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IMPROVEMENT AND CREATION OF NEW GENOTYPES OF DUCKS IN THE NORTH OF KAZAKHSTAN BASED ON THE USE OF DNA TECHNOLOGIES

ANNOTATION

For years, poultry scientists have faced the challenge of preserving farm poultry. It was especially acute with the transfer of poultry farming to an industrial basis, which led to the creation of highly productive specialized lines and crosses of poultry for the production of eggs and meat from limited genetic material.

Genotype selection has advantages over traditional methods. It does not take into account the variability of economic characteristics due to the external environment, making it possible to evaluate the bird at an early age, regardless of gender, and ultimately increases the efficiency of breeding work.

This is confirmed by the results of scientific studies in which the following indicators are reflected: egg weight, control laying of eggs for incubation; biological control during incubation; fertilization and hatchability of eggs of the dynamics of live weight of young animals (from 1 to 7 weeks) and adult birds; preservation of poultry livestock; feed costs per unit of live weight.

This article presents the results of studies conducted to improve and create new genotypes of farm animals on the ducks of crosses of the northern region of Kazakhstan, based on the use of the achievements of DNA technologies in breeding showed genetic similarities and differences of the studied crosses.

Key words: *duck, line, cross, live mass, DNA, productive indicators, genomes.*

Introduction. Selection is one of the central problems of all modern biology, and the development of fundamentally new modern techniques for improving artificial selection methods in the selection process when creating new breeds of farm animals and birds would increase the efficiency and profitability of agricultural production [1].

The rapid development of molecular genetic research methods has led to notable advances in the study of animal genetics and their genome. Due to this, large-scale studies on the evolution of species and microevolution of breeds are being carried out, as well as programs are being developed to study and preserve genetic resources in animal husbandry [2].

The most important elements of the selection are the selection of producers with a high genetic potential of productivity, a clear organization of their assessment by the quality of offspring, and the rapid reproduction of offspring of the identified improvers [3].

Improving new types of farm animals and assessing breeding value based on the use of advances in DNA technology in breeding is considered the most important approach. DNA single-nucleotide polymorphism analysis reveals rational genotypes. This approach is the main research approach in this research work, with the studied agricultural animals, in particular, the mother line of ducks “Kyzylzhar”, displayed at the “Bishkulskaya poultry farm” LLP located in Beskol village, North Kazakhstan region.

Currently, research using DNA technology in duck breeding is widely studied worldwide, including single-nucleotide polymorphism (SNP) analysis is considered the main research method. As an example, numerous world studies can be cited, in 2023, scientists Yang Shi (Yang xi) published their research paper entitled “Identification of the genetic basis of the duck growth rate in multiple growth stages using genome-wide association analysis”, which studied how many genes affect the growth rate of ducks using genomic analysis determined by the method of analysis of single nucleotide polymorphism (SNP), body growth is a complex physiological and biological process that is influenced by many factors, as well as the control and behavior of certain genes. The study identified 3 different genotypes from 3 genes: ASAP1 (Chr2: 11483045 C > T), CABYR (Chr2: 43644612 C > T), and LYN (Chr2: 42508231 G > A). Based on the results of the study, it was proved that the aforementioned genes are important candidate genes affecting the growth rate of ducks [4,5, 6, 7].

Genetic improvement of farm animal and bird populations includes addressing such issues as zonal selection based on the planning of the breeding process.

Today, for modern poultry farming, entirely based on the production of hybrid poultry, based on the use of the effects of heterosis (overdomination), it is extremely important to create genetically different parental lines. This is quite difficult, especially in cases where the selection material phenotypically (according to the external observed signs of the organism) differs little. The intensification of poultry farming has led to the widespread distribution of birds belonging to a relatively limited number of breeds and crosses. Thus, the breeding resources of the management of the Republic of Kazakhstan are represented mainly by various crosses, lines and populations of the Peking breed (classical breed of the meat direction), and in separate breeding farms in conditions of a closed herd, their economic populations and lines are created [8, 9, 10, 11].

In Northern Kazakhstan, there is little data on the use of specific breeds, lines, and crosses of poultry in production, their conditions of keeping, feeding, breeding, etc. Almost all breeds, crosses, and lines used in poultry farms in the region are used arbitrarily without comparing the economic efficiency and adaptability of these groups of birds to local conditions.

