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Effect of Alternative Production and Management Environments on Layer Reproduction System Development

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Abstract: Three different production environments were evaluated for their impact on laying hen reproduction by assessing the ovary and oviducts for the presence of physiological variations. The three environments included free-range (FR = 60), cage-free (CF = 55) and battery cage (BC = 50). The ovaries and oviducts from these hens were collected and weighed during necropsy, then stored in a freezer at -20°F for later analysis. The analysis included the oviduct length and the number of Post-Ovulatory Follicles (POFs), atretic follicles, hierarchical follicles (H = 12-40 mm), small yellow follicles (SY = 5-12 mm), large white follicles (LW = 2-5 mm), small white follicles (SW = <2 mm) and tumor numbers if present on each ovary. Free-range hens had significantly heavier oviduct weights, at 19.4 and 13.5% heavier than oviducts of battery cage and cage-free hens, respectively. The free-range hens also exhibited an increased presence of tumors as well as an increased frequency of multiple tumors on the oviducts. Hens housed in the free-range and battery cage environments had increased numbers of LW follicles compared to the cage-free hens. In addition, the free-range hens had a significantly smaller number of SW follicles when compared to the battery cage hens. Contrary to the popular belief that birds raised in free-range or cage-free environments provide healthier production alternatives than conventional battery cages, this study does not suggest that there is a significant physiological impact on the reproductive capacity of hens housed in these different production environments. However, oviduct health appears to be better in the battery cage and cage-free environments.

Key words: Layers, free-range, cage-free, cage, reproduction

INTRODUCTION

There is rising public concern for the welfare of laying hens to be taken into account when managing these birds for egg production (Anderson, 2009). In the extensive production systems of free-range and cage-free the birds to have the ability to have a more extensive behavioural repertoire which would include behaviors associated with specific environments such as dust bathing and foraging. However, the typical consumer is not aware of the fine line that exists between making egg production cost-effective while maintaining layer hen welfare. A growing number of consumers equate traditional battery cage production as poor management with respect to animal welfare, while considering cage-free or free-range production methods as more favorable alternatives due to the expanded behaviors. In order to assess animal welfare in different management methods, the physical and physiological well-being of the animals must be taken into account (Koch, 2009). To measure reproductive physiological health, the reproductive tracts of laying hens raised in different production environments were dissected and assessed for the presence of reproductive physiological variations and abnormalities.

MATERIALS AND METHODS

Laying hens from the Hy-Line brown strain were raised and managed in three different production environments (free-range; FR, cage-free; CF and battery cage; BC) at the Piedmont Research Station in Salisbury, NC (Anderson, 2011). Each production environment sample consisted of a varying number of hens, depending on bird availability; FR = 60, CF = 50 and BC = 55 for a total of n = 165. These hens were euthanized using cervical dislocation at 85 weeks of age for necropsy in agreement with NCSU-IACUC approval, after which the reproductive tracts were obtained. The ovary and oviducts were weighed separately with a gram scale. Each reproductive tract was then sealed in a labeled plastic bag and stored in a freezer at -29°C for further post-mortem assessment.

Each reproductive tract was assessed using the same method of dissection. First, the tract was thawed using a 22°C water bath. Once the tract was palpable, the ovary and oviduct were examined separately. The oviduct was carefully uncoiled by cutting away the oviductal membrane and stretched out to its full length and measured in cm length-wise from the tip of the infundibulum to the end of the uterus using a one meter

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tape measure marked in mm. The presences of oviductal tumors were also noted and recorded.

Following the examination of the oviduct, the ovary was analyzed. First, the numbers of Post Ovulatory Follicles (POFs) were counted. POFs are the residual projections of connective tissue that remain on the ovary after the hierarchal follicle ruptures after ovulation (Burley and Vadehra, 1989). Then, the follicles were carefully dissected off the ovary using precision curved tweezers. Each follicle was carefully measured in millimeters using a metric caliper (±0.1mm) to determine the follicular stage: hierarchical follicle (H = 12-40mm), small yellow follicle (SY = 5-12mm), large white follicle (LW = 2-5mm), or small white follicle (SW = <2mm). Each follicle was placed accordingly into one of four disposable plastic lab dishes labeled for each follicular stage. All follicles were counted in each plastic lab dish and recorded. If atretic follicles were present, they were counted and recorded. Once all reproductive tracts had been dissected, numerical data for each tract was recorded into an excel spreadsheet and a statistical analysis using the SAS General Linear Model (GLM) to analyze a complete randomized design was implemented. The analysis was weighted to eliminate the sample size variation impact of the means. Means were separated using LS Means and p-differences were used to separate the means which were significantly different at P<0.05. A chi squared test for independence was used to test for theassociation between tumor presence and environment.

RESULTS AND DISCUSSION

Oviduct weight: Hens raised in the free-range environment had oviducts that were 18 grams heavier (P<0.05) than the battery cage hens and 13 grams heavier than their cage-free counterparts (Table 1). This 19.4 and 13.5% respective increase in oviduct weights of the free-range hens does not appear to be related to the length of the oviduct but rather may have been due to a higher frequency of tumors, as well as the higher severity of the multiple tumors on oviducts that contained tumors Table 2.

