Keywords: Pig, Immuno-genetics, Chromosome, Selection, Craniology, Helminthiasis.

*Corresponding author: Levan Ujmajuridze: E-mail address: l.ujmajuridze@yahoo.com

Introduction

The Kakhetian pig is unique, because during an entire year they can be kept in fruitful forests on the southern slopes of the Caucasus ridge, where they feed on forest fruits (rue, chestnut, nuts, wild pear, wild apple, medler, cornel, blackberry, hawthorn, barberry, currant, bilberry, etc.), resulting in the low cost and high quality delicious meat.

Over the years, a little attention has been paid to Kakhetian pigs. Due to this fact they have faced the threat of extinction. At present, investigations using selective breeding are underway in order to recover this breed, increase its reproduction and productivity, and to provide both small family household farms and large farms with its off-springs (piglets of the above breed).

The collaborative research of the SRCAG with the Spanish company "DERAZI iberico" is aimed at the promotion of the research on the Kakhetian pig, and at the production of the world famous brand Hamon and other meat products based on this breed in Georgia for local and international markets. The products of Georgian Hamon are already available on some Georgian markets.

The Kakhetian pig is almost identical to the wild pig. Hence, its breeding and rearing will facilitate the development of hunting farms and subsequently, sustainable hunting tourism in Georgia.

It should be indicated that one of the prerequisites, for the successful accomplishment of the targeted tasks, and for the production of the high

quality meat, is the rearing of healthy livestock. Therefore, alongside the implementation of disease control measures, it is necessary to determine the current epidemiological status of pig helminthiasis, without which the prevention of helminthosis will be impossible.

Materials and methods

The research object was a nomadic Kakhetian pig population. Its genetic and craniological studies were conducted with the commonly accepted methods (taking the measures of a skull and calculating the craniological indexes, determining antigenic and genetic frequencies in the genetic systems of blood groups, studying the number of chromosomes and morphological structure according to leukocyte analysis) [1-5] in the laboratory of Animal Immuno-genetics and Hybridization of the Institute of Cytology and Genetics (Novosibirsk) of the Siberian Division of the former Soviet Union Academy of Sciences and at the department of Animal Husbandry and Genetics of the Zootechnical-Veterinary Research Institute of Georgia.

For the experiments, the Kakhetian pigs were selected in their classical distribution zones only in the villages of Akhmeta and Dusheti municipalities (East Georgia). Presently, they are farmed in the experimental base of the SRCAG, where scientific research works are underway to increase their body mass and productivity. The consolidation of the breed and determination of the breed standards will provide the basis for determining of the gene pool of the Kakhetian pig.

For determining the epidemiological status of helminthiasis in pigs in Georgia, in 2014-2017, the scatological studies were conducted on pigs aged 4-10 months in both the small family household farms and the large farms. In these studies, the flotation method [6] was applied for the diagnosis of helminthiasis in the Kakhetian and hybrid pigs.

Results and discussion

As suggested above, the Kakhetian pig descended from its wild ancestor via the selective breeding in the process of direct domestication, and which is exhibited in its phenotypic similarities-including transversal stripes of newborn piglets,- with the wild ancestor and in the results of our studies on genetic and craniological patterns/indicators. In particular, , our experiments showed that erythrocyte antigen Ga from the genetic system G of blood groups was predominantly characteristic to the Kakhetian pig and the Caucasian wild pig, while in cultural breeds they occur less frequently [7-10].

Radically different data have been received regarding to a double-allele genetic system F of the blood groups. In particular, neither the Kakhetian pigs nor European and Caucasian wild pigs had an antigen - Fa, which indicates their great phylogenetic similarity. However, almost all individuals of the Asian pigs have an antigen – Fa on the erythrocyte membrane. The vast antigenic diversity and significant differences in gene frequencies were revealed with the genetic system E in some of the previous studies [11-15,].

It is known that a diploid number of the chromosomes of domestic pigs is 38, while the European wild boar has 36 or 38 chromosomes. According to our research, the Kakhetian pigs had 38 chromosomes, and the north and south Caucasian wild populations has 38 chromosomes – a karyotype identical to the one of the Kakhetian pig (out of 18 pairs of autosomic chromosomes, 9 pairs are submetacentric, 6 pairs – telocentric, 3 pairs – metacentric, and also 1 pair – sex chromosomes, 19 pairs in total). This indicator, along with the phenotypic similarity and transversal stripes in newborn piglets, is one of the proofs that the Kakhetian pig is descended by direct domestication of its wild ancestor [3-5]. The above assumption is supported by the results of the craniological study of different breeds of pigs (the skull structure, the shape and size of the lachrymal bone, a general shape, height, width and length of the skull) (Table 1).