The bird required to determine the new line of ducks was selected according to zootechnical indicators, and 100 biological materials were taken from them (100 blood samples from ducks, 1.5 ml of each sample), DNA was isolated from the samples, the quality of DNA was checked, and DNA was extracted and genotyped.

Materials and methods of research. Selection of the maternal line of ducks is carried out in the direction of increasing fecundity, taking into account feed costs per unit of production with standard parameters of live weight at 49 days of age (2.7-3.0 kg - ducks and 2.9-3.1 kg - drakes), the percentage of ducklings hatching, the growth rate of linear and hybrid young animals and its preservation until 7 weeks of age. During operation, special attention is paid to the consolidation of the plumage color within the line.

The following productivity indicators are studied during the work:

1. Live weight and growth dynamics of young animals aged 1-7 weeks. It is determined by weekly, individual weighing of the studied livestock.

2. The live weight of an adult bird by random sampling is not less than 10% of the total livestock to control the bird’s growth and development.

3. Preservation of young animals. The ratio of the surviving livestock to the ducklings originally adopted for cultivation, expressed as a percentage, was determined (for young animals, from daily to 7 weeks of age).

4. Preservation of the adult bird. It is determined by the ratio of the fallen to the livestock transferred to the adult herd, expressed as a percentage.

5. Puberty. It is determined by laying the first egg for each laying, and in general, along the line.

6. Egg production. It is taken into account individually for each laying line, in other genetic groups of the bird, by the ratio of gross egg collection for the entire period to the initial number of laying hens.

7. Egg mass. It is taken into account by individually weighing eggs for 5 days in a row.

8. Hatching eggs yield. It is determined by the ratio of eggs suitable for incubation to gross harvest.

9. Egg fertilization. It is calculated by the ratio of fertilized eggs selected by the ovoscopy method to the number of eggs laid per incubation, expressed as a percentage.

10. Egg hatchability. It is calculated by the ratio of the number of healthy ducklings obtained to the number of fertilized eggs laid on incubation, expressed in percent.

11. Young withdrawal. It is determined by the ratio of bred healthy ducklings to the number of eggs laid on incubation, expressed in percent.

12. Feed costs per unit of production are calculated by the ratio of the amount of feed consumed per unit of production.

The material used to isolate DNA was 100 duck blood. Whole blood samples from the ducks were collected in Vacutainer tubes containing an anticoagulant and stored frozen at - 20 °C.

Blood was taken from the under-wing vein into a disposable syringe (1-5 ml). From the syringe, the blood was carefully (without foam formation) transferred to a disposable plastic tube containing an anticoagulant (3.8% Na citrate solution, in a volume ratio to liquid blood of 1:9).

Heparin was not used as an anticoagulant because it inhibits PCR. The closed tube with the contents was gently mixed (by flipping it several times). Samples were stored in the refrigerator at + 4^0C. for up to 60 days, longer periods at – 20 ^{0}C.

DNA was isolated according to the recommendations of the manufacturer of the DNeasy Blood & Tissue Kit (Qiagen). For blood samples, 10 μl of whole blood was digested for 10 min at 56 °C in 200 μl of AL buffer and 20 μl of proteinase K solution (Qiagen).

The test samples were then purified in DNeasy Mini spin columns (Qiagen). Finally, genomic DNA was eluted in 200 μl AE buffer (Qiagen).

The purity of the isolated DNA was determined by absorbance factors of 260/280 and 260/230 determined by spectrophotometry (Nanodrop 2000 spectrophotometer, Thermo Fisher Scientific) using 1 μL of each sample, measuring the absorbance of DNA extracts at 260 nm, checking for protein impurities at 280 nm. 1 R.P. at 260 nm corresponds to 50 g/ml DNA. Samples were stored at -20 °C until sequencing. The isolated DNA was also visualized by electrophoresis on a 1.0% ethidium bromide-stained agarose gel.

Using the amplification method (i.e. multiplication in the number of copies) of polymorphic DNA fragments, it is possible to characterize the genetic structure of both an individual and a line, population, and breed as a whole [12, 13, 14, 15].

