

Revision of the simplified balance method to evaluate phosphorus excretion by pullets and laying hens

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Since 2010, guidelines have been developed in Quebec to maximize the benefits and minimize the risks associated with the application of livestock manure to agricultural soils. Within these guidelines, phosphorus (P) content of manure has to be assessed and manure application adjusted to crop needs. To simplify farmers work, a simplified balance method has been proposed to quantify P excretion as the difference between farm P inputs and outputs. The goal of this work is to estimate the amount of P retained by birds during the pre-laying and laying period, which is a key parameter, and to highlight the factors of variation. A total of 12 different farms of pullets were followed during 19 weeks (W), and 13 laying-hens farms were followed from 19 W until the end of the laying period. Pullets and laying hens received diets that contained 5.3 to 8.4 g and 4.7 to 7.1 g total P/kg respectively. Body weight gain and feed intake were followed during all the experiment and 5 birds per farm were slaughtered at 0, 10 and 19 W for pullets and at 19, 31, 43, 55, 67 W of age for laying-hens. The feathers were removed, whole-body composition in bone mineral content, lean and fat was obtained using dual-energy x-ray absorptiometry (Discovery W Hologic Inc., Waltham, MA, USA) for the pool of 5 birds which was the experimental unit. They were then ground for body chemical composition in Ca, P, lipid and protein. In addition, for each laying farm, we received 36 eggs in the beginning, in the middle and at the end of laying cycle to analyze different physicochemical characteristics. Data were statistically compared using MIXED procedure of Minitab 18. In average, pullets have taken 1.15 kg during the 19 W compared with 300 g for laying hens from 19 to 67 W. Regarding pullet results, there was no effects of farms on body weight (BW, g) and BMC (g). The P retention efficiency based on carcass analysis and diet varied between 17 and 36%. The regression of body P to BW was fitted: $\text{Body P (g)} = -0.152 + 0.00664 \times \text{BW (g)}$; $R^2 = 0.98$. In sum, based on the derivative of this equation, 6.6 g P /kg of gain is retained by pullets without farm effect. For laying-hens, the P retention efficiency varied between 13 and 20%, on which only 1% of dietary P is retained by the laying hens compared with egg. The relation between body P and BW is really low ($R^2 = 0.16$) and an average of 4g P/kg gain is retained. Regarding eggs, an average of 1.83 g P/ kg fresh eggs is retained. Based on the current results a fixed 6.6 and 4.0 g of retained P per kg BWG is proposed for pullets and laying hens respectively. These values can be used in the simplified balance method to assess P manure and this method would be a valuable tool to improve poultry sustainability.

Key Words: phosphorus, pullets, retention