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REPRODUCTIVE ISOLATION AND AGE STRUCTURE IN THE NUCLEUS OF PURE ARABIAN HORSES FROM NATIONAL STUD MANGALIA

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Abstract

The elaboration of strategies in the field of conservation of animal genetic resources (and not only) had, have and will be based on genetic analysis studies. Without conducting these studies, it is practically impossible to develop management strategies for inbreeding or to develop effective breeding programs. In this paper we present two important indicators of genetic analysis in horse population and not only the reproductive isolation coefficient and the age structure. This parameter has a capital importance in animal breeding because there has a directly influence in animal population evolution. More than that, To be accepted as a population, a herd must fulfill four criteria: reproductive isolation, morphological and physiological differences, environmental requirements and genetic size. The reproductive isolation is the most important criteria for population because only reproductive isolated populations have an own evolution. Regarding the age structure, this parameter has a double importance: for exploitation (influenced directly average age), and on the other hand, for animal breeding (influenced the generation interval and population variability).

Key words*: Arabian horses, genotype, reproduction, structure.*

INTRODUCTION

This research is a part of an ample project concerning the genetic analysis (history) of Pure Arabian horses from Mangalia stud farm. An important part of animal genetic resources management it is represented by the genetic analysis studies. Only starting from this analysis, it is possible to elaborate strategies for inbreeding management (Maftei et al., 2011), and to obtain some breeders of high genetic value, with maximum genetic and economic efficiency (Maftei et al., 2022). In this study we analyze two important parameters of genetic analysis: reproductive isolation level and age structure. This parameter has a capital importance in animal breeding because has a directly influence in animal population evolution (Popa, 2009).

The population acceptance criteria are four: reproductive isolation, morphological and physiological differences, environmental requirements and genetic size (Popescu - Vifor, 1990). The reproductive isolation level is the most important criteria for population acceptance, the other three being in according to them (Draganescu, 1979). This parameter is very important because only reproductive isolated populations have an own evolution, in contrary they are influenced by evolving of immigrants populations (Maftei et al., 2004).

The age structure has a double importance: for exploitation because influenced directly average age, and on the other hand, for animal breeding because is influenced the generation interval and population variability (Marginean, 2012).

MATERIALS AND METHODS

The biologic material was represented by 12 sire stallions and 61 mares Pure Arabian horse breed (Tabel 1), representing the entire reproductive nucleus from National Pure Arabian stud farm Mangalia, at this time (September 2021).

The reproductive isolation coefficient was quantified using the follow relation, developed by Wright (Draganescu, 1979):

$$R.I.C. = \frac{AA - (AI + II)}{AA + AI + II}$$

where: AA - number of individuals accepted for reproduction in analysed interval with both autochthones parents; AI - number of individuals accepted for reproduction in analysed interval with one autochthone and one immigrant parent; II - number of individuals accepted for reproduction in analysed interval with both immigrants parents.

The age structure can be described by weight of different age categories from entire population (Marginean et al., 2005). The age structure is expressed in years.

RESULTS AND DISCUSSIONS

The values for RIC (reproductive isolation coefficient), for reproductive nucleus and also for parents and grandparents of individuals that are now in the reproductive nucleus of Pure Arabian horses from Mangalia stud, are presented in Table 2. The share of immigrant and native individuals is represented graphically, for the three generations analyzed, in Figures 1, 2 and 3.

The data presented in Table 2, reveal the fact that it has a large number of fathers (stallions) of individuals which have activated in reproductive nucleus at the time of this study, and also their grandparents because of the existence of overlapping generations and of the immigrants entered in the population, as it was shown in the past (Maftei et al., 2011).