The method of amplification of polymorphic DNA regions can reveal the degree of genetic differentiation of breeds and breeding lines. It should be borne in mind that, along with selection based on the use of heterosis from crossing combined lines of the same breed (incrossing), specialized lines of different breeds (incrossbreeding) are increasingly used for these purposes. In the course of the formative process, strict selection is carried out for many signs at once, covering almost the entire phenotype of the animal. In addition, the creation of new lines with a certain set of productivity features and well adapted to the requirements of zonal selection is possible only with a combination of lines selected in different directions of development of productivity features [16, 17, 18, 19].

Molecular characterization may play an important role in unlocking the history, assessing diversity, identity, and population structure of animal genetic resources. It can also help to avoid excessive inbreeding when genetically managing small populations [20, 21].

Results and their discussion. The research was carried out at “Bishkulskaya poultry farm” LLP. The objects of the study were populations of waterfowl of a collection herd of poultry farms in the Northern region of Kazakhstan.

Daily ducklings of cross ducks “Bishkulsky” and “Ansar” were kept in one poultry house from daily to 15 days of age in cell batteries of type KBU-3 and KBE-1, from 15 days to 49 days of age on a deep litter. Containment conditions, planting density, feeding and watering front, and microclimate parameters were the same in all groups.

To lay a line of ducks, families with high egg production (peak size and egg laying stability), viability, and hatchability of eggs are used as maternal forms.

These waterfowl are capable of carrying eggs year-round. The only exception is the molting period, which takes place 2 times a year: in summer (June - July), when the tail feathers fall out, then small, and the flight feathers are renewed; in autumn (September - October), when only the tail and small feathers are updated. During molting, it is important to provide the bird with special care, since during this period, they are most prone to diseases.

In order for egg production in laying ducks to begin promptly and develop normally, they must be prepared for this period. The quality of masonry is influenced by the duration of daylight hours, indoor microclimate, and good nutrition.

Preparation began 2 weeks before the expected onset of egg production. Daylight hours are at least 10 hours and up to 16 hours; in the poultry house, the temperature was up to 15^0C. Control weighing was carried out (the laying head should weigh at least 2.7 kg, and not more than 3 kg). Fatness is average. Plumage without any flaws: smooth, dense.

To obtain quality hatching eggs, the spleens were prepared. They were also subjected to careful selection. The pattern of behaviour was not to be aggressive, obese, or malnourished. For the formation of the maternal line, spleens of lower weight were chosen - 2.9 kg.

Early egg production does not bring positive results, usually a poor quality incubation product that does not meet the requirements of poultry farmers. In masonry, small specimens with a meager supply of nutrients are observed, which are not enough for normal fetal development.

Late masonry is also not desirable because chicks appear with good immunity, and they develop muscle mass well. But the egg production and quality of incubation material in such offspring are low. After a year of life, the duck carries high-quality eggs, grows healthy offspring. A year later, egg production is declining, the volume of masonry is reduced by 5-10%. By 5-6 years of age, the bird reaches a minimum value.

Eggs were collected for incubation from the “Bishkulsky” and “Ansar” crosses (selected for further research) of the waterfowl population of the herd of the basic farm (“Bishkulskaya poultry farm” LLP).

According to the incubation results (Table 1), the average number of eggs laid under study was 4263, 6 pieces, egg fertilization was 73%, and hatchability was 66.7%. The incubation rates are increasing, taking into account the fact that these are indicators of the initial oviposition period. The highest intensity (peak of oviposition) occurs for 2-3 months of oviposition, then the intensity begins to gradually decrease, when 50% of the intensity of oviposition is reached, the economic effect of the content of laying ducks is minimal, and they require replacement.

Table 1 – General results of egg incubation based on “Bishkulskaya poultry farm” LLP

№ i/si	Quantity laid egg, pcs.	Mirage			Fertilization, %	Hatchability		Conclusion
		waste, pcs.	%	quantity, pcs.		Heads	%	%
1	3276	2401	73,3	875	26,7	450	51,4	13,74
2	2503	1417	56,6	1086	43,4	688	63,4	27,49
3	2778	1389	50,0	1389	50,0	986	71,0	35,49
4	3085	1196	38,8	1889	61,2	1388	73,5	44,99
5	4206	1435	34,1	2771	65,9	2220	80,1	52,78
6	4131	1120	27,1	3011	72,9	no		
7	4540	991	21,8	3549	78,2	no		
8	4227	753	17,8	3474	82,2	2655	76,4	62,81
9	4272	726	17,0	3546	83,0	2420	68,2	56,65
10	4014	546	13,6	3468	86,4	2160	62,3	53,81
11	4360	586	13,4	3774	86,6	2524	66,9	57,89
12	4055	540	13,3	3515	86,7	1831	52,1	45,2
13	4570	706	15,4	3864	84,6	no		
14	5912	705	11,9	5207	88,1	4067	78,1	68,8
15	6271	715	11,4	5556	88,6	4119	74,1	65,7
16	6017	964	16,0	5053	84,0	2510	49,7	41,7
$\bar{x}$	4263,6	1011,9	27,0	3251,7	73,0	2155,2	66,7	48,2

