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The effect of monochromatic light on the blood picture and functional state of the hematopoietic system in laying hens

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Abstract. This study aimed to investigate the influence of monochromatic lighting on the haematological indices of Hy-Line W-36 laying hens. In the course of the experiment, four groups of birds were exposed to monochromatic lighting of different wavelengths: blue, green, yellow and red. The haematological study included analysis of leukocyte, erythrocyte and thrombocyte count, haemoglobin concentration, haematocrit and erythrocyte sedimentation rate (ESR). It was found that the colour composition of light affects the hematopoietic system of hens. The activity of white blood cells gradually decreased in the series of transition from short- to long-wavelength light, which indicates the weakening of immune stimulation under the influence of warm light. The content of haemoglobin and haematocrit increased under the yellow and red light, which indicates the activation of erythropoiesis and an increase in the volume of formed blood elements. The number of erythrocytes increased in the yellow and red spectrum, while thrombocytes are most sensitive to long wave radiation, which indicates the activation

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of the megakaryocytic lineage. The ESR decreased with an increase in the wavelength, which indicates the stabilisation of blood viscosity and a decrease in the aggregation of erythrocytes. One-way analysis of variance showed a significant effect of the colour composition of light on all studied indices. Thus, the analysis of experimental data indicated a clear dependence of the haematological status of laying hens on the spectral composition of lighting. In particular, replacing the blue light with red light resulted in a decrease in the number of leukocytes by 45.6% ($p < 0.001$), while the content of haemoglobin increased by 51.8% under the red spectrum compared to the blue one ($p < 0.001$). Additionally, the red light exposure led to an increase in the number of erythrocytes by 52.2% ($p < 0.001$) and a decrease in their sedimentation rate by 22.6% ($p < 0.001$). The results of the study are the scientific basis for the development of recommendations on the use of monochromatic and mixed lighting modes for optimising the productivity and increasing the stress resistance of laying hens

Keywords: leukocytes; erythrocytes; thrombocytes; haemoglobin; haematocrit; spectral composition; immune activity

Introduction

Lighting is one of the key factors that affect the physiological state and productivity of laying hens in the conditions of modern poultry farming. A number of studies indicate the importance of the spectral composition of light, including monochromatic light, in the control of biological processes. The effect of different wavelengths of light on the haemopoietic system of birds is poorly understood and requires further experimental studies to determine the mechanisms of the effects. In the study of M. Shahraki *et al.* (2025), an experimental and modelling approach was used to evaluate the impact of different light intensities (10, 40, 60 and 100 lx) on the morphofunctional state and productivity of young quails. Along with traditional physiological techniques, mathematical modelling methods were used to determine the quantitative dependencies of biological reactions on the parameters of the light environment. The bird productivity was estimated based on live weight gain, feed conversion ratio, meat quality, the rate of lipid peroxidation, the activity of antioxidant enzymes, and the immune status. An integrated analysis demonstrated that a moderate light intensity of 50 to 55 lux is physiologically optimal, ensuring the maximum realisation of growth potential, improvement of feed efficiency, decrease in the level of oxidative stress and increase in immune responsiveness. The data obtained indicate a direct dependence of metabolic processes on the photic effects.

The study by K. Mustafa & I. Al-Kirkuki (2025) investigated the effect of lighting regimens, including a five-hour dark period during the day, applied at different periods of the postnatal ontogenesis (after the 1st, 2nd or 3rd weeks of life), on the productivity of Ross broiler chickens during a 42-day growing period. Compared to continuous lighting, the application of the lighting regimen with a dark period starting from the 1st week of life was accompanied by an increase in the daily average weight gain and improvement of feed conversion ratio, with no negative effect on feed consumption and survival rate of the flock. The results indicate that the optimisation of the light regimen plays an important role in the harmonisation of growth processes and energy metabolism. A systematic review published by Y. Huang *et al.* (2026) summarises the available data on the role of light exposure in the physiological functions of poultry, with a particular emphasis on the fact that light not only performs a visual function but also plays an essential role in regulating the circadian rhythms of physiological functions. The experiment showed that lighting parameters – spectral composition, intensity, duration and type of light source – influence neuroendocrine axes, the secretion levels of melatonin, gonadotrophic hormones and growth hormone, and also influence metabolic processes, immune competence and behavioural responses in poultry. According to the authors, this necessitates an integrated approach to the development of lighting regimens aimed at increasing productivity and ensuring the welfare of poultry.

