HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

EFFECTS OF DIFFERENT LIGHTING TECHNOLOGIES ON THE PRODUCTION AND PHYSIOLOGICAL PARAMETERS OF POULTRY SPECIES

THESES OF THE DOCTORAL DISSERTATION

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1. Introduction

The aim of intensive livestock production is to ensure efficient and economically viable production in order to meet the continuously increasing demand for food. The application of modern technologies is indispensable for improving productivity, enhancing animal welfare, and ensuring sustainability. The modernization of intensive livestock production benefits not only producers but also consumers, as it enables the production of safer, more sustainable, and higher-quality food products while also meeting the expectations of ethical animal husbandry (Wu et al., 2022; Bilotto et al., 2024; Ghazal et al., 2024; Yang et al., 2024; Yu et al., 2024; Paudel et al., 2025).

Nowadays, artificial light surrounds us in almost every aspect of life, representing a relatively new phenomenon from an ecological perspective. Internal biological rhythms play a crucial role in species adaptation and survival and have been strongly shaped by natural light conditions over thousands of years. In modern intensive indoor livestock production systems, lighting has become an essential technological component. As a result, animal production is no longer dependent on natural outdoor light conditions, and farmers can precisely control the timing, duration, and intensity of illumination. At the same time, this represents a significant responsibility, as lighting in the poultry sector is not merely a technical factor but a key element influencing growth, reproduction, and overall welfare.

The visual perception of birds differs markedly from that of humans, as poultry are capable of detecting higher light frequencies and a broader spectral range (Lewis, 2006; Parvin et al., 2014). Providing appropriate lighting conditions contributes to optimal development, is essential for maintaining egg production, and reduces stress, which directly affects animal health and performance (Gregori et al., 2008; Riber, 2015). Sustained and persistent peak production can only be achieved if animals are kept under conditions that ensure good welfare. Lighting duration, intensity, spectral composition, and spatial distribution all influence biological processes, including hormonal regulation, behavioural patterns, and immune function (Lewis, 2010; Olanrewaju et al., 2006).

Overall, lighting represents a critical factor in the poultry sector, and its proper, scientifically grounded application is essential for successful and sustainable production.

The objective of my dissertation was to conduct a comprehensive comparison of modern LED lighting technology with traditionally used lighting systems (incandescent lamps and fluorescent lighting), as well as to evaluate the effects of different light spectra in various poultry species. Special emphasis was placed on production performance, meat quality, behavioural traits, hormonal regulation, and reproductive biological parameters.

1.1. Objectives

1. Investigation of broiler chickens

The aim of my research is to compare the production, behavioural, and meat quality parameters of broiler chickens reared under modern LED technology and traditional (incandescent) lighting. In addition to basic production indicators, special attention is given to slaughter yield and selected meat quality traits of broiler chickens, as well as to the behavioural patterns of birds in the two groups, for which the current scientific literature provides limited information.

2. **Investigation of broiler parent stock**

The objective of the second experiment is to compare the production performance and hormonal parameters of broiler parent stock kept under traditional (fluorescent) lighting and two different types of LED lighting, as well as the quality and hatchability parameters of the hatching eggs they produce. A further aim of the study is to explore the potential effects of two LED lighting systems with different spectral compositions on physiological and reproductive biological processes. This research is particularly gap-filling with regard to the response of broiler parent stock to LED lighting and the relationships between egg quality and hatchability parameters.

3. **Investigation of goose parent stock**

In the third experiment, I investigate the combined effects of UV spectrum supplementation, far-red spectrum supplementation, and their combined application to RGB LED lighting operating within the visible light range in a foie gras–type goose parent stock population. The aim of the research is to reveal the relationships between the spectral composition of light and the production, selected hormonal, egg quality, and hatchability parameters of goose parent stock. Particular attention is given to the biological effects of individual light spectrum supplements on goose parent stock, for which limited data are available in the current scientific literature, especially regarding egg quality and hatching egg hatchability parameters. Furthermore, the effects of far-red wavelength supplementation have so far been investigated almost exclusively in plant production (Possart et al., 2014; Demotes-Mainard et al., 2016; Tan et al., 2022), and therefore scientific data are extremely scarce, particularly in waterfowl species, despite the fact that this wavelength range is also present in natural light.

2. Material and methods

2.1. Study of different types of lighting on broiler chickens

2.1.1. Housing and feeding technology for experimental animals

In my experiment, sexed hybrid male broiler chickens of the COBB 500 genotype (Cobb-Vantress Inc., Siloam Springs, AR, USA) were used (http1).

The birds were allocated into two experimental groups with five replicates per group. Each replicate consisted of n = 40 individuals, resulting in 200 birds per group and a total of 400 birds included in the experiment. The two groups were housed in the same building but separated by a light-proof partition wall. Birds within one replicate were kept in an area of 1.5 × 2 m, corresponding to a stocking density of 14 chickens/m².

The experiment was conducted on a livestock farm located in the outskirts of Rákoscsaba (GPS coordinates: 47°50′09.72″ N, 19°30′43.72″ E). The birds were housed in a deep-litter system using softwood shavings until 42 days of age. Drinking water was provided via a nipple drinker system, while feed was supplied through conical automatic feeders. All housing and management parameters were set in accordance with the guidelines of the *Cobb Broiler Management Guide* (http2).

During the experiment, a commercially available complete feed mixture was used, complying with the current regulatory requirements (Hungarian Feed Codex, 2003) and the technological specifications of the hybrid (Cobb Broiler Management Guide (http2)). The birds were fed ad libitum in mash form according to the following three feeding phases:

1. starter phase: 0–14 days (ME: 12.58 MJ/kg; crude protein: 22.81%)
2. grower phase: 14–28 days (ME: 13.09 MJ/kg; crude protein: 21.2%)
3. finisher phase: 28–42 days (ME: 13.41 MJ/kg; crude protein: 19.46%)

Feed samples were collected from all three phases, and Weende analysis was performed according to the Hungarian Feed Codex (2003) in the laboratory of the Department of Feed Safety, Institute of Physiology and Nutrition. The analytical results confirmed that the nutrient composition of the applied feeds complied with the prescribed requirements (Hungarian Feed Codex, 2003).

2.1.2. Measurement and calculation of production parameters

Body weight was measured individually on a weekly basis for all birds (on Days 0, 7, 14, 21, 28, 35, and 42). Based on these data, the average daily body weight gain of the birds was calculated.

Feed allocation was recorded daily, and during the weekly weighing sessions (on Days 7, 14, 21, 28, 35, and 42), the remaining amount of feed in the feeders was measured. Weekly feed consumption was determined from the difference between these two values.

Feed conversion ratio of the broiler chickens was calculated on a group basis using the body weight measurements and weekly feed consumption data.

Bird and feed weights were measured using a Kern 572-57 digital scale (KERN & SOHN GmbH, Balingen, Germany).

Data obtained from the replicates were averaged in all cases, which ensured comparability between the experimental groups.

Mortality was monitored on a daily basis, and a mortality log was maintained.

Production performance was evaluated using the European Broiler Index (Broiler Index), according to the method described in the scientific literature, applying the following formula (Kryeziu et al., 2018):

$$\text{Broiler Index} = \frac{avaerage\ bordy\ weight\ (kg)\ x\ viability\ (\%)}{FCR\left(\frac{kg}{kg}\right)\ x\ rearing\ period\ (nap)}\ x100$$

2.1.3. Lighting used in the experiment

In the applied lighting program, there were no differences in the duration or intensity of illumination between the two experimental groups, as shown in Table 1. In one group, traditional tungsten filament incandescent lamps (I) were used for illumination, while in the other group light-emitting diodes (LED) were applied. In the LED group, a 5-minute sunrise and sunset simulation was implemented. In the incandescent-lit group, HELIOS® Loleo Light lamps (Fabryka Zarówek HELIOS Sp. z o.o., Katowice, Poland) (60 W, 50 Hz) were used, whereas in the LED group BrightLife® LED lamps (LED LIGHTING Kft., Budapest, Hungary) (9 W, 100,000 Hz) were applied. The colour temperature of the incandescent lamps was 2700 K, while that of the LED lighting was 4000 K. The wavelength distribution of the lighting used in the experimental groups is presented in Figure 4.

Light wavelength was measured at the height corresponding to the head level of the broiler chickens using an Ocean Optics® USB 2000+ VIS-NIR spectrometer (Ocean Insight, Orlando, Florida, USA), covering a measurement range of 350–1000 nm. Illumination measurements were carried out prior to flock placement under full lighting conditions. The graphical shape does not change with intensity; however, the relative proportions do change.

2.1.4. Behavioural testing methods

During the rearing period, continuous (non-stop) video recordings were made from one replicate of each experimental group. Video analysis was conducted by dividing the recordings into three periods: ten days from the initial phase of rearing (Days 5–14), five days from the middle period (Days 21–25), and three days from the final phase (Days 35–37). The entire housing area was clearly visible in the recordings.

The video recordings were analysed using VLC media player software (VLC 3.0.21 Vetinari) according to the following protocol: during the illuminated period (18 hours), the video was paused every 5 minutes, and the number of individuals engaged in the following activities was recorded:

1. individuals engaged in feeding (feed intake),
2. individuals engaged in drinking (drinking),
3. resting individuals (resting),
4. individuals involved in interactions (interactions).

The number of individuals in each category was subtracted from the total number of birds, resulting in the number of birds performing other activities (other activity).

Each observation point was recorded within a 10-second time window in order to reliably identify the observed behaviours, as a single still image does not always allow unambiguous determination of animal activity (e.g., moving or inactive). Data obtained from daily observations were averaged, and the temporal occurrence of each behavioural category was expressed as a daily mean percentage (%) relative to the total duration of the illuminated period.

2.1.5. Meat quality testing methods

Four animals per replicate (n = 20 per experimental group) were euthanized by severing the cervical vascular complex, in accordance with Section III/A, Article 14 of Government Decree 40/2013 (II. 14).

Following exsanguination, slaughter weight was determined. After evisceration, the weights of individual internal organs were measured, including the liver, heart, bursa of Fabricius, and spleen, and subsequently the total carcass weight (grill weight) was recorded. After carcass dissection, thigh weight was recorded, and following filleting and skin removal of the breasts, breast fillet weight was measured.

Organ weights and the weights of valuable meat parts were also expressed as relative values in relation to slaughter body weight.

For pH determination, a HANNA® pH meter (Hanna Instruments Inc., Smithfield, RI, USA) was used. The pH values of all 20 individuals per group were measured by inserting the glass electrode of the pH meter into the cranial end of the breast muscle sample. Prior to measurements, the device was calibrated using pH 4.01 and pH 7.01 reference buffer solutions to ensure accuracy. Measurements were carried out at 45 minutes post mortem and again at 24 hours post mortem on chilled samples (4 °C).

Colour measurements were performed on the freshly cut surface of the breast muscle using a reflectance spectrophotometric method on all sampled individuals (n = 20 per group). Measurements were conducted using a Minolta Chromameter CR-410 (Konica Minolta Inc., Tokyo, Japan) in the CIELAB L*a*b* colour space, where L* represents lightness (0 = black; 100 = white), a* represents redness (+ red; − green), and b* represents yellowness (+ yellow; − blue). Prior to measurements, the device was calibrated using a white calibration plate.

Differences in colour intensity between groups (ΔE*) were determined using the visual colour difference perception scale described by Lukács (1982), where ΔE* < 0.5 indicates imperceptible difference, ΔE* between 0.5 and 1.5 indicates barely perceptible difference, ΔE* between 1.5 and 3 indicates perceptible difference, ΔE* between 3 and 6 indicates clearly visible difference, and ΔE* > 6 indicates a large difference clearly visible to the naked eye.

Water-holding capacity was determined using the Honikel test (Honikel, 1987) on 10 breast samples per group. After slaughter, samples weighing approximately 100 g were weighed and then placed in a 4 °C environment in such a way that they were suspended solely by their own weight, without any external influence except gravity. After 48 hours, sample weights were remeasured. Drip loss caused by gravity was calculated from the differences in sample weights.

Breast samples were weighed prior to frozen storage at −20 °C for 30 days. After the storage period, samples were gently thawed over 24 hours to room temperature (first to 4 °C, then to 22 °C) and their thawed weight was measured. Samples were then cooked to an internal temperature of 72 °C (Russell Hobbs, VARTA Consumer Batteries GmbH & Co. KGaA, Germany), while internal temperature was continuously monitored (VOLTCRAFT® DET1R, Voltcraft, Hirschau, Germany). After heat treatment, samples were weighed again and then allowed to cool gently to room temperature for 1.5 hours. Once room temperature was reached, samples were weighed again. From these weight measurements, cooking losses—including thawing loss, cooking loss, and cooling loss—were calculated according to AMSA (2015), using the following formulas:

For the assessment of cooking losses, breast muscle samples cooled to room temperature were used for tenderness determination. From these prepared samples, two test specimens per sample with dimensions of 1 × 1 cm were obtained. Shear force was measured at five points on each specimen (n = 200) using a TA.XT PLUS texture analyser (Stable Micro Systems Ltd., Godalming, Surrey, UK) equipped with a Warner–Bratzler blade and a 50 g load cell. Each specimen was positioned perpendicular to the cutting blade, which moved through the sample at a speed of 20 mm/min. The instantaneous force was recorded by the system using Texture Exponent 32 software (Stable Micro Systems Ltd., Godalming, Surrey, UK) and expressed in force/time units (kg/s), from which the maximum force value (kg) was used.

