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MORPHOLOGICAL PARAMETERS OF EGGS, PRODUCTIVITY AND SURVIVABILITY OF DOMINANT BLACK AND DOMINANT BLUE CROSS HENS IN THE FIRST PHASE OF EGG-LAYING

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Abstract

It is believed that hens of the Dominant Black and Dominant Blue crosses are highly productive layers, resistant to various conditions. We investigated morphological indicators of eggs, productivity and survivability of Dominant Black and Dominant Blue chickens in the first phase of egg laying. Hens of both crosses laid large two-yolk eggs at the start of egg laying. Meteosensitivity was observed in the majority of hens to sharp temperature changes that lead to decrease in egg production and/or the quality of the eggshell texture. The Dominant Black cross-breed chickens tolerated hyperthermia more easily than Dominant Blue. At the same time, they laid eggs of significantly less weight than at a comfortable temperature, and asymmetric eggs with destructive defects of the shell. The weight of Dominant Blue hens' eggs was almost independent of weather fluctuations, but their shells often had slight non-destructive defects. Eggs productivity was high in both crosses. The quantity of large eggs was higher in Dominant Black hens. Survivability of chickens Dominant Blue - 100%, Dominant Black - 97.5%.

Key words*: Dominant Black, Dominant Blue, egg production, meteosensitivity, morphological parameters of eggs, survivability.*

INTRODUCTION

The production of chicken eggs has a great importance in the spectrum of complete food products for the human population needs (Puglisi & Fernandez, 2022; Avercheva, 2020; Khailov, 2018). The powerful protective properties of egg protein (antimicrobial and anticarcinogenic) are known; also chicken eggs are an optimal material for tissue engineering and regenerative medicine (Zhang et al., 2024). Demand for so-called "humane eggs" and "enriched eggs" (their yolks contain a high level of omega-3 fatty acids) from free-range chickens has increased on the global food market (Medina-Cruz et al., 2024; Sinclair et al., 2022; Filipiak-Florkiewicz et al., 2017; Hliebova & Vertiichuk, 2014). Therefore, poultry farmers all over the world are abandoning the caged birds system of keeping and short production cycles (Bonnefous et al., 2022; Campbell et al., 2020; Janczak & Riber, 2015; Moise et al., 2024). Breeders have created modern crosses of chickens that are characterized by high egg productivity and are optimally suited for free-range keeping. Dominant cross hens are especially popular (Nolberga-Trūpa et al., 2022; Isidahomen et al., 2013). Dominant chickens is the collective name of a group of crosses bred by breeders of the Dominant Cz company in the Czech Republic with the aim of achieving, in particular, the following characteristics: early maturation, high egg production, disease resistance and high adaptability to various conditions. It is known that the Dominant Black chicken cross is the result of crossing the Rhode Island Red parent population and the Barred Plymouth Rock parent population. Dominant Blue crossbred chickens are the result of crossing the original dominant homozygous genotype of the Plymouth Blue Rock parental population and the Barred Plymouth Rock maternal population. Dominant Black and Dominant Blue crossbred chickens are used by breeders on the African continent for genetic improvement of egg production in local chickens through their direct and reciprocal crossing due to their high egg production and resistance to hyperthermia (Ayorinde et al., 2012; Sola-Ojo & Ayorinde, 2011).

Heat stress in laying hens is an important ecological problem in different climatic zones in conditions of global warming (Oluwagbenga & Fraley, 2023). In many countries, researchers are studying the possibility of reducing the negative impact of heat stress on the body of laying hens. Thus, scientists Lovita et al. (2024) reported the successful overcoming of metabolic changes in laying hens caused by heat stress due to the use of probiotics

The study of the genetic ability of Dominant Black and Dominant Blue crossbred chickens to withstand high environmental temperatures and at the same time maintain egg production deserves the attention of experts and farmers. In the information sources from the Czech company, which is engaged in the selection of Dominant cross chickens, a high level of their egg production during an intensive cage system of keeping at the test station is noted. It is expedient to investigate the indicators of egg productivity in hens of the indicated crosses in specific geographical, weather and economic conditions (including free system of keeping).

