Applied Animal Behaviour Science 292 (2025) 106759

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Ultraviolet light provisioning: Preferences from the broilers' viewpoint

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ARTICLE INFO

Keywords:
UV-A
behaviour
fast-growing
slower-growing
welfare

ABSTRACT

The light provisioning in barns can have a great impact on broiler health and welfare. In contrast to humans, broilers are able to see ultraviolet light, and it has been suggested that UV-A light provisioning can have beneficial effects on broilers. However, it is yet unclear what broilers' preferences regarding UV-A light are. This study investigated preferences of in total 168 fast- (Ross 308; **R**) and slower-growing (Hubbard JA757; **H**) broilers, distributed across 14 pens, for two light conditions: UV-A light provided (**UV**) or no UV-A light provided (**non-UV**). These light conditions were provided in replicate pens with two separate compartments (one UV and one non-UV) that the birds could freely move between. From hatching until slaughter age, it was studied 1) where broilers chose to be, 2) what behaviours were performed in the two light conditions, and 3) how much feed was consumed in the two light conditions. Across the day (05.00–23.00 h), both breeds appeared to show a preference for the UV light condition in the first weeks of life but later in life no clear preferences were observed. In the evening (19.00–23.00 h), R birds did not show a clear preference, whereas H birds showed a preference for UV in the first four weeks and a preference for non-UV light in weeks 6–8. Regarding behaviour, more drinking behaviour was observed in the UV condition compared to the non-UV condition in both breeds and more foraging behaviour was observed in H birds in the non-UV light condition than H birds in UV or R birds in either light condition. Furthermore, higher average daily feed intakes were observed on the UV side than on the non-UV side, during the starter feed phase for both breeds and during the finisher feed phase for R birds. Overall, apart from the first weeks, no preference for – or avoidance of – the UV light was observed during the day, but there was a shift in preference from UV to non-UV light in the evening over time for H birds. Furthermore, there were few preferences related to behaviour, but there was an indication for a higher feed intake under UV light conditions. The results of this study emphasize the importance of offering varied light conditions to broilers, so the birds can select their preferred light condition at a given time.

1. Introduction

Adequate lighting in barns, including the light program, light intensity, light spectrum and the light source, is of great importance for the welfare and performance of broiler chickens. Lighting can affect, for example, broiler stress and fear responses (Xie et al., 2008; Sultana et al., 2013), growth and carcass characteristics (Olanrewaju et al., 2016; Deep et al., 2010), and activity levels and daily rhythms in behaviour (Blatchford et al., 2009, 2012).

Chickens' spectral sensitivity differs from that of humans, and chickens can see light in the ultraviolet (**UV**) range (Prescott and Wathes, 1999b). The UV range consists of the shorter wavelengths of the spectrum, with UV-A ranging from 315 to 400 nm, which chickens can see (Prescott and Wathes, 1999b), UV-B ranging from 280 to 315 nm, and UV-C ranging from 100 to 280 nm (Rana and Campbell, 2021).

Several studies have examined the effects of UV-A light provisioning on broiler health, performance and behaviour (see review by Rana and Campbell, 2021). For example, James et al. (2018) observed that fast-growing broilers provided with supplementary UV-A light had improved feather conditions, shorter tonic immobility durations (suggesting reduced fearfulness) and better gait scores compared to broilers that were not provided with UV-A light. Furthermore, James et al.

Abbreviations: R, Ross 308; H, Hubbard JA757; UV, UV-A light provided; Non-UV, no UV-A light provided; SP, starter phase; GP, grower phase, FP, finisher phase.

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https://doi.org/10.1016/j.applanim.2025.106759
Received 13 May 2025; Received in revised form 15 July 2025; Accepted 18 July 2025
Available online 19 July 2025

(2020) observed that broilers provided with supplementary UV-A light had slower initial growth and a lower mortality. House et al. (2020) studied fast-growing broilers either with or without UV-A light provided and observed lower physical asymmetry, plasma corticosterone and heterophil-to-lymphocyte ratios for the UV-A birds, suggesting a lower stress susceptibility in these birds. Bailie et al. (2013) studied the behaviour of broilers in houses with or without natural light, and thus with or without the UV component in light. A reduction in percentage of time spent lying and a higher average latency to lie were observed in the natural light condition with UV, although it is unclear whether these differences can be attributed to the UV component or to other aspects of natural light such as differences in intensity during the day.

Despite their potential positive effects on broilers, UV wavelengths are commonly absent from the lighting in indoor poultry housing systems (Rana and Campbell, 2021). Before routinely implementing UV light, it is of great importance to gain more insight into birds' own preferences. Kristensen et al. (2007) studied the preferences of fast-growing broilers for four different light sources and observed, at six weeks of age, that the birds spent more time in the warm white light and the Biolux light (containing some UV-A light) than in the incandescent light or the spectral sensitivity-based light (containing more UV-A light). However, due to differences between their light sources in spectral composition also outside the UV-A range, it is difficult to draw conclusions on preferences regarding UV-A alone. Moreover, the majority of studies on the effects of UV-A light on broilers focused on fast-growing broilers, whereas slower-growing broilers are increasingly used in higher welfare systems (van der Eijk et al., 2023). Although UV light is often already present in higher welfare systems with outdoor access, it is important to assess whether broilers prefer or avoid UV light to determine the most suitable (i.e., preferred) duration, location and amount of UV light availability in these production systems. Overall, it is yet unclear whether UV-A preferences differ between fast- and slower-growing breeds, with age or for specific behaviours.

In this study, the preferences of both fast- and slower-growing broilers were therefore investigated for two light conditions, consisting of baseline lighting with or without UV-A additionally provided, examining 1) where broilers choose to be, 2) what behaviours are performed in the two light conditions, and 3) how much feed is consumed in the two light conditions. It was hypothesized that broilers would choose to be more in the UV light condition, due to the earlier-mentioned positive effects of UV on stress susceptibility, and that subsequently also the feed intake would be higher in the UV light condition. The results of this study can contribute to optimizing the UV-A light provisioning for fast- and slower-growing broiler breeds, suiting their behavioural needs and preferences, and hereby potentially contributing to improved broiler welfare.