Table. 1. *The measurements of skulls of South Caucasian wild, Kakhetian and Landrace pig breeds*

Skull measurements (mm)	Pig breeds					
	South Caucasian		Kakhetian		Landrace	
	♀ 4- year-old	♂ 6- year –old	♀ 5-year-old	♂ 4,5 – year-old	♀ 4-year-old	♂ 4-year-old
Total length	305	420	337	355	310	310
Basal length	269	363	299	316	287	294
Length of the brain part	78	108	82	89	84	83
Length of the facial part	227	312	255	266	226	227
Width between zygomas	127	152	154	161	167	191
Width between eye sockets	63	84	78	73	89	108
Length of the lower part of lachrymal bone	27	39	24,5	33	25	27
Height of lachrymal bone	21	27	20	22	23	25
Maximum length of a skull	184	220	192	195	238	266

As shown in Table 1, it is clear that a total length of the skulls of the Caucasian wild and Kakhetian pigs (420 and 355 mm respectively) significantly exceeds the one (310 mm) determined for the Landrace pig. Based on the analysis of the length and height of a lachrymal bone, we identified a form of the oblong parallelepiped on the skulls of the South Caucasian wild and Kakhetian pigs, while in Landrace pigs the skull shape appeared to be square. It was found that the height of the Landrace breed skulls (266 mm) exceeds the ones (220 and 195 mm respectively) that were determined for the South Caucasian wild and Kakhetian breeds. There are also significant differences between the craniological patterns of the skulls of the South Caucasian wild and the Kakhetian breeds and the ones of the skull of the landrace breed, that exhibit the phenotypic similarity between the South Caucasian wild and Kakhetian breeds. These similarities are further shown in the photo material as follows.

The Kakhetian pig is a late-maturing and low-productive animal. Its late-maturing and low productivity have been due to the direct domestication of this breed under extreme conditions. Its live weight is 100-110 kg, fertility - 5-8 piglets, body length - 100 cm, hearth girth - 100-105 cm, withers height - 65 cm, milk production - 25-30 kg, carcass yield - 63%. The above features allow the Kakhetian pig to be at the same level with cultural breeds; moreover, in some cases, it exceeds some other breeds [4].

In 2014-2017, in the villages of Kakheti and Mtskheta-Mtianeti regions, we explored the areas of Kakhetian pig distribution and condacted initial zoo-technical studies. Based on the obtained results, the typical individuals of the Kakhetian pig were selected, which were then transferred to the experimental farm, where currently the selective-research works have been underway. Currently, the experimental farm maintains 140 pigs of different ages.

In 2015-2017, the control slaughter of Kakhetian

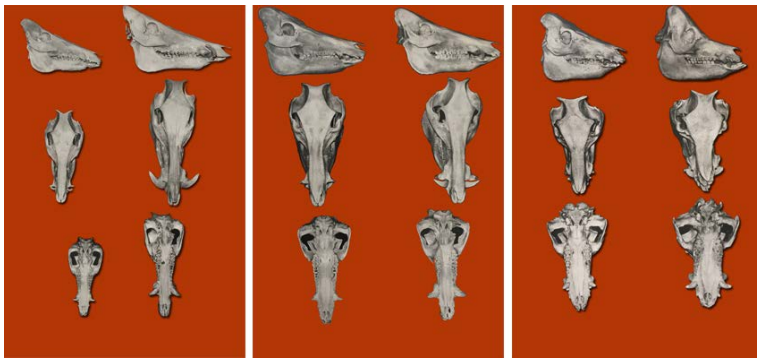

Fig.1. *Conidiogenous cells and conidia of Beauveria species. a-b B.bassiana; c-d B.pseudobassiana Molecular characterization of Beauveria spp.*

The skulls of the Kakhetian pigs are low, the profile - long and straight, while the skull of the Landrace breed is relatively high, the profile - short and bent.

It must be also indicated that newborn South Caucasian wild and Kakhetian piglets carry transversal stripes on their body, which disappear at the age of 3-4 months. The Kakhetian pigs can be characterized by a herd instinct, due to which they stay together on the pastures or in the forest. They have a well-developed ability to navigate and memorize their location. Occasionally, a few days before farrowing, a pregnant pig leaves the herd, choosing a dry place for farrowing on a hill that is usually covered with shrubs. After a certain period of time, together with piglets it returns to the herd, but sometimes, it chooses to stay in the woods and becomes wild.

pigs was held, which was followed by drying of raw meat. The process has been completed, and the first Georgian Hamon made from the Kakhetian pig breed is already available. At present, the third series of pig slaughter is planned and the production of other meat products alongside Hamon is intended.

