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The Titer of Immunity and Signs of Welfare Due to Changes in Group Size in Two Strains of Lohmann Classic Layers

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Abstract

This study examined the effect of the different group sizes on the titers of some immunological indicators and welfare status in two strains of Lohmann layers. A total 558 layers (279 Lohmann brown and 279 Lohmann selected leghorn), aged 50 weeks were homogenously classified into four groups, where 360 birds (180 Lohmann brown and 180 Lohmann selected leghorn) in 6 cages (60 layers/cage "5 $m^{2"}$) and 198 birds (99 Lohmann brown and 99 Lohmann selected leghorn) (33 layers/cage "2.8 $m^{2"}$) with the same floor space relatively. The antibody titer of avian encephalomyelitis, avian meta-pneumonia, infectious bronchitis and mycoplasma synovia were higher in small group (33 birds) than large group size (60 birds). However, the differences didn't reach the significance. In the other hand, the Lohmann selected leghorn was more susceptible to avian encephalomyelitis, infectious bronchitis and mycoplasma synovia due to the increase in its antibody titers, while the antibody titers of avian meta-pneumonia and mycoplasma gallisepticum were higher in Lohmann brown. In large group size, the scores of plumage condition were referred to the best, especially in Lohmann brown. Furthermore, the changes in feet condition in Lohmann brown were better than Lohmann selected leghorn, especially in large group. In order to achieve the full genetic growth potential, layers must be reared under optimal group size. Therefore, any deviation of the optimum management condition of layers may impair their performance, cause immunosuppression, and change their physiological responses leading to increase their susceptibility to diseases.

Keywords**:** Group Size, Layer, Immunity, Plumage, Feet.

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Introduction

Today, the poultry industry is believed to achieve perpetual and instant production of the best available sources of animal protein, and the increase towards poultry welfare in farms has led to studying the management. The poultry industry faces new challenges and changes to adapt to new market interests, new regulations, and to continue improving the productivity as well as the welfare of birds. Poor welfare often reduces productivity and profitability of layers, there was economic reason for monitoring and improving the welfare of farmed animals (Blokhuis et al., 2013). Improvements regarding the welfare of laying hens can be achieved by development and enhancement of environmental factors such as management practices (Malin, 2015). Group size is a common practice to vary stocking density by adjusting the number of hens in a fixed space (Guo et al., 2012). Hence, the effect of group size may play a role in the welfare, and performance of hens in caging systems. There were several studies paying attention on the influence of group size on layer's performance (Craig et al., 1986 and Benyi et al., 2006), egg quality (Fulvia et al., 2014) and feed conversion ratio (Sirovnik et al., 2018). Laying hen welfare may also be greatly affected by breeding goals, so selective breeding for desired traits may help to improve welfare (Lay et al., 2011) and is considered the main cause in variation of productivity and mortality rate of layers (Aerni et al., 2005 and Larsen et al., 2018). It was found that a hen's appearance and phenotypic change are relevant enough to affect bird growth and egg production (Marin et al., 2014). There were several studies studied the effect of strain of Lohmann layer on plumage condition (Mohammed, 2012) and behavior (Mohammed and Enas, 2016 and Riddle et al., 2018). For that reason, the objectives of the current study were to assess the titer of immunity and signs of welfare due to changes in group size between two commercial layer lines; Lohmann brown (LB) and Lohmann selected leghorn (LSL).

Materials and methods

Experimental animals and management

The experimental procedures were done in accordance with the Ethics and Animal Welfare Committee at the Poultry Research Unit, Faculty of Veterinary Medicine, Zagazig University, Egypt. The study was conducted in furnished cages with nest, plastic mat and perch on two batches of Lohmann brown (LB) and Lohmann selected leghorn (LSL) in two different group sizes (33 and 60 birds). A total 558 layers (279 Lohmann brown, 279 Lohmann selected leghorn), aged 50 weeks were homogenously classified in to four groups, where 360 birds (180 Lohmann brown and 180 Lohmann selected leghorn) in 6 cages (60 layers/cage "5 m2") and 198 birds (99 Lohmann brown and 99 Lohmann selected leghorn) (33 layers/cage "2.8 m2") with the same floor space relatively. During the study, a 16 hour's lighting schedule was applied from incandescent lamp. Water was provided ad libitum, while the basal layer diet was formulated to meet layer nutrient requirements (AOAC, 2002).