2. Methods

2.1. Ethical approval

The experiment was carried out at CARUS, the experimental facility of Wageningen University & Research (Wageningen, the Netherlands). All procedures were conducted in accordance with the national legislation on animal welfare and animal experiments, and approved by the institutional Animal Welfare Body. This study was submitted to the institutional Animal Welfare Body (application number NAE_2023.W-031; 7th of September, 2023, Wageningen, The Netherlands), who considered this study not to be an animal experiment under the Law on Animal Experiments.

2.2. Animals and housing

The overall approach for this study was similar to van der Eijk et al. (2025) and van der Sluis et al. (2025). A total of 168 broilers were distributed across 14 pens. These birds were obtained from a commercial hatchery (Probroed, Langeboom, the Netherlands) as day old chicks and were individually tagged with a small neck tag for individual identification upon arrival. Seven of the pens housed fast-growing Ross 308 (**R**) broilers and the other seven pens housed slower-growing Hubbard JA757 (**H**) broilers. The allocation of breeds across pens was randomized. In each pen, six male and six female birds were housed, resulting in a total of 42 male R birds, 42 female R birds, 42 male H birds and 42 female H birds. The birds were housed in these pens from 0 to 41 (R birds) or 55 (H birds) days of age. Each pen had a size of 2 × 2 m (4 m^2; 3 birds/m^2) and consisted of two compartments (2 m^2 each) that were separated by cardboard, with a 40 cm opening for the birds to move between compartments. Wood shavings were provided as bedding and both compartments were fitted with drinkers, a feeder, a bucket with hay (this was a tray with hay until 12 days of age) and a perch with a height of 5 cm (Fig. 1). The room in which the pens were located was climate controlled, with a temperature of 34 °C on the day of arrival and a subsequent gradual decrease to 18 °C from 40 days of age onwards. Feed and water were provided *ad libitum*, with a starter feed (short cut mini pellet; 2950 kcal/kg) from 0 to 14 days of age, a grower feed (3 mm pellet; 3025 kcal/kg) from 15 to 29 days of age and a finisher feed (3 mm pellet; 3150 kcal/kg) from 30 days of age onwards, all produced by ABZ Diervoeding (Leusden, the Netherlands). The birds were vaccinated for Infectious Bronchitis at the hatchery, for Newcastle Disease at 14 days of age via spray and for Infectious Bronchitis at 21 days of age via eye drops. Birds were weighed every week.

2.3. Lighting

The two light treatments consisted of UV-A light being provided (**UV**) or not (**non-UV**), in addition to the baseline lighting that was present in both compartments. This baseline lighting was Jungle Green coloured LED light (with three peaks in the colour spectrum, at approximately 445, 525 and 640 nm, aligning with sensitivity in the blue part, the green part and the red part of the spectrum; NatureDynamics Dome for Broilers, Once by Signify, Signify Netherlands B.V., the Netherlands) and the intensity at bird height was 100 gallilux at arrival of the birds and was gradually decreased to 50 gallilux at three

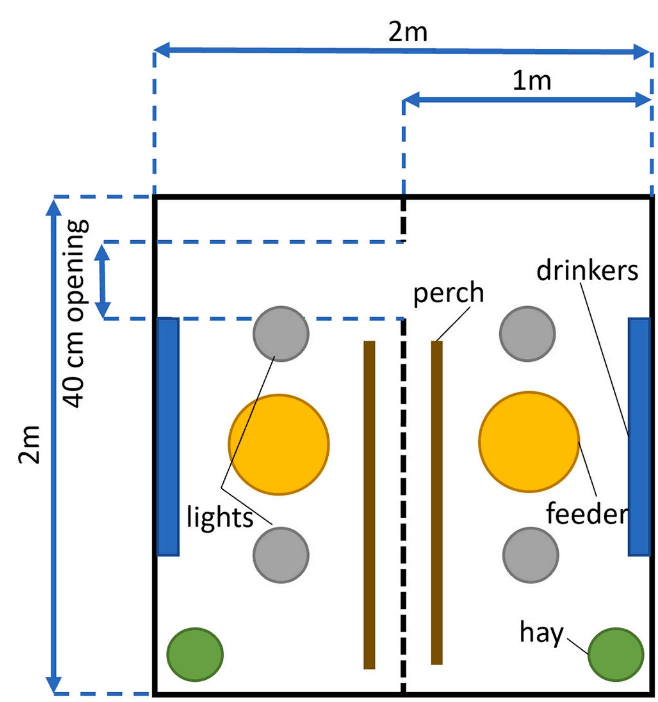

Fig. 1. Schematic layout of the pens. Lights, perches, drinkers, feeder and buckets with hay are indicated.

weeks of age and 20 gallilux at four weeks of age. The UV-A lights were set to 25 % of the baseline lighting, i.e., 25 gallilux at the start, 12.5 gallilux at 3 weeks and 5 gallilux at four weeks of age, keeping the overall light intensity the same in both compartments. The realized light spectra, measured at five locations in the pen at animal height, are shown in Supplementary data 1. All lights were installed at approximately 1 m above the pen floor. The location of the light treatments (i.e., the left and right side compartment) was randomized at the start, to avoid confounding effects of location, and then remained fixed throughout the duration of the experiment. On the first day of the trial (i.e., at 0 days of age), the lights were on continuously. At 1 and 2 days of age, the birds were provided with one hour of darkness (23.00–00.00) and from 3 days of age onwards the birds were kept under a schedule of light from 05.00 to 23.00 and darkness from 23.00 to 05.00, with a transition period of half an hour before and after the dark period.

2.4. Light preference recordings

Cameras (DS-2CE16H5T-ITE, Hikvision, China) were installed above each of the pens, that recorded video data continuously across the day, but due to problems with visibility of the birds during the dark period only the videos from 05.00 to 23.00 were used here. These cameras collected video data with a resolution of 2560 × 1440 pixels and a frame rate of 15 frames per second. The resulting video data were used to count the number of birds present on the UV and the non-UV side of the pen, using two days of video per week (not on fixed days of the week, but always using the same days for both breeds except for the last two weeks in which only H birds remained) and an automated computer vision approach.

