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POULTRY BEHAVIOR REACTIONS AND WELFARE
(review)

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Abstract

In connection with the need to improve competitiveness with foreign poultry farming, the problem of ensuring the well-being of poultry and producing high-quality products is an urgent issue (Welfare Quality® Assessment for poultry, 2009; I.J.H. Duncan, 1981; J.A. Mench, 1992). Special attention on the way to improving the welfare of animals is given to the compliance of technology with the biological characteristics of animals (D.A. Orlov et al., 2016). The level of well-being of poultry is affected by many factors: illness, stress, nutrition, conditions of housing (D.C. Jr Lay et al., 2011). A bird within certain limits is able to adapt to various environmental conditions (M. Brantsæter et al., 2018). Inability to adapt is expressed in changes in physiological status, as well as behavioral disorders that can harm both animals and maintenance personnel. Stress sensitivity is manifested in the behavior of chickens, which serves as the best indicator of well-being. Strong manifestations of fear, such as panic or abrupt escape attempts, not only increase energy costs, but can also cause damage or even death when the birds start moving through obstacles and hurt each other (S. Waiblinger et al., 2006). Fear, like an unwanted emotional state, reduces the overall activity of animals. Regular negative stimuli inhibit social interactions between animals (J.A. Mench, 2004; B. Forkman et al., 2007). Human is one of the main sources of stress for animals, the fear of human affects their well-being and productivity (T. Kutzer et al., 2015; M.A. Sutherland et al., 2012; F. Barone et al., 2018). Relationships between humans and animals can include visual, tactile, olfactory, and group perception (S. Waiblinger et al., 2006). A hen is sensitive to visual contact with a person, but some neutral interaction, such as moving a person's hands to the side of a cage or approaching a bird, even for short periods, can decrease stress (J.A. Mench, 2004). Measuring the response of animals to humans leads to conclusions about how they perceive all people or a particular person. It depends on the type of animal and the housing system, on the nature of its interactions with a person (positive, neutral or negative), on the quality of care for animals and poultry (S. Waiblinger et al., 2006). Understanding behavior is an important aspect of the concept of animal welfare (V.N. Tikhonov et al., 2008). From the point of view of ensuring the welfare of animals, it is significant to have the possibility of living their natural life through the manifestation of natural behavior and the presence of elements in the environment that bring it closer to the natural environment (Animal Welfare Issues Compendium; D. Fraser, 2008). Poultry have retained a significant part of the behavioral needs of the wild forms (M.S. Dawkins, 1988). The main needs for the behavior of poultry are nesting, food and drinking behavior, the provision of physical and comfort activity and social interactions (I.J.H. Duncan, 1998; T. Shimmura et al., 2018). The restriction of natural behavior leads to a deterioration in the well-being of the bird. Environmental factors, such as high light intensity and crowding, also contribute to the high likelihood of behavioral disturbances (M.C. Appleby et al., 2004). Animals that are kept in captivity may exhibit behavioral disorders, including "stereotypes," such as repetitive fixed cycles performed for no apparent purpose, aggressive behavior, pecking eggs (G.J. Mason, 1991; M.C. Appleby et al., 2004; I.J.H. Duncan, 1998). Hens contained in traditional cage batteries (for 4-5 heads) are less prone to problems with aggressive behavior due to the smaller number of birds in the group (H. Lukanov et al., 2013). At the same time, in floor systems, the size of the group can exceed 1000 heads, which expands the possibilities of the exploratory behavior of poultry, but increases the risk of peck and cannibalism (D.C. Jr Lay et al., 2011). The behavioral preferences of animals are the basis for designing technologies that ensure the animal welfare (M.S. Dawkins, 1988).

Keywords: poultry welfare, behavior, behavioral infractions, behavioral needs, stress

According to experts, Russia is able to become a major supplier of poultry products to the world market, but for this it is necessary to produce products that meet the requirements of foreign importers. Unfortunately, at present, this potential is poorly realized: in 2017, 165 thousand tons of poultry meat and 435 million eggs were exported. The programs provide for a significant increase in the export of poultry products [1], therefore, the production of high-quality products and ensuring the well-being of poultry become urgent.

Well-being assessment is actively used in foreign enterprises in biologizing technologies, in increasing the productive longevity of animals, and observing ethical standards. The concept of providing welfare, based on a synthesis of the psychoemotional and physical characteristics of animals [2-4], can be also implemented at Russia.

