The estimation of body composition of broilers chicken from 7 to 35 days of age by dual energy X-ray absorptiometry (DXA)

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Introduction

Body composition of broilers could be due to changes in body weight, age, feeding program, and nutrition. To improve carcass quality, meet consumer demand, and decision making process, carcass should be checked frequently using fast, easy and efficient methods. An affordable and alternative method to chemical analysis, Dual X-ray Absorptiometry (DXA), gives lean, fat and bone mineral content and density that can be transformed into protein, fat, Ca, and P with high accuracy (Mitchell et al.,1997). However, DXA has seen 30 years of continuous technological innovations and each new device requires a review of the equations to convert DXA values to chemical body composition values.

Objectives

1) Validate the use of DXA (Discovery W; Hologic Inc., Waltham, MA, USA) in evaluating the body composition in fat (FatDXA), lean (LeanDXA), and bone mineral content (BMC), in broilers receiving different levels of dietary Ca, P, crude protein and energy

2) Develop prediction equations for each of these parameters according to DXA scan.

Materials and Methods

A total of 405 one-d-old male broiler (Cobb500) were distributed into 3 experimental treatments (3 pens/treatment, with 45 birds/ pen) and body weight was recorded weekly. Experimental treatments were designed to induce body composition variations to have a robust equation.

On d 7, 14, 21, 28 and 35 post-hatch, 3 birds per replicate were euthanized, frozen and then scanned in group of 3 from the same pen, using DXA with **the rat whole body mode** for the chicken at 7 and 14 d and the **infant whole body** for the 21, 28 and 35 day animals. Broilers carcass were homogenized by grinding before chemical determination of lipid (FatC), protein (ProtC), Ca (CaC) and P (PC).

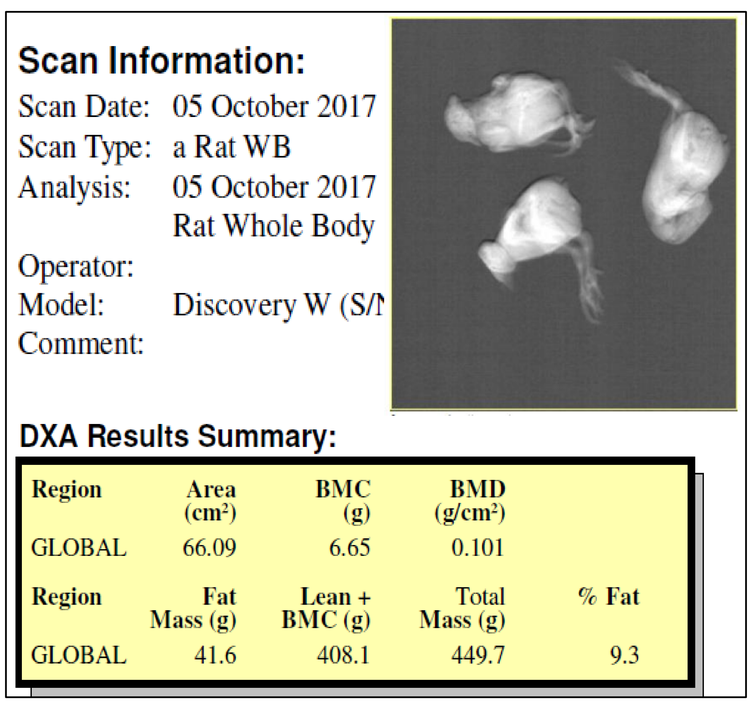

Figure 1. Dual energy x-ray absorptiometry scan report of a chicken.

Results and discussion

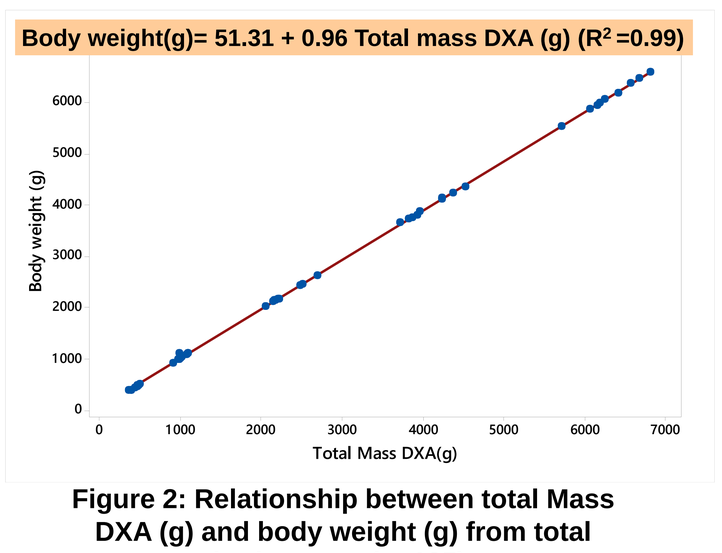

Figure 2: Relationship between total Mass DXA (g) and body weight (g) from total body scans (n=135).