An object detection model based on YOLOv8 (Jocher et al., 2023) was developed to detect birds within the pens. The model was trained using a diverse set of video data collected from various pen setups. The dataset included 1592 images from an earlier broiler preference study (van der Sluis et al., 2025) and an additional 1913 images sourced from videos recorded in this study. The dataset consisted of 3002 images for training and 503 images for validation. Annotation was performed using the LabelImg 1.8.6 tool (Tzutalin, 2015), with bounding boxes drawn around each broiler. For training and testing of the model, an ASUS workstation with a 13th Gen Intel Core i9–13900K (3.00 GHz) processor, an NVIDIA GeForce RTX 4090 graphics card, and 64 GB of RAM was used along with a PyTorch (2.3.1 +cu118), and Python (3.12.3) environment. The developed model accurately identified chickens with an average precision (AP) of 96.2 % at Intersection over Union (IoU) 0.5. When evaluated across IoU thresholds from 0.5 to 0.95, the model achieved a mean AP of 73.0 %.

Within each side of the pen (UV versus non-UV light condition) specific areas of interest (**AoIs**) were identified (Fig. 2). The trained model was used to detect and count the broilers on each side and within the defined AoIs (see Figure S2.1 in Supplementary data 2). The number of birds in these areas was determined by calculating the overlap between the detected bounding boxes of a bird and the predefined regions. This overlap percentage was measured as the intersection area between a bird's bounding box and a specific region, divided by the total area of the bounding box. A bird was assigned to a region if the overlap percentage exceeded a threshold of 40 %. The count of birds was determined every 5 min for each pen, from 05.00 to 23.00, for two days per week.

2.5. Behavioural observations

Behaviour was scored by a single trained observer through live, instantaneous scan sampling, in which the observer assessed each bird for a few seconds to identify the behaviour being performed. The behavioural categories that were scored included eating behaviour, drinking behaviour, active behaviour (locomotion and play behaviour), standing behaviour, inactive behaviour (inactive and perching), foraging behaviour (ground pecking, explorative pecking and foraging), comfort behaviour (comfort behaviour and dustbathing) and other behaviour (see detailed ethogram in Supplementary data 3, Table S3.1). The observations were performed at similar body weights for both breeds, i.e. at approximately 0.17, 0.45, 0.93, 1.32 and 2.03 kg (see Supplementary data 3, Table S3.2). On each observation day, the number of birds performing certain behaviours in each half of the pen separately was scored, and this was repeated five times per scan with an interval between subsequent observations of the same area of approximately 1 min, with three scans per side of each pen per day (in the morning, the middle of the day and the afternoon). Subsequently, the five sets of observations per scan were merged into a single record, resulting in three sets of behavioural counts per half of the pen per observation day.

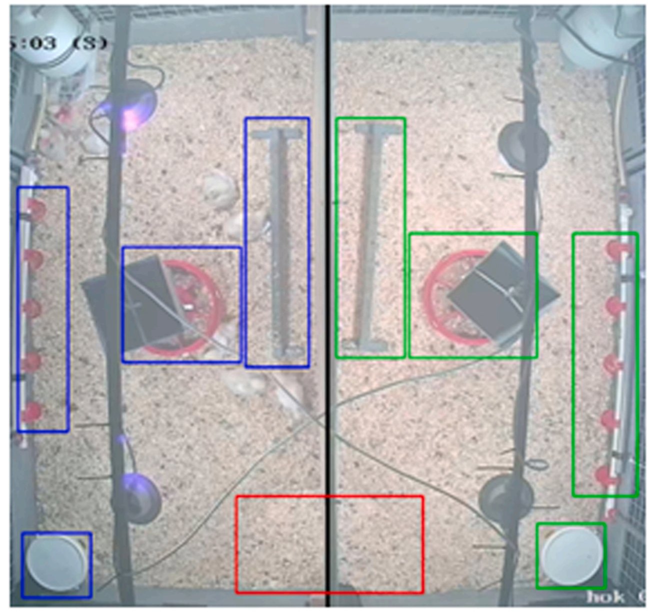

Fig. 2. Top-view video frame of the pens. The different predefined areas of interest (drinkers, hay bucket, perches and feeder) are indicated for both sides of the pen, as well as the transition zone (in red) at the bottom of the frame.

2.6. Feed intake recordings

The feeder contents were weighed before placement of the birds and then weekly, as well as at the transitions between feeding phases. Based on the difference between the feeder contents at the start and end of each feeding phase, the feed intake of the birds could be determined per pen, light treatment and feeding phase (no information on potential feed spillage in the litter was recorded). Given that not all feed types were provided equally long, and due to mortality of some birds ($n = 3$ R birds, $n = 2$ H birds), the level of feed intake was converted to an average value per day per bird for each of the three feed types. This resulted in pen-level mean feed intake levels for both light treatments (UV and non-UV) for the starter phase (**SP**; 0–14 days of age), the grower phase (**GP**; 15–29 days of age) and the finisher phase (**FP**; 30–41 days of age for R birds; 30–55 days of age for H birds).

2.7. Statistics

All statistics were performed in R version 4.4.1 (R Core Team, 2024). To examine the distribution of the birds across the UV and non-UV side of the pen over time, based on the raw count data from the video detection algorithm, beta binomial models were fitted using the glmmTMB package (Brooks et al., 2017), with week and/or breed as fixed effects and pen as a random effect. Using the respective relevant subset of data, (1) breed-week interaction effects across the first six weeks, (2) the effect of week per breed, and (3) the difference between breeds per week were examined. Models were compared using the anova command, and pair-wise contrasts were determined using the emmeans package (Lenth, 2024), using a Tukey p-value adjustment. All analyses were initially performed with all hours of the light period aggregated (i.e., from 05.00 to 23.00). As the birds seemed to often change location at the end of the day (from around 19.00 h; see Supplementary data 4), the analyses were subsequently repeated for only the evening (from 19.00 to 23.00). To assess presence in the different functional zones on the UV and non-UV side of the pen across the light period (i.e., from 05.00 to 23.00), similar beta binomial models were used, but now for each of the functional zones separately (i.e., a model for the distribution of birds within one type of functional zone across the UV and non-UV side). For the perching zone, the first week of age was excluded as no perch was present at that time, and for the zone with the hay bucket weeks 1 and 2 were excluded as the bucket was not yet present.