The titers of immunity

All data were recorded for all groups throughout the experimental period (12 weeks), where the antibody titers of avian encephalomyelitis, avian meta-pneumonia, infectious bronchitis, mycoplasma gallisepticum and mycoplasma synovia were assessed three times throughout experimental period (at 51, 55 and 59 weeks respectively) via enzyme-linked immunosorbent assay (ELISA). That was done after collecting random blood samples from wing vein in 60 birds from each strain. Serum was separated from blood samples by centrifugation at 15,000 × g for 3 min and stored at −80°C until the day of analysis and all serum samples were read against

positive and negative control antisera (Mohammed et al., 2016).

Signs of welfare (plumage and feet conditions)

Evaluation of the plumage and feet condition was scored monthly for 15 birds per cage randomly by using Tauson scale, (Mohammed, 2012 and Mohammed et al., 2017). The scoring system in Tauson scale was ranged from 1 to 4, where 4 was the best condition (completely feathered and healthy feet) and 1 was the worst (Featherless with changes in feet, as fracture nail and toe hyperkeratosis).

Statistical analysis

All statistical procedures were performed using the SAS Statistical Package (SAS, 2002). The differences among means of the data were analysed using parametric T- test.

Results

The results in Fig. 1, 2, 3, 4 and 5 included the titer of antibodies of avian encephalomyelitis, avian meta-pneumonia, infectious bronchitis, mycoplasma gallisepticum and mycoplasma synovia. The antibody titers of avian encephalomyelitis, infectious bronchitis and mycoplasma synovia were higher in small group than large one of LSL strain, as shown in Fig. 1, 3 and 5, respectively, but the differences didn't reach the significance. While Fig. 2 and 4 revealed increase of susceptibility of LB strain to avian meta-pneumonia and mycoplasma gallisepticum, where its antibody titers were higher in large one strain than small one of LB. Furthermore, Fig. 6 showed the effect of different group size on the plumage and feet condition in two strains of Lohmann classic layers under different group size. The scores of plumage and feet condition were higher in large group than small one of LB strain and these scores confirm positive impact of group size on plumage and feet condition. However, LSL hens showed a worse plumage and feed condition than LB, as shown in Fig (6). Our results confirmed that changing the housing condition and strain will maximize the risk factors influenced health and welfare status of layers.

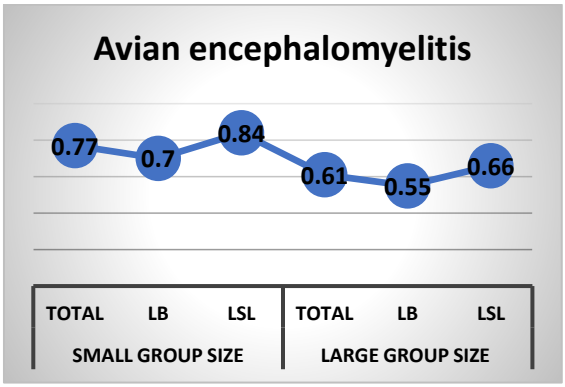

Fig. 1. Effect of group size on the titer of avian encephalomyelitis in two strains of Lohmann classic layers. The antibody titer of avian encephalomyelitis was higher in small group than large one of LSL strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

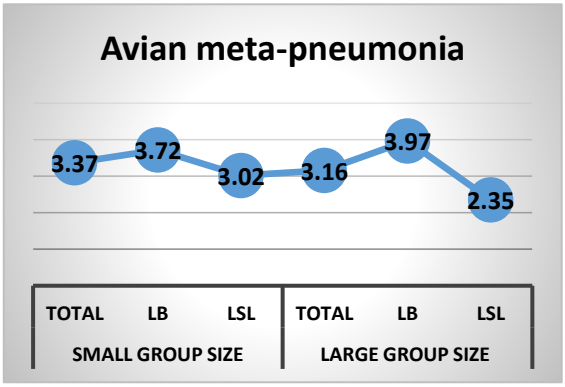

Fig. 2. Effect of group size on the titer of avian meta-pneumonia in two strains of Lohmann classic layers. The antibody titer of avian meta-pneumonia was higher in large group than small one of LB strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