The Brambell Committee which published its first report in 1965 proposed the "five freedoms" as a measure of animal welfare: freedom from hunger and thirst; freedom from discomfort; freedom from pain, damage and disease; freedom in the expression of natural behavior; freedom from fear and suffering [5].

The purpose of this review is to analyze the disturbances in the poultry behavior resulted from adversities, as well as the consideration of behavioral preferences as conditions for ensuring well-being.

There are three types of standards for protecting the welfare of poultry. The firs is the basic/model standards promoted by producer associations and restaurant chains in the United States that require approximately 440 cm^2 of floor space and free access to water and feed. The second one is the improved standards implemented in the European so-called enriched cages with 750 cm^2 area, nests, perches and litter. The third one is the alternative, used in certain production systems (for example, free-range and organic, requiring the same conditions as improved standards, as well as access to open space and natural daylight) [6].

Particular attention is paid to the conformity of the technologies to the biological features of animals [7]. Thus, a detailed comparison of the health and productivity of laying hens in different types of cages revealed frequent cases of feather cover damage and problems with limbs. Most birds had significant foot damage in cages with a sloping metal floor. Severe neck injuries of chickens were noted during feeding from a feeder set too high for comfortable access [8]. Injuries to the foot pads were found in 13% of laying hens of Lohmann cross at the age of 32 weeks, contained in specially equipped ("furnished") small-sized cages [9]. In such situations, it is enough to make some changes in the design of the cages: install solid partitions between the sections, which reduces feather loss due to wear and tear, use plastic coated floors with a slight slope and abrasive strips against claw ingrowth, reinstall the feeders [6].

Obviously, many factors affect the welfare of animals and birds: diseases, skeleton and musculoskeletal system health, parasites and parasitic infestations, stress, nutrition, and living conditions [10]. An unsatisfactory state of health, regardless of its causes, indicates a violation of the well-being of animals. Poor housing conditions lead to the aggravation of existing, including hereditary, problems [11]. Broiler health potential is undermined by genetic selection in order to accelerate growth and increase meat yield. They have an excessively rapid increase in muscle mass as compared to growth of the skeleton and internal organs, the capacity of the lungs and heart necessary to provide muscle functions is reduced. Broiler chickens suffer from limb deformity and lameness, and abnormalities in walking are found in 90% of individuals [12]. The frequency of limb problems is related to the growth rate: lameness was detected in 85% of broiler chickens of fast-growing crosses. The poultry of "slow" crosses turned out to be more prosperous on this basis (up to 27% of lame individuals) [13].

One of the most important factors of well-being is the absence of stress. The most frequently used nomenclature defines environmental stimuli leading to an imbalance of homeostasis as stressors, and the corresponding protective reactions of the animal as stress reactions, with the brain playing a central role in binding stressors to reactions. Responses include changes in behavior in the immune system, activation of the neuroendocrine system (hypothalamic-pituitary-adrenal axis) and the autonomic nervous system [14]. Catecholamines, adrenaline and norepinephrine are involved in many metabolic processes, regulate emotions and provide motivation for action. Many authors point to a positive correlation between corticosterone level and social stress [15, 16]. It was shown that the blood level of corticosterone in meat ducks depends on the stocking density, being significantly higher in groups with a high stocking density ($p < 0.05$) compared to the control (91.42 and 28.71 ng/ml, respectively). In groups with low (3 birds/m^2) and medium (4 birds/m^2) stocking density, the concentration of corticosterone was similar (61.33 and 62.96 ng/ml). The corticosterone concentration in the group with a high stocking density (6 birds/m^2) exceeded the indicator values in the control group and in the groups with low and medium density [17]. An almost 3-fold decrease in corticosterone release in chickens is reported in response to stress when using a stress-protective antioxidant (55.5 versus 148.14 nmol / L) (16).

Under stress, changes occur in the blood morphology [18]. So, at rest, the ratio of heterophiles and lymphocytes was 0.29 in stress-sensitive chickens, and 0.23 in stress-resistant chickens. Under the influence of a stimulant (turpentine test), the ratio of heterophiles and lymphocytes in sensitive and stress-resistant chickens increased to 0.64 and 0.36, respectively [19].

