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Focus on Research sponsored by the Incubation and Fertility Research Group (IFRG)

Data analysis of leghorn breeder pullet hatchability and quality

Information published about pullet hatchability (PH) and quality (PQ) of leghorn lines is scarce. Egg storage (ES) is necessary to fulfil the demands of large-layer flocks. Short periods of incubation during ES (SPIDES) have become ubiquitous in hatcheries, but their efficacy in Leghorn breeders has not been described.

Therefore, two commercial hatchery datasets were obtained to describe the effects of breeder flock age (FA) and ES on PH (dataset A, N= 39,618) and PQ (dataset B, N= 1,049) for eggs with or without SPIDES application. Observations in dataset A spanned 2013-2023 and 2022-2023 in dataset B. In each dataset, ES ≤6d were denoted as "Fresh" and ES ≥7d were identified as Stored/SPIDES. Response surface (RS) analyses were used to describe the interactive effects of FA (22-75 wks) and ES (0-25 d, dataset A and 3-24 d, dataset B), with or without SPIDES. Random effects included individual flocks, farms, and years as blocks. Multiple regression was used when no interaction was observed ($P > 0.05$). From dataset A, the 2013-14 percentage of "Fresh" eggs was 50.6% and 50.4%, respectively, and 36.6% in 2015. The "Fresh" percentage of eggs in subsequent years levelled off between 20-29%. Concurrently, the percentage of Stored/SPIDES eggs increased from 4 or 13% (2013 and 2014, respectively) to around 55-64%.

The RS fitted ($P < 0.001$) for Fresh eggs was PH = 32.64 + 0.58*FA + 0.26*ES - 0.01*FA2 - 0.04*ES2 + 0.12*SPIDES (R2 =0.80). Eggs receiving SPIDES had higher PH compared with non-SPIDES, regardless of year; however, the magnitude of improvement in PH varies depending on the Year. From dataset B, differences ($P<0.05$) between "Fresh" and Stored/SPIDES eggs were observed for PQ1 and 2. Application of SPIDES to eggs stored up to 24d resulted in a mean decrease in PQ1 (0.68%) and an increase in PQ2 (0.37%). No difference was observed between "Fresh" and Stored/SPIDES for PQ3 ($P>0.05$). In conclusion, the ES has increased in the past 11 years, with a simultaneous increase in SPIDES utilisation helping to minimise the detrimental effects of ES. The strategic application of SPIDES should consider FA to optimise both PH and PQ.

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Understanding the role of embryo development in in-ovo vaccination

Correct timing plays a critical role in in-ovo vaccination as it affects the injection site inside the egg, which in turn has direct consequences for hatching performance and the effectiveness of the vaccine.

To think about timing, it's important to understand that there can be differences between the incubation time and the estimated development of the embryo. These differences can be caused by many factors, including the age of the breeders as one of them. This study aimed to analyse the influence of the age of breeders on the differences between chronological and biological age of the embryos, and its effect on the site of injection.

The data come from field observations during 2023 and 2024 at a commercial hatchery located in Spain, equipped with a single-stage machine from a single supplier. Eggs from breeders of 11 different flocks/ages were analysed. All the eggs were incubated following the same program.

A total of 275 embryos had estimated embryonic development age and site of injection evaluated using the Global Hatchery Health Program method. Statistical analysis was performed using logistic regression followed by post hoc analysis, with embryonic development (in hours) and breeder age (in weeks) as covariates.

The results demonstrate significant differences in amnion injections depending on embryonic development. More developed embryos (>444 hours) exhibit less than 50% of injections in the amnion. It was also shown that there is a difference between development inferred by incubation time and embryonic development. A Kruskal-Wallis test followed by post-hoc analysis with breeder age (in hours) was performed, and the difference in incubation time minus embryo development was analysed.

This difference is significant ($p<0.0001$), showing an overestimated development by incubation time, and is more pronounced in breeders under 30 weeks of age (24h±8.4h), and in breeders over 60 weeks of age (18h±4.6h). Breeders between 30 and 47 weeks of age showed the least affected results (9.3h±9h), although there were two clusters with different behaviour within this age group.

