ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 8 (7): 689-691, 2009
ISSN 1682-8356

Non-Invasive Methods to Predict Breast Muscle Weight in Slow-Growing Chickens

J.-M. Larivière, C. Michaux, V. Verleyen, C. Hanzen and P. Leroy
Department of Animal Production, Faculty of Veterinary Medicine, University of Liège, 4000 Liège, Belgium

Abstract: This experiment aims to compare *in vivo* breast morphometric and ultrasound measurements, as well as live body weight to predict breast meat weight in slow-growing chickens. Traits included Thoracic Circumference (TC), Chest Width (CW), Keel Length (KL) and angle (KA), Live Weight (LW), thickness of muscle determined by sonography (TM) and Breast Meat Weight (BMW). Birds were then slaughtered and total breast muscles (*Pectoralis major* and *Pectoralis minor*) were dissected and weighed. A linear model including sex effect and the different predictor measurements, as covariates, were adjusted to the data. Homogeneity test of slopes between sexes showed no difference. Means of the traits were 115.58g (±19.72) for BMW, 1031 g (±163.44) for LW, 68.65° (±6.89) for KA, 26.81 cm (±1.57) for TC, 10.40 cm (±0.62) for KL, 4.67 cm (±0.47) for CW and 11.52 mm (±1.11) for TM. All traits were highly correlated to BMW: TC (0.85), LW (0.84), KL (0.81) and TM (0.79), except for KA (0.28) and CW (0.19). Finally, TC, LW, KL and TM appear to be valuable indicators for estimating BMW in slow-growing chickens but KA and CW remain poor predictors.

Key words: Breast muscle, morphometry, slow-growing chicken, ultrasound

INTRODUCTION

Selection efforts have efficiently improved breast meat, the most valuable part in poultry carcasses. Attempts to measure this trait have been achieved with invasive (slaughtering and dissection of progenies/sibs) or non-invasive (*in vivo*) methods. Non-invasive methods such as width, length and angle of the breast (Ricard and Rouvier, 1970; Bordas *et al*., 1978; Komender and Grashorn, 1990), thoracic circumference (Griffin *et al*., 2005) or live body weight (Le Bihan-Duval *et al*., 2001) have been used. Medical methods, such as computerized tomography (Bentsen and Katle, 1984; Bentsen and Sehested, 1989, Andrássy-Baka *et al*., 1999) and echography (König *et al*., 1997; 1998) have also been assessed. High correlation between thickness and weight of breast muscles were observed in chickens (Komender and Grashorn, 1990), ducks (Pingel and Heimpold, 1983; Sørensen and Jensen, 1992; Bochno *et al*., 2000) and geese (Grunder *et al*., 1989). Although broilers have benefited from most of research on assessing methods in chickens, morphological and anatomical differences exist between fast and slow-growing genotypes. Moreover, slow-growing lines, presenting longer carcass with longer keel bone, showed that measurements in specific locations were required when using sonography (Rémignon *et al*., 2000). Valuation of meat of unselected traditional chicken breeds may require adapted, unexpensive, easy and efficient methods to assess breast meat yield. This experiment aims to compare *in vivo* breast morphometric and ultrasound measurements, as well as live body weight to predict breast meat weight in a slow-growing unselected chicken breed.

MATERIALS AND METHODS

Subjects, operators and breast meat weight: Two operators performed *in vivo* measurements using morphological or ultrasound methods. These indicators appeared to be useful in predicting breast muscle weight in slow-growing chickens (Larivière *et al*., 2007). Data were collected on a number of twenty-four Ardennaise chickens (10 females and 14 males), randomly taken at 85 days of age. Birds were taken from a previous experiment assessing performance and carcass traits (Larivière *et al*., 2009). Each bird was individually identified with a wing-band (Hauptner GmbH, Herberholz, Germany) designed for tracing carcass at slaughter. Birds were deprived from food 12 h prior to *in vivo* breast morphometrics and ultrasound measurements and were slaughtered 10 h after these investigations. Total breast muscles (*Pectoralis major* and *Pectoralis minor*) were dissected as described by Marche (1995). Breast Meat Weight (BMW) for each identified carcass was weighed with a small digital scale (Phillips HR 2395 model, U.K.) and was recorded.