Stress sensitivity is manifested in a peculiar behavior of chickens [19, 20], which is the best indicator of well-being. Strong manifestations of fear, such as panic or sudden attempts to escape, not only provoke expend of more energy, but can also lead to damage and even death [21]. Fear is considered an undesirable emotional state. When the level of fear is low, the activity of animals increases, when it is high, activity decreases. Regular stressors inhibit social interactions between animals. The conflict between negative emotional state and positive motivation can lead to behavioral disorders [22, 23].

Fear of personnel affects the well-being and productivity of animals, since a person becomes one of the main sources of stress. Studies on cattle and pigs showed that animals with a pronounced reaction of human fear are characterized by reduced productivity (24-26). A high degree of animal fear of human affects the productivity of laying hens [27]. Thus, the variability of the peak productivity index of a laying per day varied from 53 to 61% under the influence of this factor [28]. It is worth noting that the chicken fear of personnel depends on the cross. For example, it is more pronounced in Dekalb White cross chickens than in ISA Brown [29].

There are several types of contact between people and animals: visual (non-mobile) presence; movements between animals without tactile contact (with the possible use of voice contact); physical contact; feeding (promotion); invasive, fear-provoking [21]. The poultry is sensitive to visual contact with personnel, but some interactions, such as moving a person's hands to the side of the cage or short touches of the bird, can reduce its timidity [22].

According to the assessment of corticosterone concentration, regular processing by personnel does not lead to the formation of a habit of a certain type of processing, especially if it is catching with loading birds into transport [30]. In Leghorn chickens, when sampling blood through a catheter without contact, the amount of plasma corticosterone was significantly lower than in the birds of the control groups, which was fixed manually (3.67±0.316 and 4.63±0.303 ng/ml, $p = 0, 0422$, $n = 19$), and the ratio of heterophiles and lymphocytes was significantly higher ($p < 0.001$) [31].

To prevent a bird from perceiving a person as a predator, it is important for personnel to move slowly and carefully around the poultry house [22]. J. Rushen et al. [32] identified several aspects in the personnel–animal interaction that can be used to improve well-being: positive contact with humans, especially when animals are young and more sensitive to various procedures; human understanding of what kind of behavior an animal can scare; creating conditions to reduce the number of rough treatments; avoidance of aversive techniques in handling animals, for example, the use of electrical stimulants [22].

Shy poultry avoid people. This behavior is observed in herds where farm workers, busy with their tasks, move too quickly. Fright (for example, due to a strong and sudden sound) causes broiler crowding, sometimes leading to asphyxiation. In shy chickens, a decrease in live weight gain is observed. Voice signals can indicate an emotional state (positive or negative) [11].

Estimation of animal reactions allows us to draw conclusions about how they perceive all people or a specific person. The reactions of animals reflect a mixture of different emotions. Of paramount importance, most likely, is fear. The degree of its manifestation depends on the type of animal and the keeping system, the nature of interactions with humans (positive, neutral, or negative), and the quality of care [21]. Personnel training is crucial in improving behavior towards animals, reduces problems associated with shyness. An increase in the number of low-paid and uneducated labor in livestock breeding in some countries represents a significant obstacle to good governance, since small companies are not profitable by investing in vocational training and staff incentives [22).

The birds within certain limits can adapt to various environmental conditions. Inability to adapt is expressed in violation of behavior. Behavioral problems can be associated with keeping technology (fewer problems are noted in "furnished", specially equipped cages) and microclimate disorders ($p = 0.001$) [33]. Animals that are kept in captivity exhibit stereotypes — repeated invariant patterns of behavior that are executed without a visible goal [34]. Stereotypies serve as a means of adaptation to captivity through the release of endorphins. Nevertheless, if the animals exhibit stereotypical behavior over time, the degree of well-being decreases [35). Environmental factors, such as high light intensity and crowding, contribute to the biting of eggs by chickens. Another example is the feather bite which was observed in 80% of chickens at one of the farms at the age of 14 weeks [36]. Bitings were observed in young chickens in 13 of 24 herds (54%) using the organic production system. If the youngster was prone to pecking the pen, then this behavior was observed in her further in 90% of cases, which confirms the influence of individual characteristics on the manifestation of the trait [37].