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Effect of broiler breeder female stocking density during the laying period on egg production, mortality, and hatchability

The purpose of this research was to determine the effect of two different female stocking densities during the laying period (from 26 to 59 wk of age) on egg production, hen mortality and hatchability of broiler breeder hens. Males and females were grown sex-separated in light-controlled facilities with an 8–h photoperiod. The feeding and body weight

Interpretation of hatchery breakout data

Breaking out the unhatched eggs after the incubation process is very informative, as well as examining the eggs containing infertile or dead embryos during the incubation process. It can help to identify possible causes for low hatchability and poor-quality chicks. In most hatcheries, breakouts are performed in a more or less standardised way, either as a routine procedure or as a check when the results are not according to expectations.

Although the procedure is very well described and by itself not difficult to perform, the interpretation of the data can sometimes be an unexpected challenge. When the same person does the procedure as a routine, we can expect that the data and conclusions from different observations will be interpreted in the same way and can be compared. But when more people are involved or if we compare results from different hatcheries, we need to ensure that we are comparing apples to apples.

An additional interfering factor is the determination of fertility. Different breakout procedures (candling at 7-10 days, candling and opening clear eggs, opening hatch debris, or using data provided by the transfer machines at 18 days of incubation) will estimate different fertility levels on the same set of eggs. As many key figures are based on fertility, the outcome might vary based on the breakout procedure being used. This makes it challenging to compare data between different operations.

Besides that, the level of fertility can also influence our conclusions, as embryo mortality is often expressed as a percentage of the number of eggs on the trays examined. But as infertile eggs do not contain an embryo, the same number of early dead on a low fertility or high fertility flock should lead to a different interpretation. 5 dead embryos on a tray is more severe if there are only 50 fertile eggs (10% of the embryos died) on that tray instead of 100 fertile eggs (5% of the embryos died). To be able to turn breakout data into useful information and learn from it, we must know what we are measuring. Just comparing the key figures without looking into the background of the data can be misleading.

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programs were carried out as described by Aviagen (2023). In this experiment, birds were randomly transferred from rearing houses to 4 closed fan-ventilated commercial broiler breeder laying houses with a female (Ross 308) stocking density of either 5 females/m2 (CSD) or 6.6 females/m2 (HSD), at 22 weeks.

At the beginning of the production, female feeder space was 11.32 cm/female or 15.13 cm/female for HSD and CSD groups, respectively. In HSD houses, there were 9.5 females and 5.3 males per nipple and nest hole, respectively. There were 7 females/nipple and 3.7 females/nest hole in CSD houses.

All eggs and dead hens were recorded daily from each house to calculate the total percentage of mortality and egg production/hen (HW) week. Eggs from both treatments were incubated in a commercial hatchery to determine hatchability of set eggs and the second-grade chick percentages of the treatments.

The sorting of chicks into first and second grade was done by the hatchery personnel, and the first-grade chicks were counted by an automatic system. The data were analysed by the One-Way ANOVA procedure of SAS, and a Z-test was used to determine the existence of differences in two proportional mortality values.

Egg production was reduced 1.2 % (HW) in HSD from 26 to 59 weeks of age ($P > 0.05$). In addition, hen mortality for the same period was significantly higher in the HSD treatment than the CSD treatment (6.34% vs 5.21%; $P = 0.001$). Cumulative hatchability was significantly lower in eggs collected from HSD treatment when compared with CSD treatment ($P < 0.05$), but there is no significant difference in the percentage of second-grade chicks of the treatments ($P > 0.05$).

These results indicated that a 30% increase in stocking density from 5.0 to 6.6 females/m2 during the production period reduced the female feeder space and influenced the performance of broiler breeders. Birds at higher density produce fewer eggs (177.5 vs 181.5 eggs) and chicks (148.3 vs 154.1 chicks) per female broiler breeder. However, total egg or chick production per m2 was higher in HSD compared to CSD treatment

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Hatchability and first week mortality were severely impaired after inoculation of 18-day-incubated embryonated broiler eggs with escherichia coli and enterococcus faecalis

During in-ovo vaccination process, various factors, including bacterial contamination of embryonated eggs, can negatively impair hatchability, chick quality and first week mortality. The aims of this study were to assess which bacterial strains affect hatchability, chick quality and first week performance.

The effects of different bacterial concentrations and the site of inoculation on the same parameters were determined. Three experiments were conducted. In all experiments, 18-day incubated embryonated broiler eggs were inoculated with 0.1 ml suspension or peptone physiological saline. 36 eggs per group were used in experiments 1 and 2, and 114 eggs per group in experiment 3. Hatching rate, time of hatch, chick length, Pasgar score, mortality, time of death and chick weight at the end of the experiment were determined. Two different isolates of Escherichia coli and Enterococcus faecalis, isolated from in-ovo vaccinated unhatched eggs, and combinations of both were used in experiment 1. Per egg, 106 colony-forming units (cfu) of the bacteria were inoculated.