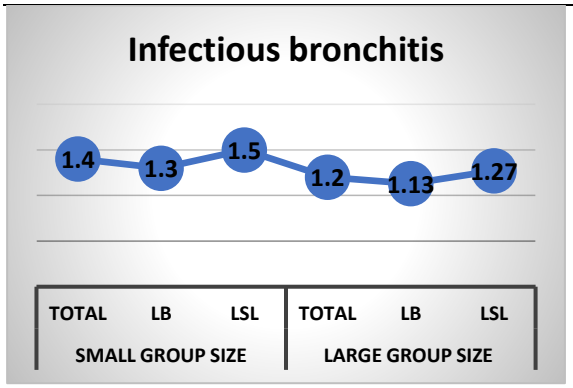

Fig. 3. Effect of group size on the titer of infectious bronchitis in two strains of Lohmann classic layers. The antibody titer of infectious bronchitis was higher in small group than large one of LSL strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

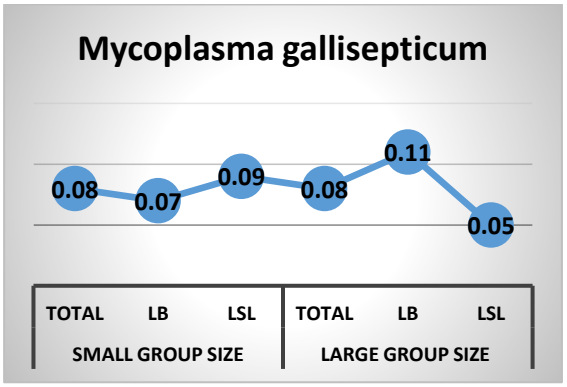

Fig. 4. Effect of group size on the titer of mycoplasma gallisepticum in two strains of Lohmann classic layers. The antibody titer of mycoplasma gallisepticum was higher in large group than small one of LB strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

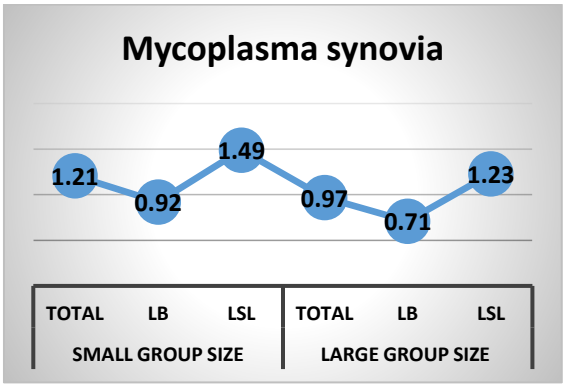

Fig. 5. Effect of group size on the titer of mycoplasma synovia in two strains of Lohmann classic layers. The antibody titer of mycoplasma synovia was higher in small group than large one of LSL strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