Some studies show that feather damaging is the so-called biased behavior related to feeding behavior or to taking dust baths [38]. The hypothalamus is considered to be a potentially important part of the brain for the study and control of behavior associated with pecking [38, 39]. There is no complete understanding of the fundamental biological mechanisms of feather pecking, but they can be due to the synthesis of serotonin and/or dopamine, associated with the content of aromatic amino acids tryptophan, phenylalanine and tyrosine in blood plasma. For example, in the laying hen line with low mortality, a large number of aggressive pecks was associated with an increased tyrosine content ($n = 78$, $r = 0.643$, $p < 0.001$) and a low tryptophan/(phenylalanine + tyrosine) ratio ($n = 78$, $r = –0.541$, $p < 0.001$). In highly productive laying hens, the correlations for tyrosine (n = 73, r = –0.308, p = 0.005) and the ratios of tryptophan/(phenylalanine + tyrosine) (n = 73, r = 0.314, p = 0.004) were reversed [40].

Often, pecking-related problems are controlled via debeaking (beak trimming), but in some countries it is prohibited [41]. It should be understood that pecking problems are multifactorial [42]. The age of the bird, feather color, feeding regime, the ability to exhibit natural behavior (search and getting feed) should be regarded, and individuals initiating pecking should be removed. That is, the pecking-related problems can be prevented via effective flock management without beak trimming [41, 42].

Regulation of the light regime is a key factor determining the frequency and severity of pecking and cannibalism in chickens [43]. Not only lighting, but also its intensity plays an important role in the regulation of behavior [44, 45]. For example, low-intensity red light decreases the frequency of pecking and damage to plumage, timidity, and cannibalism-related mortality in chickens [46]. The risk of pecking increases with more intense lighting under commercial automation systems for poultry farming, so a 5-10 lux lighting intensity is advisable to maintain [47]. It was found that feather cleaning, pecking and aggressive behavior of 3-week-old turkey poults significantly increased at 50 lux against 5 and 25 lux [48]. Blue light resulted in higher frequency of feather pecking in Lohmann Brown Classic laying hens (65.7% for blue light vs. 45.2% for fluorescent light, 52.9% for incandescent light, and 53.7% for daylight lamps) [49]. Besides, the frequency of feather pecking depended on an increase in the intensity of blue light (18.7% at 50 lux vs. 11.7% at 5 lux) [49[.

Aggressive behavior of poultry is less common in small herds, which is associated with the identification and memorization of relatives [19, 20]. That is why, according to a number of authors, poultry kept in traditional battery cages 4-5 birds each is at a lower risk of aggressive behavior due to the smaller number of individuals in the group [50]. The group size in cage-free poultry can exceed 1000 birds, which stimulates exploratory behavior, but increases the risk of pecking and cannibalism [10]. Food deprivation also leads to higher aggression. This is the most common procedure to induce artificial molting [51]. Triggers of forced molting are determined by the functional state of the pituitary gland. Its activity through the hypothalamus is regulated by the nervous system, which, in turn, adapts the body to stressors that induce molting [52]. A direct correlation was found in chickens between the period of food deprivation and the frequency of aggressive contacts [53]. Most of the chickens kept in cages, especially the light hybrid lines, become more aggressive before egg laying [54]. Serotonin has been shown to be the primary regulator of aggression [55]. An increase in the level of aggression is associated with an increase in dopamine concentration [56].

Understanding behavior is an important aspect in the concept of poultry well-being. Behavior as an adaptive trait is associated with the reproductive traits and characterizes animal fitness and adaptive ability [57]. From the point of view of ensuring animal well-being, experts especially emphasize the possibility of living a natural life through the manifestation of natural behavior and presence in the animal environment of elements which bring it closer to natural conditions [51, 58]. Therefore, the behavioral needs of birds are of great importance.

It is the behavioral preferences of animals that should be the basis for the design of technologies that ensure well-being. A domesticated poultry is prone to exhibit behaviors similar to the behavior of a wild birds, which serves as the basis for survival [35]. When considering the concept of “behavioral needs”, it is important how often various patterns of behavioral reactions are observed in a bird, what exactly causes the manifestation of natural instincts and how strongly their occurrence is motivated [54]. The main behavioral needs include nesting, perching, fodder getting, dust baths, comfortable behavior, physical activity, exploratory behavior, feeding and drinking behavior, personal care (preening, cleaning), social interactions [54, 59, 60]. Obviously, in industrial poultry farming, development of territories, sexual behavior, gestation and incubation, reaction to predators should be excluded from the basic needs.