It is important to take into account and decipher in time the influence of abiotic factors on egg production in chickens (Ncho et al., 2024; Davydovych et al., 2021; An et al., 2019; Roberts, 2004). It is necessary to analyze the changes in morphological indicators of eggs, because they are clear signals about the state of the organism of the laying hen (Liakhovich et al., 2024; Hassan & Abdul-Careem, 2020; Roberts et al., 2011). Objective information about etiology of changes in morphological indicators of eggs contributes to the optimization of egg production in chickens (Cheng & Ning, 2023; Liakhovich et al., 2023; Greenacre, 2015).

MATERIALS AND METHODS

We studied the level of egg production, morphological parameters of eggs and the preservation of laying hens of Dominant Black (n=40) and Dominant Blue (n=40) crosses in the first phase of egg production in free-range conditions. Chickens at the age of 3.5 months were purchased from the producer (they were hatched in an incubator and subsequently kept on the floor). From the age of 3.5 months, chickens of each cross were kept separately on a private poultry farm in two specially equipped poultry houses with free range to form an egg-bearing flock. Zoohygienic and veterinary sanitary standards were observed during keeping, feeding and operating chickens. The poultry houses had natural ventilation. At night, the chickens were in aviaries with perches and nests (one nest per four chickens). During daylight hours, the chickens roamed freely in spacious areas surrounded by bushes and trees and surrounded by a fence. Both areas for chickens have the same composition of vegetation. The chickens were fed with moistened mixtures of cereals (wheat, rolled oats, crushed corn), chopped vegetables, root crops, flax seeds, sunflower seeds, and pumpkins. From time to time, fermented milk products of own production and waste from the fishing industry (shredded fragments of fish skin and fins) were added to the feeding ration. From the beginning of egg-laying, chickens were fed crushed and heat-treated eggshells. Free-range chickens had the opportunity to forage and obtain additional sources of protein feed: slugs, snails, earthworms. When feeding the chickens, we used the scheme of advanced feeding - with each subsequent week, the portion of feed was increased for successful future egg production. The chickens had constant access to clean water. In order to adjust and maintain a stable level of electrolytes in the body of chickens on hot days, a mixture of chopped ripe cucumbers and zucchini was added to their diet.

Observation of individually identified laying hens of both crosses contributed to deciphering the motivation for changing their behavior and objective analysis of the information obtained.

The condition of the hens' bodies, feed and water consumption, productivity and egg weight were monitored daily. The shape, color and condition of the shell of each egg were studied. A collection of 9347 eggs was studied. The internal contents of eggs (n=90) were selectively studied: in the protein part, the volume, condition and color were studied; in the yolk part - size, color, integrity of the perivitelline membrane. We studied integrity and structure of the subshell membrane during examination of eggs internal components. To make macropreparations from it, we used our own method: the subshell membrane was

prepared and selected and placed on specially made glass plates, 3 ml thick. After that, an analogue of hematoxylin - a natural dye (*Vaccinium myrtillus* juice) was applied to the surface of the subshell membrane. Then the macropreparation was air-dried until completely dry. Then, the structure of the subshell membrane was examined visually and with the use of optical lenses set on a dissection table with an opening for a source of additional illumination. We obtained on average 92 eggs from each cross during the first four months from the start of egg laying. Feed consumption of Dominant Black crossbred chickens was: 120 g/chicken/day; in cross-breed chickens Dominant Blue - 135 g/chicken/day. At the same time, the indicator of the ratio of the weight of feed to 1 kg of eggs in chickens of both crosses did not differ significantly. This indicates that the Dominant Black chickens digested the feed with a corresponding increase in live weight. Dominant Blue chickens had a more compact structure and, accordingly, lower body weight.