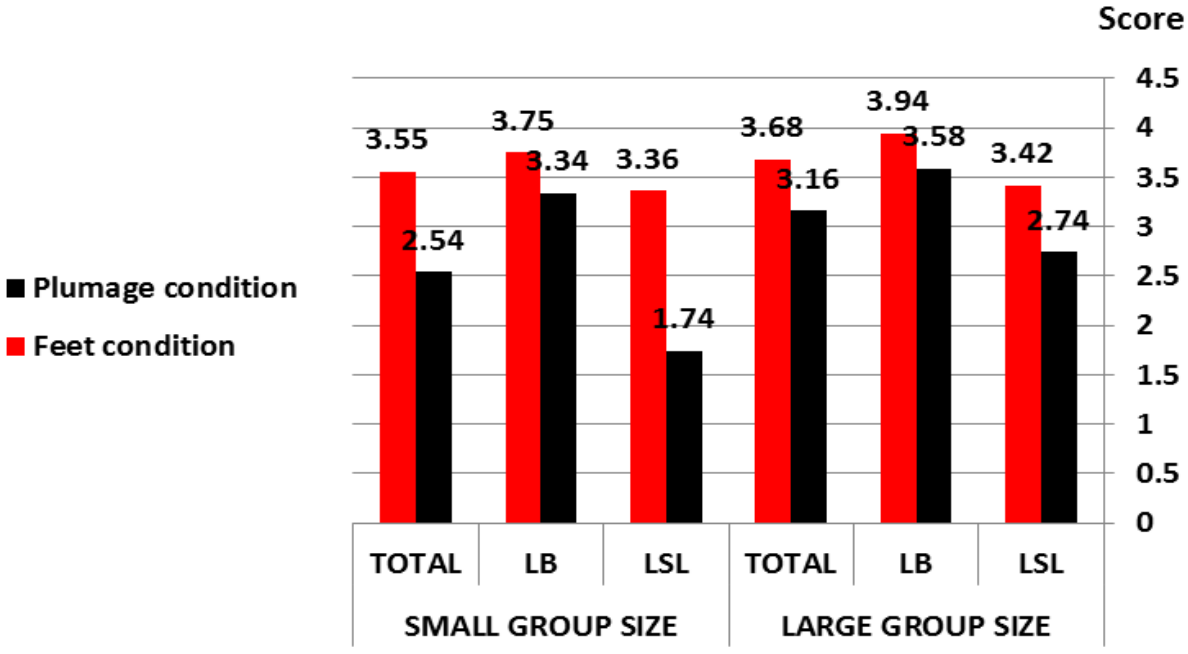

Fig. 6. Plumage and feet condition in two strains of Lohmann classic layers under different group size. The scores of plumage and feet condition were higher in large group than small one of LB strain. LB, Lohmann brown; LSL, Lohmann selected leghorn.

Discussion

Because the Lohmann selected leghorn (LSL) and Lohmann brown (LB) layer lines have been identified for high egg production, these are belonging to the worldwide leading commercial layer lines. Therefore, the present study examined the effect of group size on the titer of immunity and signs of welfare in the both strains of Lohmann classic layers. Group size is a common practice to vary stocking density by adjusting the number of hens in a fixed space. The results in Fig. 1, 2, 3 and 5 included the upregulation of the titer of antibodies of avian encephalomyelitis, avian meta-pneumonia, infectious bronchitis and mycoplasma synovia. These titers were higher in small group (33 birds) than large group size (60 birds). Our results revealed the higher susceptibility of layers to previous diseases in small groups and the question of group size has aroused great interest worldwide as it can have several practice implications on laying hens production (Wall, 2011). As general, there was no difference in susceptibility of layers to mycoplasma gallisepticum, although the differences between the LB and LSL. It was found that smaller flocks had higher survivality than those of larger flocks (Tid and Ambrosen, 1988). Therefore, any deviation of optimum management condition of layers may impair their performance and change their physiological responses (Mohammed et al., 2016). In the other hand, LSL was more susceptible to avian encephalomyelitis, infectious bronchitis and mycoplasma synovia due to the increase in its antibody titers (Fig 1, 3 and 5), while the antibody titers of avian meta-pneumonia and mycoplasma gallisepticum were higher in LB, as mentioned previously in Fig. 2 and 4. Difference in immunological patterns between LSL and LB might relate to the hen's serum heterophil/lymphocyte ratios and stress modulation for egg laying in housing system (Rautenschlein et al., 2011, and Lentfer et al., 2015). Moreover, several studies have compared poultry strain differences in combination with other factors such as age, sex, gene expression, and management factors that influence the yield of poultry (Woyengo et al., 2010, Abdullah et al., 2010, Lopez et al., 2011, Habig et al., 2012, and Riddle et al., 2018). Fig (6) described the conditions of plumage and feet, where it was the best in layers reared in large group especially in Lohmann brown. That confirms the positive impact of group size on plumage and feet condition, as previously reported (Bilcík and Keeling, 1999, and Allen and Perry 1975). Likewise, hyper keratotic alterations have been observed in the small group of LB line (Weitzenbürger et al., 2006) due to the use of perches and grasping the wire floor of furnished cages. Our results may be due to the increase of allelomimetic, comfort behavior among birds in large group (Mohamed and Mohamed, 2013). Moreover, good signs of health and welfare in LB agreed with (Hughes and Duncan, 1972, Jonsen et al., 1998 and Mohammed, 2012). However, LSL hens showed a worse plumage and feed condition than LB It may be due to the more increasing in comfort behavior in LB (Wall et al., 2008) or related to its genetic resistance to infection than LSL (Kaufmann et al., 2011). Our findings provide gene implications involved in economically important line characteristics of commercial laying hens.