Exploring is useful for animals for several reasons: it motivates to gain knowledge about the environment, gives freedom of choice and certain skills [59, 61]. In laying hens kept in cages the exploring time was 326 minutes for 16 hours for a group size of 7 birds and stocking density of 430 cm^2 per hen. Less exploring activity (227 minutes for 16 hours) was noted for a group size of 2-3 birds and landing densities of 333 and 455 cm^2 per hen [61]. Significant differences were found between the manifestation of exploring behavior in poultry when kept on the floor (20.1%) and in cages (14.7%) [62]. It is believed that the exploring reaction to a new object is associated with human fear and characterizes the well-being of the bird [2].

Brooding and incubating behavior is characterized by morphological, behavioral, and physiological changes [63, 64]. This is accompanied by an increase in concentration of prolactin [65] which helps suppress the secretion of luteinizing hormone during incubation, possibly acting on the hypothalamus and the anterior pituitary gland [66]. In the experiments, laying turkey hens showed a gradual decrease in egg laying during the time they were receiving ovine prolactin (oPrl) [64]. Research by S. Crisystomo et al. [65] confirms the hypothesis of a regressive effect of a high prolactin content on steroidogenesis, which subsequently leads to ovarian regression. This can be controlled, for example, by passive immunization of poultry with rabbit serum containing antibodies against recombinant turkey prolactin. It has been shown that even a single injection of antiserum to prolactin to Bentham chickens during manifestation of brooding instinct leads to an increase in the content of luteinizing hormone and disrupts this behavior [67, 68].

It should be noted that in hybrid lines there is no behavior associated with brooding which does not arise either from environmental influences or during hormonal stimulation; presumably, it is due to the lack of reaction of the corresponding brain regions due to selection [54, 69]. Thus, frequency of brooding in Bentham and White Leghorn hens varied significantly (78.6 and 0%, respectively). Frequency of incubation behavior of crosses from direct and reverse crossing of Leghorn and Bentham breeds did not coincide with the maternal breed (61.6 and 56.8%, respectively). The incubation behavior during backcrossing crossbred males Leghorn × Bentham with Leghorn females was only 5.8%, which was significantly less ($p < 0.001$) than expected (39.3%). It was revealed that the incubation behavior is not controlled by a major gene (or genes) on Z chromosome. It has been suggested that there are two dominant autosomal genes that equally affect the expression of behavior [70].

Sexual behavior is largely driven by external stimuli [71-73]. Before egg laying, hens sometimes demonstrate squatting down or sitting, which is associated with an increase in the content of sex hormones [73]. Dominant males can interrupt copulation attempts by subordinates (up to 78% of cases) [74].

In red partridge males, the duration of a voice call as an external stimulus positively correlates with the size of the crest ($F_{1.7} = 19.88$, $p = 0.003$) [75]. Pedigree Bentham males manifest sexual behavior at 8-12 weeks of age [76]. Camphor stimulates sexual behavior of Japanese quails when added to the feed at 0.5 g/kg ($p < 0.05$) [77].

For laying hens during the laying period, exercising is important [78], associated with free movement in space. It was found that about 24% of chickens kept in cages at the end of the productivity period suffer from bone fractures. Greater bone strength is observed in birds, which are kept on a deep litter with perches [79, 80]. The need for long exercises or their compensation with short walks (as in extensive containment systems) has not yet been proved in intensive poultry industry [36, 54]. However, a higher ($p < 0.01$) concentration of blood corticosterone was detected in birds kept on a litter without motions than in free range poultry. Less feed conversion ($p < 0.05$), egg laying time ($p < 0.001$), frequency of feather cleaning ($p < 0.05$), dust baths ($p < 0.001$) and mating ($p < 0.01$) were observed indoor compared to birds under free-range system. At the same time, the bird, when kept indoor, consumed more water ($p < 0.001$), rested more ($p < 0.01$) and was more aggressive ($p < 0.05$) [81].

The movement of birds in nature is accompanied by getting feed, which is prevented in cages. Feeding behavior [82] accompanied by sewing beak and claws, free walking [83]. It is worth noting that broiler pullets have less pronounced feeding behavior (by 57%) in the evening than in the morning [84]. It is noteworthy that females more often and actively manifest feeding behavior ($F_{1.16} = 63.3$, $p < 0.001$), regardless of breed [85]. Red junglefowl spends about 34% of time budget actively scratching and foraging, and 60% of the time is spend for ground pecking [86-88]. Equipping cages with a special material for scratching stimulate scraping in birds [89]. In some species held in captivity (for example, in mink) stereotypes associated with food consumption are mostly observed before feeding. In birds, the number of stereotypes increases after eating. The lack of space may prevent the manifestation of the motor form of stereotype before feeding [90]. Feeding behavior is affected by a stocking density. Thus, at stocking density of 2000 birds/ha, the time spent for searching feed decreased compared to that at 10,000 and 20,000 birds/ha [87]. In a cage for 20 birds, feed getting took 98.4% of the time, and at 40 and 60 birds per cage this time decreased to 96.37 and 94.45%, respectively [89].