To assess whether there were differences between breeds, body weights (i.e., ages) and UV treatments (UV versus non-UV) in what behaviours were performed, beta binomial models were fitted using the glmmTMB package (Brooks et al., 2017) to analyse the counts of each of the behavioural categories from the scan sampling separately. Each model started with breed, body weight and light treatment and their two- and three-way interactions as fixed effects, and pen as random effect to account for repeated measurements, and subsequently interaction effects that were not statistically significant ($P > 0.05$) were excluded from the model (first for the three-way interaction and then testing for each of the two-way interactions in the presence of the other two-way interactions). In the results, interaction effects are reported when present, and main effects are reported when no significant interaction effects were observed. The behavioural class ‘other’ was excluded from the analyses, as there were very few observations of this behaviour. Furthermore, for the analyses of eating and drinking behaviour, the starting model did not include the three-way interaction but only the two-way interactions, as otherwise the models did not converge. Pair-wise contrasts for the resulting models were determined using the emmeans package (Lenth, 2024), using a Tukey p-value adjustment. The model estimates used for the overview table in the results section were derived using the emmeans package, and included the three-way interaction between breed, body weight and light treatment to obtain estimates for all combinations of factors.

To assess differences in feed intake between the light treatments and breeds, linear models were fitted. This was done for each of the three feed phases (SP, GP and FP) separately, where the feed intake was modelled as a function of the breed and light treatment and the interaction between these. The emmeans package (Lenth, 2024) was used for subsequent pairwise comparisons, with a Tukey p-value adjustment, and for obtaining model estimates used for the visualisations.

Visualisations were made using the ggplot (Wickham, 2016) and ggpattern (FC et al., 2024) packages. The level of statistical significance was set at 0.05.

3. Results

3.1. Location preference

The proportions of birds counted during the full day in the UV versus non-UV light treatment across weeks are shown in Fig. 3 (see Supplementary data 4 for within-day and pen-level distribution results). No statistically significant breed by week interactions were observed across the first six weeks ($p = 0.31$). For R birds, there appeared to be a slight preference for the UV light condition in the first two weeks of life, while in later weeks the distribution of birds across the two light treatments was roughly equal (Fig. 3). However, the week effect was not statistically significant ($p = 0.17$). For H birds, there also appeared to be a preference for the UV light condition in the first week. An effect of week was observed ($p = 0.01$), with subsequent pairwise comparisons showing a difference between week 1 and week 3 ($p = 0.02$), week 4 ($p = 0.01$), week 5 ($p = 0.02$), week 6 ($p = 0.02$) or week 7 ($p = 0.01$). Furthermore, a statistical trend for a difference between week 1 and week 8 was observed ($p = 0.06$). As can be seen in Fig. 3, there was a stronger preference for the UV light condition in week 1 than in weeks 3–8. A comparison between breeds within weeks (weeks 1–6) revealed a difference in week 6 ($p = 0.05$) between the breeds in their distribution across the two light treatments (Fig. 3), with R birds showing more of a preference for UV than H birds at that age.

When specifically focussing on the evening (19.00–23.00 h; Fig. 4), statistically significant breed by week interactions were observed across the first six weeks ($p = 0.02$). Within R birds, there was no week effect ($p = 0.52$), but within H birds there was an effect of week ($p < 0.001$),

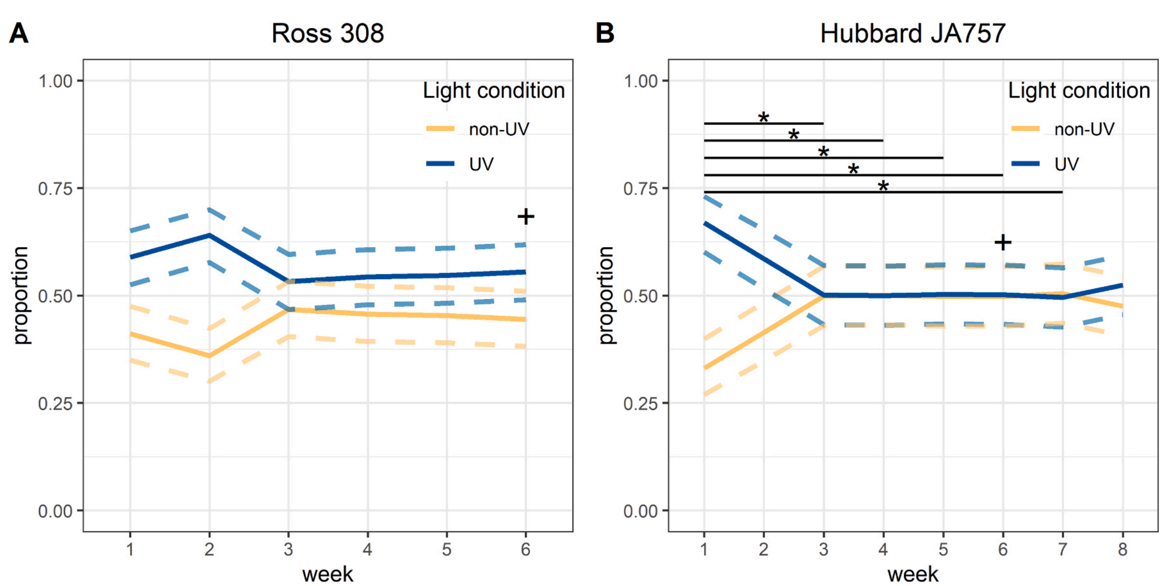

Fig. 3. Estimated proportions of birds present in the different light treatment compartments over time, across the full day (05.00–23.00 h). Different panels show the different breeds, with A) Ross 308 broilers and B) Hubbard JA757 broilers, and the week of age is shown on the x-axis. The solid lines represent the model fit and the dashed lines indicate the 95 % confidence intervals. UV = UV light present; non-UV = no UV light present; * = significant differences between weeks within the breed; + = significant differences between breeds within a week.