In the experiment conducted by L. Galan *et al.* (2025), it was found that monochromatic light of different parts of the spectrum has different effects on the functional activity of the endocrine system of broilers by affecting complex neuroendocrine mechanisms that regulate growth, metabolic processes and stress responsiveness. Stimulation of somatotropin secretion and activation of early myogenesis was observed under the influence of green light, while blue light contributed to preserving the muscle mass at later ontogenetic stages and stabilising the pro-oxidant-antioxidant balance. The obtained results indicate the possibility of purposeful spectral light correction of the hormonal status and optimisation of productive qualities. Meanwhile, the analysis of the literature shows that the data on the effect of monochromatic lighting of different spectra on the productive and reproductive qualities of laying hens are fragmented and sometimes contradictory, especially in relation to the combined effect of wavelength, illuminance and photoperiod on the productive and reproductive qualities of laying hens. In the absence of unified, scientifically based recommendations for industrial keeping conditions, further studies are needed to delve deeper into the mechanisms of photoneuroendocrine regulation. The study of K. Takeshima *et al.* (2026) investigated the effects of natural daylight spectrum and artificial light spectrum (in the feeding area) on the growth performance, the rate of sexual maturation and reproductive traits of female Ross 708 broiler breeders reared under a precision feeding system. It was found that continuous red light supplementation delayed the onset of sexual maturation, delayed the onset of egg laying (by about four weeks) and decreased egg production. Conversely, the green spectrum of light did not have any negative effect on reproductive performance and helped to maintain circadian rhythmicity in physiological functions.

The review of G. Gržinić *et al.* (2023) considered the environmental and biomedical impact of intensive poultry farming in relation to the environmental and human health risks posed by the gaseous emissions (ammonia, nitrogen oxides, methane), bioaerosols, pathogenic micro-organisms and residues of antimicrobials. It was concluded that intensive poultry production contributes significantly to anthropogenic pressure, the dissemination of antibiotic resistance and poses a risk to the health of farm workers and the population in the surrounding areas. This implies the need for environmentally focused measures to be taken in the course of the development of this industry. It was established in the Ukrainian research of Yu.V. Osadcha (2021) that the wavelength of light can modulate the non-specific adaptive responses in hens. Thus, the spectral composition of light affects the phase structure of the adaptation process, the activity of the antioxidant system and metabolic indices. In the joint study of Yu.V. Osadcha & H.I. Sakhatsky (2021), the correlation dependence between the spectral characteristics of lighting and indices of viability and reproductive capacity of hens was found, which indicates the expediency of spectral optimisation of the lighting regime.

Although there is already a rather large number of scientific studies, the complex mechanisms of the action of monochromatic light of different spectral composition on the neuroendocrine regulation of the reproductive function of laying hens have not been sufficiently studied. In particular, there are not enough data on the function of the hypothalamic-pituitary-gonadal axis, as well as on the secretion of melatonin and gonadotropins under the conditions of commercial production. In this regard, this study aimed to conduct a comprehensive analysis of the effect of various monochromatic light spectra on the haematological indices of laying hens and to reveal possible neuroendocrine mechanisms of physiological reactions observed in the study.

Materials and Methods

The experimental study used egg-laying hens of the Hy-Line W-36 cross from a commercial flock. The experiments were conducted in accordance with the requirements of the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes (European Union, 2010). The study was carried out in a modern facility for the production of table eggs from 2022 to 2024. Four groups of laying hens were formed for the experiment and housed in poultry buildings equipped with 12-tier cage battery systems of the Big Dutchman type (Germany). The lighting regime during the rearing of pullets and after their transfer to the production flock complied with the recommendations of the cross developer (Hy-Line W-36 Final Hybrid, Management Guide, 2020).