One Dominant Black cross hen out of 40 (2.5%) died at this study. This individual had certain features of the masculine type and was dominant among the Dominant Black chickens. To establish the cause of the chicken's death, a pathological autopsy was performed on its corpse in the conditions of the section hall of the department of normal and pathological morphology of the State University of Biotechnology (Ukraine). The dead chicken was dissected in daylight, in the supine position, by the method of partial evisceration (Kotsiumbas et al., 2011). The methods of intravital research were used (ethological and clinical observation; accounting for egg productivity; determination of morphological indicators of eggs; postmortem research of reproductive organs (autopsy and its analysis, anatomical preparation) (Altaey et al., 2023). A set of low-power optical lenses was used for optimal visualization of morphological indicators of eggs and internal organs during autopsy.

RESULTS AND DISCUSSIONS

The investigated chickens of both crosses quickly adapted to the free-range housing conditions and actively moved throughout its territory. Their favorite locations were elevated areas of the landscape. In the aviaries, hens demonstrated the behavior of sitting, and later - nesting, at a height of at least 1 m from the floor. At the beginning of the first egg-laying, hens of both crosses were secretive and hid in the pasture, where, as it turned out, they were laying eggs. The first egg laying in some chickens of the Dominant Black cross occurred at the age of 5.5 months. At the start of egg laying, these hens were more massive than the Dominant Blue cross hens, on average, by 120-140 g. In particular, they had a larger pectoral area and longer wings and legs. They had lush, shiny black plumage that contrasted with bright orange-red streaks around the neck (Figure 1).

Figure 1. Appearance of a Dominant Black cross-layer hen during a walk (own source)

The Dominant Blue chickens had a lush bluish-ashy plumage with a dark gray-black tint on the head and neck (Figure 2).

Figure 2. The appearance of the Dominant Blue cross-breeding hen during a walk (own source)

The first egg-laying of all Dominant blue cross hens occurred at the age of 6 months.

The behavior of chickens depended on changes in the weather: air temperature, wind speed, rainfall, direct sunlight. The behavior of chickens in different weather was influenced by

the presence of bushes and trees, premises with the possibility of shelter from the sun or from predatory birds and animals. The hens of both breeds stayed near the chicken coops when outside was a gusty wind.

Sensitivity of laying hens of Dominant Black and Dominant Blue crosses to high ambient temperature. At an air temperature of 30°C, symptoms of respiratory disorders with the phenomenon of hyperventilation were observed in Dominant Blue cross chickens. They spread their wings, breathed with open beaks. In chickens of the Dominant Black cross, similar symptoms were observed at air temperatures above 32°C. Cross Dominant Black hens had larger combs compared to Dominant Blue hens. Researchers Yakubu et al. (2018) note that the large comb is a kind of heat exchanger that, under the influence of high air temperature, provides cooling of the brain by evaporation.

Study of egg production and morphological indicators of eggs in chickens of the Dominant Black and Dominant Blue crosses. At the beginning of egg-laying, which fell on the month of June, hens of both crosses laid eggs weighing 45-49 g, uniform in shell texture and other morphological indicators. The shell of the eggs was clean, perfectly smooth, evenly peach-beige or cream-beige in color. The internal contents of the eggs were conditioned. Some of the chickens of both crosses laid two-yolk eggs weighing 74-78 g against the background of a long photoperiod (this was manifested massively on the eve and day of the solstice) (Figure 3).

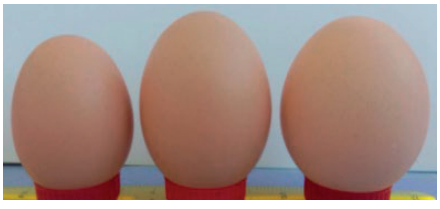

Figure 3. The appearance of eggs from hens of the Dominant Black and Dominant Blue crosses of the first phase of egg-laying: on the left – a single-yolk egg; in the center and on the right – two-yolk eggs (own source)

According to the Salamon (2020), two-yolk eggs is common in chickens at the beginning of egg laying, when 25% of the egg follicles are laid in pairs. The phenomenon of two-yolk eggs is also an effect of photoperiodism, which stimulates ovulation through the production of estrogens (Salamon & Kent, 2020; Navara et al., 2019).

