© South African Society for Animal Science

Short Communication

Carcass and muscle yields of ostriches as influenced by genotype

L.C. Hoffman[1,#], M.M. Brand[1,2], M. Muller[2] and S.W.P. Cloete[1,3]
[1]University of Stellenbosch, Department of Animal Sciences, Private Bag X1, Matieland, 7602, South Africa
[2]University of Stellenbosch, Department of Consumer Science, Private Bag X1, Matieland, 7602, South Africa
[3]Institute For Animal Production: Elsenburg, Private Bag X1, Elsenburg 7607, South Africa

Abstract

Live, carcass, leg and muscle weight (kg) as well as dressing percentage were compared between South African Black (*Struthio camelus* var. *domesticus*) ostriches, purebred Zimbabwean Blue Neck (*Struthio camelus australis*) ostriches and the progeny of Zimbabwean Blue Neck males crossed with South African Black females, commercially slaughtered at 14 months of age. South African Black ostriches had the lowest live (84.9 kg) and carcass (43.3 kg) weights, compared to Zimbabwean Blue Necks (100.9 and 51.2 kg, respectively). In general, crossbred birds resembled Zimbabwean Blue Necks more closely for the quantitative meat traits. However, dressing percentage (51.1%) and yields of different carcass components (bone, leg) did not differ between genotypes. Six of the major muscles present in the ostrich leg (*M. gastrocnemius*, *M. femorotibialis accessorius*, *M. iliotibialis cranialis*, *M. iliotibialis lateralis*, *M. iliofibularis* and *M. iliofemoralis*) showed significant weight differences between genotypes, with South African Black ostriches yielding the lowest values.

Keywords: *Struthio camelus*, ostriches, genotypes, crossbreeding, carcass yields
[#] Corresponding author. E-mail: lch@sun.ac.za

In the ostrich industry the focus has shifted from production of feathers during the early 1900s to the current situation where the skin and meat are regarded as the most economically important products (Petitte & Davis, 1999; Van Zyl, 2001; Cloete *et al*., 2002). Ostrich meat, contributing up to 45% of the income from the ostrich (Hoffman, 2005), plays an integral role in the survival and sustainability of the South African ostrich industry. In volume and value the ostrich industry is the leading South African meat exporter of all types of meat, including beef and poultry (National Agricultural Marketing Council, 2003). In 2003 South Africa had 10 European Union approved abattoirs for ostrich meat, compared to five export abattoirs for other types of red meat (National Agricultural Marketing Council, 2003).

Different subspecies of ostrich have different phenotypic characteristics (Duerden, 1919; Sauer, 1968; Brown *et al*., 1982; Freitag, 1992), including differences in mature live weight and growth rate (Jarvis, 1998). Currently there is a tendency to crossbreed Kenyan Red Neck (*Struthio camelus massaicus*), Zimbabwean Blue Neck (*Struthio camelus australis*) and South African Black (*Struthio camelus* var. *domesticus*) ostriches, without scientific evidence to guide crossbreeding decisions (Petitte & Davis, 1999). This study was undertaken in an attempt to provide scientific information on the carcass composition and carcass yield of different ostrich genotypes.

A total of 46 ostriches, comprising of different genotypes of ostriches (34 South African Black, two Zimbabwean Blue Neck and 10 Zimbabwean Blue Neck male X South African Black female crosses), were slaughtered at approximately 14 months of age during 2005 at Klein Karoo Co-operative in Oudtshoorn, South Africa. All birds were reared at the Oudtshoorn Experimental Farm near Oudtshoorn, South Africa, and kept in one flock under the same housing, feeding and husbandry conditions.

Ostriches were slaughtered at a commercial abattoir at Oudtshoorn, following commercial procedures, which involved lairage in roofed pens for a period of 24 h with free access to drinking water. The ostriches were electrically stunned (105 to 110 V, 400 to 800 mA, 10 s), suspended by both legs and bled by a high neck cut and a cut to the aortic vein (thoracic stick). Following health inspection, legs were removed (within 45 min from stunning) and allowed to chill for 24 h at 0 to 4 °C.

© South African Society for Animal Science

Live weight of the birds was recorded just before slaughter. Carcass weight was obtained after health inspection, before the legs were separated from the carcass. After the 24 h chilling period, the left leg was weighed, after which the legs were deboned by hand into 12 specific individual muscles, Grade A and B trimmings and bone. The large membranes and visible fat were trimmed from individual muscles before weighing.

A one-way analysis of variance (ANOVA) was performed on carcass data, whereas a two-factor factorial randomised block design was performed regarding muscle weights to include genotype and muscle, the individual carcass being an experimental unit. The Shapiro-Wilk test was performed to test for non-normality (Shapiro & Wilk, 1965), and Student's t-Least Significant Difference was calculated at the 5% significance level to compare treatment means (Ott, 1998).

Means for live, carcass and leg weight (kg), and dressing percentage, bone weight relative to leg weight (%), leg weight relative to live weight (%), and leg weight relative to carcass weight (%), for the different genotypes of ostrich are presented in Table 1. Dressing percentage was defined as percentage of carcass weight relative to live weight.