From 18 weeks of age, light intensity in the poultry houses was maintained at 30 lx with a 12hour photoperiod. Thereafter, until the hens reached 30 weeks of age, day length was gradually increased to 16 hours. Subsequently, the lighting regime with an intensity of 30 lx and a 16-hour photoperiod was maintained until the end of the laying period. The only difference between the poultry houses concerned the type of LED luminaires used to create distinct spectral lighting regimes (Table 1). The peak emission wavelength of each monochromatic LED luminaire was determined using an MK 350 UPRtek spectrometer (UPRtek, Taiwan).

Table 1. *Experimental design for investigating the effect of light wavelength on the viability and productivity of laying hens*

Characteristics	Hen group			
	1	2	3	4
Light wavelength, nm	~490	~540	~580	~660
Spectral colour	blue	green	yellow	red
Number of cages	4,704			
Number of birds per cage	101			
Number of birds per group	475,104			
Stocking density, birds/m^2	24.9			
Space allowance, cm^2/bird	401.4			
Cage dimensions, cm: – length – depth	362 112			
Cage area, cm^2	40,544			
Number of drinker nipples per cage	12			
Feeding front, cm	7.2			
Poultry house dimensions, m: – length – width – height	110 26.5 15.0			
Poultry house volume, m^3	43,725			
Poultry house area, m^2	2,915			

Source: developed by the authors

The experimental groups of laying hens were kept under different monochromatic lighting conditions that varied in spectral characteristics. The experimental groups were exposed to LED light sources with peak wavelengths of approximately 490 nm (blue spectrum), 540 nm (green spectrum), 580 nm (yellow spectrum) and 660 nm (red spectrum). Each group consisted of 4,704 cages, with 101 birds in each cage, resulting in a total of 475,104 hens per group. The stocking density was 24.9 birds per m^2 and the floor space per bird 401.4 cm^2. The size of the cages was 362 × 112 cm with a total area of 40,544 cm^2. Each cage was equipped with 12 nipple drinkers; the feeding space was 7.2 cm per bird. The hens were kept in poultry houses 110 × 26.5 × 15.0 m in size with a total area of 2,915 m^2 and a volume of 43,725 m^3. During the entire experiment, the birds were kept under microclimatic conditions that corresponded to the current standards and recommendations of the HyLine W-36 crossbreed developer (Hy-Line W-36 final hybrid. Content guide, 2020). Feeding was carried out with complete compound feeds formulated according to DSTU 4120-2002 (2003); the quality of drinking water met the requirements of DSTU 7525:2014 (2015). The automated cup feeders and nipple drinkers provided the birds with constant access to feed and water.

In each experimental group, 30 blood samples were collected from laying hens at 18 weeks of age (at the start of the study) and again at 52 weeks of age. Blood sampling was carried out from the axillary vein with a volume of 1.0 to 1.5 ml and placed into tubes with K_2 EDTA as an anticoagulant. Sampling of the birds and the selection of animals were carried out in accordance with generally accepted methodological approaches approved by the ASVCP (2012). The haematological studies were carried out on a Micros 60 haematology analyser (Horiba Ltd., Japan) at the Bald laboratory (certificate No. LB/02/2016). Commercial reagents supplied by Horiba Ltd. (USA) were used, including the diluent ABX Minidil LMG, lysing reagent ABX Minilyse LMG, cleaning solution ABX Cleaner, deproteinising agent ABX Miniclair, reagent container ABX Minipack LMG, and the control set 2N, 1H, 1L Para 12 Extend.

The following haematological parameters were determined: erythrocyte, leukocyte and thrombocyte counts by the electrical impedance method (conductometric method); haemoglobin concentration by spectrophotometry; and haematocrit by whole-blood integration. Mean erythrocyte volume, mean haemoglobin content per erythrocyte, mean corpuscular haemoglobin concentration, erythrocyte distribution width, and mean thrombocyte volume were calculated from the recorded primary measurement data. Using the conductometric method, the differential count of leucocytes (monocytes, lymphocytes, eosinophils, basophils and heterophils) was also determined. The reference values of haematological parameters were used according to the data of N.C. Jain (1993).