Procedures for *in vivo* breast morphometrics: Thoracic Circumference (TC) was assessed using a flexible tape. Chest Width (CW) and Keel Length (KL) were measured with a caliper. Keel angle (KA) and Live Body Weight (LW) were evaluated with a protractor and a hanging scale (Salter Brecknell, 235-6S model, U.K.), respectively. The reference point for TC, CW, KL and KA on the live bird was at the cranial end of the sternum keel.

Procedures for ultrasound measurements: Thickness of Muscle (TM) was determined by sonography with a

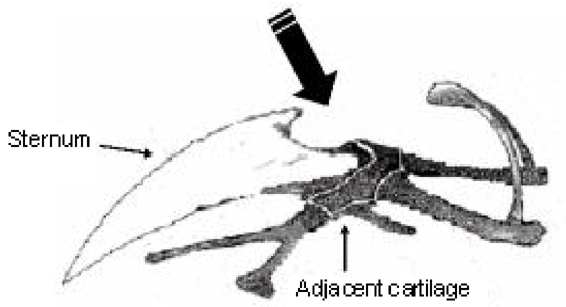

Fig. 1: Optimal position and direction of the scanner (black arrow) after adjustments beyond cranial end of the sternum and adjacent cartilage

Pie medical 100 ultrasound apparatus (Pie Medical Equipment B.V., Maastricht, The Netherlands). Sonography used a scanner of 5 MHZ positioned perpendicularly to the cranial end of the sternum keel (Fig. 1). A contact gel was applied on the breast skin to ensure a better transmission of the ultrasound. The site was an optimal point for measuring muscle thickness in broilers and the easiest site to identify (König *et al.*, 1997). Contrasting features of the bones served as fixed points. The scanner needed to be tilted to pinpoint the fixed points appearing in the image. The two highest points of the sternum were projected and an optimal point was then found and viewed on the screen as the silhouette of a flying bird. The thickness of muscle was above these points. Three images per bird were visualized on a video screen, recorded on a hard-disk and then transferred on software (Echo Image Viewer) to measure the average thickness of muscle.

Statistical analysis: A linear model including sex effect and the different predictor measurements, as covariates, were adjusted to the data using Proc GLM (SAS, 1989). Correlations and coefficients of regression between BMW and the various traits were estimated. The best models selected by stepwise multiple regression analysis (SAS, 1989) to explain the variation of BMW, were also compared using R^2 and Mallow's Cp test.

RESULTS AND DISCUSSION

Homogeneity test of slopes showed no difference between sexes. Means and standard errors of the traits, correlation with BMW and coefficient of regression are presented in Table 1. All traits were highly correlated (0.79-0.85) to BMW except for KA (0.28) and CW (0.19). Combination of TM and KL is the best model selected by the stepwise multiple regression analysis, according to F-value probability of the variable contribution to the model (Table 2). This was further confirmed by its lowest Mallow's C (p) statistic value (6.87) and high R^2 (0.84).

Table 1: Means, standard deviations (± SD), correlations with BMW and coefficients of regression for each variable measured

Variable	Mean	Standard deviation (±)	Correlation with BMW	Coefficient of regression
BMW(g)	115.58	19.72	-	-
TC(cm)	26.81	1.57	0.85	15.45
LW(g)	1031.0	163.44	0.84	0.10
KL(cm)	10.4	0.62	0.81	30.07
TM(mm)	11.52	1.11	0.79	8.57
KA(°)	68.65	6.89	0.28	1.12
CW(cm)	4.67	0.47	0.19	6.63

Table 2: Best models obtained by stepwise multiple regression analysis

Variable (s) included in the model	F-value probability of the variable contribution to the model	Model R^2	C (p)
TC	***	0.73	23.38
TC+LW	*	0.79	16.05
TC+LW+TM	*	0.81	14.14
TC+LW+TM+KL	*	0.85	9.06
LW+TM+KL	TC no more significant, excluded	0.85	7.32
TM+KL	LW no more significant, excluded	0.84	6.87

C (p): Mallow's Cp statistic; *** $p<0.001$, ** $p<0.01$, * $p<0.15$.

Conclusion: Finally, TC, LW, KL and TM appear to be valuable indicators for estimating BMW in slow-growing chickens but KA and CW remain poor predictors. In this experiment, the ideal model matches ultrasound technology to a simple instrument to measure keel length. However, the choice for non-invasive methods to predict breast meat quantity should also take into account, handling of the birds, speed, cost and ease to operate routine measurements.