The most virulent strains of E. coli and E. faecalis were used in experiment 2, and embryonated eggs were inoculated with three different bacterial doses (102, 104 or 106 cfu/egg) of these bacteria. In experiment 3, E. faecalis (104 cfu/egg) was

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Changes of pekin duck hatchability during the year

Hatchability results in poultry depend on a wide range of genetic, biological (e.g., flock age), and environmental factors. Despite the automation of microclimate control in poultry reproductive flock buildings and hatcheries, the weather seems to affect hatchability results. This phenomenon has not been analysed in detail so far, especially in the case of domestic duck artificial incubation.

The analysis included all 871 batches of hatching eggs (252-24,696 eggs/batch) incubated at the commercial hatchery in Wieszowa (E.G.G. Ltd) from 2019 to 2023. Eggs were collected from 10 parental flocks of ducks (Cherry Valley) that began to lay cyclically, so that eggs from four parental flocks of different ages were usually incubated simultaneously. The effect of the month of egg collection on indicators such as fertilisation, embryo mortality between days 1 and 7 of incubation (E1-E7), E8-E24, and E25-E28, and hatchability from set and fertilised eggs was tested using the Kruskal-Wallis test, followed by a post hoc Dunn test.

All analysed indicators depended on the month of egg collection ($P<0.05$). The highest fertilisation of duck eggs (mean ± SD) was found in November (95.9±1.66%), while the lowest was in spring, in April (93.7±3.64%; $P=0.025$) and May (94.1±3.15%; $P=0.070$), and in late summer, specifically in August (94.0±2.91%; $P=0.002$) and September (94.1±3.53%; $P=0.010$). There was a tendency for early embryo mortality to decrease in summer (June-July), but simultaneously, mortality increased during the hatching period. Embryo mortality in E25-E28 was 13.8±7.20%, 14.6±7.68%, and 15.2±4.99% ($P<0.05$) in June, July, and August, respectively, while it was lowest in April (8.2±2.58%), November (9.7±3.24%), and February (10.0±4.43%). As a result, the highest hatchability from total set eggs was in late winter and spring (February 89.2±5.48%, March 87.8±7.37%, April 91.1±2.82%) and November (89.3±3.32%), while the lowest was in the summer months (June 85.1±8.12%, July 84.0±8.69%, and August 83.5±5.57%).

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inoculated in the amniotic cavity or in the embryo. The observed hatchability in all experiments was very low (0-19%) in the E. coli inoculated groups and moderate (48-69%) in the E. faecalis inoculated groups. In experiment 2, E. coli was pathogenic in all doses used, and no chicks hatched in these groups. Hatchability did not significantly differ between the different doses when E. faecalis was inoculated, and ranged from 56 to 69%.

Chick quality did not differ from the control groups in all experiments. First week mortality was, in general, high (>50%) in all experiments regardless of the bacterial species, dose and inoculation route.

Strict hygiene measures should be taken in hatcheries to avoid contamination of eggs with low numbers (<102 cfu/egg) of virulent bacteria, such as E. coli and E. faecalis.

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HATCHERY TRENDS

Digital tools in hatcheries: data use, integration, and overload

GLOBAL OVERVIEW

Digital tools are revolutionising hatchery operations, providing real-time monitoring, environmental control, and traceability, but challenges persist in integration, interpretation, and decision-making.

NORTH AMERICA

North American hatcheries are utilising precision tech, but a unified platform is needed to interpret trends and make better decisions despite multiple standalone systems.

LATIN AMERICA

Digital tool adoption in Latin America varies, with larger hatcheries investing in climate control and incubation monitoring, while smaller operators face financial and logistical barriers.

EUROPE

Europe's harrowing sustainability and traceability requirements are accelerating the adoption of digital solutions in logging emissions, temperature, and chick handling metrics.

ASIA/OCEANIA

Industry growth drives demand for tech-enabled hatchery systems, with producers experimenting with mobile apps and IoT monitoring tools, but some facilities struggle to balance technology with practical workflows.

AFRICA

Africa's hatcheries are exploring mobile-friendly systems for temperature control and performance tracking, and digital dashboards for remote management, despite limited on-site expertise.

SUMMARY

Digital tools in hatcheries are expanding rapidly, but their successful implementation depends on integration, interpretation, and data-driven action, necessitating industry integration and smarter systems.