For comparison between groups, Student's t-test, one-way analysis of variance (ANOVA) and Tukey-Kramer post hoc test were used. Normality of data distribution was tested by the Kolmogorov–Smirnov test. In the case of non-normal distribution, the non-parametric Mann-Whitney U test was used. Significance was set at $p < 0.05$.

Results and Discussion

The results show that the spectral characteristics of light influenced the leukocyte count in hens (Table 2, Figs. 1, 2). The maximum values were found under the blue light. Transition to the green light led to a 19.6% decrease in the leukocyte count compared to the initial level ($p < 0.001$). The yellow spectrum provoked a 24.7% decrease in the leukocyte count in comparison with the blue light group ($p < 0.001$). The most pronounced changes were observed under the red light, where a 45.6% decrease in the leukocyte count was found compared with the blue light ($p < 0.001$). The results of pairwise comparison between the groups are as follows: between the green and yellow, 6.4% ($p < 0.001$); between the yellow and red, 20.9% ($p < 0.001$). Thus, an increase in the wavelength of the lighting led to a consistent and significant decrease in the leukocyte count in the hens, which indicates a decrease in immune activation. Changes in the leukocyte component of the blood of hens under the influence of different light spectra are associated with the complex interaction between the neuroendocrine and immune systems.

Table 2. *Haematological parameters of hens depending on the intensity of the light stimulus, M ± m, n = 30*

Parameter	Group/light wavelength, nm				Reference values
	1	2	3	4	
	~490	~540	~580	~660	
	blue	green	yellow	red	
Leukocytes, thousand/μl	52.6 ± 0.45	$42.3 \pm 0.42^{***}$	$39.6 \pm 0.45^{***\circ\circ\circ}$	$28.6 \pm 0.25^{***\circ\circ\circ''}$	20-40
Haemoglobin, g/dl	8.3 ± 0.19	$9.6 \pm 0.13^{***}$	$11.9 \pm 0.15^{***\circ\circ\circ}$	$12.6 \pm 0.18^{***\circ\circ\circ''}$	7-13
Haematocrit, %	32.0 ± 0.25	31.9 ± 0.28	$34.8 \pm 0.32^{***\circ\circ\circ}$	$34.7 \pm 0.41^{***\circ\circ\circ}$	22-35
Erythrocytes, million/mm^3	2.3 ± 0.06	2.3 ± 0.04	$2.9 \pm 0.03^{***\circ\circ\circ}$	$3.5 \pm 0.08^{***\circ\circ\circ''}$	2.5-3.5
Thrombocytes, thousand/mm^3	22.6 ± 0.53	$29.1 \pm 0.63^{*}$	$56.8 \pm 0.96^{***\circ\circ\circ}$	$62.3 \pm 1.12^{***\circ\circ\circ''}$	32-100
ESR, mm/h	6.2 ± 0.07	$5.4 \pm 0.04^{***}$	$5.0 \pm 0.09^{***\circ\circ\circ}$	$4.8 \pm 0.21^{***\circ\circ\circ}$	4.0-6.5

Note: *p < 0.001 compared with the first group; °p < 0.05, °°p < 0.001 compared with the second group; ‘p < 0.05, “p < 0.001 compared with the third group

Source: developed by the authors

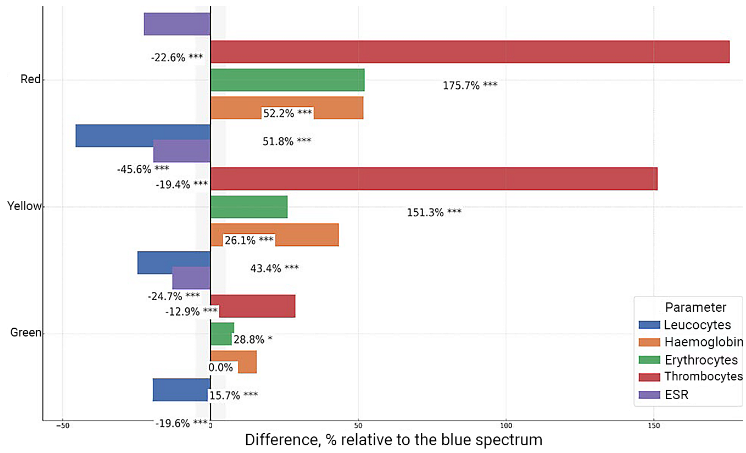

Figure 1. *Percentage differences in haematological parameters of hens under different light wavelengths*