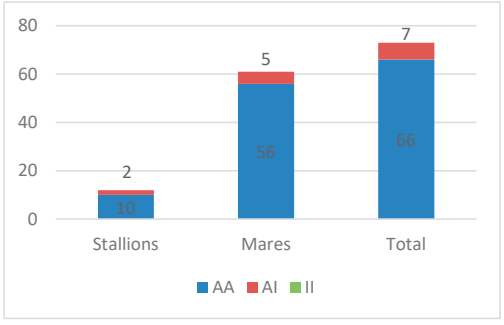

Figure 1. Share of immigrants and local individuals in the reproductive nucleus

Table 1. The biologic material

No.	Name	Sex	Spec.
1	HADBAN XXXVIII	M	AA
2	SIGLAVY BAGDADY XVIII	M	AA
3	GAZAL XX	M	AA
4	NEDJARI XIII	M	AA
5	MERSUCH XXVI	M	AA
6	SIGLAVY BAGDADY XIX	M	AA
7	MERSUCH XXVIII	M	AA
8	IBN GALAL III	M	AA
9	GAZAL XXIII	M	AA
10	HADBAN XL	M	AA
11	EL IMAN I	M	AI
12	CYGAJ IV	M	AI
13	833 CYGAJ 15	F	AI
14	834 SIGLAVY BAGDADY XIV - 54	F	AA
15	835 NEDJARI IX - 83	F	AA
16	837 SIGLAVY BAGDADY XIV - 52	F	AA
17	839 IBN GALAL II -3	F	AA
18	840 IBN GALAL II 4	F	AA
19	852 CYGAJ 42	F	AI
20	853 IBN GALAL II 18	F	AA
21	855 IBN GALAL II 26	F	AA
22	859 CYGAJ 59	F	AI
23	861 CYGAJ 62	F	AI
24	863 IBN GALAL II - 34	F	AA
25	879 HADBAN XXXVIII -13	F	AA
26	880 SIGLAVY BAGDADY XVIII - 11	F	AA
27	881 MERSUCH XXVI - 7	F	AA
28	882 IBN GALAL II - 51	F	AA
29	884 GAZAL XIX - 19	F	AA
30	887 HADBAN XXXVIII - 19	F	AA
31	889 MERSUCH XXVI - 11	F	AA
32	891 HADBAN XXXVIII - 26	F	AA
33	892CYGAJ I - 9	F	AA
34	896 NEDJARI XIII-17	F	AA
35	901 HADBAN XXXVIII - 29	F	AA
36	902 EL IMAN I - 33	F	AA
37	903 MERSUCH XXVI - 19	F	AA
38	905 GAZAL XIX - 25	F	AA
39	908 SIGLAVY BAGDADY XVIII - 27	F	AA
40	909 CYGAJ I-17	F	AA
41	910 GAZAL XIX - 31	F	AA
42	911 EL IMAN I - 35	F	AA
43	912 CYGAJ I - 15	F	AA
44	914 NEDJARI XIII-22	F	AA
45	915 EL IMAN I-42	F	AA
46	916 HADBAN XXXVIII-33	F	AA
47	917 GAZAL XIX-32	F	AA
48	918 EL IMAN I-46	F	AA
49	919 EL IMAN I-47	F	AA
50	920 GAZAL XX-33	F	AA
51	921 HADBAN XXXVIII-35	F	AA
52	922 NEDJARI XIII-28	F	AA
53	923 NEDJARI XIII-27	F	AA
54	924 SYGLAVY-BAGDADY XVIII-33	F	AA
55	926 HADBAN XXXVIII-36	F	AA
56	927 MERSUCH XXVI-31	F	AA
57	928 MERSUCH XXVI-32	F	AA
58	929 MERSUCH XXVI-30	F	AA
59	930 SIGLAVY-BAGDADY XVIII-37	F	AA
60	931 SIGLAVY-BAGDADY XIX-1	F	AA
61	932 MERSUCH XXVI-34	F	AA
62	933 CYGAJ 82	F	AI
63	934 MERSUCH XXVI-36 XISTA	F	AA
64	935 NEDJARI XIII-33	F	AA
65	936 NEDJARI XIII-35	F	AA
66	937 NEDJARI XIII-3	F	AA
67	938 SIGLAVY-BAGDADY XVIII-41	F	AA
68	939 SIGLAVY-BAGDADY XIX-3	F	AA
69	940 NEDJARI XIII-38	F	AA
70	941 GAZAL XX-43	F	AA
71	942 NEDJARI XIII-39	F	AA
72	943 EL IMAN I-51	F	AA
73	944 GAZAL XX-45	F	AA

The genetic persistence of immigrants individuals can be easily seen as a result of maintaining in population of a large percent of stallions and mares with one immigrant parent or even immigrants themselves.