Significant linear correlations were found between the body composition components as determined by DEXA scanning and the corresponding wet chemistry results.

- **Regression analysis revealed a higher correlation of the total mass DXA with body weight (R^2=0.99) (Fig 2) .**

In general DXA measurements of birds above 100 g of body weight were higher than the scale measurements. Overestimation of scale body mass by DXA has been reported in chickens (Swennen et al.,2004; Mitchell et al., 1997). Our results are in agreement with Mitchell *et al*. (1998) and Salas et al.,(2012).

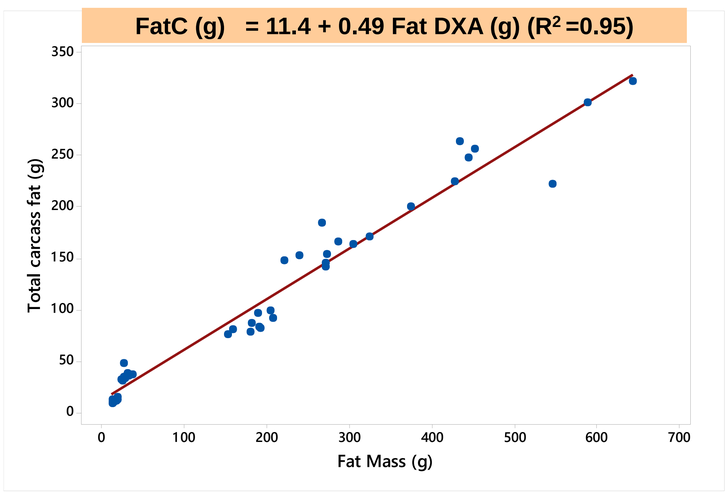

Figure 3: Relationship between total Fat mass DEXA(g) and total carcass fat (g).

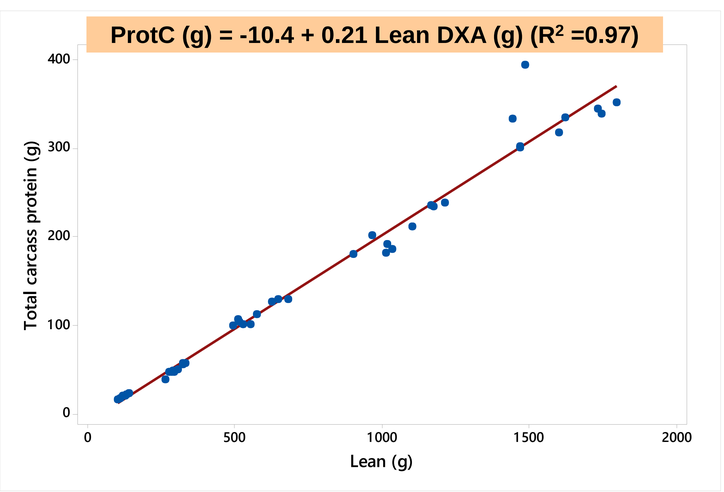

Figure 4: Relationship between Lean DEXA(g) and total carcass protein(g)

- **Total fat and protein were predicted with good accuracy (R^2>0.95) (Fig 4)**

Despite that the DXA procedure does not provide a direct measure of either muscle mass or protein content, but rather of lean tissue, which is a composite of many components, exclusive of fat and bone mineral (Mitchell et al.,1998). The DXA measurement of lean tissue mass (total mass less fat and bone mineral) was correlated with carcass protein (R^2 = 0.97) , Salas et al. (2012) has found the same results .

- **Ca and P percentage of broilers carcass were all predicted with good accuracy (R^2>0.96) (Fig 5 and 6)**

In the same way, Salas et al. (2012) concluded that there was a high positive correlation between the DXA BMC and total body ash content. Onyango et al. (2003) concluded that BMC and BMD measured by DXA, and tibia ash are more sensitive as indicator of dietary Ca and P concentrations than shear force in broiler chicks . However, Mitchell et al., (1997) found a low correlation between DEXA BMC and total body ash.