Source: developed by the authors

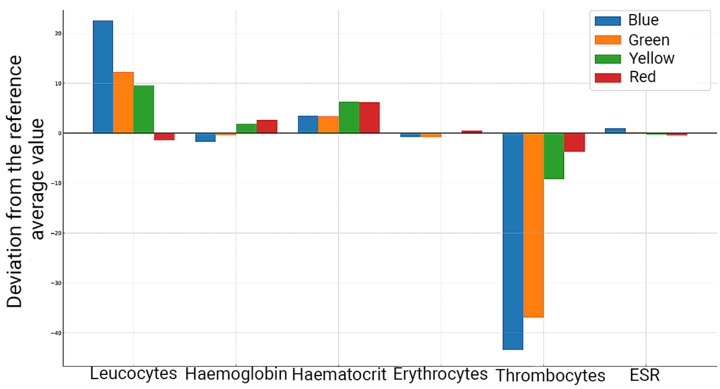

Figure 2. *Deviations of haematological parameters of hens from reference values*

Source: developed by the authors

Leukocyte count in the peripheral blood of hens decreased with an increase in the wavelength of the light from blue to red, with differences between groups of 45-46%. This is an adaptive restructuring of neuroendocrine and immune regulatory mechanisms in response to the change in the spectral composition of the lighting. Light is perceived not only by retinal photoreceptors but also through the skull by hypothalamic photoreceptors and brain structures that regulate the secretion of gonadotropin-releasing hormone (GnRH) and gonadotropin-inhibitory hormone (GnIH). In another experiment, M. Baxter *et al.* (2014) proved the importance of the red light for the stimulation of the reproductive axis in hens in the absence of retinal photoperception, thus validating the crucial role of transcranial photoreceptors in the regulation of the hypothalamic-pituitary system. Further, M. Baxter & G.Y. Bédécarrats (2019) showed that the spectrum of light affects reproductive traits in laying hens, thus, once again, underscoring the systemic nature of photoneuroendocrine response. Therefore, a decrease in the number of leukocytes in the current experiment with the increase of wavelength can be interpreted as an indirect effect of the activation of the reproductive axis and redistribution of metabolic resources in favour of the reproductive function. Blue light with a shorter wavelength is known to enhance the production of melatonin, which, being a central hormone of the circadian system and immune response, can, according to C.H. Teo *et al.* (2021), influence GnIH expression, thus ensuring elevated immune activity in the form of higher levels of leukocyte count in the peripheral blood.

With the increase of wavelength, transcranial photostimulation of the hypothalamic structures is enhanced, which leads to the activation of the hypothalamic-pituitary-gonadal axis and enhanced secretion of oestradiol and progesterone (Lewis *et al.*, 2000). Summarising the data presented by P.D. Lewis & R. Gous (2009), it can be concluded that the spectral sensitivity of poultry covers both the visible and ultraviolet parts of the spectrum, and that different wavelengths have different effects on neuroendocrine regulatory mechanisms. It is also noted that the short-wave and ultraviolet parts of the spectrum are mainly involved in the behavioural reaction, while long-wave radiation is more effective for photostimulation of deep-seated photosensitive brain structures, which agrees with the hypothesis of the enhanced transcranial activation of the hypothalamic centres by red light. An increase in the concentration of these steroid hormones has a pronounced immunomodulatory effect, which consists of reducing the proliferation and release of leukocytes into the peripheral blood. E.M. Hassanein *et al.* (2024) in their analysis of the physiological effects of GnRH and related hormonal changes underscore a close relationship between the activation of the reproductive axis and systemic metabolic and immune reactions, which corroborates the treatment of the reduced number of leukocyte count as an element of endocrinologically mediated adaptation reaction. Therefore, the decline in the number of leukocytes along the blue–red axis represents a physiological trade-off between the immune system and reproduction.