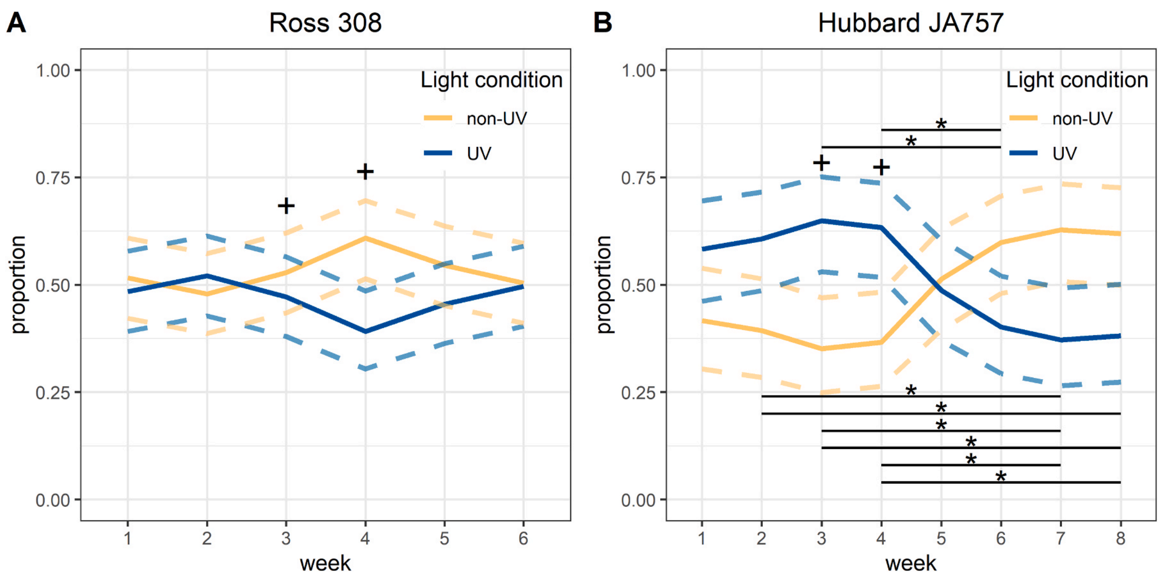

Fig. 4. Estimated proportions of birds present in the different light treatment compartments over time, in the evening (19.00–23.00 h). Different panels show the different breeds, with A) Ross 308 broilers and B) Hubbard JA757 broilers, and the week of age is shown on the x-axis. The solid lines represent the model fit and the dashed lines indicate the 95 % confidence intervals. UV = UV light present; non-UV = no UV light present; + = significant differences between breeds within a week; * = significant differences between weeks within the breed.

with pairwise comparisons showing differences between week 2 versus week 7 ($p = 0.02$) or week 8 ($p = 0.03$), week 3 versus week 6 ($p = 0.01$), week 7 ($p = 0.003$) or week 8 ($p = 0.004$), and between week 4 versus week 6 ($p = 0.02$), week 7 ($p = 0.005$) or week 8 ($p = 0.007$). Moreover, statistical trends were observed for week 1 versus week 7 ($p = 0.08$) or week 8 ($p = 0.09$), and for week 2 versus week 6 ($p = 0.07$). As can be seen in Fig. 4, there was a stronger preference in H birds for the UV light condition in the evening in weeks 2, 3 and 4 than in weeks 6, 7 and 8 in which a preference for non-UV was observed. A comparison between breeds within weeks (weeks 1–6) revealed a difference between the breeds in week 3 ($p = 0.001$) and week 4 ($p = 0.04$), in which H birds show a stronger preference for UV light than R birds (Fig. 4).

When assessing the use of the functional zones, no differences between weeks or breeds were observed for the drinking area, the perches, or the area with the hay bucket, and for R birds the model for the hay bucket area did not converge due to low presence of the birds in this location. For the area with the feeder, no breed by week interaction was observed, and there were no differences between weeks within breeds (although a trend was observed for H birds; $p = 0.06$), but a difference was observed between the breeds in weeks 4 ($p = 0.04$) and 6 ($p = 0.01$). Fig. 5 shows that in weeks 4 and 6 a larger proportion of R birds were observed in the feeder area on the UV side, compared to H birds at those ages.

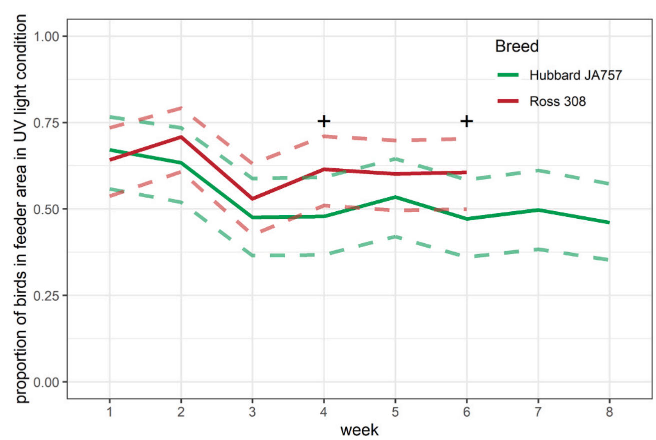

Fig. 5. Estimated proportions of birds present in the feeder area in the UV light treatment (in comparison to the proportion of birds present in the feeder area in the non-UV light condition) over time, across the full day (05.00–23.00 h). The week of age is shown on the x-axis. The solid lines represent the model fit and the dashed lines indicate the 95 % confidence intervals. + = significant differences between breeds within a week.

3.2. Behaviour

Table 1 shows the model-estimated proportions of behaviours shown per breed, body weight category and light treatment. The beta binomial models showed a two-way interaction between breed and light treatment for eating behaviour ($p = 0.003$), but subsequent pair-wise comparisons revealed no differences. For drinking behaviour, there were differences between breeds and light treatments, with a larger proportion of drinking behaviour in R birds ($p = 0.028$) and in UV light ($p = 0.025$). For active behaviour, there was a difference between the body weight groups, with larger proportions of active behaviour at 0.17 and 0.45 kg than at 0.93 and 2.03 kg (0.17 vs 0.93: $p = 0.018$; 0.17 vs 2.03: $p < 0.001$; 0.45 vs 0.93: $p = 0.033$; 0.45 vs 2.03: $p < 0.001$). For standing behaviour, there was a breed effect, with more standing behaviour in H than in R birds ($p < 0.001$). For foraging behaviour, there was an interaction between breed and light treatment, with more foraging behaviour in H birds in the non-UV light treatment than H birds in UV or R birds in either light treatment ($p = 0.004$). For inactive behaviour, effects were observed for breed and body weight. R birds showed more inactive behaviour than H birds ($p = 0.001$) and the proportion of inactive behaviour was larger at 2.03 kg than at 0.45 kg ($p = 0.018$). In terms of comfort behaviour, no effects of breed, body weight or light treatment were observed.