The number of eggs laid by a female in a certain period of time is called egg production. This is the main selectable trait and a decisive indicator of egg productivity not only of egg birds (egg breeds of ducks - alabio, Indian runners, etc.), but also of meat birds, as it determines its fertility, i.e. ultimately the amount of meat obtained from the offspring of one female. Egg production in birds begins from the moment of puberty. The age of puberty in females is considered the day of laying the first egg, in males - the day of obtaining mature sperm. The age at which the first egg is laid most closely matches the biological meaning of sexual maturity. When characterizing groups of birds, age is used as a criterion of sexual maturity and homogeneity, in which egg laying capacity of this group reaches 50% in two adjacent days. Puberty in ducks based on "Bishkulskaya poultry farm" LLP came on day 196. The average egg production of ducks was 226.9 eggs per initial laying.

In this case, ducks with age, as a rule, reduce egg production by 10-15%. The overall dynamics of egg production and egg laying intensity of the "Bishkulsky" and "Ansar" crosses (selected for further research) are presented in Table 2.

Table 2 – Dynamics of egg production and intensity of duck population laying at "Bishkulskaya poultry farm" LLP

Age, days	Cross			
	Bishkulsky		Ansar	
	egg laying intensity, %			
	to the initial bearing	to the middle bearing	to the initial bearing	to the middle bearing
196-226	66,5	66,7	66,3	66,5
227-256	84,8	86,7	90,0	91,6
257-286	80,2	83,7	84,4	86,8
287-316	78,7	83,1	81,3	84,6
317-346	76,2	83,7	87,6	92,5
347-376	74,1	85,6	87,1	82,8
377-406	69,1	82,6	81,0	87,5
407-436	65,5	81,0	76,8	83,6
437-466	61,0	78,3	77,1	84,2
196-476	72,3	81,0	81,0	85,4
egg laying capacity of laying ducks, pcs.				
196-226	19,9	20,0	19,9	20,0
227-256	25,4	26,0	27,0	27,5
257-286	24,1	25,1	25,3	26,0
287-316	23,6	24,9	24,4	25,4
317-346	22,9	25,1	26,3	27,8
347-376	22,2	25,6	26,1	27,8
377-406	20,7	24,8	24,3	26,3
407-436	19,7	24,3	23,1	25,1
437-466	18,3	23,5	23,1	25,3
196-476	202,5	226,8	226,9	239,1

As can be seen from the table, the highest intensity of oviposition was observed in the second month at the age of 7.5 months. The average intensity of egg laying for the average laying was 81% for the "Bishkulsky" cross, and 85.4% for the "Ansar" cross.

The growth and development of ducklings from the breeder's corps was studied by weekly weighing from daily to 7 weeks of age. Live weight and growth dynamics of young animals from the breeder corps at the age of 1-7 weeks were determined by weekly, individual weighing of the entire livestock (Table 3).

Table 3 – Dynamics of live weight of ducklings, g ($\overline{X} \pm S_{\bar{x}}$)

Age, days	Group	
	Ducks	Drakes
daily	49,5±0,37	49,9±0,39
7	207,6±0,65	210,7±0,29
14	438,4±0,78	511,7±0,76
21	824,2±0,98	861,6±0,87
28	1223,4±0,68	1380,8±0,85
35	1668,2±0,48	1776,7±0,84
42	2234,1±0,79	2435,3±0,29
49	2581,4±0,37	2792,3±0,63

Weighing young animals at 7 weeks of age showed that the average weight of ducks was 2.581 g, and the average weight of drakes was 2.792 g. The average weight of young animals in ducks was 2581.4 kg, and in drakes 2792.3 kg, low weight gain in the breeder's body is explained by the fact that the bird is in the breeder of the first year of life.