Preening behavior [91] is necessary as a response to external influences on the feather, as well as a substitution upon a slight degree of frustration or conflicts between individuals. Its frequency is affected by stocking density and microclimate conditions [92]. Thus, the Preening frequency ($F_{2.16} = 8.19$, $p < 0.05$) decreased in small commercial cages (70×30×55 cm) [93]. In medium-sized cages (160×75×70 cm) with a 7.14 birds/m^2 stocking density, the frequency of preening increased up to 21 repetitions per hour ($p < 0.05$) compared to small cages (120×50×45 cm) with a stocking density of 10 birds/m^2 and 3.6 repetitions per hour [94]. In turkeys, at low ambient temperatures (–18 °C), the frequency of feather cover cleaning decreased to 5.1% [95].

Nesting [88] is defined as the basic behavioral need of laying hens. Nesting behavior is a characteristic of a sequence of behavioral reactions associated with nest-site selection, nest construction, and egg laying. In the wild, 90 minutes before laying, the hens go away to a secluded place, carefully dig a small depression in the ground and build a nest. Similar behavior is observed when keeping hens on floor. Hens are initially motivated to gain access to the nesting place during the laying period [96, 97]. Other factors influencing nesting behavior are the ability to use perch [10] and the design of nests. In large cages with open nests hens were more active during 1 hour of observation than hens in nests closed with a plastic curtain (56.15±6.79 vs. 28.79±2.85 nesting acts per hour; $p = 0.0003$) In small cells, the frequency of aggressive interactions was higher in open nests than in closed nests (66.00 ± 15.97 vs. 9.65±2.10 acts per hour; $p < 0.0001$) [98]. The number of eggs laid both in cages with open and closed nests was small (0.8-1.5%) [99]. It was also established that hens in small cages laid more eggs on red smooth floors than on yellow wire mesh floors (55.6±2.3 vs. 43.4±2.3%, $p = 0.0012$). No similar differences were found for large cages (50.7±3.4 vs. 48.4±3.4%; $p = 0.89$) [99]. Suppression of the nesting instinct upon cage keeping system often leads to severe frustration [21].

Birds is anatomically adapted to perching and roosting [100], that is, their limbs are evolutionally adapted to climbing trees. The use of perches plays an important role in maintaining healthy bones and avoiding interactions with more aggressive relatives. In the wild, birds spend night time and rest time on trees [101-103]. As a rule, hens do not give preference to either round or hexagonal perches ($p = 0.59$-0.98). With age, birds use perch more often ($p < 0.01$), regardless of its shape. In total, hens spend about 10% daytime on perches. More than 75% of hens are perching nightly [104)]. Chickens of the first week of life prefer a flat surface and realize more behavioral needs on the ground (52%) compared to a 5-9-week-old birds ($p < 0.0001$). Aboveground surface (15-69 cm height), chickens begin to use from 2-week age and realize 45% of their behavioral needs there [105].

Normally, poultry should not be thirsty. More than a century ago, the behavior was described of chicks that consumed water only from droplets on plant leaves. In industrial poultry farms, chickens begin to drink from a fixed water surface and then adapt to a variety of water supply technologies [36]. Broilers are known to spend 16% of their time for drinking behavior [82]. This type of behavioral activity is described as pecking at the water bowls, which increases by 49% in the evening compared to the morning time. This is not associated with water consumption and is regarded as a manifestation of stereotype. The frequency of water bowl pecking is significantly reducing during 10 to 16-17 weeks of age (0.28±0.04 vs. 0.05±0.02 acts per chicken for 15 minutes, $p < 0.0001$) [84]. The stocking density affects the water consumption frequency which is higher at moderate (4 birds/m^2) than at low stocking density (3 birds/m^2) [17].

