

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Selection Of Volzhskaya White Breed Of Guinea Fowl By Gender-Related Plumage Pigmentation.

Vladimir A Zabaykin^{1*}, Aleksey B Trubyanov¹, and Tatyana V Zabaykina².

¹Mari State University, Lenin Square1, Yoshkar-Ola city, 424000, Russia.

²Expert and criminalistics center of Ministry of Internal Affairs for the Republic of Mari El, street Communist 16, Yoshkar-Ola city, 424000, Russia.

ABSTRACT

We studied the phenotype of volzhskaya white breed of guinea fowl plumage and developed techniques of improvement the accuracy of their sexation according to the strength of plumage pigmentation. We conducted analytical crossing in order to study the inheritance of differently colored plumage of existing breeds and populations of guinea fowl. Gender-related plumage bird groups were created among paternal and maternal lines of volzhskaya white breed of guinea fowl, the accuracy of visual determination of their sex is 96.1%.

Keywords: guinea fowl, gender-related plumage, sexing

**Corresponding author*

INTRODUCTION

Among the factors constraining the growth of guinea fowl production is late sexual maturity and low productivity of this type [1]. Sexual maturity of guinea fowl comes at the age of 8-9 months. However, before puberty male and female guinea fowls do not differ in development of exterior and live weight [2]. The absence of effective methods of their separation by sex at an early age is a restraint, affecting the economics of breeding the volzhskaya white breed of guinea fowl created in the Mari El Republic. The cloaca separation method of guinea fowl on sex designed in All-Russian Scientific Research and Technological Institute of Poultry allows dividing the birds of this type into males and females at an early age, but it is quite time-consuming, and the accuracy of sexing depends on the age and skill of the operator [3]. Therefore, there is a necessity to explore the development of new methods of determining the sex of guinea fowl at an early age and to determine the relationship of birds' sex with genes, which control the amount of pigmentation deposited in the plumage.

MATERIALS AND METHODS

The work was carried out on the guinea-fowl breeding grounds of poultry farms "Volzhskaya" (1989-1994) and "Akashevskaya" (1995-2002) of the Mari El Republic. The research was conducted on volzhskaya white breed of guinea fowl of one-day age till the age of 34 week. The coloring and plumage pigmentation were evaluated at the age of 1 day and 12 weeks. The degree of pigmentation coloring of the down and feather was determined visually with a specially developed scale. We evaluated the intensity of plumage on head, back, abdomen, wings and tail. The reproduction of the bird was held in individual cells using artificial insemination. In each group of crossbreeding there were formed from 3 to 10 nests in the sex ratio 1:4. All one-day guinea fowls involved in the experiment were ringed with marks containing the information about the origin of their father and mother. From 500 to 6000 birds were estimated yearly. Basic assessment of the guinea fowl phenotype was conducted in 2 replicates. In 1989, before the beginning of focused selection based on gender-related plumage, and in 1999, after 10 years of selection of birds on this principle.

Eggs of pure-bred guinea fowl of colored populations and breed, such as gray-speckled (gs), zagorskaya white-breasted (zw), blue-white-breasted (bw), and cream (cr) guinea fowl of selection of All-Russian Scientific Research and Technological Institute of Poultry, were delivered from Experimental Breeding Farm of All-Russian Scientific Research and Technological Institute of Poultry in Sergiev Posad of Moscow region to "Akashevskaya" poultry farm for analytical crossing of differently colored guinea fowl. Volzhskaya white breed of guinea fowl (vw) selected by Mari State University was used as an experienced bird.

RESULTS AND DISCUSSION

During the study of volzhskaya white breed of guinea fowl phenotype, it was noted that plumage coloring ranges from almost white to light brown. Differences in color intensity were noted as at one-day guinea fowl in down pigmentation so at adult birds in the color of the feather. Meanwhile there are individuals in the herd with varying degree of pigmentation of the down and feather - weak, medium and strong.

The division of one-day guinea fowl by the color of down was the following: 35.0-37.2% of which had weak pigmentation, 34.2-37.6% had strong pigmentation, 25.6-29.9% had medium pigmentation. To determine and check the sex 30 birds from a group were killed. It was found that there is a relation between the degree of down pigmentation and the sex of poultry. In 77.0-80.0% cases individuals with weak pigmentation were males and in 83.0-87.0% birds with strong pigmentation were females. In the group of guinea fowl holding intermediate position by the down coloring, males and females were about the same number.