3.3. Feed intake

Fig. 6 shows the model estimates of the daily feed intake of the birds for the three feed phases (SP, GP and FP), for the two breeds separately. In the starter phase, there was an interaction between breed and light treatment ($p = 0.011$). For both breeds, the feed intake was higher on the UV side of the pen, and the feed intake was higher for R birds on the

Table 1
Estimated proportions of behaviours shown per breed, light treatment and body weight, based on the beta-binomial model estimates for a model with a three-way interaction between breed, light treatment and body weight. SE = standard error; UV = UV light present; non-UV = no UV light present.

		Ross 308		Hubbard JA757	
Behaviour	Weight (kg)	Proportion in UV (SE)	Proportion in non-UV (SE)	Proportion in UV (SE)	Proportion in non-UV (SE)
Eating	0.17	0.026 (0.008)	0.020 (0.007)	0.023 (0.007)	0.025 (0.008)
	0.45	0.039 (0.010)	0.031 (0.009)	0.035 (0.009)	0.038 (0.010)
	0.93	0.043 (0.011)	0.034 (0.009)	0.039 (0.010)	0.042 (0.011)
	1.32	0.046 (0.011)	0.036 (0.010)	0.041 (0.010)	0.044 (0.011)
	2.03	0.028 (0.008)	0.022 (0.007)	0.025 (0.007)	0.027 (0.008)
Drinking	0.17	0.028 (0.007)	0.018 (0.006)	0.018 (0.005)	0.011 (0.004)
	0.45	0.041 (0.009)	0.026 (0.007)	0.026 (0.007)	0.017 (0.004)
	0.93	0.027 (0.007)	0.017 (0.005)	0.017 (0.005)	0.011 (0.003)
	1.32	0.033 (0.008)	0.021 (0.006)	0.021 (0.005)	0.013 (0.004)
	2.03	0.028 (0.007)	0.018 (0.005)	0.018 (0.005)	0.011 (0.003)
Active	0.17	0.037 (0.007)	0.031 (0.007)	0.047 (0.008)	0.039 (0.008)
	0.45	0.035 (0.007)	0.029 (0.006)	0.044 (0.008)	0.037 (0.007)
	0.93	0.019 (0.004)	0.016 (0.004)	0.024 (0.005)	0.020 (0.004)
	1.32	0.020 (0.005)	0.017 (0.004)	0.026 (0.006)	0.022 (0.005)
	2.03	0.012 (0.003)	0.010 (0.003)	0.015 (0.004)	0.012 (0.003)
Standing	0.17	0.029 (0.005)	0.024 (0.005)	0.059 (0.009)	0.050 (0.009)
	0.45	0.029 (0.005)	0.025 (0.005)	0.061 (0.010)	0.052 (0.009)
	0.93	0.022 (0.004)	0.018 (0.004)	0.045 (0.008)	0.039 (0.007)
	1.32	0.025 (0.005)	0.022 (0.004)	0.053 (0.009)	0.045 (0.008)
	2.03	0.017 (0.004)	0.015 (0.003)	0.036 (0.007)	0.031 (0.006)
Foraging	0.17	0.094 (0.015)	0.084 (0.016)	0.101 (0.015)	0.155 (0.023)
	0.45	0.074 (0.012)	0.066 (0.012)	0.079 (0.013)	0.124 (0.017)
	0.93	0.073 (0.012)	0.065 (0.011)	0.079 (0.012)	0.123 (0.018)
	1.32	0.059 (0.010)	0.053 (0.010)	0.064 (0.011)	0.100 (0.015)
	2.03	0.068 (0.011)	0.061 (0.010)	0.073 (0.012)	0.115 (0.016)
Inactive	0.17	0.718 (0.028)	0.716 (0.032)	0.646 (0.032)	0.643 (0.035)
	0.45	0.669 (0.029)	0.667 (0.029)	0.591 (0.031)	0.589 (0.031)
	0.93	0.752 (0.025)	0.750 (0.025)	0.685 (0.028)	0.682 (0.029)
	1.32	0.754 (0.026)	0.752 (0.026)	0.687 (0.029)	0.684 (0.029)
	2.03	0.764 (0.024)	0.762 (0.024)	0.698 (0.028)	0.696 (0.028)
Comfort	0.17	0.105 (0.016)	0.100 (0.017)	0.115 (0.017)	0.110 (0.018)
	0.45	0.133 (0.018)	0.127 (0.017)	0.145 (0.019)	0.139 (0.018)
	0.93	0.086 (0.013)	0.082 (0.013)	0.094 (0.014)	0.090 (0.013)
	1.32	0.093 (0.014)	0.088 (0.014)	0.102 (0.015)	0.097 (0.015)
	2.03	0.094 (0.014)	0.089 (0.013)	0.103 (0.015)	0.098 (0.014)

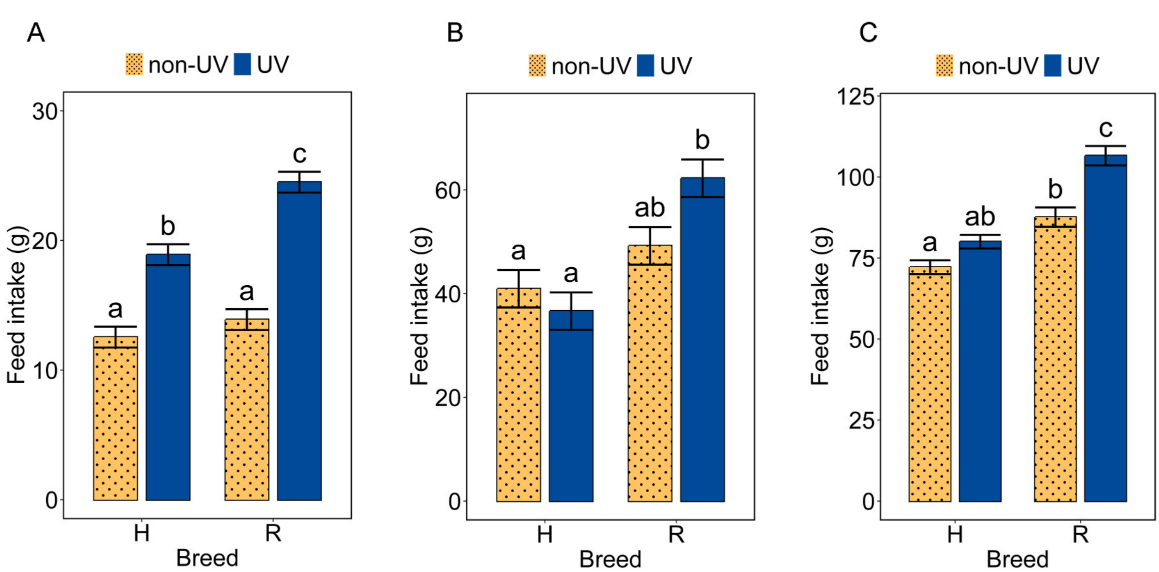

Fig. 6. Model-estimated daily feed intake per bird under the different light treatments (UV versus non-UV) for the three feed phases: starter phase (left), grower phase (middle) and finisher phase (right). Error bars indicate standard errors of the estimated means. Means indicated by a common letter within a plot are not significantly different according to the model analyses. H = Hubbard JA757; R = Ross 308; UV = UV light present; non-UV = no UV light present.