In Georgia, pigs are kept in nomadic or semi-stationary conditions. In homestead farms, locals keep predominantly 2-3 pigs, which move around the settlement during the day. Such a practice bears a risk for acquiring and transmission of helminthiasis.

In the second half of the XX century, incidence and prevalence of helminthiasis in pig populations were studied in Georgia [6,17]. The results of our study, which was conducted to determine the epidemiological status of pig helminthiasis in the country, are shown in Table 2.

Table. 2. *Helminthiasis cases in populations of the Kakhetian and complex hybrid pigs in Georgia in 2014-2017*

Breed	District, country	Invest. (No.)	Infect .(No.)	% of Infect.	Among them							
					Asc	%	Oes	%	Tr	%	M et	%
Kakhetian	Telavi	13	7	-	0	-	7	-	0	-	0	-
	Akhmeta	135	54	40,0	3	2,2	50	37,1	2	1,5	2	1,5
	Tianeti	45	21	46,7	0	-	21	46,7	0	-	0	-
	Dusheti	21	13	61,9	2	9,5	13	61,9	0	-	0	-
	Gardabani	95	29	30,5	0	-	28	29,5	3	3,1	0	-
	Kvareli	10	7	-	0	-	7	-	0	-	0	-
	Total	319	131	41,1	5	1,6	126	39,6	5	1,6	2	0,6
Hybrid	Georgia	728	347	47,7	117	16,1	237	32,6	34	4,7	37	5,1
Total		1047	478	45,6	122	11,6	363	34,7	39	3,7	39	3,7

Invest. – investigated; infect. - infected
Asc – Ascarida; Oes – Oesophagostomum; Tr – trichocephalus; Met – Metastrongylus;
The percent of infection was not calculated when a number of the examined pigs was less than 15.

Our study revealed that in Georgia, the following four helminthiases predominate in the pig populations: ascaridosis, oesophagostomosis, trichocephalosis and metastrongylosis, - the agents of which had infected 45.6% of the animals investigated. It is noteworthy that mixed helminths predominate more in the hybrid pigs (47.7%) than in the Kakhetian pigs (41.1%). The most common helminthiasis was oesophagostomosis, which was observed in 34.7% of the pigs tested. The extensiveness indicators of infection of the hybrid and Kakhetian pigs with oesophagostomosis made 32.6% and 39.6% respectively. It was found that the Kakhetian pigs were less infected with ascaridas, trichocephalus and metastrongylus (1,6%, 1,6%, and 0,6% respectively) than hybrid pigs (16,1%, 4,7%, and 5,1% respectively).

After the control slaughter of the Kakhetian pig, the carcass of five pigs were examined by the trichinelloscopy method. No trichinellas were observed during the examination.

Conclusion

1. Double-allele genetic systems G and F of blood groups, these immuno-genetic indicators of North and South Caucasian wild and Kakhetian breeds are identical. The above two breeds have identical karyotypes - 38 chromosomes as well. In the European wild pig, karyotypes reflect either 36 or 38 chromosomes. These indicators, along with transversal stripes in newborn piglets, strongly suggest that the Kakhetian pig descended from its wild ancestor in a process of the direct domestication.

2. The shapes of skulls of the South Caucasian and Kakhetian pigs are similar. However, they are dramatically different from skulls of the Landrace pig. In particular, the skulls of South Caucasian wild and Kakhetian pigs are low with the long and straight profile, while the skull of the Landrace breed is relatively high with theshort and bent profile.

3. Our studies on the selection of pig populations allowed us to form a herd consisting of 140 typical Kakhetian pigs of different ages. First slaughters were carried and first Georgian hamon was produced.

4. In Georgia, the following four helminthiases predominate in the pig populations: ascaridosis, oesophagostomosis, trichocephalosis and meta-strongylosis.

It is suggested that the Kakhetian pigs are more resistant to these diseases than the hybrid pigs. This can be partially explained by the fact that the Kakhetian pig is more resistant, which, as we suggest, is due to the lifestyle and feeding habits of the above pig; the vegetation (rue, chestnut, nuts, wild pear, wild apple, medlar, cornel, blackberry, hawthorn, barberry, currant, bilberry, etc.) that they feed on in the woods must have some helminthicide properties establishing special environment negatively affecting helminths in the digestive tract

of a pig. However, more in-depth studies are needed to strongly support the above suggestion.

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