Subsequently, sex of the remaining baby guinea fowl was determined at the age of 12 weeks by the presence or absence of penis. The majority of young birds (85.7-90.7%) with weak pigmentation were males and on the contrary, those with strong pigmentation (84.6-89.0%) were females. In the group with intermediate intensity of feather pigmentation as well as in the first case there was approximately an equal number of males and females.

In general, on the studied groups, the sexation accuracy of one-day guinea fowl by the intensity of feather pigmentation was not high and amounted to 63.0-67.0%. Errors in the definition of sex were caused by the presence of significant (up to 29.0%) number of individuals classified as intermediate group with medium pigmentation. At the same time, separation accuracy of guinea fowl at the age of 12 weeks into males and females based on the coloring reached 79.0-81.0%. Nevertheless, it can not be called high. The further selection of the birds was necessary. We performed reciprocal crossing of birds with different coloring to develop the methodology for increasing gender-related plumage of volzhskaya white breed of guinea fowl. There were formed four groups of guinea fowl. In the first group of crossing mid-pigmented females were inseminated with sperm obtained from slightly pigmented males. In the second group of females were strongly pigmented and males were weakly pigmented. In the third group was crossed males and females with medium degree of feather pigmentation. The fourth group consisted of males and females with strong pigmentation. Offspring evaluation results obtained from all the groups of guinea fowl are presented in the Table 1.

Table 1: Offspring plumage coloring resulting from mating experimental groups

Crossing groups	Bird sex	Offspring plumage coloring					
		Weak		Medium		Strong	
		Total number	%	Total number	%	Total number	%
1	Males	177	39.6	37	8.4	8	1.8
	Females	9	2.0	43	9.6	172	38.6
2	Males	198	42.8	35	7.5	3	0.6
	Females	4	0.7	33	7.1	191	41.3
3	Males	170	38.7	46	10.5	8	1.8
	Females	9	2.1	55	12.5	151	34.4
4	Males	186	41.3	45	10.0	5	1.1
	Females	6	1.3	43	9.6	165	36.7

The analysis of the crosses showed that in these groups some differences in the coloring of offspring's plumage depended on the degree of pigmentation of their parents' feather. The largest number of birds with strong and weak pigmentation was in the second group of crossing - 41.9 and 43.5%, respectively. In this group of crossing there were only 14.6% of individuals with medium degree of feather pigmentation (intermediate subgroup). Thus, in all groups, regardless of parents plumage pigmentation most descendants with weak pigmentation were males (94.7-98.0%) and those with strong pigmentation were females (94.7-98.4%). Among individuals with medium degree of feather pigmentation the number of males and females was roughly equal (46.5-53.5%). The accuracy of separation of guinea fowls into males and females based on the degree of feather pigmentation reached 78.2% in the first group, 84.1% – in the second, 73.1% – in the third, and 78.0% – in the fourth group of birds. The difference in comparison with the group in which both parents had medium degree of pigmentation was 11.0%. If only one of the parents (father or mother) had a medium degree of pigmentation the difference was 6.0%.

To understand the mechanism of inheritance and nature of plumage coloring of this bird species we have conducted analytical crossings of several differently colored breeds and populations of guinea fowl.

The work consisted of three stages. At the first stage we have conducted crossing and backcrossing of guinea fowls (F-0) of different color populations. At the second stage we had picked up the bird from the descendants of F-1, collected from all types of crossings, but with a feather coloring characteristic for one of the parents' phenotype. All the birds used at the second stage of crossing were heterogeneous in plumage coloring. At the final stage we carried out crossings of hybrids of the second generation (F-2) with each other. We used the guinea fowl received from all the types of crossings in F-2, but only those which had feather coloring like that of volzhskaya white breed. The data obtained are presented in Table 2, 3 and 4.