UV side than for H birds in either of the light treatments, while the feed intake on the non-UV side for R birds was not different from the feed intake of H birds on the non-UV side (Fig. 6). In the grower phase, there was also an interaction between breed and light treatment ($p = 0.020$), with a higher feed intake for R birds on the UV side of the pen than for H birds in either of the light treatments, but no difference between the feed intake of R birds on the non-UV side and H birds in either of the light treatments (Fig. 6). In the finisher phase, which lasted longer for the H birds (until 55 days of age for H birds and until 41 days for R birds), there was again an interaction between breed and light treatment ($p = 0.035$). For H birds, there was no difference in feed intake for the two light treatments, whereas for R birds the feed intake was higher on the UV side of the pen compared to R birds on the non-UV side and H birds in either light treatment (Fig. 6).

4. Discussion

In this study, the preferences of fast- and slower-growing broilers for UV-A light were investigated. Below, the findings for bird counts, behavioural observations and feed intake levels are each discussed separately, and, where possible, interconnections between the findings are highlighted.

4.1. Location preference

In general, the preferences observed based on the bird counts were not strong and may have been impacted slightly by the imperfect model performance (mean AP of 0.73). Therefore, the results should be interpreted with some caution. Few differences between fast- and slower-growing broilers were observed in overall preference across the day for UV versus non-UV light treatments, suggesting that genetic selection for fast versus slower growth has not strongly affected UV light preferences. Both breeds appeared to show a slight preference for the UV light condition in the first weeks of life but later in life no clear preferences were observed. Possibly, with UV light present, broilers are better able to assess their surroundings in terms of where to find food and recognition of their conspecifics, as seeds, berries and insects often reflect UV-A radiation (Bennett and Cuthill, 1994; Prescott and Wathes, 1999b) and so do feathers (Prescott and Wathes, 1999a). It might be the case that, after initial assessment of the environment in the first weeks of life, broilers get used to their surroundings and the UV light is no longer of importance for the birds. Interestingly, also in other studies broiler light preferences (for spectrum and intensity) were stronger in the first weeks of life (van der Sluis et al., 2025; van der Eijk et al., 2025), suggesting that light conditions might be more important for broilers early in life than later in life. An alternative explanation is that there might have been effects of social contagion or group dynamics in the observed preference patterns. However, this cannot be definitively concluded, as social behaviours of the birds were not continuously assessed and birds were not individually identified over time. It may have been the case that only some birds showed a clear preference and that other birds followed as they preferred to stay close to conspecifics, especially at a younger age. Future research including individual identification could help to elucidate the potential effect of social contagion.

Later in life (in weeks 6–8) H birds appeared to prefer the non-UV condition at the end of the day (i.e., in the evening), while this shift was not observed for R birds. Studies in laying hens have shown that UV-A light conditions resulted in more active behaviours than light conditions without UV-A (Wichman et al., 2021). Possibly, when H birds are older, they are more prone to be inactive at the end of the day and preferably do so in light without UV-A. However, our behavioural observations did not show a difference between the two light treatments in the proportions of active or inactive behaviour shown, but this may be explained by the limitation that no behavioural observations were made in the evenings, only during the daytime. The preference for the non-UV treatment at the end of the day may be linked to the UV conditions in the natural environment of chickens. The amount of UV radiation is larger when the sun is higher in the sky (RIVM, 2025) and thus less when night falls, and possibly the birds' preference for non-UV is linked to the natural daily pattern in UV light in a day, but this remains to be investigated. Further research including behavioural observations before the onset of the dark period could provide more insight into the apparent preference of H birds for non-UV light at the end of the day, and shine more light on the observed breed differences in (the shift in) this preference.

When looking at the presence in the different functional zones in the UV and non-UV light conditions, a larger proportion of R birds was observed in the feeder area on the UV side in weeks 4 and 6, compared to H birds at those ages. This aligns with the observations on feed intake (discussed further on) of the broilers.

Overall, it is important to note that at all recorded ages, on both sides of the pen broilers were found (i.e., the preference for a light condition was not 100 %), albeit not necessarily the same individuals over time as birds were not identified. This suggests that preferences may differ between individual broilers and/or over time, and that providing birds with light options to choose between is important, to meet the preferences of all birds in a flock at all times.

4.2. Behaviour performed under different light conditions

Some behavioural preferences were observed for the different light conditions, although it must be noted that the preferences were numerically not strong. In the UV light treatment, more drinking behaviour was observed, which aligns with existing literature. For example, in a study by Sans et al. (2021), in which broilers could freely move between artificial lighting (with no UV) alone versus natural (through a window; some UV passing through) and artificial lighting provided together, a higher frequency of drinking behaviour was observed in the natural light condition, although this was confounded with light intensity differences. However, this contrasts with our observation of no difference in presence in the drinker area between the two light conditions, according to the bird counts. It must however be noted that the proportions for the bird counts did not account for the total number of birds present on each side of the pen (i.e., the number of birds in the drinker area on the UV side was compared to the number of birds in the drinker area on the non-UV side, while not counting the total number of birds present on each side of the pen), while in the behavioural observations this was accounted for. Moreover, presence in the drinker area (according to the bird counts) does not necessarily indicate drinking by the birds, as the birds could for example also be resting in close proximity to the drinker and still be detected in the drinker area. Possibly, the increase in drinking behaviour is associated with the higher levels of feed intake that were observed in the UV light treatment, as it has been shown that water and feed intake are positively correlated in broilers (Aggrey et al., 2023), although it must be noted that no associated increase in proportion of eating behaviour was observed for the UV treatment (but behavioural observations were made with a low resolution and only during the day and not early in the morning or in the evening). It has been reported that, at low densities, broilers tend to prefer to stay close to feeders and drinkers (Arnould and Faure, 2004), and therefore the drinkers closer to the feeders where birds consume more feed (or vice versa) might be preferred (i.e., they might not move to the other side of the pen to drink or eat). Even though this contrasts with the shift in location preference to the non-UV area in the evening that was observed for H birds later in life, it does align with the (numerically) higher feed intake on the UV side during the finisher phase, suggesting that the majority of feed and water intake may have taken place during the day, on the UV side.