For chemical composition analysis, frozen breast samples were gently thawed to room temperature (first to 4 °C, then to 22 °C), then minced and homogenized (HR1600 Pro Mix Daily Collection, 550 W, Philips, Amsterdam, The Netherlands). The chemical composition of the samples was determined using near-infrared spectroscopy (NIR; PerkinElmer Inc., DA6200, Shelton, CT, USA). After homogenization, samples were placed into the NIR sample cup, and each sample was measured in three replicates, the results of which were averaged. The device provided results expressed as percentages for moisture, protein, fat, collagen, ash, and salt content.

2.2. Testing different types of lighting on broiler parents stock

2.2.1. Animals participating in the experiment

In the experiment, a Ross 308 broiler parent stock flock was used. Rearing of pullets and breeder roosters was carried out at the Bro-Ker-Bét Kft. facility, Farm No. 1. Female and male birds involved in the experiment were reared separately by sex in identical housing units. The experiment was conducted at the Bro-Ker-Bét Kft. facility in Újhartyán, Farm No. 3, involving three poultry houses. The houses were identical in size, each with a floor area of 1000 m² and identical orientation. Pullets and young roosters were placed at 19 weeks of age. The birds were monitored from 19 weeks of age until 53 weeks of age. Under a combined deep-litter housing system, each poultry house simultaneously housed 500 roosters and 5000 hens at a sex ratio of 1:10 and a stocking density of 5.5 birds/m². Feeding was carried out in a restricted manner using a commercially available complete feed formulated to meet the nutritional requirements of breeding stock. From 18 to 23 weeks of age, birds received pre-lay feed; between 23 and 38 weeks of age, Ross broiler parent stock layer 1 feed; and from 38 weeks of age onward, Ross broiler parent stock layer 2 feed, provided in crumbled form in accordance with the recommendations of the Ross Parent Stock Management Handbook (Ross P.S.M.H.). Mortality data were continuously recorded.

2.2.2. Measurement and calculation of production parameters

Live body weight of the breeding birds was measured weekly (separately by sex) in accordance with the recommendations of the Ross Parent Stock Management Handbook (Ross P.S.M.H.), sampling 1% of the flock size prior to feed distribution. The live body weights of the measured birds were treated as group means.

Restricted feed distribution was carried out daily at the same time each day, using feeding amounts recommended by the Ross Parent Stock Management Handbook (Ross P.S.M.H.).

The number of eggs produced was recorded daily in the house log, distinguishing between hatching eggs and eggs unsuitable for incubation (e.g., cracked, size-defective, deformed).

Feed conversion was calculated based on the number of eggs produced and the amount of feed allocated to the hens.
Egg production intensity was calculated from the number of hens present in the house and the daily number of eggs produced.
The number of dead birds was recorded daily by sex in the house log.

2.2.3. Lighting used

The three poultry houses included in the experiment (Houses 1, 2, and 5; marked as I, II, and V in Figures 8–10) and the applied housing technology were identical in all experimental groups, except for lighting. Light spectra were measured in all three houses using an Ocean Optics® Overture USB 2000+ VIS-NIR spectrometer (Ocean Insight, Orlando, Florida, USA) and were visualized using Microsoft Excel. LED lighting was used in House 1 (LED1) and House 2 (LED2), emitting light with different wavelength compositions, while fluorescent lighting was applied in House 5. During the production period, the duration of illumination was uniformly set to 14 hours in all experimental groups, with an illumination level of 100 lux.

2.2.4. Collection and preparation of blood, and faeces samples

Blood sampling was performed monthly in all three groups in accordance with standard veterinary practice. The first sampling was carried out at 18 weeks of age at the rearing facility, and subsequent samplings were conducted in the selected production houses under investigation (Houses 1, 2, and 5) until the birds reached 53 weeks of age. Blood sampling was always performed in the morning hours, and in each group, 10 female and 10 male birds were randomly selected for sampling. Blood was collected from the right wing vein of the birds. Following disinfection of the puncture site (Egisept®), blood was collected using Vacuette® needles (21G × 1” green) into 9 ml sodium-heparin Vacuette® vacuum tubes, with 6 ml collected per animal. Blood samples were stored and transported under refrigerated conditions (4 °C) until further processing.
Blood sample processing was carried out in the laboratory of the Department of Animal Production Technology and Animal Welfare at the Szent István Campus. Blood separation was performed by centrifugation (Hermle Z 206A, Hermle Labortechnik GmbH, Gosheim, Baden-Württemberg, Germany) at 2500 rpm for 15 minutes. Following separation of plasma and red blood cell fractions, 300 µl of plasma was aliquoted in triplicate into reaction tubes (Eppendorf Tubes®, 1.5 ml) using a Proline pipette (Sartorius, 100–1000 µl, Weender Landstrasse 94–108, 37075 Göttingen, Germany). The samples were then stored at −20 °C until further analysis. Sample processing and storage complied with the requirements described in hormone assay manuals (P4 User Manual; E2 User Manual; LH User Manual; FSH User Manual; PTH User Manual; T User Manual; CT User Manual).
Faecal sample collection was performed monthly prior to blood sampling, during the morning hours. At least six fresh faecal samples were collected per group.

Samples were handled separately by group, pooled within each group, and treated as composite samples. Samples were then transported under refrigerated conditions and stored at −20 °C until further use.
Preparation of faecal samples for analysis began with thawing to room temperature. From each sample, 0.5 g was weighed and diluted tenfold with 96% ethanol. Following vortex mixing, the diluted samples were shaken for 30 minutes to ensure efficient extraction of corticosterone. The resulting mixture was centrifuged, and 50 µl of the supernatant was pipetted and mixed with 200 µl of dilution buffer.
The prepared samples were subsequently processed and analysed according to the instructions provided in the Corticosterone ELISA Kit (KORT User Manual).

2.2.5. Hormone measurements

Hormone analyses were performed using samples collected from flocks at 17, 30, and 35 weeks of age.

Progesterone (P4) concentration in plasma was determined using the NovaTec® Progesterone ELISA Kit (Cat. No.: DNOV006) (P4 User Manual).

Oestrogen (E2) concentration in plasma was determined using the NovaTec® 17 beta-Estradiol ELISA Kit (Cat. No.: DNOV003) (E2 User Manual).

Luteinizing hormone (LH) concentration in plasma was determined using the SunLong Biotech® Chicken Luteinizing Hormone (LH) ELISA Kit (Cat. No.: SL0057Ch) (LH User Manual).

Follicle-stimulating hormone (FSH) concentration in plasma was determined using the SunLong Biotech® Chicken Follicle-Stimulating Hormone (FSH) ELISA Kit (Cat. No.: SL0019Ch) (FSH User Manual).

Parathyroid hormone (PTH) concentration in plasma was determined using the CUSABIO® Chicken Parathyroid Hormone (PTH) ELISA Kit (Cat. No.: CSB-E11880Ch) (PTH User Manual).

Testosterone (T) concentration in plasma was determined using the NovaTec® Testosterone ELISA Kit (Cat. No.: DNOV002) (T User Manual).

Calcitonin (CT) concentration in plasma was determined using the SunLong Biotech® Chicken Calcitonin (CT) ELISA Kit (Cat. No.: SL0209Ch) (CT User Manual).

Corticosterone (KORT) concentration in faeces was determined using the DetectX® Corticosterone ELISA Kit (Cat. No.: K014-H1/H5) (KORT User Manual).

2.2.6. Examination of hatching results

Hatching experiments were conducted using hatching eggs produced by the flocks included in the experiment. The eggs originated from hens housed in the experimental poultry houses 1, 2, and 5 at the Bro-Ker-Bét Kft. facility in Újhartyán (Farm No. 3). Egg collection and handling were performed according to standard farm practice using a conveyor belt system with two collections per day, during which farm staff subjectively removed eggs unsuitable for incubation (e.g., cracked, size-defective, deformed). Incubation was carried out at the Herbro Kft. broiler hatchery in Hernád. Experimental incubation was always performed using eggs collected at the same time from all three experimental groups, with 162 eggs per group (one setter tray), corresponding to approximately 3.5–4% of daily egg production. Hatching experiments were conducted bimonthly on four occasions, using eggs produced by the experimental birds at 23, 31, 39, and 47 weeks of age. All eggs included in each experimental hatch were handled identically in accordance with hatchery practice, and the three setter trays containing eggs from the experimental groups were always placed directly above one another within the same setter room to ensure identical incubation conditions. The routine Day-19 candling procedure was omitted by the hatchery for the experimental eggs in order to allow further examination of unhatched eggs. On Day 19, eggs were transferred from the setter to the hatcher, where the three experimental groups were again placed together in the same location, one above the other.

A few hours prior to placement in the setter, the three groups of experimental eggs were individually marked to prevent later mixing, and all eggs (162 per group) were individually weighed using a scale with 0.5 g precision (EXCELL® SI-130). Group mean egg weights were calculated from these data.

Healthy chicks emerging in the hatching baskets were selected and weighed individually (EXCELL® SI-130). Individual identification was not possible, as it was not feasible to determine which chick hatched from which egg. Average chick weight (g) was calculated relative to the average weight of the set eggs (g) and expressed as relative chick weight (%).

Following chick selection and weighing, unhatched eggs and eggshells remaining after hatching were collected from the baskets and transported to the laboratory of the Institute of Animal Science at the Szent István Campus for further examination.

Hatchery loss (%) was calculated from the ratio of unhatched eggs to the total number of set eggs.

Eggshell thickness of the experimental eggs could only be measured on eggshells remaining after chick hatching. Measurements were performed without the inner and outer shell membranes, always at the equatorial region of the egg. Measurements were carried out only on shells that could be unequivocally identified based on pre-incubation individual marking, thereby avoiding duplicate measurements from the same egg. Eggshell thickness was measured using a Mitutoyo® ABSOLUTE Digimatic thickness gauge with 0.01 mm precision. Group mean values were calculated from the measured data.

2.3. Examination of lighting with different spectral ranges on goose parent stock

2.3.1. Animals participating in the experiment

The experiment was conducted using an INTEGRAL MB 09 foie gras goose parent stock provided by Kisbéri Lúdtenyésztő Kft. The birds were housed at the Mátraderecske facility of Állatház Kft., in poultry house No. 3, under a closed deep-litter housing system. The poultry house was divided into four separate units using light-proof partitions. Each experimental group consisted of 200 females and 73 ganders, corresponding to a sex ratio of 2.5 females per 1 gander and a stocking density of 1.2 birds/m². During the experimental period, the flock was in its first production cycle. Birds had ad libitum access to water via nipple drinkers and to feed via spiral automatic feeders. Body weight measurements were performed on a monthly basis. Daily egg production and mortality were recorded in the house logbook. Egg production intensity was calculated based on the number of eggs laid daily and the number of laying females. During the egg production period, body weight measurements were conducted on nine occasions at two-week intervals, with individual weighing of 25% of both the female and male birds.

2.3.2. Lighting used

Among the four experimental groups, lighting was the only factor that differed between treatments. The light spectra in all poultry houses were measured using an Ocean Optics® Overture USB 2000+ VIS-NIR spectrometer (Ocean Insight, Orlando, Florida, USA) and were visualized using Microsoft Excel. The control group was illuminated with LED lighting covering only the visible light wavelength range, while in the other groups this spectrum was supplemented with additional wavelength ranges. In the second group, the aim was to approximate a full spectrum, achieved by supplementation with UVA and UVB plus far-red light (UV+far-red). In the third group, supplementation was provided exclusively with far-red wavelengths, while in the fourth group supplementation consisted of UVA and UVB wavelengths. The correlated colour temperature of the lighting was 5000 K in all experimental groups, and light intensity ranged between 50 and 60 lux. The duration of illumination was 11 hours per day in all groups, from 06:00 to 17:00. In groups 2 and 4, the applied UVB supplementation was provided for only 5 hours per day, from 09:00 to 14:00.

2.3.3. Collection and preparation of blood, and faeces samples

Blood sampling was performed on a monthly basis in all four groups. At each sampling occasion, blood was collected from 8 female and 8 male birds in each experimental group. Blood and faecal sample collection and processing were carried out as described in Section 2.2.4.