The concentration of haemoglobin increased with the increasing length of the light wavelength. Compared to the blue light, the concentration of haemoglobin under the green, yellow, and red light increased by 15.7% ($p < 0.001$), 43.4% ($p < 0.001$), and 51.8% ($p < 0.001$), respectively. The difference in haemoglobin concentration between the green and yellow light was 23.9% ($p < 0.001$) and between yellow and red light, 6.1% ($p < 0.05$). Similarly, the haematocrit under the yellow and red lights was greater than that under the blue light by 9.1% and 8.8%, respectively ($p < 0.001$). These results are in line with those of I.C. Dunn *et al.* (2009), who found that oestradiol promotes the production of red blood cells by increasing the responsiveness of progenitor cells to erythropoietin and enhancing the proliferation of erythroid progenitors. However, it should be noted that these authors conducted their studies on mammals, and therefore, one should be cautious when extrapolating these mechanisms to birds due to the known species-specific features of erythropoiesis in hens. The data of this study can be considered indirect evidence in support of this hypothesis; however, to confirm it, it is necessary to measure the level of erythropoietin and oestradiol. In addition, J. Li *et al.* (2014) studied how oestrogen regulates the expression in the liver of hens of two key gene-molecular markers of yolk protein, *vitellogenin II* (VTG II) and *very low-density apolipoprotein II* (ApoVLDL II), and the type of receptor mediating this effect (ER-α, ER-β, or GPR30). The authors showed that oestrogen (17β-estradiol) significantly increased the expression of VTG II and ApoVLDL II mRNAs in hepatocytes of laying hens, and that this stimulation occurred mainly through ER-α, but not through ER-β or GPR30. These mechanisms contribute to an increase in the oxygen-carrying capacity of the blood, which is necessary to provide energy for reproductive functions. The rise in the number of red blood cells in the blood of hens is a manifestation of the stimulation of the erythropoietic component of haematopoiesis due to the neuroendocrine effect and an increase in the secretion of steroid hormones. This is in line with F. Zhang *et al.* (2024), who wrote about the effect of low-intensity red and near-infrared light (600-1,100 nm) on tissues through photobiomodulation, including stimulation of cellular processes. Their article will be useful for those interested in this issue and the effects of individual wavelengths of light on biological objects.

The platelets showed the greatest sensitivity to the change in the light spectrum. The number of these cells under the green spectrum was 29.0% ($p < 0.05$) higher than under the blue spectrum; under the yellow spectrum, it was 151.0% ($p < 0.001$) higher and under the red spectrum it was 175.7% ($p < 0.001$) higher. When comparing green and yellow light, the number of platelets increased by another 95.6% ($p < 0.001$), and when comparing yellow and red light, it increased by 9.0% ($p < 0.05$). These data are in agreement with the information of K. Tsutsui *et al.* (2010), which summarises the role of gonadotropin-inhibitory hormone (GnIH) as a key factor regulating the hypothalamicpituitary-gonadal axis and controlling the reproductive functions of birds, including the mechanisms of gonadotropin secretion inhibition. It has been shown that GnIH suppresses the synthesis and release of luteinising hormone and follicle-stimulating hormone and, thereby, controls follicular growth and ovulation. Activation of GnIH secretion may weaken egg production, while the regulation of this system is necessary for the optimal realisation of the reproductive potential of laying hens. In addition, C. Hanlon *et al.* (2022) presented a detailed review of the non-gonadal roles (i.e. outside the reproductive glands) of 17β-estradiol (E2) in laying hens and in broiler breeder hens, as well as its influence on individual physiological processes associated with reproductive function. The authors showed that, apart from the ovaries, E2 is produced in the heart, liver, muscles, brain, fatty tissue, and other organs, and that, through its receptors (ERα, ERβ, GPR30), it controls the processes of yolk formation, metabolism, bone formation, and the oviposition cycle, and, as a consequence, affects egg production and quality, both in laying and in broiler breeder hens.

