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A study on the development of locomotion and flight in chickens to improve the freedom of movement in aviary systems for laying hens

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Key words
Locomotion, development, ramp incline, anticipation, balance, aviary, laying hens

Aim of the study
This study was conducted to: (i) understand the development of locomotor performance and physical activity levels of layer chicks as they mature from hatchlings to mature hens in an aviary setting using tri-axial accelerometers; (ii) determine potential differences in anticipation of, modes of locomotion on, and success rates on various ramp inclines; (iii) assess and compare laying hens with and without production issues to determine differences in how they navigate up and down in an aviary system; (iv) evaluate and compare the abilities of adult laying hens with and without physical health problems (production diseases) to maintain balance using a series of environmental challenges.

Material and methods
This study focused on the development of locomotor and physical activity patterns of four strains (Hyline Brown, Lohmann Brown, LSL, Dekalb White) of 160 laying hens housed in 16 complex three-dimensional aviaries. Using video recording and tri-axial accelerometry, we recorded how the birds allocated their time within the various levels of the multitier aviary, as well as how they navigated the system. The navigational preferences of laying hens with and without production issues (keel bone injuries, poor feather cover, foot pad dermatitis) were compared using video recordings to determine how the birds locomote vertically within an aviary (ramps, perches or flight).
The safest method (to prevent injuries and falls) for ramp ascent was determined using 20 laying hens and evaluating their locomotor style, ability and climbing capacity (0-70°) in relation to age and surface substrate (sandpaper or wire grid). Hind-limb modification (step velocity, foot contact time and variation in center-of-pressure) and peak ground-reaction-force (GRF) were recorded to determine how the laying hens anticipated the various ramp inclines (0°, 40°, 70°).
To assess and compare the balancing skills of laying hens with (n=15) and without (n=5) production issues (aforementioned), a custom-built swaying perch was used. High-speed video cameras and accelerometers were used to record the balancing skills of birds under a series of environmental challenges, consisting of visual (using a head mask) and spatial constraints (perch obstacles), and static and swaying perch states.

Results and significance
Video observations of layer chicks (1-9 wks) showed that they preferred to remain on the ground rather than elevated surfaces and preferred levelled surfaces to inclined surfaces (ramps/ladders). Elevated surface use began at 8 days of age. Tri-axial accelerometry showed that birds (10-36 wks) allocated 71%, 22% and 7% of their time towards moderate- (e.g. walking), low- (e.g. small postural movements), and high- (e.g. aerial ascent) intensity physical activities, respectively. Pullets performed the most high-intensity activity. Chicks and adults performed walking to climb 40° ramp inclines, but performed wing assisted-incline running or aerial ascent on steeper ramp inclines, generating higher GRFs (force plate measurement) with longer foot contact. Tri-axial accelerometer data indicated that birds with physical health problems performed a higher frequency of rotational corrections (to keep the body centered/balanced), and that environmental challenges (overcrowding, visual constraints) required more intense and variable movement corrections. To promote proper locomotor development for layer-hen chicks, we recommend an aviary design with elevated surfaces connected via surfaces with incline

angles of ≤ 40°. Overall, these findings provide the novel insight that developing chicks/laying hens preferentially locomote lower elevations with moderate activity when navigating a structurally-complex aviary. Collectively, these results highlight that poor physical health and environmental challenges all reduce balancing performance.

Publications, posters and presentations

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