Samples collected at placement were used as absolute controls, and faecal samples collected monthly throughout the production period (Months 1–6) were analysed for corticosterone concentration.
From the obtained blood plasma samples, progesterone, oestrogen, and testosterone concentrations were determined between the 2nd and 6th months of the production period as follows:

2.3.4. Hormone measurements

Progesterone hormone (P4) concentrations were determined from plasma samples using the DRG® Progesterone ELISA Kit (EIA-1561) according to the manufacturer's instructions (P4 Instructions for Use).

Oestrogen hormone (E2) concentrations were determined from plasma samples using the DRG® 17 beta-Estradiol ELISA Kit (EIA-2693) following the manufacturer's protocol (E2 Instructions for Use).

Testosterone hormone (T) concentrations were determined from plasma samples using the DRG® Testosterone ELISA Kit (EIA-1559) according to the manufacturer's instructions (T Instructions for Use).

Corticosterone (KORT) concentrations were determined from faecal samples using the ZELLX® Corticosterone ELISA Kit (ZX-55101) following the manufacturer's instructions (KORT Instructions for Use).

2.3.5. Investigation of egg quality and hatching results

Egg quality assessments were performed biweekly on 15 randomly selected hatching eggs per group.

The measurements were carried out using a TA.XT PLUS C texture analyser (Stable Micro Systems Ltd., Godalming, Surrey, UK) equipped with a 10 kg load cell. Data acquisition and analysis were performed using the Exponent Connect Egg Testing software (Version 8.1.9.0; Stable Micro Systems Ltd., Godalming, Surrey, UK).

First, egg weight (g) was measured, followed by shell breaking strength (g) using a 25 mm diameter flat compression plate, which provided shell strength values. Subsequently, the egg was broken onto the instrument tray and albumen height was measured, from which the system automatically calculated the Haugh unit. The strength of the vitelline membrane (g) was determined using a spherical probe, measuring the maximum force required to rupture the membrane. Finally, eggshell weight (g) and shell thickness (mm) were measured.

Hatching was carried out in Jászapáti by Recsi Keltető Kft. Each week, eggs produced by the four experimental groups were placed separately but incubated simultaneously in the same incubator. Incubation parameters and results were recorded in the hatchery logbook.

Fertility percentage was calculated based on the number of eggs identified as infertile during candling, while hatchability percentage was calculated from the ratio of hatched goslings to the total number of eggs set.

Day-old goslings were graded by the hatchery into Class I and Class II categories. Class I goslings were intact, had closed navels, well-dried down, and showed vigorous behaviour, making them suitable for rearing. Goslings with deformities or other abnormalities were classified as Class II and were not recommended for further rearing.

In addition, the number of goslings per female was calculated by relating the number of hatched goslings to the total number of females in production during the given week.

2.4. Ethical and legal compliance during the examinations

None of my three examinations qualify as animal experimentation under Act XXVIII of 1998 on the protection and welfare of animals and Government Decree 40/2013 (II. 14), as the applied procedures did not cause pain, suffering, distress, or lasting harm exceeding a level equivalent to, or greater than, that caused by a needle puncture performed in accordance with good veterinary practice. All procedures conducted on broiler chickens, broiler parent stock, and goose parent stock—including housing, measurement, and sampling protocols—were carried out with the prior approval and under the continuous supervision of the Institutional Animal Welfare Committee of the Hungarian University of Agriculture and Life Sciences, Szent István Campus (SZIC-MÁB) (MATE MKK 2020/22), in full compliance with national legislation (Act XXVIII of 1998; Government Decree 40/2013 (II. 14)) and Directive 2010/63/EU of the European Parliament and of the Council.

2.5. Statistical methods used in the studies

Statistical analyses of all three experiments were performed using the R software environment (R Core Team, 2013; R version 4.3.2; 2023-10-31 ucrt). Normality of data distribution was assessed using the Shapiro–Wilk test, while homogeneity of variances was evaluated using the F-test. When the samples met the assumptions for parametric testing, one-way ANOVA was applied, followed by Tukey's post hoc test to identify significant differences between groups, at a significance level of $p < 0.05$. In cases where the data did not show normal distribution, the Kruskal–Wallis test was used, followed by the Dunn–Bonferroni post hoc test at a significance level of $p < 0.05$ to determine differences among groups. Pearson's correlation analysis was conducted between the examined parameters (production, egg quality, meat quality, and hormonal parameters) using pairwise comparisons to determine simple correlation coefficients.

3. Results

3.1. Presentation of the results of experiments conducted on broiler chickens

3.1.1. Presentation of production results

In every week of the rearing period, birds in the LED group achieved higher body weight gain. During the first five weeks, this difference between the two groups was statistically significant ($p < 0.05$). The average body weight difference (*LED–I) is also presented in Table 4. At the beginning of the experiment, the I group started with a slightly higher initial body weight (0.3 g), which was not significant (N.S.); however, from the second week onward, individuals in the LED group reached higher body weights, and this difference became statistically verifiable by Day 35 ($p < 0.05$). By the sixth week of the experiment, the average difference between the two groups was 43 g per bird in favour of the LED group, which, however, could not be statistically confirmed.

Significant differences in average daily weight gain were observed during the first five weeks ($p < 0.05$). In every examined week, the LED group showed higher average daily weight gain.

No statistically significant difference was observed between the two groups in mortality.

Data related to feed consumption and feed efficiency are presented in Table 6. During the examined periods, weekly and average daily feed intake varied between the groups: during Days 1–7, 8–14, 22–28, and 29–35, the LED group showed higher values, whereas during Days 15–20 and 36–42, feed intake was higher in the I group. The difference was statistically significant in week 6 ($p < 0.01$), when the LED group consumed significantly less feed than the I group. Over the 6-week period, birds in the LED group consumed an average of 4273.7 g feed/bird/42 days, whereas birds in the I group consumed 4335.7 g feed/bird/42 days.

In weeks 2 and 3, feed conversion ratio (kg/kg) was significantly lower in the LED group compared to the I group ($p < 0.05$). This tendency persisted from week 4 until the end of the experiment; however, the differences between groups were not statistically significant.

3.1.2. Presentation of differences observed in the behaviour of broiler chickens

Differences between the two groups within specific periods

During the initial phase of the rearing period (dDys 5–14), the time spent on feed intake showed a variable trend between the groups. On 7 of the 10 examined days, birds in the LED group spent more time eating. Drinking time, resting time, and other activity also differed between groups in this initial phase. On 6 of the 10 days, birds in the LED group spent more time eating and resting, and on 7 of the 10 days more time eating, whereas birds in the I group spent more time on other activities on 7 days. Interactions between birds were identical in both groups on day 12 of the first period; with the exception of Day 6, the LED group spent more time in interactions on all other days, showing significant differences on Days 8 and 13 ($p < 0.05$).

In the middle phase of the rearing period, five days were examined (days 21–25). Time spent eating was significantly higher in the LED group on all five days ($p < 0.01$). With the exception of day 24, the LED group spent more time drinking on four days, with significant differences observed on Days 22 and 25 ($p < 0.01$). Time spent resting was significantly higher in the I group on all five days ($p < 0.05$). Time devoted to other activities during the middle phase showed opposite trends between the groups over the five examined days. Bird interactions were higher in the LED group on all five days, with a significant difference on Day 22 ($p < 0.01$).

In the final phase of the rearing period, three days were examined (days 35–37). Time spent eating was higher in the LED group on all examined days, with a significant difference on day 36 ($p < 0.001$); however, drinking time and resting time showed opposite trends between the groups. Time devoted to other activities was significantly higher in the I group on the examined days ($p < 0.05$). On Days 35–37, no interactions between birds were observed in either group; interactions had practically ceased by this period, and both groups spent the majority of their time (approximately 80%) resting.

Differences between periods within the LED group

Time spent on feed intake in the LED group was 26.44% in the initial phase of the rearing period, 25.2% in the middle phase, and 9.05% in the final phase (initial–middle $p = 0.00000497$; middle–final $p < 0.000001$).

Time spent drinking in the LED group was 5.41% in the initial phase, 5.32% in the middle phase, and 3.86% in the final phase (middle–final $p < 0.0001$).

Time spent resting in the LED group was 45.01% in the initial phase, 52.68% in the middle phase, and 83.64% in the final phase (initial–middle $p < 2 \times 10^{-16}$; middle–final $p < 2 \times 10^{-16}$).

Time spent on other activities in the LED group was 23.01% in the initial phase, 16.64% in the middle phase, and 3.45% in the final phase (initial–middle $p < 2 \times 10^{-16}$; middle–final $p < 2 \times 10^{-16}$).

Time spent on interactions in the LED group was 0.123% in the initial phase, 0.155% in the middle phase, and completely ceased (0%) in the final phase (middle–final $p < 0.0001$).

Differences between periods within the incandescent group

Time spent on feed intake in the incandescent group was 26.55% in the initial phase of the rearing period, 21.24% in the middle phase, and 7.58% in the final phase (initial–middle $p < 2 \times 10^{-16}$; middle–final $p < 2 \times 10^{-16}$).

Time spent drinking in the incandescent group was 5.66% in the initial phase, 4.66% in the middle phase, and 4.08% in the final phase (initial–middle $p < 0.001$; middle–final $p < 0.001$).

Time spent resting in the incandescent group was 44.15% in the initial phase, 57.12% in the middle phase, and 81.55% in the final phase (initial–middle $p < 2 \times 10^{-16}$; middle–final $p < 2 \times 10^{-16}$).
Time spent on other activities in the incandescent group was 23.57% in the initial phase, 16.95% in the middle phase, and 6.78% in the final phase (initial–middle $p < 2 \times 10^{-16}$; middle–final $p < 2 \times 10^{-16}$).
Time spent on interactions in the incandescent group was 0.06% in the initial phase, 0.04% in the middle phase, and completely ceased (0%) in the final phase (initial–final $p = 0.000234$).

3.1.3. Examination of body, organ, and valuable meat part weights

No statistically verifiable differences were observed in dressing percentage or in the proportion of valuable meat cuts (relative breast weight and relative thigh weight) (N.S.).

Relative liver, heart, and spleen weights were higher in the LED group, with significant differences detected for relative liver weight ($p = 0.009$) and relative spleen weight ($p = 0.0459$).

3.1.4. Results of meat quality tests

The pH values measured 45 minutes (pH1) and 24 hours (pH2) after slaughter were nearly identical (N.S.), and the course of pH decline can be considered normal in both groups.

No significant differences were observed in the L*, a*, and b* values of the breast muscle (N.S.). Using the colour difference equation of Lukács (1982), a ΔE*IL value of 0.45 was obtained, indicating that the difference between the breast muscles of the two groups is not perceptible to the human eye.

Higher moisture and protein contents were found in the breast muscle of the LED group, while higher fat, collagen, ash, and salt contents were observed in the incandescent lamp group. However, none of these differences (moisture, protein, fat, collagen, ash, salt) were statistically significant (N.S.).

No significant difference was detected in the drip loss of the breast muscle.

Thawing, cooking, and cooling losses were higher in the incandescent lamp group in all three cases; however, total cooking losses did not differ significantly between the groups (N.S.).

Tenderness was objectively determined using shear force values. Shear force was significantly higher in the incandescent lamp group ($p = 0.00022$); nevertheless, this value can still be considered indicative of tender meat..

3.1.5. Results of the most important correlations between meat quality and meat content parameters

In the LED group, a strong negative correlation was observed between collagen content and cooling loss ($r = -0.95$), while a strong positive correlation was found between collagen content and shear force (r = 0.92). In addition, in the LED group, relative breast (r = 0.99) and thigh (r = 0.91) yields showed strong positive correlations with breast muscle collagen content. These correlations were not detectable in the incandescent lamp group; however, based on the correlation analysis, the effect of pH45 was much more pronounced in this group. A strong negative correlation was observed with the ash content of the breast muscle (r = −0.95), a moderate negative correlation with meat lightness (L*) (r = −0.45), and a moderate positive correlation with thawing loss (r = 0.64).

3.2. Presentation of the results of tests carried out on broiler parent stock

3.2.1. Changes in the live weight of broiler parent stock

No differences were observed in the live body weights of roosters and hens between the groups at any of the examined time points (N.S.).
No statistically significant differences (N.S.) were detected between the groups in mortality data in either sex.