In the course of the studies, the productive indicators of the ducks of the carriers of the "Bishkulsky" and "Ansar" crosses (selected for further research) for an incomplete productive period (40 weeks of life) were studied (Table 4).

Table 4 – Average productivity indicators of ducks of parent forms of crosses of the collection herd of "Bishkulskaya poultry farm" LLP

Indicator	Line	
	Maternal	Paternal
Egg production per initial laying in 40 weeks, pcs.	185	190
Average egg weight, g	69,7	65,3
Preservation of adult ducks,%	96	95
Yield of hatching eggs, %	93	95
Egg fertilization, %	86	87
Withdrawal of ducklings, %	70	66
Preservation of daily ducklings, %	85	70
Exit ducklings from the parent couple, head	140	130

Egg laying at 40 weeks of the cycle was 185 maternal eggs and 190 paternal eggs; the average weight of eggs on the maternal side is 69.7 g, and on the paternal side 65.3 g; the yield of hatching eggs is 96% and 95%, respectively; the yield of hatching eggs on the maternal side is 93%, and on the paternal side 95%; fertilization in the range of 86-87% on both lines; withdrawal of young 70% on the maternal side and 66% on the paternal side; preservation of daily ducklings 85% and 70%, respectively, along the lines; exit of ducklings for laying 140 heads on the maternal side and 130 heads on the paternal side. This is preliminary data on the breeder building for an incomplete productive period. Work on the breeder building continues.

An important zootechnical and economic indicator is the safety of livestock. The profitability of duck breeding largely depends on its level. Livestock safety is all the components of poultry farming: prevention, vaccination, adequate feeding, new technologies, microclimate, and the qualifications of specialists serving the farm. However, the causes of death may vary. And if the death rate is easy to calculate, then the damage from a weak bird due to its lack of productivity is difficult to assess.

Ensuring the high safety of poultry is a complex step–by-step process that lasts from incubation to slaughter and depends not only on generally accepted measures, but also on many seemingly insignificant technological nuances.

The safety of ducks of 13 conclusions ranged from 75.4 - 99.7% (Table 5).

Table 5 – Safety of ducks of “Bishkulskaya poultry farm” LLP, %

Withdrawal number	Age of ducks		Safety ducks, %
	Daily	7 weeks	
withdrawal 1	450	437	97,1
withdrawal 2	688	686	99,7
withdrawal 3	986	968	98,2
withdrawal 4	1388	1380	99,4
withdrawal 5	2100	1583	75,4
withdrawal 8	2655	2287	86,1
withdrawal 9	2420	2300	95,0
withdrawal 10	2160	2150	99,5
withdrawal 11	2524	2510	99,4
withdrawal 12	1831	1818	99,3
withdrawal 14	4067	4054	99,7
withdrawal 15	4119	4103	99,6
withdrawal 16	2510	2501	99,6

The overall average preservation of the population of “Bishkulskaya poultry farm” LLP amounted to 96.0%. the reason for the ducks’ departure was mainly mechanical injuries. It should be noted the good viability of ducks, which confirms the possibility of growing them in industrial production.

Spectrophotometric analysis showed the quality and amount of DNA isolated, the fraction measured at 260/280 nm used as an indicator of protein contamination was within the range suitable for DNA analysis.

The result of visualization of DNA samples by electrophoresis (figure 1, 2).