In conclusion, to achieve the full genetic growth potential, layers must be reared under optimal management conditions to improve their welfare and productivity. Any deviation of this optimization protocol may impair their performance, cause immunosuppression, and change their physiological responses leading to increase their susceptibility to diseases.

Acknowledgments

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Abbreviations

LB, Lohmann brown; LSL, Lohmann selected leghorn and ELISA, enzyme-linked immunosorbent assay.

Contributions

Hesham H. Mohammed and Ibrahim F. Rehan were mutually contributed to design the study protocol, edit, and approve the final manuscript as submitted.

References

Abdullah AY, Al-Beitawi NA, Rjoup MM, Qudsieh RI, Ishmais MA (2010). Growth performance, carcass and meat quality characteristics of different commercial crosses of broiler strains of chicken. Japanese Poultry Science, 47: 13-21.

Aerni V, Brinkhof M, Wechsler B, Oester H, Fröhlich E (2005). Productivity and mortality of laying hens in aviaries. A systematic review. World Poultry Science, 61: 130-142.

Allen J, Perry GC (1975). Feather pecking and cannibalism in a caged layer flock. British Poultry Science, 16: 441-451.

AOAC (2002). Official Methods of Analysis. Association Official Analytical Chemists, Gaithersburg, USA.

Benyi K, Norris D, Tsatsinyane PM (2006). Effects of stocking density and group size on the performance of white and brown Hy-line layers in semi-arid conditions. Tropic Animal Health & Production, 38: 619-624.

Bilcík B, Keeling LJ (1999). Changes in feather condition in relation to feather pecking and aggressive behaviour in laying hens. British Poultry Science, 40: 444-451.

Blokhuis HJ, Jones RB, Veissier I, Miele M (2013). Introduction. In: Blokhuis HJ, Miele M, Veissier I, Jones RB. (Eds) Improving Farm Animal Welfare: Science and Society Working Together: The Welfare Quality Approach. Wageningen Academic, 13-18.

Bovera F, Iannaccone F, Piccolo G, Meo CD, Russo F, Piscitelli D, Attia YA, Hassan SS, Nizza A (2012). The effect of group size and stocking density on the welfare and performance of hens housed in furnished cages during summer. Animal Welfare, 21: 41-49.

Craig JV, Craig JA, Vargas JV (1986). Corticosteroids and other indicators of hens' well-being in four laying-house environments. Poultry Science, 65: 856-863.

Habig C, Geffers R, Dish O (2012). Differential gene expression from genome-wide microarray analysis distinguishes lohmann selected leghorn and lohmann brown layers. PIoS one, 7(10): e46787.

Hughes BO, Duncan IJH (1972). The influence of strain and environmental factors upon feather pecking and cannibalism in fowls. British Poultry Science, 13(6): 525-547.

Johnsen PF, Vestergaard KS, Nørgaard-Nielsen G (1998). Influence of early rearing conditions on the development of feather pecking and cannibalism in domestic fowl. Applied Animal Behavior Science, 60: 25-41.

Kaufmann F, Daş G, Preisinger R, Schmutz M, König S, Gauly M (2011). Genetic resistance to natural helminth infections in two chicken layer lines. Veterinary parasitology, 176(2-3): 250-257.