3.2.2. Changes in feed conversion ratio during the experiment

In week 28, the LED2 group achieved the most favourable feed conversion ratio, with a statistically significant difference observed between the fluorescent lamp (F) and LED2 groups (p = 0.0034). In Week 29, the lowest feed conversion ratio was recorded in the LED1 group, where significant differences were found between LED1 and LED2 (p = 0.0217), as well as between the fluorescent lamp (F) and LED2 groups (p = 0.0136). The LED1 group also showed the most favourable feed conversion ratio in Week 45, with a significant difference between the LED1 and LED2 groups (p = 0.0062). During Weeks 34, 35, 38–44, and 51–52, significant differences were observed between the fluorescent lamp (F) and LED2 groups ($p < 0.05$). In Weeks 38, 41–43, 46, 48, and 51–53, significant differences were detected between the fluorescent lamp (F) and LED1 groups ($p < 0.05$). Furthermore, statistically significant differences ($p < 0.05$) between the LED1 and LED2 groups were observed in Weeks 39, 40, 43, and 44.

3.2.3. Changes in weekly egg and hatching egg production intensity of broiler parent stock hens

Egg production intensity between weeks 24 and 29 did not differ among the groups at the beginning of the laying period. All three groups reached peak production at 28 weeks of age. Significant differences between the groups were observed in Weeks 28 and 29. In Week 28, a significant difference was detected between the fluorescent lamp (87.36%) and LED2 (90.58%) groups (p = 0.0029). In Week 29, differences were found between LED1 (89.1%) and LED2 (88%) (p = 0.02), as well as between LED2 and the fluorescent lamp group (88.94%) (p = 0.014).

Between Weeks 30 and 35, the LED1 group showed the highest egg production intensity between weeks 30 and 33. In week 30, significant differences were observed between LED2 (88.32%) and LED1 (89.96%) ($p < 0.001$), as well as between the fluorescent lamp group (88.43%) and LED1 ($p < 0.001$). Further differences were observed in Weeks 34 and 35, when the fluorescent lamp group showed the most favourable egg production. In Week 34, a significant difference was found between the fluorescent lamp (89.65%) and LED2 (87.77%) groups ($p = 0.0117$). In week 35, a difference was observed between the fluorescent lamp (88.95%) and LED2 (87.77%) groups ($p = 0.0245$).

Between Weeks 36 and 41, the LED1 group showed significantly higher production in Week 37, whereas between Weeks 38 and 41 the fluorescent lamp group performed significantly better. In Week 37, significant differences were found between LED2 (86.84%) and LED1 (87.74%) ($p < 0.001$), and between the fluorescent lamp group (87.09%) and LED1 ($p = 0.0063$). In Week 38, differences were observed between LED2 (86.47%) and LED1 (85.96%) ($p = 0.045$), between the fluorescent lamp group (87.80%) and LED1 ($p < 0.001$), and between the fluorescent lamp group and LED2 ($p = 0.0022$). In Week 39, a significant difference was detected between LED2 (84.53%) and LED1 (86.25%) ($p < 0.001$). In week 40, a difference was found between the fluorescent lamp group (84.42%) and LED2 (82.1%) ($p = 0.013$). In Week 41, significant differences were observed between the fluorescent lamp group (85.56%) and LED1 (81.44%) ($p < 0.001$), as well as between the fluorescent lamp group and LED2 (81.99%) ($p < 0.001$).

Between Weeks 42 and 47, the fluorescent lamp group consistently showed more favourable egg production intensity. In Week 42, significant differences were observed between the fluorescent lamp group (84.22%) and LED1 (81.99%) ($p < 0.001$), as well as between the fluorescent lamp group and LED2 (80.77%) ($p < 0.001$). In Week 43, differences were detected between LED2 (81.26%) and LED1 (81.99%) ($p = 0.0082$), between the fluorescent lamp group (84.22%) and LED1 ($p < 0.001$), and between the fluorescent lamp group and LED2 ($p < 0.001$). In Week 44, differences were found between LED2 (79.45%) and LED1 (81.67%) ($p < 0.001$), and between the fluorescent lamp group (82.2%) and LED2 ($p < 0.001$). In Week 45, a difference was observed between the fluorescent lamp group (79.92%) and LED2 (78.74%) ($p = 0.048$). In Week 46, a significant difference was found between the fluorescent lamp group (79.59%) and LED1 (78.19%) ($p < 0.001$).

Between Weeks 48 and 53, significant differences in egg production intensity were observed in Weeks 48 and 51–53, with the fluorescent lamp group performing more favourably. In Week 48, a difference was found between the fluorescent lamp group (79.05%) and LED1 (77.47%) ($p = 0.039$). In Week 51, significant differences were observed between the fluorescent lamp group (76.80%) and LED1 (74.88%) ($p < 0.001$), as well as between the fluorescent lamp group and LED2 (74.30%) ($p < 0.001$). In Week 52, differences were detected between the fluorescent lamp group (75.08%) and LED1 (72.01%) (p =

0.00016), and between the fluorescent lamp group and LED2 (71.40%) ($p < 0.0001$). In Week 53, a significant difference was observed between the fluorescent lamp group (73.86%) and LED1 (71.16%) ($p = 0.042$).

Between Weeks 23 and 28, a significant difference in the proportion of hatching eggs was first observed in Week 28, when the LED1 group performed the best. Significant differences were found between LED2 (91.48%) and LED1 (92.41%) ($p = 0.041$), as well as between the fluorescent lamp group (90.73%) and LED1 ($p < 0.001$). Between Weeks 29 and 34, the LED1 group performed more favourably every week, with significant differences observed in Weeks 29 and 31–33. In Week 29, a difference was detected between the fluorescent lamp group (92.59%) and LED1 (93.71%) ($p = 0.0305$). In Week 31, significant differences were found between LED2 (93.87%) and LED1 (95.39%) ($p < 0.001$), and between the fluorescent lamp group (95.11%) and LED2 ($p = 0.00156$). In Week 32, differences were observed between LED2 (94.47%) and LED1 (95.76%) ($p < 0.001$), between the fluorescent lamp group (95.48%) and LED2 ($p = 0.00593$), and in Week 33 between LED2 (94.84%) and LED1 (96.01%) ($p = 0.0224$).

Between Weeks 35 and 40, the fluorescent lamp group performed more favourably in every week. Significant differences were observed between weeks 36 and 39. In Week 36, differences were found between LED2 (95.99%) and LED1 (96.91%) ($p = 0.022$), and between the fluorescent lamp group (97.31%) and LED2 ($p = 0.00112$). In Week 37, significant differences were detected between LED2 (96.15%) and LED1 (97.02%) ($p = 0.0103$), between the fluorescent lamp group (97.73%) and LED1 ($p = 0.0336$), and between the fluorescent lamp group and LED2 ($p < 0.001$). In Week 38, differences were observed between LED2 (96.21%) and LED1 (97.25%) ($p = 0.0112$), and between the fluorescent lamp group (97.36%) and LED2 ($p = 0.0058$). In Week 39, significant differences were found between LED2 (96.6%) and LED1 (97.68%) ($p < 0.001$), and between the fluorescent lamp group (97.85%) and LED2 ($p < 0.001$).

Between Weeks 41 and 46, the fluorescent lamp group also performed more favourably each week, with significant differences observed in Weeks 41 and 44. In Week 41, a difference was found between the fluorescent lamp group (97.60%) and LED2 (96.48%) ($p = 0.0074$). In Week 44, significant differences were observed between the fluorescent lamp group (97.91%) and LED1 (96.94%) ($p = 0.0113$), and between the fluorescent lamp group and LED2 (96.97%) ($p = 0.0155$). Significant differences were also observed in Weeks 47 and 48. In Week 47, differences were detected between the fluorescent lamp group (97.44%) and LED1 (96.58%) ($p = 0.0407$), and between the fluorescent lamp group and LED2 (96.45%) ($p = 0.0197$). In Week 48, a significant difference was found between the fluorescent lamp group (97.56%) and LED1 (96.22%) ($p = 0.0115$).

3.2.4. Changes in the weight and shell thickness of breeding eggs

At 23 weeks of age, the largest egg weight was produced by the fluorescent lamp group (50.02 g), at 31 weeks by the LED2 group (60.25 g), at 39 weeks by the

LED1 group (64.89 g), and at 47 weeks by the LED2 group (65.94 g). At Week 31, significant differences were observed between LED1 (58.25 g) and the fluorescent lamp group (59.87 g) ($p < 0.0001$), between LED2 (60.25 g) and LED1 ($p < 0.0001$), while at Week 39 differences were found between LED1 (64.89 g) and the fluorescent lamp group (63.22 g) ($p < 0.001$), as well as between LED2 (63.75 g) and LED1 ($p = 0.0158$). No considerable deviation from the technological recommendation (lemon yellow column) was observed during the examined production periods (ROSS 308 PO, 2021).

Eggshell thickness of hatching eggs decreased with advancing age of the flock. At 23 weeks, the thickest shells were produced by the LED1 group (0.327 mm), at 31 weeks also by the LED1 group (0.304 mm), at 39 weeks by the LED2 group (0.292 mm), and at 47 weeks by the LED1 group (0.302 mm). At Week 23, significant differences were observed between LED1 (0.327 mm) and the fluorescent lamp group (0.313 mm) ($p = 0.00069$), and between LED2 (0.313 mm) and LED1 ($p = 0.00096$). At Week 47, differences were found between LED1 (0.302 mm) and the fluorescent lamp group (0.283 mm) ($p < 0.0001$), as well as between LED2 (0.289 mm) and LED1 ($p = 0.0034$).

3.2.5. Changes in the relative body weight of hatched chicks and hatchery loss

At 23 weeks of age, the largest goslings were observed in the LED1 group (34.22 g), at 31 weeks in the LED2 group (41.85 g), at 39 weeks in the LED1 group (43.44 g), and at 47 weeks also in the LED1 group (45.08 g). In the LED1 group, a strong positive correlation ($p = 0.0162$; $r = 0.8942$) was observed between relative gosling weight and the FSH levels of the hens, while a moderate negative correlation was found with the calcitonin levels of the laying hens ($p = 0.0223$; $r = -0.6495$). Similar results were observed in the LED2 group, where relative gosling weight showed a positive correlation with FSH levels ($p = 0.031$; $r = 0.8525$). At week 23, significant differences were observed between LED2 (66.17 g) and the fluorescent lamp group (67.92 g) ($p = 0.0027$), and between LED2 and LED1 (68.65 g) ($p = 0.00012$). At Week 31, differences were found between LED1 (68.72 g) and the fluorescent lamp group (69.31 g) ($p = 0.00003$), as well as between LED2 (69.46 g) and LED1 ($p < 0.00001$).

From the eggs set for incubation from the 23-week-old flock, the lowest proportion of eggs lost during incubation was observed in the LED1 group (26.54%). In the 31-week-old flock, the lowest proportion was identical in the LED1 and fluorescent lamp groups (8.64%), while in the 39-week-old (9.26%) and 47-week-old (9.88%) flocks, the fluorescent lamp group showed the lowest proportion of eggs lost during incubation.

3.2.6. Changes in hormonal parameters measured during the study

A statistically significant difference in progesterone levels was observed at Week 30 between female individuals in the LED1 and LED2 groups ($p = 0.042$), with higher progesterone levels recorded in the LED1 group. Progesterone levels in the fluorescent lamp group showed a strong positive correlation with corticosterone levels ($p = 0.0073$; $r = 0.8514$). At Week 35, higher progesterone levels were observed in the LED1 and LED2 groups; however, these differences were not statistically significant (N.S.). In males at Week 30, individuals in the LED1 and LED2 groups exhibited higher progesterone levels, and a statistically significant difference was detected between the LED1 and fluorescent lamp groups ($p = 0.036$).

No statistically significant differences were found among the groups in oestrogen levels at any of the examined time points (N.S.).

Regarding luteinizing hormone (LH) levels, higher values were observed at Week 30 in females in the LED1 and LED2 groups; however, these differences were not statistically significant (N.S.). A similar trend was observed at Week 35, when the fluorescent lamp group showed significantly lower LH levels compared to the LED1 ($p = 0.047$) and LED2 ($p = 0.007$) groups. In males, similar trends to those observed in females were detected at Weeks 30 and 35, but these differences were not statistically supported (N.S.).

For follicle-stimulating hormone (FSH) levels, nearly identical values were recorded in hens at Week 30 (N.S.). At Week 35, hens in the LED1 and LED2 groups exhibited higher FSH levels compared to the fluorescent lamp group, with the LED1 group showing a significantly higher value than the fluorescent lamp group ($p = 0.02$). Male FSH levels showed similar patterns at both examined time points, with no statistically significant differences detected (N.S.).

Parathyroid hormone (PTH) levels in hens were lowest in the fluorescent lamp group at both Weeks 30 and 35; however, these differences were not statistically significant (N.S.). In males, an opposite trend was observed for PTH levels. At Week 30, higher values were recorded in the LED2 and fluorescent lamp groups (N.S.), while at Week 35, higher PTH levels were observed in the LED1 and LED2 groups (N.S.).

In females, negligible testosterone levels were detected at both examined time points. In males, the highest testosterone levels were observed in the fluorescent lamp group at Week 30 (N.S.), whereas at Week 35 the highest values were recorded in the LED1 group (N.S.). No statistically significant differences were detected at any of the examined time points.