Erythrocyte sedimentation rate showed a consistent decrease with increasing light wavelength. The ESR under green light was 12.9% lower compared to blue light; under yellow light, 19.4% lower; and under red light, 22.6% lower ($p < 0.001$). The ESR decrease is related to a decrease in immune stress, a membrane-stabilising effect on erythrocytes and a decrease in their aggregation ability in the state of elevated secretion of steroid hormones. L. Liu *et al.* (2015) and S. Li *et al.* (2016) came to similar conclusions. They studied the impact of various monochromatic light colours (blue, green, red and white as control) on laying performance and the expression of oestrogen receptors (ERα, ERβ) and progesterone receptor (PR) in ovarian follicles. Their results showed that blue and green light increase serum oestradiol and progesterone concentrations, up-regulate the expression of ER and PR in granulosa cells of the follicles, and improve egg production and peak laying period, suggesting that the reproductive axis in hens is regulated by light colour.

Thus, the light spectrum is a physiological factor regulating neuroendocrine, immune, and haematopoietic adaptive responses in hens. Short-wavelength light enhances immune response, while long-wavelength light enhances reproductive response, erythropoiesis and thrombopoiesis, thereby promoting better functional adaptation of the haematological system in the context of modern poultry farming. These observations are supported by the findings of N. Tez & M. Akşit (2024), who evaluated the effects of red monochromatic LED light compared with white LED light on laying hen performance in terms of sexual maturity age, egg production, egg quality, feed intake and certain behavioural traits in enriched cages. The researchers reported that red LED light accelerated sexual maturity and peak laying and enhanced egg production and egg weight when compared to white light. However, no significant differences were noted among groups for feed intake, feed conversion, most egg quality traits or behavioural characteristics.

One-way analysis of variance showed that light wavelength had a significant impact on all the assayed haematological parameters (Table 3). In case of leukocytes, the highest proportion of variance was explained by the factor "light spectrum" $F = 684.2$; $p < 0.001$ ($\eta^2 = 0.89$), which corresponds to 45%-46% intergroups difference. There were also significant differences in haemoglobin – $F = 312.5$; p <м0.001 ($\eta^2 = 0.78$), haematocrit – $F = 97.4$; $p < 0.001$ ($\eta^2 = 0.62$), erythrocytes – $F = 421.7$; $p < 0.001$ ($\eta^2 = 0.84$), thrombocytes – $F = 859.3$; $p < 0.001$ ($\eta^2 = 0.91$), ESR – $F = 204.8$; $p < 0.001$ ($\eta^2 = 0.73$). The η^2 values show strong and stable effects of light spectrum on haematopoiesis, which are particularly sensitive in the white blood cell and megakaryocyte lineage.

Table 3. *Influence of lighting spectrum on the haematological characteristics of hens (one-way ANOVA)*

Haematological parameter	F-value	p-value	η² (proportion of variance)	Effect description
Leucocytes	684.2	<0.001	0.89	Very strong effect; intergroup differences up to 45%-46%
Haemoglobin	312.5	<0.001	0.78	Strong effect of the light spectrum
Haematocrit	97.4	<0.001	0.62	Moderately strong effect
Erythrocytes	421.7	<0.001	0.84	Very strong effect
Thrombocytes	859.3	<0.001	0.91	Maximally pronounced effect
ESR	204.8	<0.001	0.73	Strong effect

Source: developed by the authors

The photoregulatory mechanisms seem to be involved in the united effect of the light spectrum on the neuroendocrine and immune systems. The effect of the short-wavelength blue light is likely related to the high immune activity, which maintains the higher levels of leukocytes and ESR. The long-wavelength light, in turn, probably excites transcranial hypothalamic photoreceptors that stimulate the reproductive axis and promote an increase in oestradiol and progesterone levels. The latter induces erythropoiesis and thrombopoiesis and increases the levels of haemoglobin, haematocrit and erythrocytes. It partially suppresses immune function and decreases ESR. Thus, the spectral composition of light regulates the ratio of reproductive function and immune activity to improve functional adaptation of the haematopoietic system.