The internal content of two-yolk eggs was conditional: the protein part was transparent and had the appropriate consistency in its two parts; yolks were rich yellow and had an intact perivitelline membrane (Figure 4).

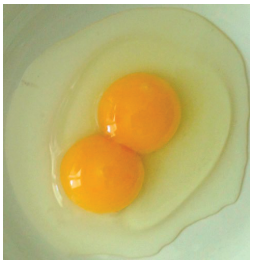

Figure 4. The internal content of a two-yolk egg from a cross-breed chicken Dominant Black: conditioned protein part; bright yellow yolks (own source)

Drabik et al. (2024) indicate significant differences in the chemical composition of two-yolk eggs compared to single-yolk eggs. According to their data, double-yolk eggs contain more fatty acids than single-yolk eggs and can be used as food.

Two-yolk eggs were periodically laid by hens of both crosses during the first four weeks of egg-laying.

In Dominant Black cross-breed chickens, a clear effect of feeding them sour milk and sour milk cheese on the appearance of white calcareous spots of different shapes and thicknesses on the eggshells was observed (Figure 5).

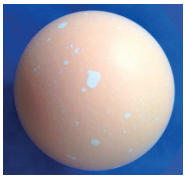

Figure 5. The appearance of the external surface of the egg of the laying hen of the cross Dominant Black: the presence of white local chalk layers on the shell (own source)

This property was periodically repeated the next day after the next feeding of fermented milk products. The transient appearance of local calcium deposits is due to the probable

excess of calcium that entered the body of the chicken with dairy products through the alimentary route. After 8 weeks from the start of egg-laying, each of the hens of both crosses stably laid 5-6 eggs per week. At the same time, the weight of a third of the eggs was in the range of 61-64 g. In the period from the 8th to the 11th week from the beginning of egg laying, in the Dominant Black cross hens, an important morphological feature of some eggs, along with an increase in their weight, was a rounded shape (Figure 6).

Figure 6. The appearance of a rounded egg from a Dominant Black cross hen (own source)

Analysis of the internal contents of round eggs showed the presence of conditioned yellow-orange yolks and partial thinning of the protein part at the lower (expanded) end.

It is known that the shape of the egg is the result of the balance between pressure inside and outside (Mytiai, 2008). In case of its violations, it is necessary to take into account the probability of influence of various factors. Normally, the egg moves in the fallopian tube in one direction due to the contraction of the smooth muscles in its wall. The contact effect and pressure of these muscles on the lateral parts of the egg contribute to its ellipsoidity, forcing it to expand in front and narrow in the back. A significant role in creating the shape of the egg belongs to the elastic membrane (it forms around the egg white and yolk) and the shell (Sah & Mishra, 2018; Makatsch, 1976). Potentially, it is more difficult for shells to form around a massive and not sufficiently viscous protein part, which blurs. The round shape of the egg is also due to the rational use of calcium by the body of the laying hen. After all, with the same length, spherical eggs have a smaller surface area than ellipsoidal ones (Ruda, 2017). Less calcium is needed to form their shell. Large eggs need significantly more calcium than medium-sized eggs during forming the shell. Therefore, the shape of the large eggs we studied was often spherical or close to it. The round shape of the eggs can also indicate a wider lumen of the oviduct of the hen that laying them.

Accordingly, the elongated shape of the eggs indicates a narrow lumen of the oviduct. The wall of fallopian tube loses its ability to stretch during process of egg-lying as a result of fallopian tube damages. On the outer surface of the shell of such eggs, there are even deformations caused by the pressure of the folded inner shell of the oviduct (Cheng et al., 2023).

There were a tendency to an elongated shape of eggs in chickens, which secretly laid eggs on self-selected parts of high farm structures near the poultry house. The chickens flew a long distance in this period. Therefore, the flight contributed to the elongation of the eggs during their formation.

In nests located at a height of more than 2 m above the ground, we found elongated eggs of Dominant Blue hens (Figure 7).