During the egg production period, hens in the fluorescent lamp group exhibited the highest calcitonin levels at both Weeks 30 and 35; however, these differences were not statistically significant (N.S.). In males, nearly identical calcitonin values were measured across all three groups at both examined time points (N.S.).

In hens, the highest corticosterone levels at Week 30 were observed in the fluorescent lamp group (N.S.), whereas at Week 35 higher values were recorded in the LED1 and LED2 groups (N.S.). In males, the highest corticosterone levels at both Weeks 30 and 35 were observed in the LED2 group (N.S.). No statistically significant differences were detected among the groups at any of the examined time points.

3.3. Presentation of the results of experiments conducted on goose parent stock

3.3.1. Changes in live body weights of goose parent stock

The live body weight of ganders decreased toward the middle of the production period and then began to increase again toward the end. This trend was observed in all groups. No statistically significant differences in body weight were detected among the groups (N.S.).

In females, following an initial phase of intensive weight gain, a decrease in body weight was observed in all groups, which coincided with the increase in egg production. The average live body weight of females showed a similar pattern across all groups (N.S.).

No significant differences in mortality were observed among the groups in either sex.

3.3.2. Changes in egg production intensity

Egg production intensity showed a marked increase by the 4th week of production, during which the Far-red group achieved a significantly higher egg production intensity in Weeks 2 and 3 ($p < 0.05$). At peak production in week 6, the performance of the UV group was significantly lower ($p < 0.05$) compared to all other groups, while during the declining phase the decrease in production intensity was more moderate compared to the other treatments, reaching a significantly higher value than the Far-red group in Week 16 ($p < 0.05$). During the main production phase, in several weeks (weeks 8, 12, and 15), the control group achieved a significantly higher ($p < 0.05$) egg production intensity.

3.3.3. Changes in the quality of breeding eggs measured during the study

A significant difference in the average weight of hatching eggs was observed only in Week 14, when eggs from the control group had a higher weight ($p = 0.049$) compared to those from the UV group. In all examined weeks, the average egg weight ranged between 156 and 169 g.

The measured eggshell strength values did not show any significant (N.S.) differences between the groups in any of the examined weeks.

No significant (N.S.) differences were observed among the groups in Haugh unit values of the examined eggs in any production week; the obtained values varied over time. According to the classical interpretation, all examined eggs fell into the good or excellent quality categories.

No statistically verifiable (N.S.) differences were found in total eggshell weight at any of the examined time points. In all groups, a decrease in average eggshell weight was observed as production progressed.

Eggshell thickness of hatching eggs increased compared to the first measurement and then decreased during the second half of the production period. Fluctuations among groups were observed throughout production; however, in several examined weeks the control group exhibited lower eggshell thickness ($p < 0.05$). In Week 4, all other groups produced significantly thicker eggshells compared to the control group (UV+Far-red $p < 0.001$; Far-red $p < 0.001$; UV $p = 0.001$). In Week 8, a significant difference ($p < 0.01$) was observed between the UV+Far-red and UV groups, with the UV+Far-red group showing thicker eggshells. In Week 12, the control group lagged behind the UV ($p = 0.003$) and UV+Far-red ($p < 0.001$) groups, and a significant difference was also observed between the UV+Far-red and Far-red groups ($p = 0.006$), where the UV+Far-red group produced thicker eggshells. In Weeks 14 and 18, the UV group achieved greater eggshell thickness compared to the control group (week 14 K–UV $p = 0.002$; week 18 K–UV $p = 0.00694$), whereas in Week 16 the control group showed higher eggshell thickness ($p < 0.05$) compared to the Far-red and UV groups.

Vitelline membrane strength decreased as the production period progressed. A verifiable difference was observed in Week 6, when the UV group exhibited stronger vitelline membranes ($p = 0.033$) compared to the Far-red group, and in Week 8 the UV+Far-red group showed stronger vitelline membranes ($p = 0.029$) compared to the UV group.

3.3.4. Changes in hatching and reproductive biology indicators

The average fertility of hatching eggs during the production period was around 90% (control: 89.5%; UV+Far-red: 91.8%; Far-red: 89.2%; UV: 90.4%). When projected over the entire production period, the UV+Far-red group achieved significantly more favourable fertility compared to the control ($p = 0.023$) and the Far-red ($p = 0.002$) groups.

The hatchability of hatching eggs calculated per eggs set reached its maximum in Week 7, with hatching rates exceeding 80% in two groups (control and UV+Far-red). When projected over the entire production period (control: 67.1%; UV+Far-red: 71.8%; Far-red: 69%; UV: 72%), a statistically verifiable difference ($p = 0.049$) was found between the control group and the UV group, indicating that the hatchability of the UV group was more favourable over the entire breeding period.

No difference (N.S.) was observed in the proportion of Class I goslings when projected over the entire production period.

The number of goslings per female per production cycle was 27.17 in the control group, 27.57 in the UV+Far-red group, 28.24 in the Far-red group, and 27.92 goslings in the UV group. When projected over the entire breeding period, no significant (N.S.) differences were observed among the groups.

3.3.5. Changes in hormonal parameters measured during the study

The corticosterone levels of faecal samples collected from the parent stock varied across the examined periods. In Months 1, 2, 3, and 6, the lowest corticosterone levels were observed in the UV+Far-red group, whereas in Months 4 and 5 the same was true for the control group (N.S.). In the UV group, a negative correlation coefficient was observed between corticosterone level and egg weight ($p = 0.045$; $r = -0.8213$), as well as between corticosterone level and eggshell weight ($p = 0.0198$; $r = -0.8827$).

A moderately strong relationship was observed between the live body weight of ganders and their progesterone concentration ($p = 0.0466$; $r = 0.4388$). In Months 2 and 6, no differences were found in progesterone levels among the groups. In Month 3, the progesterone level of the Far-red group was lower than the values measured in the UV+Far-red ($p = 0.006$) and UV ($p = 0.041$) groups. In Month 4, the highest progesterone level was observed in the UV group, showing a significant difference compared to the control ($p < 0.001$) and Far-red ($p = 0.034$) groups. In Month 5, ganders in the UV group again showed outstanding progesterone levels compared to the control ($p = 0.001$) and Far-red ($p = 0.038$) groups. A difference was also observed between the control and UV+Far-red groups ($p = 0.023$).

The progesterone levels of females varied among the groups at the examined time points. In Month 2, a significant difference was observed between the UV+Far-red and UV groups ($p = 0.047$), with higher progesterone levels in the UV group. In Month 3, the UV+Far-red group showed a significantly lower progesterone level compared to the UV ($p = 0.033$) and control ($p = 0.011$) groups. In Month 4, the highest progesterone level was observed in the control group, which differed from the UV+Far-red group ($p = 0.025$). In Months 5 and 6, no mathematically verifiable differences were observed among the groups.

The oestrogen levels of ganders did not show significant (N.S.) differences among the groups during the examined periods.

In females, the oestrogen level of the control group was higher in Month 4 ($p = 0.04$) than the value measured in the UV+Far-red group. Similarly, in Month 6, the control group showed higher oestrogen levels than those measured in the other groups (UV+Far-red $p = 0.033$; Far-red $p = 0.012$; UV $p = 0.001$). This tendency was also observed in Month 5, where the control group reached the highest (N.S.) level. In Month 2, the highest (N.S.) oestrogen level was observed in the Far-red group, while in Month 3 oestrogen levels were nearly identical across all groups.

Considering all groups, the testosterone levels of ganders showed a decreasing trend in Months 5 and 6, with nearly identical magnitudes across all groups. Among the examined time points, in Month 3 the lowest testosterone level was observed in the UV+Far-red group, which was significantly lower ($p = 0.045$) than the value measured in the Far-red group.

In females, a significant difference ($p = 0.027$) in testosterone levels was observed in Month 3 between the UV+Far-red and UV groups. In Month 4, the testosterone level of the control group was higher than those measured in the Far-red ($p = 0.02$) and UV ($p = 0.032$) groups. Similarly, the values of the UV+Far-red group were also higher than those measured in the Far-red ($p = 0.032$) and UV ($p = 0.048$) groups. In the other examined months, no differences were observed in the testosterone levels of females.

4. Conclusions and recommendations

4.1. Conclusions and practical recommendations from studies conducted on broiler chickens

My results on feed intake and feed conversion ratio are consistent with previous studies. Olanrewaju et al. (2018) reported that heavy broiler chickens reached a live body weight of 3.97 kg at 56 days under fluorescent lighting, whereas birds kept under LED lighting reached 4.1 kg ($p < 0.05$). Gregory (2016) obtained similar results regarding the effects of LED and incandescent lighting on production performance and feed conversion in broiler chickens. At 45 days of age, birds in the LED group achieved a significantly higher live body weight (3.07 kg, $p < 0.05$). In parallel, at Day 45 the incandescent lighting showed a higher feed conversion ratio (1.46 kg/kg) compared to the LED group (1.43 kg/kg). Similar findings were reported by Mendes et al. (2013) when comparing compact fluorescent lamps and LED lighting. In contrast, the results of Rogers et al. (2015) did not confirm this tendency, as they found no statistically verifiable difference in live body weight between birds reared under LED and incandescent lighting.

Previous studies have not specifically addressed the effects of LED and incandescent lighting on the behaviour of broiler chickens, particularly with regard to the percentage distribution of time spent on different activities. However, the literature contains results that provided a basis for my work and for formulating conclusions from my findings. Sophie et al. (2011) investigated the importance of vision and showed that visually impaired individuals exhibit altered species-specific behavioural patterns: certain activities, such as pecking at the environment, decreased markedly ($p < 0.001$), while time spent resting increased significantly ($p < 0.01$) compared to sighted individuals. Several authors have examined the effects of different monochromatic lights on behaviour. According to Franco et al. (2022), white light increased activity, whereas under blue light birds were calmer and spent more time resting and preening. Hesham et al. (2018) found that birds spent the most time feeding and were the calmest under blue light, while they were most active under red light. In the study of Gregory (2016), the effects of LED and incandescent lighting on broiler chickens were examined using an isolation test. The results showed that birds kept under incandescent lighting exhibited stronger fear responses than those kept under LED lighting. Other studies also confirm that birds reared under LED lighting are less fearful than those kept under other lighting systems (Gregory 2015; Jesse and Gregory 2015).

In our study, it is likely that the birds in the LED group were more active due to a lower level of fear, which was manifested by the fact that on several examined days they spent more time feeding, rested less during the middle phase of the rearing period, and showed a higher rate of interactions during the early and middle phases of rearing.

The increased relative liver and spleen weights observed in the LED group may be explained by the greater body weight gain achieved in this group. In the case of more intensive growth, the metabolic demand of the liver increases, which results in a relatively larger organ size (Zaefarian et al. 2019; Ahmadzadeh et al. 2025). Enhanced immune activity and increased metabolic processes may also lead to a parallel increase in spleen weight alongside the liver (Martínez et al. 2021; Sjofjan et al. 2021).

The intensive growth dynamics and high breast muscle yield of broiler chickens usually alter the structural properties of muscle tissue and influence the physiological processes regulating it (Huang and Ahn 2018). The rheological properties of the breast muscle—generally considered soft and juicy—are influenced, among other factors, by the age of the animal, growth rate, and stress level, which also affect the moisture content of the product (Zhang et al. 2020; Bordignon et al. 2022). The conversion of glycogen to lactic acid reduces muscle pH. A decrease in pH may be associated with a lighter colour of the product and increased drip and cooking losses (Zhang et al. 2012; Hao and Gu 2014). If a rapid pH decline occurs in the early post mortem period, it leads to myofibrillar shrinkage, affects protein functionality, and reduces water-holding capacity. Thus, the extent and temporal pattern of lactic acid accumulation significantly influence protein structure, which directly affects water-holding capacity and shear force values, as well (Duclos et al. 2007; Wilhelm et al. 2010; Gholamreza et al. 2019). In my studies, no differences were observed between the two groups in pH values, colour, or moisture content. According to the Lukács (1982) colour difference scale, the difference in breast muscle colour between the two groups was not perceptible to the naked eye ($\Delta E^* = 0.45$). However, the tendency of drip loss was higher in birds kept under LED lighting (3.5%) compared to the incandescent group (2.51%), although this difference could not be verified using mathematical–statistical methods. In contrast, a strong and significant difference was observed in shear force ($p < 0.001$): 1.78 kg in the LED group and 2.1 kg in the incandescent group. This can presumably be related to the greater body weight gain and lower collagen content in the LED group. Similarly, Kim et al. (2013) reported lower shear force values in birds reared under white LED light (1.76 kg) compared to those kept under incandescent lighting (2.33 kg).