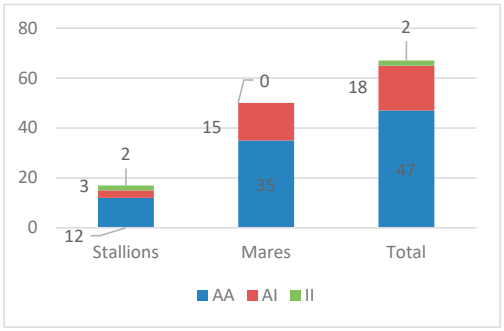

Figure 2. Share of immigrants and local individuals in parents of reproductive nucleus

The obtained values of reproductive isolation coefficient, give us the right to say that the Pure Arabian horses from Mangalia stud is still a population with an independent evolutionary path to other similar populations. Current number of sire stallions (RIC = 0.6667) with a big percent of autohtone stallions - both parents (N = 10) and only two stallions with one immigrant parent, plus the number of brood mares (RIC = 0.9107) that have a significant share of autohtone mares - both parents (N = 56) and only a small proportion (N = 5) with an immigrant parent, shows that population still maintain their own evolutionary way, but with clear genetic influence of populations from which come the immigrants (Germany, Egypt , Poland, etc.).

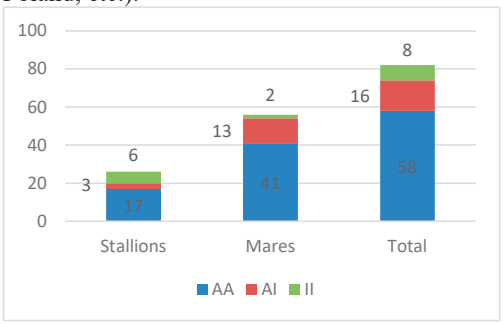

Figure 3. Share of immigrants and local individuals in grandparents of reproductive nucleus

The largest number of immigrants it was recorded in the generation of grandparents of RN (N = 8, 6 stallions and 2 mares), but it is easy to observe an evolution of reproductive isolation coefficient (Figure 4). We consider that the use of immigrant stallions it was made for the desire to expand the number of bloodlines.

Table 2. Reproductive isolation coefficient values

Specifications		No.	Immigrants (I)	Parents			R.I.C.
				AA	AI	II	
Reproductive nucleus (RN)	♂	12	-	10	2	-	+0.6667
	♀	61	-	56	5	-	+0.9107
	Total	73	-	66	7	-	+0.8082
Parents of RN	♂	17	2	12	3	2	+0.4118
	♀	50	-	35	15	-	+0.4000
	Total	67	2	47	18	2	+0.4030
Grandparents of RN	♂	26	6	17	3	6	+0.3077
	♀	56	2	41	13	2	+0.4643
	Total	82	8	58	16	8	+0.4146

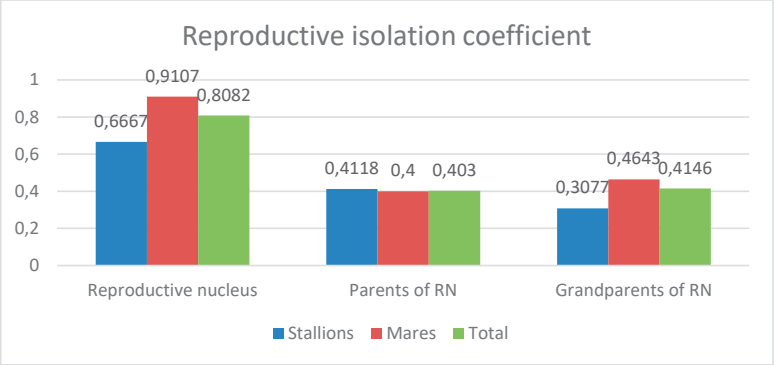

Figure 4. The dynamics of reproductive isolation coefficient

Table 3. Age structure in the reproductive nucleus of Pure Arabian horses from Mangalia stud farm

Sex	Total	Year of birth																										Average age
		1995		1996		1999		2000		2001		2002		2004		2005		2006		2007		2008		2009		2010		2011		
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
M	12	1	8.33	1	8.33	2	16.67			1	8.33	1	8.33							1	8.33			1	8.33			2	16.67	17.5
F	61	2	3.28	1	1.64	3	4.92	2	3.28	1	1.64	3	4.92	2	3.28	1	1.64	2	3.28	1	1.64	1	1.64	3	4.92	3	4.92	3	4.92	12.67