Larsen H, Hemsworth PH, Cronin GM, Gebhardt-Henrich SG, Smith CL, Rault JL (2018). Relationship

between welfare and individual ranging behaviour in commercial free-range laying hens. Animal, 1-9.

Lay D, Fulton R, Hester P, Karcher D, Kjaer J, Mench J, Mullens B, Newberry R, Nicol C, O'Sullivan N, Porter R (2011). Hen welfare in different housing systems. Poultry Science, 90: 278-294.

Lentfer TL, Pendl H, Gebhardt-Henrich SG, Fröhlich EKF, Von Borell E (2015). H/L ratio as a measurement of stress in laying hens–methodology and reliability. British poultry science, 56(2): 157-163.

Lopez KP, Schilling MW, Corzo A (2011). Broiler genetic strain and sex effects on meat characteristics. Poultry Science, 90: 1105–1111.

Malin A (2015). Welfare Indicators in Laying Hens, Doctoral Thesis, Swedish University of Agricultural Science, Faculty of Veterinary Medicine and Animal Science.

Marin RH, Liste MG, Campderrich I, Estevez I (2014). The impact of phenotypic appearance on body weight and egg production in laying hens: A group-size- and experience-dependent phenomenon. Poultry Science, 93 (7): 1623-1635.

Mohamed HH, Mohamed EM (2013). Studying the behaviour and performance of balady male goats managed in different group sizes with the same individual floor space under Egyptian conditions. Benha Veterinary Medical Journal, 24(1): 34-42.

Mohammed HH (2012). Assessment of the behavior, plumage and feet conditions in two commercial layer breeds. International Journal of Applied Animal Sciences, 1: 18-22.

Mohammed HH, Enas S (2016). Behavior of laying hens in relation to housing system and strain. Japanese Journal of Veterinary Research, 64: 143-148.

Mohammed HH, Enas S, Shereen A (2017). Impact of different litter materials on behavior, growth performance, feet health and plumage score of Japanese quail. European Poultry Science, 81.

Mohammed HH, Mohamed I, Al-Sadik S (2016). Effect of different light intensities on performance, welfare and behavior of turkey. Journal of Advanced Veterinary and Animal Research, 3(1): 18-23.

Rautenschlein AS, Petersen AH, Teske AL, Suerie BC, Haertle CS, Haase AC (2012). Comparison of immunological and health parameters of different layer hybrids housed in aviary and enriched colony systems. In Western Poultry Disease Conference, 82.

Riddle ER, Ali AB, Campbell DL, Siegford JM (2018). Space use by 4 strains of laying hens to perch, wing flap, dust bathe, stand and lie down. Public Library of Science one, 13(1): e0190532.

SAS (2002). SAS/stat users guide. sas institute inc, cary, nc 27513, USA. S148.

Sirovnik J, Würbel H, Toscano MJ (2018). Feeder space affects access to the feeder, aggression, and feed conversion in laying hens in an aviary system. Applied Animal Behaviour Science, 198: 75-82.

Tind E, Ambrosen T (1988). Laying hen kept in cages, the effect cage shape, group size and unit area. Poultry Abstracts.

Wall H (2011). Production performance and proportion of nest eggs in layer hybrids housed in different designs of furnished cages. Poultry Science, 90: 2153-2161.

Wall H, Tauson R, Elwinger K (2008). Effects of litter substrate and genotype on layers' use of litter, exterior appearance, and heterophil: lymphocyte ratios in furnished

cages. Poultry Science, 87: 2458-2465.

Weitzenbürger D, Vits A, Hamann H, Hewicker-Trautwein M, Distl O (2006). Macroscopic and histopathological alterations of foot pads of laying hens kept in small group housing systems and furnished cages. British Poultry Science, 47: 533-543.

Woyengo T, Golian A, Bennett C, Muc H, Guenter W (2010). Performance of two 1970s and Ross 308 broiler strains fed drug-free low-protein and recommended-protein diets. Journal of Applied Poultry Research, 19: 101-111.