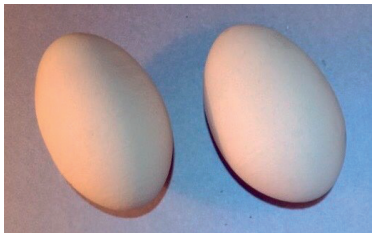

Figure 7. Viev of elongated eggs of Dominant Blue hens found in improvised nests located more than 2 m above the ground (own source)

Due to the ethological observation of the studied hens of both crosses, negative consequences of their inadequate behavior (in terms of impact on health and egg production) in the rainy season were revealed. Such a phenomenon was observed in the summer, when the hot weather suddenly changed to cool with prolonged rain (within one hour there was a sharp drop in air temperature from 30°C to 15°C). During the torrential rain, the chickens paradoxically did not hide in shelters, but actively looked for earthworms.

The next night, most of the Dominant Black cross hens laid eggs without shells prematurely:

they were found right under the perches (Figure 8).

Figure 8. The appearance of an egg without a mineralized shell layer, prematurely laid by a Dominant Black cross hen after a sharp change in temperature and general hypothermia (own source)

At the same time, a similar situation occurred in Dominant Blue cross hens. In the same chronological period, they also observed a single mass and synchronous premature laying of eggs with an unformed thin shell (Figure 9).

Figure 9. View of an egg with a thin and fragile shell from a laying hen of the Dominant Blue cross, laid after a sharp change in temperature and general hypothermia (own source)

Hester et al. (1991) report that during stress in chickens, the profile of hormones in the blood plasma changes (in particular, the concentration of prostaglandin increases). This leads to the premature expulsion of an unformed egg with a soft shell from the fallopian tube. Kim et al. (2022) note the role of relative humidity in the initiation of the reaction to temperature stress in laying hens. This model of temperature stress development was probable in the studied chickens.

The owner of the poultry farm took into account the indicated inadequacy of the chickens' behavior in the rainy season and their inability to hide from the rain. Subsequently, he controlled this problem: in the rainy season, he lured (stimulated) chickens with their favorite feed into the chicken coops or shelters. The phenomenon of mass premature laying of substandard eggs was not repeated.

However, in Dominant Blue cross hens, after a case of hypothermia in rainy weather, changes in the texture of the eggshell and its color appeared. Thus, within three weeks after the described case of their hypothermia in the rain, an increase in the range of shades of the shell of most eggs was observed (from ivory to caramel color). The shape of part of the eggs also changed: they became evenly rounded from both poles. Therefore, it was difficult to differentiate the upper and lower ends of the egg (Figure 10).

Figure 10. Appearance of eggs of Dominant Blue cross hens: different shape and color of the shell; on the left – two eggs with lighter shades of the shell have a weak differentiation of the upper and lower poles (own source)

In Dominant Blue cross hens, with a decrease in the intensity of eggshell pigmentation, its thickness decreased. The surface of the shell of many eggs was not perfectly smooth, as at the start of egg laying. The shade and topography of the shell differed even in different parts of the egg. On top of the rounded eggs, the surface of the shell was unevenly colored and loose. Zhang et al. (2012) note the effect of cold stress in chickens on the expression of inflammatory genes. In this case, the development of inflammatory changes in the oviduct is natural in chickens.

Individual hens of the Dominant Black cross began to lay eggs with a speckled shell 2.5 months after the start of egg laying. On their beige background, there were indistinct speckles of various sizes and pigmentation (brown and lilac) (Figure 11).

Figure 11. The appearance of eggs with a speckled shell from Dominant black cross hens: on the left - an egg with small dust-like brown speckling; on the right – an egg with lilac spots of different sizes hen during a walk (own source)

Spotted eggs were rarely found in Dominant Blue cross hens and only in autumn.

Cheng et al. (2023) found no significant differences in performance and reproductive performance between hens laying plain eggs and speckled shell eggs. We also did not observe changes in the level of egg production in the studied hens during the period of when hens lay speckled eggs.