Small white and large white follicles: Follicular development in the laying hen is characterized by a sophisticated and highly regulated method of follicle selection. In the avian specie, follicles undergo growth in a hierarchy as the hen matures; these follicles are categorized by size and color, corresponding to their stage of growth (Johnson, 2012). The development of follicles begins with the small white follicle which may develop into the large white follicle, the surviving large white follicle may develop into the small yellow follicle and then into the hierarchical follicle; which may be selected for ovulation (Romanoff and Romanoff, 1949). In the course of follicular development, the follicles not selected for growth will undergo death, or atresia and will not develop into the next stage of follicular growth. In this study, the follicles in each stage of growth were documented.

The free-range hens had a significantly (P<0.05) smaller number of SW follicles (n = 66.8) when compared to the battery cage hens (n = 78.0) but not to the cage-free hens (n = 73.3). Adversely, the free-range and battery cage hens had a larger number (P<0.05) of LW follicles (n = 29.4 and n = 29.7, respectively) when compared to the cage-free hens with an average of n = 24.6 LW follicles. Since hens reared in the free-range and battery cage environments had a larger number of LW follicles, this may have resulted in higher hen-day egg production in range hens, as well as in higher hen-housed egg production of caged hens (Romanoff and Romanoff, 1949). This referred increase in follicle production within the free-range and battery cage hens may suggest a higher capacity for follicular selection. This may indicate increased egg production which could be demonstrated by the cage layers since they produced the greatest number of SW follicles. However, it appears that LW folicles may be a better indicator of productivity, as the free-range hens produced the smallest number of SW follicles but selectively produced equally as many LW follicles as the caged layers.

Overall reproductive physiological variations: Overall, there were few significant reproductive physiological differences between hens raised in a free range, battery cage, or cage-free production environment. As a result, this study showed that hens reared in free-range or cage-free environments do not appear to provide sounder conditions conducive to improved reproductive

Table 1: Means and standard error of reproductive physiological variables across varying production environments

		Oviduct		Frequency						
Environment	Oviduct wt (g)	length (cm)	Ovary (g)	H	SY	LW	SW	POFs	Atretic	Tumors
Battery cage	92.8^{c}	60.2	40.4	4.0	11.5	29.7^{a}	78.0^{a}	3.1	3.5	0.4
Cage free	97.7^{b}	62.7	41.5	4.3	10.6	24.6^{b}	73.3^{ab}	3.5	3.0	0.4
Free range	110.9^{a}	59.6	40.9	4.1	10.2	29.4^{a}	66.8^{b}	3.4	3.3	0.6
Standard error	4.7	1.2	1.9	0.2	0.7	1.3	2.8	0.2	0.8	0.1

ab (p<0.05)

Table 2: Frequency of tumors in hens raised across varying production environments

		STPO			
Environment	NT	1	2	3	TS
Battery Cage	39	12	4	0	55
Cage Free	35	12	1	2	50
Free Range	35	17	6	2	60
All Environments	109	41	11	4	165

NT: Number of tumors, STPO: Severity of tumors per oviduct, TS: Total sample

physiological health, when compared to hens reared in conventional battery cages. This could be associated with Curtis (2007) axiom that productivity and reproductive performance may be a better indicator of welfare than other methods, in which case the environments in this study would be equivalent.

This study showed that hens maintained in the free-range and battery cage production environments had a larger number of large white follicles compared to the cage-free hens indicating a potential for greater productivity. In addition, the free-range hens had a significantly smaller number of small white follicles when compared to the battery cage hens but not significantly smaller than the cage-free hens. Surprisingly hens maintained in the free-range environment had heavier oviduct weights. This may actually be a result of a higher presence of oviductal tumors, since when present, these tumors were often larger and more numerous than oviductal tumors in battery cage or cage-free hens.

REFERENCES

Anderson, K.E., 2009. Overview of natural and organic egg production: Looking back to the future. J. Applied Poult. Res., 18: 348-354.

Anderson, K.E., 2011. Single Production Cycle Report of the Thirty eighth North Carolina Layer Performance and Management Test. Vol. 38, No.4. November 2011. http://www.ces.ncsu.edu/depts/poulsci/tech_manuals/layer_reports/38_single_cycle_report.pdf

Burley, R.W. and D.V. Vadehra, 1989. The Avian Egg Chemistry and Biology. 1st Edn., Canada: John Wiley and Sons, Inc., Pages: 19.

Curtis, S.E., 2007. Commentary: Performance indicates animal state of being: A Cinderella axiom? Professional Anim. Sci., 23: 573-583.

Johnson, P.A., 2012. Follicle Selection in the Avian Ovary. Reproduction in Domestic Animals. Vol. 47, s4: 283-287. August 2012.

Koch, V. Wensley, 2009. American veterinarians' animal welfare limitations. J. Vet. Behavior: Clin. Applications Res., 4.5: 198-202.

Romanoff, A.L. and A.J. Romanoff, 1949. The Avian Egg. 1. Ithaca, New York: John Wiley and Sons, Inc., pp: 177-182.