Dustbathing [88] helps maintain skin and feather health. It has been experimentally proven that it balances the amount of feather lipids. Such behavior is controlled by both the nervous system and external factors. For example, in cages equipped with perches, nests and a special bath, birds took dust baths once in the afternoon for 5 minutes. In traditional cages, the dust baths were brief and fragmented (3 times for 10 s) [106). Optimal lighting, temperature, and a dry, loose substrate contribute to this behavior [89, 107]. The frequency of dustbathing was higher at a temperature of 22 °C ($p <0.01$) than at 10 °C [108].

Dustbathing helps to maintain feather cover in many bird species, including broiler chickens. Thanks to them, chickens get rid of contaminants, including litter particles. Failure to use dust baths may indicate problems with beddings or flooring (e.g. humidity or excessive stiffness) [11]. The frequency of such behavior is also affected by age. According to G. Vasdal et al. [109], dustbathing was observed in broilers aged 16 days ($p = 0.009$), but was not recorded at the age of 30 days.

Engaging in comfort behavior (other maintenance behavior) [54, 110] is important to maintain good condition and feather cover. It includes sipping, flapping wings, swinging the body. Cage keeping has a negative effect on manifestation of this behavior because of too small space [111, 112]. When kept in cages, chickens are more likely to stand or to sit ($p < 0.05$), while in free-range systems they demonstrate running and jumping at certain hours [113]. In using systems with peat-rich, alfalfa-rich and raised platforms, 16- and 30-day-old broilers flapped their wings ($p = 0.016$) and shocked their bodies ($p = 0.002$) more often than in systems without enrichment [109].

The comfort of the birds during sleep and rest (sleeping behavior) is equally important [93]. The bird’s natural position for sleep is perched, but birds can quite easily adapt to other conditions. All housing systems for laying hens provide for a substantial period without lighting for rest. Broiler housing systems have long light periods. Currently, regimes of Intermittent lighting or a gradual increase in lighting are being introduced to deal with the problem of rapid growth in poultry [36]. The frequency of sleep ($p < 0.01$) increases significantly in industrial small cages (0.70×0.30×0.55 m) than in medium-sized (1.00×0.33×0.55 m) and large cages (1.30×0.36×0.55 m) [93].

Response to predators [54] arises as a result of external factors in the presence of a stimulus. In the poultry keeping system, there is no key stimulus, i.e. association with a predator, although under certain conditions a person is perceived as such [21, 36, 79]. In experiments using a prey bird model, the number of hens with normal behavior decreases ($p < 0.001$) and does not remain unchanged during the day under the predator model exposure ($p = 0.12$). In addition, the influence of time (before/after exposure of the predator model) and the number of days of exposure on anxious ($p < 0.001$) and panic behavior ($p < 0.001$) was noted, i.e., the bird gets used to the attacks of the model predator [114].

Social interactions [115, 116] are necessary for any keeping systems [21, 36, 79]. An increase in aggression against partners may indicate a decrease in the well-being of the aggressor [53]. It has been shown that the manifestation of aggression while reducing the critical distance between individuals is affected by the general activity of the bird [117] and changes in the environment. So, after the removal of perches, social interactions in cages increased by 19.3% [115]. It is known that red junglefowl hens exhibit synchronous social behavior, which is manifested, among other things, in the pecking of the feathery coat of relatives ($p = 0.058$) [85]. An unfavorable microclimate, air pollution, and ammonia concentration increase aggression in the flock and lead to a decrease in well-being [81].

Thus, animal behavior characterizes its adaptiveness and may be the best indicator of welfare. The degree of well-being of poultry is influenced by many factors: diseases, stress, nutrition, and living conditions. Inability to adapt is expressed in changes in physiological status, as well as in behavioral disorders that can harm both animals and maintenance personnel. From the point of view of ensuring animal well-being, they especially emphasize the ability to exhibit natural behavior and the presence of elements in an environment that brings it closer to the natural environment. Domestic hens have retained a significant part of the behavioral needs of wild relatives (the main are nesting, feeding and drinking behavior, motor activity, comfort behavior, and social interactions). The restriction of natural behavior leads to a deterioration in poultry welfare. The consequence of this may be a violation of homeostasis, leading to a decrease in stress resistance and an increase in risks to poultry health. Productivity of modern poultry breeds and crosses is so high that under industrial technologies, when birds fail to realize behavioral needs, any deviations from the standards of keeping and feeding lead to significant losses. Effective production performance of commercial poultry requires a balance between financial interests and bird welfare.

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