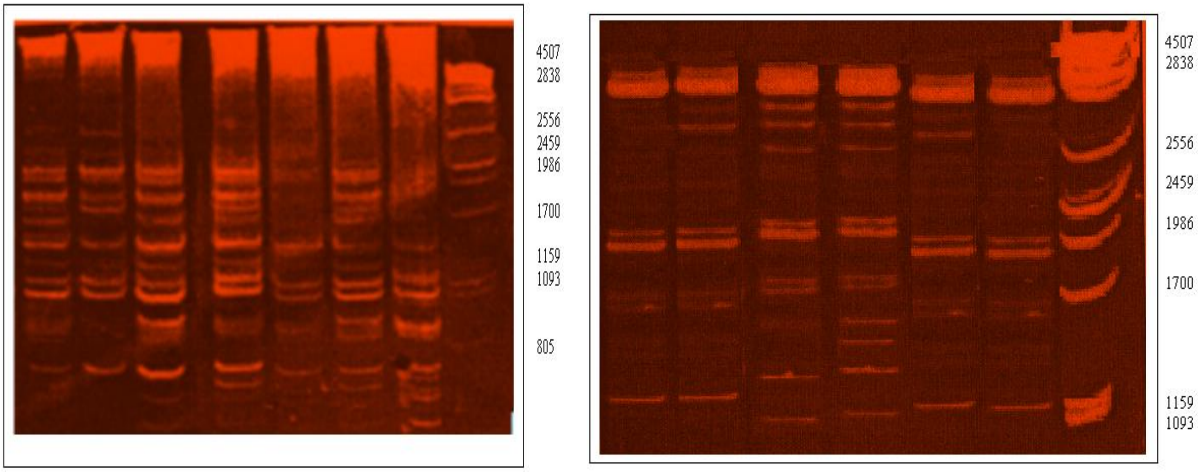

Figure 1 – Index of genomic analysis of duck blood DNA samples by electrophoresis

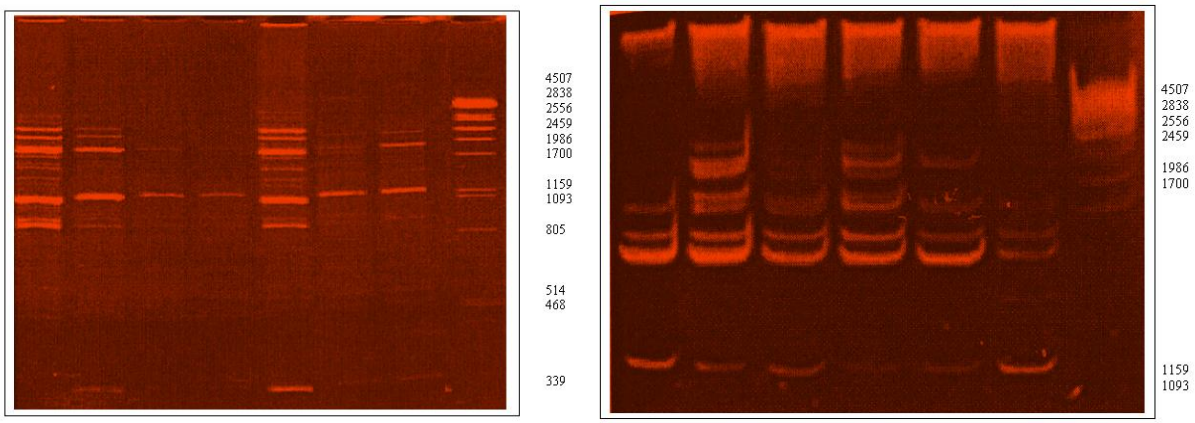

Figure 2 – PCR response index of the STC2 gene during electrophoresis

An important problem in genetics and breeding is the study of the interaction of genotype and environment, as well as some biochemical indicators, with animal productivity. Studying this issue will solve the problem of using animals in different environmental conditions, predict their productivity.

It is known that selection for the same characteristics can lead to the formation of genetically different animals, since the same level of productivity can be determined by different gene complexes, however, the question arises of the need to develop objective criteria that make it possible to judge the degree of genetic differentiation of the selected material.

However, the increasing productivity of farm animals by the mid-70s led to the appearance in herds of animals in which a correlation was observed between an increase in productivity by certain signs and such negative phenomena as an increase in stress sensitivity, fertility disorders, a decrease in meat quality and susceptibility to diseases. This indicates that selection for some signs of productivity has approached the biological boundaries of the development of traits. Therefore, unconventional ways of selection work and its justification are required, especially since the observed phenomena are difficult to understand within the framework of existing traditional selection genetic ideas, in particular, about inbreeding. In the process of shaping, it is desirable to justify and correct the crossing pattern, to control not only the development of productive features, but also the change in the genetic structure, as well as the influence of each of the parent forms and breeds on the gene pool of the population of each generation [22].

Conclusion. Genotype selection has advantages over traditional methods. It does not take into account the variability of economically useful traits due to the external environment, makes it possible to evaluate animals at an early age, regardless of the sex of the animals, and ultimately increases the efficiency of breeding work.