Based on the results of my studies, broiler chickens kept under LED lighting showed more favourable production and behavioural indicators compared to birds reared under traditional incandescent lighting. Birds reared under LED lighting achieved higher live body weight, improved feed conversion, and exhibited more

active behavioural patterns, which may indicate lower fear levels and better welfare. In parallel with increased body weight gain, the increase in relative liver and spleen weights observed in the LED group may be attributed to more intensive metabolic processes. Regarding meat quality parameters, no significant differences were found between the two groups in terms of pH, colour, and moisture content; however, lower shear force values were observed in the breast muscle of chickens reared under LED lighting, indicating a softer, more tender texture. This is most likely explained by muscle structural differences resulting from faster growth and lower collagen content.
Based on my studies, the application of white LED lighting in broiler chicken production yields more favourable results in terms of production performance, animal welfare, and meat quality compared to incandescent lighting. Considering the energy efficiency of LED light sources, their wider application in poultry production is recommended.

4.2. Conclusions and practical recommendations from studies conducted with broiler parent stock

Egg production intensity and the proportion of hatching eggs showed variable trends during the production period. Kai et al. (2018) compared LED and fluorescent lighting in Hy-Line W-36 commercial laying hens and found no difference in egg production intensity between the two experimental groups. Similarly, Kamanili et al. (2015), comparing incandescent, fluorescent, and LED lighting, did not detect differences in feed intake, feed conversion, egg production, or certain egg quality parameters. Likewise, Borille et al. (2013) found no difference in egg production intensity between incandescent and white LED lighting in commercial laying hens. In line with these authors, it can also be stated that in broiler parent stock hens there is no substantial difference in egg production intensity or in the proportion of hatching eggs. However, in the second half of the production period, the egg weight of the LED-lit groups showed a higher rate of increase, which may positively influence the relative weight of hatched chicks and thus their development and viability. Based on this, LED light sources can be recommended as an alternative to fluorescent lighting.
Differences were observed among the experimental groups in egg quality parameters. By the second half of production (weeks 39 and 47), egg weight increased more intensively in the LED groups than in the fluorescent group. In week 39, the LED1 group achieved a significantly higher egg weight ($p < 0.001$) compared to the fluorescent group. Larger eggs result in larger chicks, which exhibit more favourable growth dynamics and vitality (Ramaphala and Mbajiorgu 2013; Iqbal et al. 2023; Tribudi et al. 2023). In my studies, the relative chick weight values showed the most favourable results at each measurement point in one of the LED-lit groups; however, these differences were not statistically significant between groups. The FSH concentration measured in the LED1 group may positively influence embryonic development and chick hatch weight (p =

0.0162; r = 0.8525), which was also true for the LED2 group (p = 0.031; r = 0.8525). In the fluorescent group, a strong correlation was observed between progesterone and corticosterone levels (p = 0.0073; r = 0.8514), which may indicate that increased stress hormone levels can influence reproductive hormone concentrations, thereby exerting a negative effect on egg production and egg quality.

Eggshell thickness was greater in the LED groups than in the fluorescent group at all examined periods. In Weeks 23 and 47, the LED1 group achieved a significantly thicker eggshell ($p < 0.001$) compared to the fluorescent group. A thicker eggshell is advantageous because it reduces the likelihood of cracking or breakage during collection, transport, storage, or other technological processes (e.g., incubation) (Knaga et al. 2019). This is also supported by the observed trends in calcitonin and parathyroid hormone (PTH) levels in hens. Parathyroid hormone increases plasma calcium levels, facilitating the availability and incorporation of calcium required for shell formation. In the LED1 and LED2 groups, PTH levels were higher at both examined time points, although not statistically significant, which may be associated with the thicker eggshells measured. In contrast, in the fluorescent group, calcitonin levels were higher at both examined time points, again without statistical significance. The higher calcitonin levels observed in the fluorescent group may inhibit calcium release from bones, thereby limiting calcium availability for shell formation, which could have resulted in thinner eggshells in this group (Zhouzheng et al. 2019; Lim and Ryu 2022; Fu et al. 2024; Gracia-Mejia et al. 2024).

The pattern of eggshell thickness likewise showed a favourable trend in the LED groups, with significantly thicker shells at several measurement points. This difference can presumably be explained by differences in the hormonal regulation of calcium metabolism, particularly the balance between parathyroid hormone and calcitonin. Thicker eggshells are advantageous from both technological and economic perspectives, as they reduce breakage losses and improve hatchability. Based on my results, white LED lighting is a suitable alternative to conventional fluorescent lighting in broiler parent stock flocks, as it does not impair egg production parameters while potentially improving certain egg quality traits (egg weight, eggshell thickness), in addition to offering a more energy-efficient solution.

4.3. Conclusions and practical recommendations from studies conducted with goose parent stock

No significant differences were observed among the groups in the live body weight of the breeding animals. Egg production intensity and the weight of hatching eggs showed variable patterns at the examined time points. In an experiment conducted on White Roman geese, Chang et al. (2016b) found significant differences in production intensity; however, they compared white LED light with red and blue monochromatic spectra. They concluded that under

blue monochromatic light, white LED and red monochromatic LED resulted in more favourable ($p < 0.05$) egg production intensity, and red light also had a positive effect on the length of the egg production period. Sobotik et al. (2020) investigated LED and UV-supplemented LED lighting in laying hens and found no substantial differences in production parameters, but measured more favourable stress parameters in the UV-supplemented group. Similar results were reported by House et al. (2020b) in Pekin ducks. In my study, the negative correlation observed in the UV group between egg weight ($p = 0.045$; $r = -0.8213$) and eggshell weight ($p = 0.0198$; $r = -0.8827$) may indicate that higher stress levels can negatively affect egg production and may also adversely influence calcium metabolism and, consequently, shell formation.
Eggshell thickness developed more favourably ($p < 0.05$) in the experimental groups than in the control group during several examined weeks. The UV+Far-red group (91.8%) favourably ($p = 0.023$) influenced the fertility of breeding geese compared to the control group (89.5%). Hatchability of hatching eggs developed most favourably in the UV group (72%), showing a significant ($p = 0.049$) difference compared to the control group (67.1%). This result may be related to the progesterone level of the ganders, as at several examined time points the highest progesterone levels were measured in the UV group ($p < 0.05$). In males, progesterone serves as a steroid precursor and can be converted into testosterone, which may have positively influenced fertility (Péczely, 2013; Lawrence et al. 2022). In the UV+Far-red group, the positive relationship ($p = 0.0466$; $r = 0.4388$) between gander body weight and progesterone level may indicate higher hormonal activity in males with better body condition.
For producers, the most important factor is how many goslings can be marketed per female. The number of goslings per female was 27.17 in the control group, 27.57 in the UV+Far-red group, 28.24 in the Far-red group, and 27.92 in the UV group. Although no significant (N.S.) difference was observed among the groups when projected over the breeding period, per 1,000 females this still resulted, compared to the control group, in 40 more marketable goslings in the UV+Far-red group, 75 more in the UV group, and 107 more in the Far-red group.
Based on the results of the study, LED lighting with different spectral supplements (UV, Far-red, UV+Far-red) did not significantly affect the live body weight or egg production intensity of breeding geese; however, favourable trends were observed in several production and reproductive parameters in the supplemented spectrum groups.
Based on the investigations, complex LED lighting supplemented with UV+Far-red can be recommended for producers. Although the Far-red group resulted in the most favourable values in terms of gosling numbers, UV+Far-red lighting was the treatment in which fertility of hatching eggs developed most favourably ($p = 0.023$), and in most of the examined weeks it provided the most favourable eggshell thickness, hatchability of hatching eggs, and proportion of first-class goslings (N.S.), while not causing negative differences in production intensity. Furthermore, the UV+Far-red group showed the lowest corticosterone level

tendency in weeks 1, 2, 3, and 6, which may indicate a more favuorable animal welfare status.

5. New scientific achievements

1. I established that broiler chicken kept under LED lighting achieved more favourable feed conversion during the rearing period compared to the group illuminated with tungsten filament bulbs, which contributed to the higher average live body weight of the LED group (days 7–35, $p < 0.05$).
2. I demonstrated that under LED lighting, broiler chicken spent significantly more time feeding ($p < 0.01$) during the middle phase of the rearing period (days 21–25) compared to their counterparts kept under incandescent lighting. I further established that by the end of the rearing period, behavioural interactions among birds (animal-directed behaviours such as aggression or fighting) practically ceased (LED: middle–final period $p < 0.0001$; incandescent: initial–final period $p = 0.000234$), which was associated with increasing body weight and changes in other behavioural patterns (resting, LED and incandescent: initial–middle period $p < 2 \times 10^{-16}$; middle–final period $p < 2 \times 10^{-16}$).
3. I was the first to conduct a comprehensive examination covering whole body, organ weights, valuable meat cuts, pH, colour, drip loss, cooking losses, shear force, and meat chemical composition parameters in broiler chicken kept under LED and incandescent lighting. I demonstrated that the shear force value of the breast muscle in the LED group was significantly lower ($p < 0.001$) compared to the incandescent-light group.
4. I verified that LED lighting has no negative effect on egg production intensity or the proportion of hatching eggs in broiler parent stock compared to fluorescent lighting. This was also supported by the results of hormonal analyses (P4, E2, LH, FSH, T), where no substantial differences were observed between groups at the examined time points. Furthermore, in the fluorescent group, I demonstrated a strong association between stress hormone (corticosterone) levels and progesterone levels ($p = 0.0073$; $r = 0.8514$), indicating that increased stress was accompanied by elevated progesterone levels.
5. I confirmed that the application of LED lighting improves certain egg quality parameters of broiler parent stock during specific periods compared to the fluorescent-lit group, particularly with regard to increased egg size (week 39 LED1 > F, $p < 0.001$) and improved eggshell quality (week 23 LED1 > F, $p < 0.00069$; week 47 LED1 > F, $p < 0.0001$).
6. I was the first to investigate the effects of LED lighting, as well as its supplementation with UV, Far-red, and UV+Far-red spectra, on the production and reproductive parameters of goose parent stock. I established that supplementation of LED lighting with UV and Far-red spectra had no effect on the live body weight or egg production intensity

of goose parent stock (N.S.). UV and UV+Far-red supplementation significantly increased eggshell thickness of hatching eggs during specific periods (week 4 UV+Far-red $p < 0.001$, Far-red $p < 0.001$, UV $p = 0.001$; week 12 UV $p = 0.003$, UV+Far-red $p < 0.001$; week 14 UV $p = 0.002$; week 18 UV $p = 0.00694$; across the entire production period control < UV+Far-red, $p = 0.00576$).

7. I established that LED lighting supplemented with the UV+Far-red spectral range favourably influenced the fertility of eggs produced by goose parent stock (control vs. UV+Far-red, $p = 0.023$), and that supplementation of LED lighting with the UV spectrum positively affected the hatchability of hatching eggs ($p = 0.049$).

6. The author's published scientific papers to date

6.1. Publications related to the topic of the dissertation

1. Pap, Tibor István; Gede, Petra; Szabó, Rubina Tünde; Dolányi, Ágnes; Kustos, Károly; Berta, Andrea Ilona; Heincinger, Mónika; Kovács-Weber, Mária, A FÉNYINTENZITÁS ÉS A MEGVILÁGÍTÁS IDŐTARTAMÁNAK HATÁSA ZÁRT TARTÁSÚ LÚD SZÜLŐPÁROK TOJÁSTERMELÉSI TELJESÍTMÉNYÉRE, In: Molnár, Zoltán; Némethné, Wurm Katalin (szerk.), 40th ÓVÁR SCIENTIFIC DAY INTERNATIONAL CONFERENCE „Green Deal and agriculture: sustainability or competitive advantage?" Mosonmagyaróvár, Magyarország: Széchenyi István Egyetem Albert Kázmér Mosonmagyaróvári Kar (2025) pp. 178-178., 1 p., Közlemény:36443662 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
2. Pap, Tibor István; Szabó, Rubina Tünde; Liptói, Krisztina; Végi, Barbara; Drobnyák, Árpád; Kissné, Váradi Éva; Heincinger, Mónika; Dolányi, Ágnes; Vajda, Tamás; Lukács, Gábor et al., Tenyészludak zárt tartása II. – világítás, BAROMFI ÁGAZAT: BAROMFI- ÉS NYÚLTENYÉSZTŐK LAPJA 25: 3 pp. 52-56., 5 p. (2025), Közlemény:36443499 Nyilvános Forrás Folyóiratcikk (Szakcikk) Tudományos
3. Pap, Tibor István; Szabó, Rubina Tünde; Pacz, Marcell; Podmaniczky, Béla; Drobnyák, Árpád; Zimborán, Ágnes; Kovács-Weber, Mária, Eltérő fényforrások hatása pecsenyecsirkék egyes termelési paramétereire, In: Póti, Péter; Bényi, Erzsébet; Kovács-Weber, Mária; Bodnár, Ákos; Pajor, Ferenc, VII. Gödöllői Állattenyésztési Tudományos Nap: Előadások és poszterek összefoglaló kötete, Gödöllő, Magyarország: Szent István Egyetemi Kiadó (2019) pp. 40-40., 1 p., Közlemény:30936816 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
4. Tibor, István Pap; Rubina, Tünde Szabó; Gergely, Németh; Mária, Kovács-Weber, Effect of two Different Colour Temperature LEDs on Egg Production

in Hens, In: Aniko, Kelemen-Erdos; Anett, Popovics; Pal, Feher-Polgar (szerk.), Aniko Kelemen-Erdos. XVI. FIKUSZ 2021 International Conference: Abstract Book. (2021) ISBN:9789634492719, Budapest, Magyarország: Óbudai Egyetem, Keleti Károly Gazdasági Kar (2021) 75 p. pp. 69-69., 1 p., Teljes dokumentum, Közlemény:32579613 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos

5. Tibor, István Pap; Rubina, Tünde Szabó; Mária, Kovács-Weber, Effects of fluorescent lamp and two different LED lighting on the relative weight of hatching eggs and one day old chickens in broiler breeding pairs, In: Kiss, Orsolya (szerk.), 19th Wellmann International Scientific Conference: Book of Abstracts, Hódmezővásárhely, Magyarország: University of Szeged Faculty of Agriculture (2022) 109 p. pp. 69-69., 1 p., Közlemény:32811001 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
6. Kissné, Váradi Éva ; Pap, Tibor István* ; Drobnyák, Árpád ; Liptói, Krisztina ; Heincinger, Mónika ; Kustos, Károly ; Kovács-Weber, Mária** ; Végi, Barbara, LÚD SZÜLŐPÁROK TERMELÉSÉNEK VIZSGÁLATA ELTÉRŐ FÉNYÖSSZETÉTELŰ MEGVILÁGÍTÁS MELLETT, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), IX. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 9th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of Presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem, Szent István Campus (2024) 115 p. p. 57, Közlemény:35635526 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
7. Pap, Tibor István ; Szabó, Rubina Tünde ; Kovács-Weber, Mária, ELTÉRŐ MEGVILÁGÍTÁSBAN TERMELŐ BROJLER SZÜLŐPÁROK KELTETÉSI PARAMÉTEREI, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), IX. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 9th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of Presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem, Szent István Campus (2024) 115 p. pp. 62-63., 2 p., Közlemény:35610875 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
8. Pap, Tibor István ; Szabó, Rubina Tünde* ; Bodnár, Ákos ; Pajor, Ferenc ; Egerszegi, István ; Podmaniczky, Béla ; Pacz, Marcell ; Mezőszentgyörgyi, Dávid ; Kovács-Weber, Mária, Effect of Lighting Methods on the Production, Behavior and Meat Quality Parameters of Broiler Chickens, ANIMALS 14 : 12 Paper: 1827 (2024), DOI WoS Scopus Egyéb URL, Közlemény:35063916 Admin láttamozott Forrás Folyóiratcikk (Szakcikk) Tudományos, Nyilvános idéző összesen: 4 | Független: 4 | Függő: 0 | Nem jelölt: 0 | WoS jelölt: 3 | Scopus jelölt: 3 | WoS/Scopus jelölt: 3 | DOI jelölt: 4

9. Drobnyák, Árpád; Pap, Tibor István*; Kissné, Váradi Éva; Liptói, Krisztina; Heincinger, Mónika; Kustos, Károly; Kovács-Weber, Mária**; Végi, Barbara, Eltérő fényspektrumok hatása a szülőpárok termelésére (2024), Megjelenés: Magyarország, Közlemény:35309374 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
10. Pap, Tibor István; Szabó, Rubina Tünde; Pacz, Marcell; Podmaniczky, Béla; Kovács-Weber, Mária, Examination of the effect of light sources on meat quality parameters for broilers, In: Boro, Mioč; Ivan, Širić (szerk.), 55th Croatian & 15th International Symposium on Agriculture: Book of abstracts, Zagreb, Horvátország: University of Zagreb, Faculty of Agriculture (2020) 335 p. pp. 233-233., 1 p., Közlemény:31208697 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
11. Pap, Tibor István; Szabó, RubinaTünde; Varga, Barbara; Tóth, Márk; Podmaniczky, Béla; Pacz, Marcell; Kovács-Weber, Mária, ELTÉRŐ MEGVILÁGÍTÁSOK HATÁSA BROJLERCSIRKÉK TERMELÉSÉRE ÉS VISELKEDÉSÉRE A NEVELÉSI IDŐ KÖZÉPSŐ SZAKASZÁBAN (2022), 20. Nemzetközi Takarmányozási Szimpózium Poszter, Közlemény:33999163 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
12. Tibor, István Pap; Rubina, Tünde Szabó; Gergely, Németh; Mária, Kovács-Weber, Effect of two different LED spectrum compositions on hatching egg production in hens, In: 57th Croatian and 17th International Symposium on Agriculture Book of Abstracts., (2022) pp. 260-260., 1 p., Közlemény:32917636 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
13. Pap, Tibor István; Szabó, Rubina Tünde; Podmaniczky, Béla; Pacz, Marcell; Kovács-Weber, Mária, Különböző világítási módok hatása a brojler ágazatban, In: Fodor, Marietta; Bodor-Pesti, Péter; Deák, Tamás (szerk.), A Lippay János – Ormos Imre – Vas Károly (LOV) Tudományos Ülésszak tanulmányai = Proceedings of János Lippay – Imre Ormos – Károly Vas (LOV) Scientific Meeting, Budapest, Magyarország: Magyar Agrár- és Élettudományi Egyetem, Budai Campus (2022) 814 p. pp. 555-561., 7 p., Közlemény:32878017 Egyeztetett Forrás Könyvrészlet (Konferenciaközlemény) Tudományos
14. Pap, Tibor István; Kovács-Weber, Mária, A LED megvilágítás a bojler szülőpárokra gyakorolt hatásának vizsgálata, összehasonlítva más hagyományos megvilágításokkal. (2022), Közlemény:32811045 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
15. Pap, Tibor István; Szabó, Rubina Tünde; Podmaniczky, Béla; Pacz, Marcell; Kovács-Weber, Mária, A brojler ágazatban alkalmazott különböző megvilágítási módok hatása, In: Pepó, Péter (szerk.), "Innovatív tudományos műhelyek a hazai agrár felsőoktatásban" EFOP-3.6.3-VEKOP-16-2017-00008: Hallgatói tudományos publikációk gyűjteménye, Debrecen, Magyarország: Debreceni Egyetem (2022) 280 p. pp. 224-229., 6 p.,

Közlemény:32755604 Nyilvános Forrás Könyvrészlet (Szaktanulmány) Tudományos

16. Pap, Tibor István; Szabó, Rubina Tünde; Varga, Barbara; Podmaniczky, Béla; Pacz, Marcell; Kovács-Weber, Mária, LED és hagyományos (Wolfram szálas izzó) megvilágítás hatásai pecsenyecsirkék viselkedésére és termelési paramétereire (Előzetes etológiai vizsgálati eredményekkel), In: Bene, Szabolcs (szerk.), XXVII. Ifjúsági Tudományos Fórum, Keszthely, Magyarország: Magyar Agrár- és Élettudományi Egyetem, Georgikon Campus (2021) pp. 36-41., 6 p., Közlemény:32491548 Nyilvános Forrás Könyvrészlet (Konferenciaközlemény) Tudományos
17. Pap, Tibor István; Varga, Barbara; Szabó, Rubina Tünde; Pacz, Marcell; Podmaniczky, Béla; Kovács-Weber, Mária, A megvilágítás hatása pecsenyecsirkék viselkedésére és az ezzel összefüggésbe hozható termelési paraméterekre, In: A Magyar Etológiai Társaság XXII. (online) konferenciája: PROGRAM és KIVONATFÜZET, Magyar Etológiai Társaság (2020) 66 p. pp. 44-45., 2 p., Közlemény:31710016 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos

6.2. Publications not related to the topic of the dissertation

1. Szabó, Stella; Kovács-Weber, Mária; Pap, Tibor István; Dolányi, Ágnes; Ferenc, Pajor; Ákos, Bodnár; Vajda, Tamás; Heincinger, Mónika; Szabó, Rubina Tünde, Effect of postbiotics on the production parameters of rearing goose, VETERINARY AND ANIMAL SCIENCE 30 Paper: 100541 (2025) DOI WoS Scopus Egyéb URL, Közlemény:36440902 Egyeztetett Forrás Folyóiratcikk (Szakcikk) Tudományos
2. Végi, Barbara; Drobnyák, Árpád; Kissné, Váradi Éva; Pap, Tibor; Kovács-Weber, Mária; Heincinger, Mónika; Liptói, Krisztina, Tenyészludak zárt tartása - telepítési sűrűség, ivararány, BAROMFI ÁGAZAT: BAROMFI- ÉS NYÚLTENYÉSZTŐK LAPJA 25: 1 pp. 48-55., 8 p. (2025), Közlemény:36101585 Nyilvános Forrás Folyóiratcikk (Szakcikk) Tudományos
3. Pap, Tibor István; Székács, András; Takács, Eszter; Kovács, Levente; Gócza, Elen; Ecker, András; Tóth, Roland; Adányi, Nóra; Józwiak, Ákos; Süth, Miklós et al., A baromfiágazat járványügyi biztonságának javítása NetPoulSafe program segítségével, In: Hajdú, Péter (szerk.), I.Magyar Agrártudományi Doktoranduszok Szimpóziuma 2023: Absztraktkötet, Debrecen, Magyarország: Doktoranduszok Országos Szövetsége (DOSZ) (2023) 100 p. pp. 22-22., 1 p., Központi kezelésű Közlemény:33682752 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos

4. Kovács-Weber, Mária; Pap, Tibor István*; Szabó, Rubina Tünde; Szabó, Stella; Bánki, Zoltán; Liptói, Krisztina**; Heincinger, Mónika, Gyógynövényekkel és posztbiotikumokkal az egészséges termékelőállításért és az állatjólét biztosításáért (2025), előadás, XXVI. Kiskunfélegyházi Libafesztivál, 2025. szeptember 12., Közlemény:36339642 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
5. Drobnyák, Árpád; Pap, Tibor István*; Kissné, Váradi Éva; Liptói, Krisztina; Heincinger, Mónika; Kustos, Károly; Kovács-Weber, Mária**; Végi, Barbara, Különböző takarmánykiegészítők hatása a szülőpárok termelésére (2025), előadás, XXVI. Kiskunfélegyházi Libafesztivál, 2025. szeptember 12., Közlemény:36339676 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
6. Andrea, Ilona Berta; Rubina, Tünde Szabó; Tibor, István Pap; Mária, Kovács-Weber, A study of consumption knowledge of table eggs, In: XXth European Symposium on the Quality of Eggs and Egg Products and XXVIth European Symposium on the Quality of Poultry Meat: Book Of Abstracts, (2025) pp. 81-81., 1 p., Közlemény:36339492 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
7. Rubina, Tünde SZABÓ; Balázs, TIBOL; Tibor, István PAP; Mária, KOVÁCS-WEBER, Effect of postbiotic supplementation on pheasant meat production and quality, In: XXth European Symposium on the Quality of Eggs and Egg Products and XXVIth European Symposium on the Quality of Poultry Meat: Book Of Abstracts, (2025) pp. 75-75., 1 p., Közlemény:36339421 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
8. Rubina, Tünde SZABÓ; Tibor, István PAP; Mónika, VALASEK; Andrea, Ilona BERTA; Béla, PODMANICZKY; Mária, KOVÁCS-WEBER, Changes of some quality parameters during storage of eggs, In: XXth European Symposium on the Quality of Eggs and Egg Products and XXVIth European Symposium on the Quality of Poultry Meat: Book Of Abstracts, (2025) pp. 73-73., 1 p., Közlemény:36339395 Nyilvános Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
9. Pápai, Bánk; Kovács, Zsófia; Tóth-Lencsés, Kitti Andrea; Bedő, Janka; Chan, Khin Nyein; Kovács-Weber, Mária; Pap, Tibor István; Csilléry, Gábor; Szőke, Antal; Veres, Anikó, Investigating the Variation between Lignin Content and the Fracture Characteristics in Capsicum annuum Mutant Stems, AGRICULTURE-BASEL 14: 10 Paper: 1771, 11 p. (2024), DOI WoS Scopus Egyéb URL, Közlemény:35443048 Admin láttamozott Forrás Folyóiratcikk (Szakcikk) Tudományos
10. Márk, Tóth; Tibor, Pap; Szabina, Kulcsár; Zsolt, Ancsin; Márta, Erdélyi; Mária, Kovács-Weber, Foot pad dermatitis survey on three hungarian broiler farms, In: A.C., Barroeta; C., Garcés Narro; G., Sayegh (szerk.), XVI. European's Poultry Conference: Book of abstracts, Valencia, Spanyolország: Middle East Agrifood Publishers (2024) 597 p. pp. 436-436., 1 p.,