Table 2: Inheritance of plumage coloring by descendants (F-1) as a result of colored guinea fowl crossing

Crossing type	Number of received guinea fowl	Guinea fowl feather coloring %			
		gray-speckled (gm)	zagorskaya white-breasted (zw)	blue-white-breasted (bw)	volzhskaya white (vw)
1 (vw x gs)	32 (12)	68.7 (100.0)	0.0 (0.0)	0.0 (0.0)	31.3 (0.0)
2 (gs x vw)	165 (27)	64.2 (63.0)	0.0 (0.0)	0.0 (37.0)	35.8 (0.0)
3 (vw x zw)	54 /133/	22.2 /31.0/	55.5 /68.1/	1.9 /0.0/	20.4 /0.9/
4 (zw x vw)	100 /73/	17.0 /45.2/	53.0 /41.2/	9.0 /0.0/	20.0 /13.6/
5 (bw x vw)	152 (21)	0.0 (42.8)	25.6 (0.0)	46.1 (47.6)	28.3 (9.6)
6 (vw x bw)	105 (14)	0.0 (21.5)	40.0 (0.0)	30.5 (78.5)	29.5 (0.0)
7 (zw x bw)	18	0.0	38.9	16.7	44.4
8 (bw x zw)	15	0.0	46.7	0.0	53.3
9 (gs x bw)	26 (17)	15.4 (100.0)	61.5 (0.0)	0.0 (0.0)	23.1 (0.0)

Note. The results obtained by Weizmann L.N. [4] are given in parentheses; in oblique –by Gromov A.M.[5] from the same types of crossing at the floor maintenance.

As it can be seen from the data the crossings (F-0) give mainly the same results of segregation. It was found that in all types of cross-breeding the offspring of hybrids of the first generation split on the basis of feather coloring into 3-4 types. All color forms of guinea fowl give complex polyhybrid segregation after crossing, while most of obtained hybrids have traits of intermediate character. After phenotypic evaluation of guinea fowl we revealed that some of the birds (9.5%), which we had referred to the gray-speckled population had 2-3 white flight feathers and a small amount of white feathers on the chest. This bird was mainly allocated in the 1 and 2 types of crossing. In our view, the guinea fowl with such a phenotype, called "piebald" by the definition of L.N. Weizmann, could serve as a starting material for producing the population of birds like zagorskaya white-breasted.

Table 3: Inheritance of plumage coloring by descendants (F-2) as a result of colored hybrid guinea fowl crossing

Crossing type	Total number of birds	Gray-speckled (gs)		Zagorskaya white-breasted (zw)		Blue-white-breasted (bw)		Vozhskaya white (vw)	
		Birds	%	Birds	%	Birds	%	Birds	%
1 (gs x gs)	450	297	66.0	15	3.3	16	3.6	122	27.1
2 (zw x zw)	361	97	26.9	121	33.5	55	15.2	88	24.3
3 (vw x vw)	205	0	0.0	12	5.9	144	70.2	49	23.9

Table 4: Inheritance of plumage coloring by descendants (F-3) as a result of white hybrid guinea fowl crossing

Crossing type	Total number of birds	Gray-speckled		Zagorskaya white-breasted		Blue-white-breasted		Volzhskaya white	
		Birds	%	Birds	%	Birds	%	Birds	%
1 (vw x vw)	308	-	-	-	-	-	-	308	100.0
Including		With plumage coloring like the type «volzhskaya white»						164	53.2
		With plumage coloring like the type «french cream»						144	46.8

It should be noted that the area of white feather on the chest and abdomen of descendants with blue feather coloring had enlarged, especially of individuals obtained as a result of crossing of volzhskaya white males and blue females. Among guinea fowls, which are referred by coloring to Zagorskaya white-breasted (3-4, 7-8 types of crossing), in most cases inter-population crossing had led to reduction of the area of white feather by 1/3.

The data presented in Table 3 show that there is an excision of new phenotypes from the descendants of F-2 in all types of crossings. While in group 1 (gsx gs) the proportion of the descendants of F-2, excised from the gray-speckled (66.0%) and the volzhskaya phenotype (27.1%), almost coincided with those of groups 1 and 2 in F-1 - 68.7% of gray-speckled and 31.3% of volzhskaya. The existing difference in 2.7 - 4.2% (6.9%) is almost equally distributed in F-2 among the descendants of "intermediate" feather color – the Zagorskaya white-breasted and the "blue." In the 2 and 3 groups of crossing, a similar pattern of splitting was observed - the lighter (in the share of white feathers and feather pigmentation) parents formed a couple, the less dark descendants segregated (in the share of gray-speckled feathers and feather pigmentation). Individual phenotypic evaluation of guinea fowl showed that some guinea fowls (16.5%) referred by us in feather coloring to gray-speckled population after juvenilemolting produced 2-3 white pen-feather on the wing, and a small amount of white feathers on the chest. Some part of the blue guinea fowl (30.8%) enlarged the area of white feathers on the chest and abdomen in comparison with their parents (P). An area of white feathers of other blue guinea fowl (9.5%), whose parents were obtained by crossing gray-speckled and the blue bird (P), on the contrary decreased. Also it should be noted that there appeared individuals who had completely blue with no white areas plumage, the share of such birds was 25.4%. The phenotype of the remaining blue guinea fowl corresponded to the parent's one (P).