Signs of certain respiratory disorders were observed in chickens of both crosses at hot temperatures. But Dominant Black chickens tolerated it more easily than Dominant Blue. This is consistent with the data of Isidahomen et al. (2012), who describe a comparatively higher ability of Dominant Black crossbred chickens to adapt to high environmental temperatures than Dominant Blue chickens. At the same time, hens of both crosses continued to lay eggs. But in Dominant Black cross chickens, eggs weight decreased by 8-10%, compared to the weight of eggs laid at a comfortable temperature. Separate specimens of eggs with various shape and shell defects were also encountered, in particular, asymmetric eggs with a totally depigmented and deformed shell. Asymmetric eggs were flattened on one side, the outer surface of their shell had thickenings of different shapes (crater-shaped and spiral-shaped) (Figure 12).

Figure 12. View of a defective egg with deformations and depigmentation of the shell (arrow) from a Dominant Black cross hen, laid against the background of heat stress (own source)

The appearance of the described defective egg shell indicated that it broke during formation in the oviduct, and then was restored due to new portions of the mineralized layer. In the equatorial part of the egg, the shell was delicate, and protein seeped through it. This shell defect was classified as destructive. According to the data of Tumová et al. (2014), the quality of the eggshell and its mineral composition are primarily influenced by the age of the hen, the temperature of the environment, and the time (within a day) of egg laying. Kim et al. (2014) reported that heat stress in chickens reduces feed intake, productivity and egg quality, which is a consequence of changes in blood profiles.

Three months after the start of egg laying, most of the eggs from hens of both crosses had a rounded or ellipsoidal shape, and were conditioned by shell texture and internal content. A third of eggs from Dominant Black cross hens were large in size (weighing 64-67 g). Some hens of both crosses rarely laid eggs weighing more than 70 grams after 4 months from the start of egg-laying. The maximum egg weight was 74 g.

When studying the internal components of the eggs of the Dominant Black and Dominant Blue crosses, certain differences were found in the proportions, consistency of the protein part, and the amount and intensity of yolk pigmentation. So, in eggs from Dominant Black chickens, the protein part was larger than in Dominant Blue chickens. At the same time, the protein density of eggs from Dominant Black hens was lower. The intensity of yolk pigmentation was consistently higher in eggs from Dominant Blue hens (Figure 13).

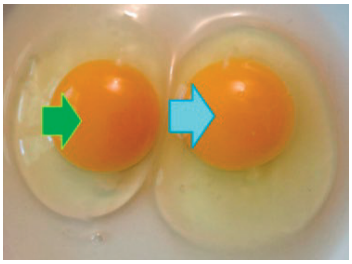

Figure 13. The view of the internal content of chicken eggs: on the right – from Dominant Black (larger amount of white with partial opacity, weaker yolk pigmentation – blue arrow); on the left – from Dominant Blue (dense transparent protein, intense yolk pigmentation – green arrow) (own source)

A valuable morphological property of eggs from chickens of both crosses and important in a technological sense was an extremely strong subshell membrane. After the shell membrane was separated from the shell, placed on a glass slide and dried, it resembled thin papyrus (Figure 14).

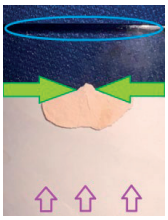

Figure 14. Macroscopic preparation. A fragment of the subshell membrane of an egg from a Dominant Blue cross hen (native view): membrane (vertical arrows), part of the egg shell – horizontal arrows, the edge of the glass plate is an oval (own source)

It is known, subshell membrane is a kind of filter for cleaning air, moisture and various pathogens that can penetrate into the egg.
During making macroscopic preparations from fragments of the subshell membrane and staining them with *Vaccinium myrtillus* juice, long-lasting native preparations on glass were obtained, which were additionally examined under artificial illumination of the preparation plate using a set of optical lenses (Figure 15).