ACKNOWLEDGEMENT

This research work was supported by the Ministère de l'Agriculture et de la Ruralité, Région Wallonne (Belgium). Thanks are also extended to Mr and Mrs Defays (Ferme de Strée) for technical assistance and their care to the birds and to Mr van Rutegem from Abattoir de Volailles Ciney for providing premises and staff.

REFERENCES

Andrássy-Baka, G., R. Romvári and Z. Petrási, 1999. *In vivo* measurements of breast muscle in broiler chickens by means of CT, Acta Agraria Kaposváriensis, 3: 203-211.

Bentsen, H.B. and J. Katle, 1984. The use of computerised tomography in poultry breeding and science. In: Proc. 17th World Poultry Congress, Helsinki, Finland, pp: 145-146.

Bentsen, H.B. and E. Sehested, 1989. Computarised tomography of chickens. Br. Poult. Sci., 30: 75-89.

Bochno, R., J. Rymkiewicz and J. Szeremeta, 2000. Regression equations for *in vivo* estimation of the meat content of Pekin duck carcases, Br. Poult. Sci., 41: 313-317.

Bordas, A., P. Mérat, D. Sergent and F.H. Ricard, 1978. Influence of the naked neck gene Na on growth, food consumption and body composition of chicken depending on temperature. Ann. Génét. Sél. Anim., 10: 209-231.

Griffin, A.M., R.A. Renema, F.E. Robinson and M.J. Zuidhof, 2005. The influence of rearing light period and the use of broiler or broiler breeder diets on forty-two day body weight, fleshing and flock uniformity in broiler stocks. J. Appl. Poult. Res., 14: 204-216.

Grunder, A., B. Pawluczuk, A. Fortin and J.R. Chambers, 1989. Heritabilities, phenotypic and genetic correlation of live and carcass traits and carcass parts in ganders. Arch. Geflügelkunde, 53: 157-162.

Komender, P. and M. Grashorn, 1990. Ultrasonic measurement of breast meat. In: Poult. Int., 29: 36-40.

König, T., M.A. Grashorn and W. Bessei, 1997. Estimation of breast meat yield in living broilers using B-Scan sonography. First report: Defining sites of measurement. Arch. Geflügelkunde, 61: 227-231.

König, T., M.A. Grashorn and W. Bessei, 1998. Estimation of breast meat yield in living broilers using B-Scan sonography. Second report: Accuracy of the method. Arch. Geflügelkunde, 62: 121-125.

Larivière, J.-M., C. Michaux, V. Verleyen, C. Hanzen and P. Leroy, 2007. Comparison of non-invasive methods to predict breast muscle weight in slow-growing chickens. In: Proc. 15th European Symposium on the Quality of Poultry Meat and 12th European Symposium on the Quality of Eggs and Egg products (WPSA), Prague, Czech Republic, pp: 262-263.

Larivière, J.-M., F. Farnir, J. Detilleux, C. Michaux, V. Verleyen and P. Leroy, 2009. Performance, breast morphological and carcass traits in the Ardennaise chicken breed, Int. J. Poult. Sci. (accepted).

Le Bihan-Duval, E., C. Berri, F. Seigneurin and M. Reffay, 2001. Les ultrasons pour prédire le développement musculaire, Viandes et Produits Carnés, 22: 59-62.

Marche, G., 1995. Dissection of poultry carcasses. INRA-SYSAAF, CD-ROM, Editor: Yves Nys.

Pingel, H. and M. Heimpold, 1983. Effectivität der Selektion auf Lebendmasse und Brustfleischanteil bei Enten. Arch. Tierzucht, Berlin, 26: 435-444.

Rémignon, H., F. Seigneurin and F. Moati, 2000. *In vivo* assessment of the quantity of breast muscle by sonography in broilers. Meat Sci., 56: 133-138.

Ricard, F.H. and R. Rouvier, 1970. Study of anatomical composition of chicken. Ann. Génét. Sél. Anim., 1: 151-165.

SAS, 1989. SAS/STAT User's Guide, Version 6, Fourth Edition, Vol. 2, Cary, NC: SAS Institute Inc., 846 pp.

Sørensen, P. and J. Jensen, 1992. Use of ultrasonic techniques to detect breast muscle proportion in live ducks. Proc. 19th World Poultry Congress, Amsterdam, The Netherlands, pp: 225-228.