Conclusions

The spectral composition of light has a determining role in the control of the haematological condition of laying hens. The short-wavelength blue light is characterised by enhanced leukocytogenesis and higher erythrocyte sedimentation rate values, which can be attributed to the activation of immune function and the predominance of immunoregulatory mechanisms. As the wavelength of the light increases (green, yellow, red), we observed a stepwise increase in the concentration of haemoglobin, haematocrit, and the content of erythrocytes and thrombocytes, which is evidence of the activation of erythro- and megakaryocytopoiesis and enhanced oxygen-transport function of the blood. Leuko- and megakaryocytic lineages of haematopoiesis are the most sensitive to the spectral composition of light, which highlights their key role in the adaptation of the organism to the light environment. The decrease in erythrocyte sedimentation rate observed under the long-wave light is related to the stabilisation of the physicochemical properties of the blood and the development of adaptive mechanisms directed toward the maintenance of homeostasis in conditions of increased reproductive load. In general, the data indicate that the light spectrum is a valid means to control the functional activity of the haematopoietic system and can be used as a regulated parameter for improving the physiological status and productivity in laying hens.

The results of this experiment showed that lighting spectral effects on haematological traits of laying hens. In the case of switching blue to red light, the significant decrease of leukocyte by 45.6% ($p < 0.001$), increase of haemoglobin by 51.8% ($p < 0.001$) in red light compared with blue light, the significant increase of erythrocyte by 52.2% ($p < 0.001$) and significant decrease of erythrocyte sedimentation rate by 22.6% ($p < 0.001$) in red light were detected. Future research should focus on investigating the impact of certain combinations of the spectrum of lighting on physiological traits and adaptive reactions in laying hens in order to improve these traits. The study of the interactions among light spectrum, reproduction and production traits (laying, egg quality, morpho-functional state of the reproductive organs) and the use of the cellular and molecular methods for the understanding of the functions of neuropeptides and hormonal pathways in the realisation of lightdependent effects are of great interest.

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Conflict of Interest

None.

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Вплив монохромного світла на гематологічні показники та функцію системи кровотворення курей-несучок

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Анотація. Метою дослідження було вивчити вплив монохромного освітлення на гематологічні показники курей-несучок кросу Hy-Line W-36. Було проведено експеримент із чотирма групами птиці, де відмінністю слугував колір світла: блакитний, зелений, жовтий та червоний. Аналіз гематологічних параметрів включав визначення кількості лейкоцитів, еритроцитів, тромбоцитів, концентрації гемоглобіну, гематокриту та швидкості осідання еритроцитів (ШОЕ). Результати показали, що спектральний склад освітлення суттєво впливає на систему кровотворення у курей. Лейкоцитарна активність поступово зменшувалася при переході від коротких до довгих хвиль, що свідчить про зниження імунної активації під дією теплого світла. Концентрація гемоглобіну та гематокрит збільшувалися при використанні жовтого і червоного світла, що відображає стимуляцію еритропоезу та збільшення об'єму формених елементів крові. Кількість еритроцитів зростала у жовтому та червоному спектрах, тоді як тромбоцити проявляли найбільшу чутливість до довгих хвиль, що свідчить про активацію мегакаріоцитарного ростка. ШОЕ навпаки знижувалося при збільшенні довжини хвилі, демонструючи стабілізацію в'язкості крові та зменшення агрегації еритроцитів. Однофакторний дисперсійний аналіз підтвердив статистично значущий вплив спектрального складу світла на всі досліджені параметри. Проведений аналіз експериментальних даних засвідчив істотну залежність гематологічного статусу курей-несучок від спектральних характеристик світлового режиму. Зокрема, при зміні блакитного освітлення на червоне встановлено зниження кількості лейкоцитів на 45,6 % ($p < 0{,}001$), водночас рівень гемоглобіну зростав на 51,8 % у червоному спектрі порівняно з блакитним ($p < 0{,}001$). Крім того, використання червоного світла супроводжувалося достовірним збільшенням чисельності еритроцитів на 52,2 % ($p < 0{,}001$) та зменшенням швидкості їх осідання на 22,6 % ($p < 0{,}001$). Отримані результати формують науково обґрунтовану основу для розроблення рекомендацій щодо застосування монохроматичних і комбінованих світлових режимів з метою оптимізації продуктивності та підвищення стресостійкості курей-несучок

Ключові слова: лейкоцити; еритроцити; тромбоцити; гемоглобін; гематокрит; спектральний склад; імунна активність