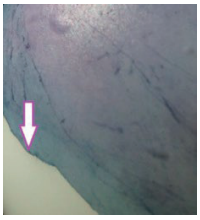

Figure 15. Macroscopic preparation. A fragment of the subshell membrane of an egg from a Dominant Blue cross hen (staining with *Vaccinium myrtillus* juice); edge of the membrane (arrow) (own source)

The subshell membrane is waterproof and its thickness is an indicator of protection against evaporation of moisture from the egg and ensuring its preservation in hot conditions. Eggs storages for a long period of time without spoilage because of strong and elastic subshell membrane.
Shi et al. (2021) indicate that the subshell membrane of chicken eggs is used in tissue engineering and as a biosorbent.
Maeda & Sasaki (1982) note the effectiveness of using materials from the subshell membrane of eggs as a biological dressing for burns. This information indicates the expansion of the scope of application of chicken egg components.

Survival (viability) of chickens of the Dominant Blue and Dominant Black crosses in the period from 3.5 months to 10 months.
The survival rate of Dominant Blue cross chickens during the research period was 100 %. The survival rate of Dominant Black crossbred chickens was 97.5% (one chicken out of 40 died). At the age of 5 months, the most massive chicken among the Dominant Black cross breed chickens died. An important feature of the dead chicken's exterior is a disproportionate figure (an increase in the epiphyses of long bones was observed). It is known that the acquisition of secondary sexual characteristics in sexually mature chickens is the result of hormonal secretion.
According to Tsang & Grunder (1984), aberrations of estrogen metabolism in laying hens are observed with vitamin D deficiency. It is known from the anamnesis that at an early age the chickens, from which the population of the studied chickens was formed, were diagnosed with signs of D-hypovitaminosis. The chicken died on a hot day with an air temperature of over 32°C. Indeed, the air temperature was the same for several days and, accordingly, signs of heat stress were observed in all the examined chickens. The hen died after two detections (with an interval of two days) on the floor of the poultry house of three types of formations of bright yellow color: cyst-like, baggy with liquid content and dense (Figure 16).

Figure 16. The appearance of cyst-like, baggy and dense formations eggs laid by the Dominant black cross hen by a at the age of 5 months (own source)

The bag-like formation contained a liquid yolk substrate. The cyst-like formation had a characteristic structure: the external connective tissue folded membrane surrounded a jelly-like yellowish transparent substance without odor (Figure 17).

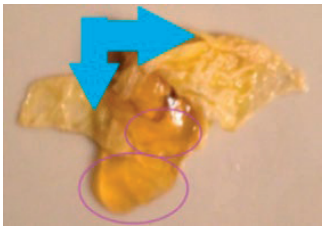

Figure 17. The appearance of a cyst-like formation eggs laid by the Dominant black hen at the age of 5 months, on a section: connective tissue membrane (arrows); jelly-like substance (ovals) (own source)

A fragment of a ruptured oviduct, a massive dense beige formation and a cyst-like formation with a yellow, transparent, odorless mucinous substance were found at the door of the poultry house on the day of the chicken's death (Figure 18).

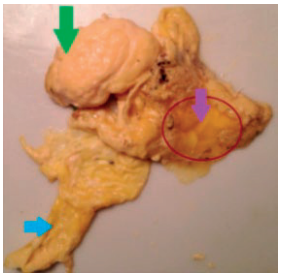

Figure 18. View of the terminal part of the oviduct of a Dominant Black chicken at the age of 5 months (blue arrow) after its rupture; massive dense ovoid formation of light beige color (green arrow) and cyst-like mucinous formation on the cut (own source)

During the post-mortem examination of the dead chicken, extraordinary jelly-like and hydrophilic structures were observed in its coelomic cavity. A sign of increased gloss of tissues and organ capsules indicates increased vascularity, which is typical for shock pathologies. The deceased hen was diagnosed with ovarian atrophy with lack of follicle differentiation (there were no large preovulatory hierarchical follicles), total edema and hemorrhages in its stroma. The thoracoabdominal cavity contained massive clots of dark cherry blood. (Figure 19). During the preparation of the fallopian tube, its underdevelopment, atony with the consequence of rupture was established. The chicken died from the development of painful and hypovolemic shock. Similar age-related physiological disorders in breeder hens have been documented (Gheorghe et al., 2022).