Since the phenotype of hybrids depends not only on the productivity of parental forms, but also on the degree of their genetic differences, the chosen method provides additional information on the degree of diversity of breeding material (interlinear, intra- and intergeneric differences), will help to draw up a further scientific plan of work with the existing gene pool.

Breeding in poultry farming is an integral part of the overall technological process. Success in poultry production can be achieved only when breeding work is constantly underway to improve and create new lines, the crossing of which will lead to the maximum manifestation of economically useful signs. The identification of individual lines during crossing will make it possible to identify positive signs in each of them and find combinations that provide intensive growth of hybrid ducklings with good forms [23].

Gene-assisted selection can potentially reduce the selection efficiency gap typically existing between large populations breeding in industrial production systems and small local populations where population genetic assessment systems and selection schemes cannot be applied.

Genotype selection has advantages over traditional methods. It does not take into account the variability of economic characteristics due to the external environment, making it possible to evaluate the bird at an early age, regardless of gender, and ultimately increases the efficiency of breeding work. Effective breeding requires monitoring of the genetic structure of rocks.

Gratitude. Research work was conducted under the Project BR21882327 “Development of new technologies for organic production and processing of agricultural products” PTF MES of RK has set a goal: to develop a technology for improving and creating new genotypes of farm animals based on the use of the achievements of deoxyribonucleic acid technologies in breeding.

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ТҮЙІН

Көптеген жылдар бойы құс шаруашылығы ғалымдары фермадағы құс етін сақтау мәселесіне тап болды. Осы жағдай әсіресе құс шаруашылығын өнеркәсіптік негізге көшіру кезінде өткір

болды, бұл шектеулі генетикалық материалдан жұмыртқа мен ет өндіру үшін жоғары өнімді мамандандырылған құс желілері мен кресттерін құруға әкелді.

Генотипті таңдаудың дәстүрлі әдістерге қарағанда артықшылығы бар. Ол сыртқы ортаға байланысты экономикалық сипаттамалардың өзгергіштігін ескермейді, бұл құсты жынысына қарамастан ерте жастан бағалауға мүмкіндік береді және сайып келгенде, асылдандыру жұмыстарының тиімділігін арттырады.

Бұл ғылыми зерттеулердің нәтижелерімен расталады, онда келесі көрсеткіштер көрсетіледі: жұмыртқа салмағы, инкубация үшін жұмыртқа салуды бақылау; инкубация кезіндегі биологиялық бақылау; жас жануарлардың (1-ден 7 аптаға дейін) және ересек құстардың тірі салмағының динамикасының жұмыртқаларын ұрықтандыру және инкубациялау; құс малдарын сақтау; тірі салмақ бірлігіне жем шығындары.

Бұл мақалада біздің еліміздің солтүстік аймағының кросс үйректерінде ауылшаруашылық жануарларының жаңа генотиптерін жетілдіру және құру бойынша жүргізілген зерттеулердің нәтижелері келтірілген, ДНК технологиясының жетістіктерін селекцияда қолдану негізінде зерттелген кресттердің генетикалық ұқсастықтары мен айырмашылықтары көрсетілген.

РЕЗЮМЕ

На протяжении многих лет ученые-птицеводы сталкивались с проблемой сохранения сельскохозяйственной птицы. Особенно остро она встала с переводом птицеводства на промышленную основу, что привело к созданию высокопродуктивных специализированных линий и кроссов домашней птицы для производства яиц и мяса из ограниченного генетического материала.

Отбор по генотипу имеет преимущества перед традиционными методами. Он не учитывает изменчивость хозяйственных признаков, обусловленную внешней средой, что позволяет оценить птицу в раннем возрасте, независимо от пола, и в конечном итоге повышает эффективность селекционной работы.

Это подтверждается результатами научных исследований, в которых отражены следующие показатели: масса яйца, контрольная закладка яиц на инкубацию; биологический контроль в процессе инкубации; оплодотворяемость и выводимость яиц, динамика живой массы молодняка (от 1 до 7 недель) и взрослой птицы; сохранность домашней птицы поголовье скота; затраты на корма на единицу живого веса.

В данной статье представлены результаты исследований, проведенных с целью улучшения и создания новых генотипов сельскохозяйственных животных на утках кроссов северного региона Казахстана, основанные на использовании достижений ДНК-технологий в селекции, показали генетические сходства и различия изучаемых кроссов.