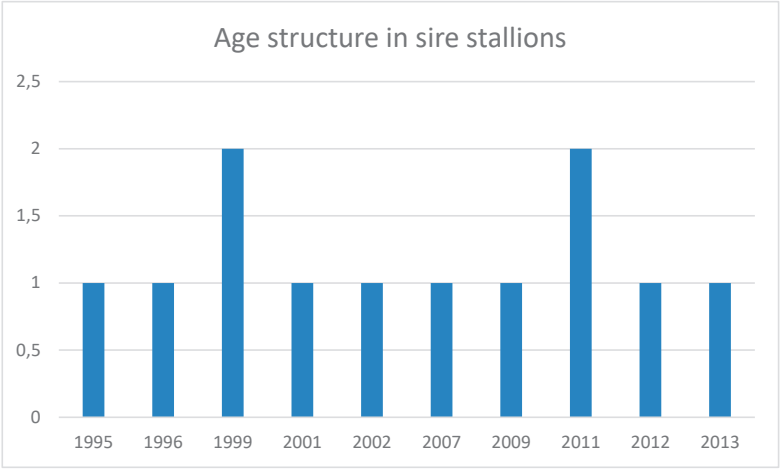

Figure 5. Age structure in sire stallions

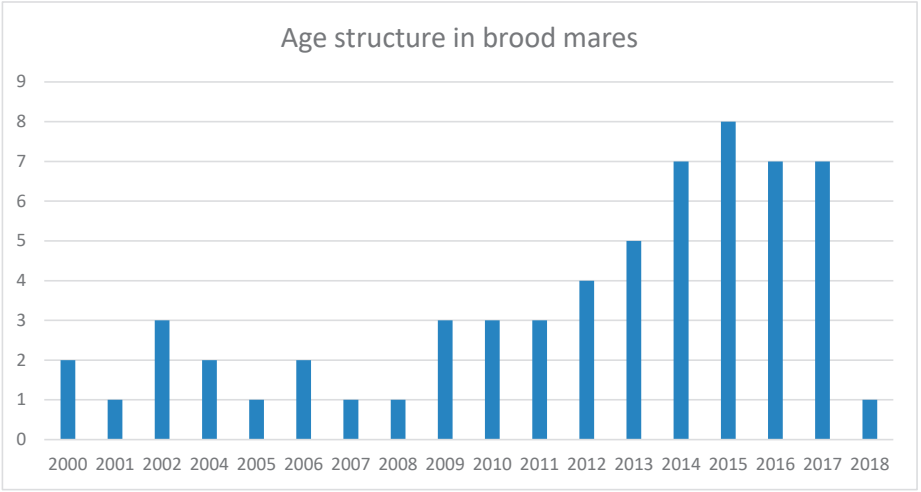

Figure 6. Age structure in the reproductive nucleus of Pure Arabian horses from Mangalia stud - broodmares

The age structure is presented in Table 3 and in Figures 5 and 6. It is obvious that we have here an unbalanced age structure. Age of stallions fluctuates between 9 and 27 years old, with an average age of 17.5 years old. In case of mares, due to the admittance in the reproductive nucleus to a significant number of young mares in the last years, the age structure can be more easily balanced than in the case of sire stallions. For broodmares the average age is 12.67 years old, with limit at 4 and 22 years old. All this age structure is not properly from genetically and economically.

CONCLUSIONS

The Pure Arabian horses from Mangalia stud is a population having his own evolution. The value of reproductive isolation coefficient has an ascendant trend which suggest that the desire of breeder was only to come with other bloodlines and maybe to "correct" some external characters or energetic.

Maintaining or continued use of immigrant stallions it is very possible to have a negative impact on the Pure Arabian horses from Mangalia stud because the evolution of the breed will be disturbed being influenced by the genetic influence of immigrant populations. In this case it will be possible to talk about the absorption process. And this would be inconceivable, and even shameful, given that the specimens of the Pure Arabian horses, bred in the Mangalia stud farm, are considered representative of the classic type of Arabian horse.

The age structure is improper for increasing genetic progress because is increasing the generation interval as following the existence of a significant share of old parents (in specially in the sire stallions rank). A half from the sire stallions are too old.

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TECHNOLOGIES OF THE AGRO FOOD PRODUCTS PROCESSING