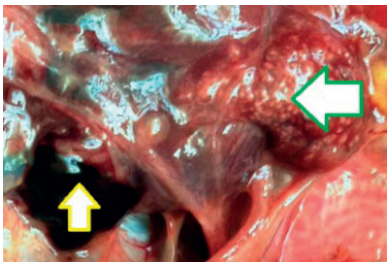

Figure 19. Autopsy. View of a part of the coelomic cavity of a dead 5-month-old Dominant Black hen: horizontal arrow – ovary (atrophy, swelling, hemorrhages in the stroma, absence of large preovulatory hierarchical follicles); vertical arrow – a massive blood clot. Magnification with a low-multiplier x3 optical lens (own source)

We do not rule out the negative and life-critical effect of heat stress on the body of the dead chicken. In particular, due to severe changes in her reproductive tract. First of all, it concerns regressive changes of the ovary and obturation of the fallopian tube. Rozenboim et al. (2007) indicate that heat stress can cause reproductive dysfunction in laying hens. According to their data, short-term and long-term exposure to heat caused significant hyperthermia in chickens, a decrease in egg production, egg mass, ovary mass, and the number of large follicles. According to the data of researchers Yan et al. (2022) and Li et al. (2020), heat stress in chickens reduces egg laying by inducing ovarian follicular cell apoptosis. Rupture of the oviduct in the studied hen occurred due to obstruction of its lumen by formations of various sizes. Data on rupture of the oviduct in Dominant Black cross hens at the start of egg laying were not found in available information sources. A rare case of oviduct rupture in an adult laying hen is described by Mariappan et al. (2016). During necropsy, they found an egg without a shell in the abdominal cavity of the chicken, an overflowing fallopian tube and a prolapse of the mucous membrane of its front part due to a rupture of the wall.

CONCLUSIONS

In the Dominant Black and Dominant Blue crossbred chickens, at the beginning of the first

phase of egg production, there were separate violations of its rhythm with the effect of laying two-yolk eggs (weighing from 74 to 78 g). This coincided with the longest photoperiod in the calendar year. The weight of single-yolk eggs of Dominant Black and Dominant Blue chickens increased from 45-49 g to 64-67 g over the entire research period; individual eggs 3.5 months after the start of egg laying weighed more than 70 g.

The shape of the eggs of the Dominant Black cross hens was rounded and ellipsoidal. In Dominant Blue cross hens, the egg shape was ellipsoidal.

The internal content of the majority of eggs from hens of both crosses was conditioned: a large protein part by mass with a slight opacity and reduced viscosity in the expanded part of the egg and bright orange yolks. Periodically, after feeding sour-milk products, Dominant Black cross hens laid eggs with calcium deposits on the shell, and in the third month of egg production, spotted eggs were found in them. In Dominant Blue hens, speckled eggs were rarely found and only in autumn. In hot weather, hens of both crosses maintained egg production.

At the same time, the weight of eggs in Dominant Black cross hens was 8-10% less than under thermoneutral conditions, and there were some cases of asymmetric eggs with severe textural defects of the shell. But, in general, most eggs from Dominant Black cross hens had a high-quality shell. In Dominant Blue chickens, the proportion of eggs with non-destructive and minor shell defects increased in the autumn period.

The intensity of the color of the yolk was higher in eggs from Dominant Blue cross hens, regardless of the season.

Eggs from chickens of both crosses were stored for a long time without spoilage due to the strong and elastic subshell membrane. One out of 40 Dominant Black chickens died (2.5%) with a critical defect in the development of organs of the reproductive system.

Feed costs for obtaining egg production were higher in Dominant Black chickens, which is explained by their greater total weight (this gives reason to consider them as dual-purpose chickens in terms of obtaining products: egg and meat). Survival was higher in Dominant Blue chickens.

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