As a result of crossing of the white hybrids (Table 4) darker descendants did not excised. However, among the obtained offspring (F-3) almost half of the guinea fowl had a feather coloring characteristic to cream guinea fowl of All-Russian Scientific Research and Technological Institute of Poultry breeding (no stripes on the head and back). We did not use the guinea fowl of this population in any of the crosses conducted. Obviously, the "white-cream" guinea fowl have complex nature of plumage coloring, being heterogametic on this basis rather than a "recessive mutants". Apparently, along with genes of feomelanin color of *S* and *s* they carry genes of eumelanin color of *e +*, repressed by a certain number of color attenuating genes. The fact that assessment scale of down and feather pigmentation, developed in 1995 on the Volzhskaya white breed, have been applied to the cream guinea fowl of All-Russian Scientific Research and Technological Institute of Poultry selection, is also affirmed, it means that the cream guinea fowl are is also gender-related plumage in feather coloring.

CONCLUSION

On the based of data obtained during conducting analytical crossings we developed a method of selection of the volzhskaya white breed of guinea fowl, aimed at improving gender-related plumage. According to the proposed method, pairs were chosen considering the degree of plumage pigmentation. For the reproduction of the herd we used males with weak and females with strong degree of feather pigmentation. The obtained off spring were bred "in them self." The bird with intermediate plumage coloring was a subject to culling. In the first year of assessment (F0), the number of birds with an intermediate degree of feather pigmentation was in average 14.6% in the lines, in F5 it was 12.1%, and in F10 it was at level of 4.9%. Reduction of number of individuals with intermediate plumage coloration was due to culling of off springs produced from heterozygous in this trait parents. Birds were culled from the herd, regardless of their level of productivity.

The result of bird selection on the degree of feather pigmentation is improvement of sexation accuracy. So, if at the beginning of the work (F0) the birds exation accuracy was 84.3%, after selection conducted the descendants F3 were shared with an accuracy of 87.0%, the offspring F5 – 91.8%, and F10– 96.1%.

Based on the results of the research, we can assume that this kind of bird has a complex polygenic nature of plumage inheritance caused by the mutual action of wild eumelanin *e + / e +* and feomelanin *S / s* genotype. The fact is also affirmed that the guinea fowl have color attenuating genes, part of which at the white and cream guinea fowl is consolidated in sex chromosomes and works as non-allelic modifier genes and determines their gender-related plumage on the degree of down and feather pigmentation. At the same time, they play the role of pigmentation amplifiers in sex chromosomes of females, and color attenuators – of males. Their joint action in heterogeneous (on this basis) individuals leads to an intermediate degree of feather pigmentation.

For reproduction of created gender-related plumage groups of the volzhskaya white breed of guinea fowl, it was recommended to use only weakly pigmented males and strongly pigmented females, which are homozygous on the basis of feather pigmentation.

REFERENCES

- [1] Gromov, A.M. & Guseva N.K. Inheritance plumage color of guinea fowl at hemehybridization. Russia journal of poultry 1974; 2: 39.
- [2] Kogan, Z.M. (). Traits of the exterior and interior of hens. Novosibirsk: Nauka 1979: 158-228.
- [3] Royter, Ya.S., & Guseva N.K. Sexing guinea fowl. Russia journal of poultry. N 1978; 9: 36-37.
- [4] Weitzman, L.N. Features of sexual dimorphism in guinea fowl. Proceedings of the Institute of Genetics of Academy of Sciences of the USSR 1952; 19: 271-278.
- [5] Weitzman, L.N. Inheritance plumage color of guinea fowl Siberian population. Russian journal of genetics 1972; 98: 166-167.
- [6] Weitzman, L.N. The role of "hemehybridization" in creating Zagorskaya white-breasted guinea fowl. Russian journal of genetics 1975; 11: 155-159.
- [7] Zabiyaikin, V. A. The results of volzhskaya white guinea fowl selection for autosexing. Archiv fur geflugelkunde: Special Issue September 2002-11th European poultry conference "European Poultry Science Revue de Science Avicole Europeenne" - Bremen, Germany, 2002: 97.