An interaction effect was observed for the proportion of foraging behaviour, with more foraging behaviour in H birds in the non-UV light treatment than H birds in UV or R birds in either light treatment. This higher proportion of foraging behaviour in slower- than in fast-growing broilers is in line with literature (e.g., Dixon, 2020). However, the observation of more foraging behaviour for H birds in the non-UV light treatment contrasts with reported observations in literature. For example, in the earlier-mentioned study by Sans et al. (2021) foraging behaviour was observed more frequently in the daylight condition (with UV) in broilers between 9 and 15 d old. Similarly, Bailie et al. (2013) studied the behaviour of broilers in houses with or without natural light and observed more ground pecking (which is included in our definition of foraging; see Supplementary data 3) in the natural light. However, it must be noted that in these studies not only UV light provisioning differed between the two light conditions but also other aspects such as light variation and intensity. Nonetheless, it was expected that foraging behaviour would be observed more in the UV light treatment than in the non-UV light treatment in this study, as UV light vision is hypothesized to serve a role in foraging behaviour in birds, enhancing their ability to find seeds, berries and insects that often reflect UV-A radiation (Bennett and Cuthill, 1994; Prescott and Wathes, 1999b). One hypothesized explanation for our observation of less foraging behaviour in the UV light condition might be that the UV light helped to make it clearly visible that there were no interesting resources (such as insects or seeds) present in the bedding. In the non-UV treatment, this might have been less clearly visible and therefore more exploration of the bedding by pecking and scratching might have been performed. For actual feed intake an increase in intake in the UV light treatment was observed (discussed further on).

Overall, the observed differences in proportions of behaviours shown in the different light treatments highlight the importance of offering a varied environment to broilers, in which they are free to select their preferred light condition for performing a specific behaviour.

4.3. Feed intake under different light conditions

Higher average daily feed intake levels were observed on the UV side than on the non-UV side, during the starter phase for both breeds and during the finisher phase for only R birds. For the starter phase this aligns with where birds spent most of their time, based on the bird counts. If there is an overall preference for UV light early in life, this might also result in birds eating where they spend most time. The higher feed intake on the UV side may furthermore be linked to UV light likely increasing broilers' ability to find food that reflects UV-A radiation (Bennett and Cuthill, 1994; Prescott and Wathes, 1999b). It is hypothesized here that with UV light present the feed provided to the birds might look more interesting and may therefore induce higher levels of feed intake in the UV versus the non-UV light treatment, as it has been indicated that broilers show different levels of feed intake when presented with a choice between diets with different colours (e.g., Vargas et al., 2025). During the grower phase, no difference in feed intake was observed for the two light conditions. This is in agreement with the lack of a clear location preference at this point in time (based on the bird counts) and may furthermore be linked to potential differences between the diets for the different phases in terms of their light-reflective properties (i.e., possibly the grower feed contained less UV reflecting components, but this was not assessed). For the finisher phase, a higher feed intake was again observed on the UV side for R birds, while no clear preference for the UV side was seen at that point in time based on the bird counts. This might suggest that the R broilers specifically went to the UV side to eat, but performed other behaviours preferably on the non-UV side, averaging out the time spent in both light treatments. However, the behaviour observations in this study indicated no clear preferences for performing certain behaviours in the non-UV treatment for R birds during the finisher phase. Moreover, with the generally observed decrease in active behaviour in broilers as they age (Riber, 2015; Dawson et al., 2021), which is likely even stronger in fast-growing broilers than in slower-growing broilers (Dixon, 2020), it would not be expected that a shift between light treatments specifically for feeding would be seen more clearly in the finisher phase than in the grower phase and more clearly in R birds than in H birds. What underlies the observed differences in feed intake in the different light conditions at different ages thus remains to be investigated.

5. Conclusions

This study investigated preferences of fast- and slower-growing broilers for UV-A light. Both breeds appeared to show a preference for the UV light condition in the first weeks of life but later in life no clear preferences were observed across the day. In the evening time, H birds showed a preference for UV in the first weeks and a preference for non-UV in the last weeks. The results of this study suggest that there is individual variation between broilers, i.e., they do not all stay on the same side of the pen (as shown by the counts) and perform behaviours in both light conditions (as shown by the behavioural scans and feed intake records). At the same time, some behaviours (drinking, foraging) appeared to be preferably shown in one of the two light treatments provided here. This emphasizes the importance of offering a varied environment to broilers, in which they are free to select their preferred light condition at a given time and/or for performing a specific behaviour. Providing the broilers with such a choice may help to improve their welfare in production systems.

CRediT authorship contribution statement

Dennis E. te Beest: Writing – review & editing, Visualization, Formal analysis. **Rodania Bekhit:** Writing – review & editing, Software, Methodology, Data curation. **Stephanie Melis:** Writing – review & editing, Investigation. **Henk Gunnink:** Writing – review & editing, Investigation. **van der Eijk Jerine A. J.:** Writing – review & editing, Methodology, Data curation, Conceptualization. **Malou van der Sluis:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis. **Ingrid C. de Jong:** Writing – review & editing, Project administration, Methodology, Funding acquisition, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This study was funded by the Dutch Ministry of Agriculture, Fisheries, Food Safety and Nature, Aviagen EPI, Avined, Hubbard Breeders, Norsk Kylling and Once by Signify within the framework of the public-private partnership 'Functilight' (TKI-AF-, project number LWV20.133, BO-63–001–044). The caretakers of the experimental facility are acknowledged for their assistance with the experiment.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.applanim.2025.106759.

Data availability

The datasets generated and/or analysed in the current study are available from the corresponding author upon reasonable request.

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