Közlemény:35149305 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos

11. Bánki, Zoltán ; Szabó, Stella* ; Pap, Tibor István ; Szabó, Rubina Tünde ; Végi, Barbara ; Heincinger, Mónika ; Liptói, Krisztina** ; Kovács-Weber, Mária, PRO- ÉS POSZTBIOTIKUM KIEGÉSZÍTÉS HATÁSÁNAK VIZSGÁLATA LÚDTERMÉK ELŐÁLLÍTÁSBAN, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), IX. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 9th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of Presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem, Szent István Campus (2024) 115 p. pp. 49-50., 2 p., Közlemény:35635522 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
12. Szabó, Stella; Szabó, Tünde Rubina; Fehér, János; Podmaniczky, Béla; Pap, Tibor István; Hoffmann, Flóra; Kovács-Weber, Mária, Effect of lysed probiotic preparation and micronised polysaccharide mixture on some production parameters of broilers, In: Nutztiere in Nährstoffkreisläufen: Ernährungsphysiologie und Umwelt im Dialog: 22. BOKU-SYMPOSIUM TIERERNÄHRUNG TAGUNGSBAND (2024), Közlemény:34731275 Nyilvános Forrás Egyéb konferenciaközlemény (Konferenciaközlemény) Tudományos
13. Drobnyák, Á.; Kissné, Váradi É.; Liptói, K.; Barna, J.; Szőke, Zs.; Molnár, Z.; Pap, T. I.; Kovács-Weber, M.; Szabó, R. T.; Heincinger, M. et al., Effects of stocking density and sex ratio on the reproductive parameters of breeding geese in indoor keeping system, In: A.C., Barroeta; C., Garcés Narro; G., Sayegh (szerk.), XVI. European's Poultry Conference: Book of abstracts, Valencia, Spanyolország: Middle East Agrifood Publishers (2024) 597 p. pp. 374-374., 1 p., Teljes dokumentum, Közlemény:35189679 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
14. Lengyel, Ármin; Pap, Tibor István*; Szabó, Rubina Tünde; Kovács-Weber, Mária, Eltérő Kiegészítő Takarmányozási Módok Hatása Galambfiókák Egyes Növekedési Mutatóira=ELTÉRŐ KIEGÉSZÍTŐ TAKARMÁNYOZÁSI MÓDOK HATÁSA GALAMBFIÓKÁK EGYES NÖVEKEDÉSI MUTATÓIRA, ANIMAL WELFARE ETOLÓGIA ÉS TARTÁSTECHNOLÓGIA / ANIMAL WELFARE ETHOLOGY AND HOUSING SYSTEMS 17: 2 pp. 154-163., 10 p. (2021), Teljes dokumentum, Közlemény:32578781 Admin láttamozott Forrás Folyóiratcikk (Szakcikk) Tudományos
15. Lengyel, Ármin; Pap, Tibor István; Szabó, Rubina Tünde; Kovács-Weber, Mária, Effect of different supplementary feeding methods on some growth parameters ofpigeon nestlings, HUNGARIAN AGRICULTURAL RESEARCH: ENVIRONMENTAL MANAGEMENT LAND USE BIODIVERSITY 31: 3-4 pp. 4-8., 5 p. (2021), Teljes dokumentum,

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16. Pap, Tibor István; Szabó, Rubina Tünde; Drobnyák, Árpád; Kovács-Weber, Mária, A baromfitartásban alkalmazott LED megvilágítás hatásának összefoglaló elemzése (Irodalmi áttekintés), ÁLLATTENYÉSZTÉS ÉS TAKARMÁNYOZÁS 70: 2 pp. 123-132., 10 p. (2021), REAL-J Matarka, Közlemény:32131274 Admin láttamozott Forrás Idéző Folyóiratcikk (Összefoglaló cikk) Tudományos
17. Pap, Tibor István; Szabó, Rubina Tünde; Kovács-Weber, Mária, Telepítési sűrűség hatásainak áttekintése baromfifajokban, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap: Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő: Book of Abstracts of presentations and Posters, Gödöllő, Magyarország: Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 80-80., 1 p., Közlemény:33285180 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
18. András, Barbara ; Szabó, Rubina Tünde ; Heincinger, Mónika ; Lengyel, Ármin ; Kustos, Károly ; Pap, Tibor István ; Tóth, Márk ; Kovács-Weber, Mária, Integrált és specializált kacsatelepek termelési rendszerének összehasonlítása, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 78-78., 1 p., Közlemény:33285170 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
19. Tóth, Petra Panna ; Pap, Tibor István ; Szabó, Rubina Tünde ; Tóth, Márk ; Kovács-Weber, Mária, Eltérő hőmérsékleten tárolt fürjtojások minőségvizsgálata, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 53-53., 1 p., Közlemény:33285160 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
20. Éliás, Gergő; Szabó, Rubina Tünde; Pap, Tibor István; Tóth, Márk; Kovács-Weber, Mária, Fogyasztási preferenciák vizsgálata a szalámi fogyasztásban, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap: Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő: Book of Abstracts of presentations and Posters, Gödöllő, Magyarország: Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 43-43., 1 p., Közlemény:33284438 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos

21. Dolányi, Ágnes; Pap, Tibor István; Szabó, Rubina Tünde; Tóth, Márk; Kovács-Weber, Mária, Kolbászok minőségvizsgálata, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap: Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő: Book of Abstracts of presentations and Posters, Gödöllő, Magyarország: Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 42-42., 1 p., Közlemény:33284060 Admin láttamozott Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
22. TÓTH, Márk; KOVÁCS-WEBER, Mária; ANCSIN, ZSolt; PAP, Tibor István; BALOGH, Krisztián; SZABÓ, Rubina Tünde; ERDÉLYI, Márta, NAGY ARÁNYÚ BÚZA DDGS HATÁSA BROJLERCSIRKE TERMELÉSI PARAMÉTEREIRE, ÉS EGYES HÚSMINŐSÉGI PARAMÉTEREIRE, In: Molnár, Zoltán; Némethné, Wurm Katalin (szerk.), 39. Óvári Tudományos Nap Konferencia, Mosonmagyaróvár, Magyarország, Veszprém, Magyarország: Széchenyi István Egyetem Albert Kázmér Mosonmagyaróvári Kar, VEAB Agrártudományi Szakbizottság (2023) pp. 113-113., 1 p., Közlemény:34441964 Admin láttamozott Forrás Könyvrészlet (Absztrakt / Kivonat) Tudományos
23. Pap, Tibor István; Szabó, Rubina Tünde; Heincinger, Mónika; Tóth, Márk; Kovács-Weber, Mária, A megvilágítási paraméterek sajátosságainak összefoglalása a lúdáru-termelésben, In: Molnár, Zoltán; Némethné, Wurm Katalin (szerk.), 39. Óvári Tudományos Nap Konferencia, Mosonmagyaróvár, Magyarország, Veszprém, Magyarország: Széchenyi István Egyetem Albert Kázmér Mosonmagyaróvári Kar, VEAB Agrártudományi Szakbizottság (2023) pp. 57-58., 2 p., Közlemény:34441870 Admin láttamozott Forrás Könyvrészlet (Absztrakt / Kivonat) Tudományos
24. Pap, Tibor István; Kovács-Weber, Mária, Lúd állományok termelési és hormonális paramétereinek vizsgálata a telepítési sűrűség és ivararány függvényében (2023), Előadás, Közlemény:33952745 Nyilvános Forrás Egyéb (Nem besorolt) Tudományos
25. Tóth, Márk; Kovács-Weber, Mária; Pap, Tibor; Erdélyi, Márta, Relationship between nutrition factors and development of food pad dermatitis (FPD), COLUMELLA: JOURNAL OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES 10: 1 pp. 5-13., 9 p. (2023), DOI Egyéb URL, Közlemény:34049083 Egyeztetett Forrás Folyóiratcikk (Szakcikk) Tudományos
26. Tóth, Márk ; Erdélyi, Márta ; Pap, Tibor István ; Kulcsár, Szabina ; Szabó, Rubina Tünde ; Bagó, Zsolt ; Gyurcsó, Gábor ; Kolozsi, Gergely ; Szarka, Dávid ;, Kovács-Weber, Mária, Talpfekély előfordulásának felmérése hazai brojlercsirke állományban, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal

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27. Balog-Szabó, Sára ; Szabó, Rubina Tünde ; Erdélyi, Márta ; Szabó, Bence ; Heincinger, Mónika ; Lengyel, Ármin ; Kustos, Károly ; Pap, Tibor István ; Tóth, Márk ; Kovács-Weber, Mária, A tömőalapanyag nevelés hatékonyságának vizsgálata a telepítési sűrűség függvényében, In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 40-40., 1 p., Közlemény:33284058 Egyeztetett Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
28. Pap, Tibor István ; Szabó, Rubina Tünde ; Balláné, Erdélyi Márta ; Tóth, Márk ; Kustos, Károly ; Heincinger, Mónika ; Lengyel, Ármin ; Végi, Barbara ; Liptói, Krisztina ; Drobynák, Árpád et al., Állománysűrűség hatása lúd szülőpár tojástermelésére (előkísérlet), In: Bényi, Erzsébet; Bodnár, Ákos; Pajor, Ferenc; Póti, Péter (szerk.), VIII. Gödöllői Állattenyésztési Tudományos Nap : Előadások és poszterek összefoglaló kötete = 8th Scientific Day of Animal Breeding in Gödöllő : Book of Abstracts of presentations and Posters, Gödöllő, Magyarország : Magyar Agrár- és Élettudományi Egyetem (2022) 82 p. pp. 48-48., 1 p., Közlemény:33284474 Egyeztetett Forrás Egyéb konferenciaközlemény (Absztrakt / Kivonat) Tudományos
29. Pap, Tibor István, A XXIII Kiskunfélegyházi libafesztivál, BAROMFI ÁGAZAT: BAROMFI- ÉS NYÚLTENYÉSZTŐK LAPJA 22: 4 pp. 38-39., 2 p. (2022), Közlemény:33999114 Nyilvános Forrás Folyóiratcikk (Rövid közlemény) Tudományos
30. Tóth, Márk ; Pap, Tibor István ; Kiss, Brigitta ; Kovács-Weber, Mária ; Erdélyi, Márta, A TALPFEKÉLY KIALAKULÁSA ÉS A TAKARMÁNYOZÁS KÖZÖTTI KAPCSOLAT, In: Halas, Veronika; Tóthi, Róbert (szerk.), Innovations in Animal Nutrition and Food Poduction = Innovációk a takarmányozás és az élelmiszer-előállítás gyakorlatában : 20th International Symposium on Animal Nutrition, 29 September, 2022 Kaposvár, Hungary : Proceedings = 20. Nemzetközi Takarmányozási Szimpózium, 2022. szeptember 29. Kaposvár : Tanulmányok, Gödöllő, Magyarország : MATE Press (2022) 127 p. pp. 117-121., 5 p., Közlemény:33989190 Admin láttamozott Forrás Könyvrészlet (Konferenciaközlemény) Tudományos
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32. Lengyel, Ármin; Pap, Tibor István*; Szabó, Rubina Tünde; Kovács-Weber, Mária, Különböző módon adagolt kiegészítő takarmány hatása galambok utódnevelési eredményességére, In: Pepó, Péter (szerk.), "Innovatív tudományos műhelyek a hazai agrár felsőoktatásban" EFOP-3.6.3-VEKOP-16-2017-00008: Hallgatói tudományos publikációk gyűjteménye, Debrecen, Magyarország: Debreceni Egyetem (2022) 280 p. pp. 154-163., 10 p., Közlemény:32755634 Nyilvános Forrás Könyvrészlet (Szaktanulmány) Tudományos
33. Drobnyák, Á.; Szabó, R. T.; Bódi, L.; Pap, T.; Zimborán, Á.; Kustos, K.; Weber, M., VEDLETETT ÉS NEM VEDLETETT ŐSHONOS MAGYAR TYÚKFAJTÁK TOJÁSHÉJMINŐSÉGÉNEK ÖSSZEHASONLÍTÁSA, In: Tóth, Csilla (szerk.), Őshonos- és tájfajták - Ökotermékek - Egészséges Táplálkozás - Vidékfejlesztés: A XXI. század mezőgazdasági stratégiái, Nyíregyháza, Magyarország: Nyíregyházi Egyetem, Műszaki és Agrártudományi Intézet (2016) 399 p. pp. 45-45., 2 p., Közlemény:3181006 Nyilvános Forrás Könyvrészlet (Absztrakt / Kivonat) Tudományos