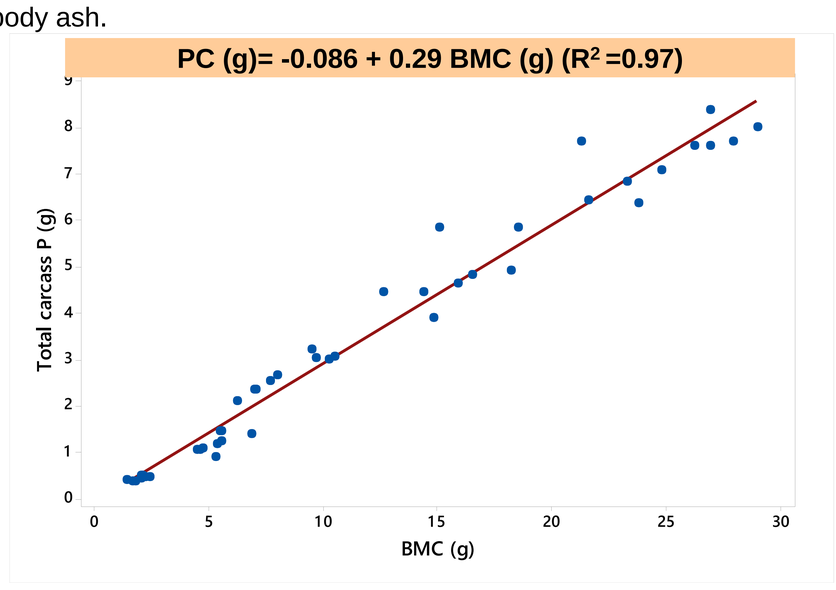

Figure 5: Relationship between BMC DEXA(g) and total carcass P(g)

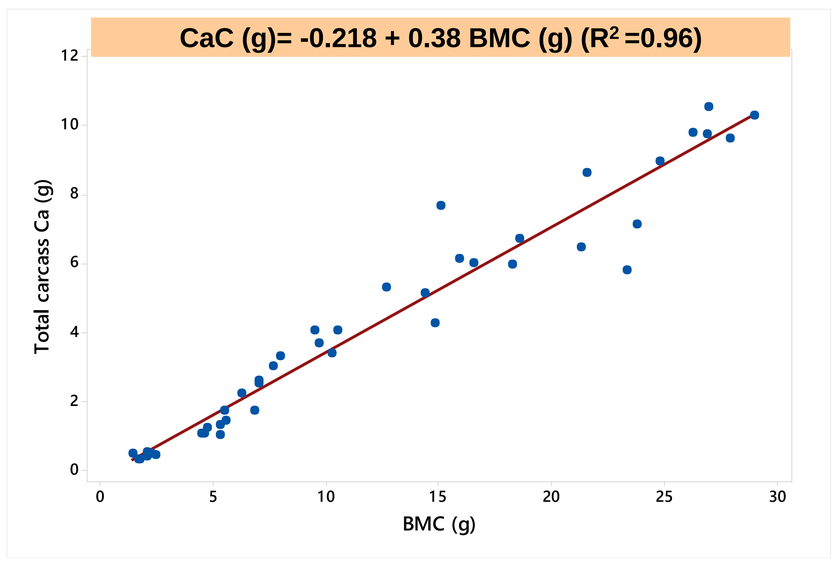

Figure 6: Relationship between BMC DEXA(g) and total carcass Ca(g)

Conclusions

Prediction equations of chemical body composition in protein, lipid, Ca and P from DXA scan allowed an accurate prediction of body composition of broilers at different age from 7 to 35 days.

References

Mitchell *et al.,* (1998), *J Anim Sci* 1998. 76:2104-2114**; Mitchell *et al.,* (**1997), Poult. Sci. 76:1746–1752; **Swennen *et al.,*** (2004) Poult. Sci. 83:1348-1357; **Salas *et al.,* (**2012) Int.J.Poul. Sci. 11(7):462-468; **Schreiweis *et al.,*** (2005), Poult. Sci. 84: 91-99. **Onyango *et al.,*** (2003) Poult. Sci. 82:1787-1791.

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