Table 1 Mean weights (kg ± s.d.) and proportions of carcass components for different ostrich genotypes

Yield parameters	South African Black (n = 34)	South African Black X Zimbabwean Blue Neck (n = 10)	Zimbabwean Blue Neck (n = 2)
Live weight (kg)	$84.9^{b} \pm 9.2$	$96.8^{ab} \pm 11.2$	$100.9^{a} \pm 4.2$
Carcass weight (kg)	$43.3^{b} \pm 5.2$	$51.1^{a} \pm 5.0$	$51.6^{a} \pm 1.1$
Dressing percentage (%)	50.9 ± 2.1	51.2 ± 1.7	51.2 ± 1.0
Leg weight (kg)	$14.7^{b} \pm 1.7$	$18.0^{a} \pm 1.9$	$18.2^{a} \pm 0.3$
Bone weight relative to leg weight (%)	17.1 ± 1.2	15.9 ± 0.9	16.1 ± 0.5
Leg weight relative to live weight (%)	35.8 ± 1.8	36.4 ± 1.6	36.2 ± 0.8
Leg weight relative to carcass weight (%)	71.0 ± 2.2	71.5 ± 1.6	70.7 ± 0.2

[ab]Means in rows with different superscripts are different (P < 0.05)

South African Black ostriches yielded lower (P < 0.05) values for live, carcass and leg weights, compared to Zimbabwean Blue Neck ostriches, whereas that of the crossbred birds more closely resembled Zimbabwean Blue Necks (P > 0.05). However, dressing percentage and proportions of bone and leg to live and carcass weight did not differ (P > 0.05) between genotypes. The above findings are consistent with the argument that the mature live weight of Zimbabwean Blue Neck ostriches is higher than that of South African Black ostriches (Jarvis, 1998). However, mature live weights reported by Jarvis (1998) were 125 kg for Zimbabwean Blue Necks, compared to 115 kg for South African Black ostriches, with animal age not reported. Live weight for ostriches of unknown genotype as reported by various researchers (Harris *et al*., 1993; Jones *et al*., 1994; Morris *et al*., 1995a; b; Pollok *et al*., 1997a) ranges from 84 to 99.7 kg, with carcass weights from 43.5 to 55.9 kg, and dressing percentage from 49.0 to 60.0%. Swart (1981) reported a mean leg weight of 16.1 kg for 14 months old ostriches from Oudtshoorn, South Africa.

Mean weight (kg) and proportions for the individual muscles derived from the three different ostrich genotypes are presented in Tables 2 and 3. Weights of the *M. femorotibialis accessorius*, *M. gastrocnemius pars interna* and *M. iliotibialis lateralis* were lower (P < 0.05) in South African Black ostriches than either Zimbabwean Blue Necks or crosses. On the contrarily, crossbred birds resembled South African Blacks rather than Zimbabwean Blue Necks in the case of the *M. gastrocnemius pars externa*. When the *M. iliofemoralis* was considered, crossbred birds were intermediate, not differing from either purebred genotype (P > 0.05). The difference (P < 0.05) between the purebred genotypes was in favour of Zimbabwean Blue Necks. Weight of the *M. iliofibularis* differed (P < 0.05) between all genotypes, with Zimbabwean Blue Necks outperforming the crosses, which in turn outperformed the South African Blacks

© South African Society for Animal Science

(all differences P < 0.05). When the weight of the *M. iliotibialis cranialis* was considered, it was higher (P < 0.05) for the crossbred birds than for South African Black ostriches. The Zimbabwean Blue Neck ostriches were intermediate in this respect and not different from the other groups (P > 0.05; Table 2).

Table 2 Mean weights (kg ± s.d.) for muscles derived from different ostrich genotypes

Muscles	South African Black (n = 34)	South African Black X Zimbabwean Blue Neck (n = 10)	Zimbabwean Blue Neck (n = 2)
M. femorotibialis accessorius	0.69 [b] ± 0.10	0.88 [a] ± 0.12	0.88 [a] ± 0.11
M. fibularis longus	0.29 ± 0.04	0.32 ± 0.03	0.36 ± 0.01
M. flexor cruris lateralis	0.30 ± 0.04	0.36 ± 0.05	0.35 ± 0.04
M. gastrocnemius pars externa	0.59 [b] ± 0.08	0.63 [b] ± 0.08	0.74 [a] ± 0.03
M. gastrocnemius pars interna	0.84 [b] ± 0.13	1.00 [a] ± 0.10	1.01 [a] ± 0.14
M. iliofemoralis	0.40 [b] ± 0.06	0.46 [ab] ± 0.08	0.50 [a] ± 0.01
M. iliofemoralis externus	0.19 ± 0.03	0.22 ± 0.03	0.21 ± 0.00
M. femorotibialis internus	0.11 ± 0.02	0.14 ± 0.02	0.13 ± 0.01
M. iliofibularis	1.41 [c] ± 0.15	1.63 [b] ± 0.14	1.76 [a] ± 0.15
M. iliotibialis cranialis	0.49 [b] ± 0.07	0.60 [a] ± 0.11	0.56 [ab] ± 0.03
M. iliotibialis lateralis	1.08 [b] ± 0.15	1.28 [a] ± 0.15	1.34 [a] ± 0.02
M. obturatorius medialis	0.55 ± 0.08	0.58 ± 0.08	0.55 ± 0.00

[a,b,c]Means in rows with different superscripts are different (P < 0.05)

Table 3 Muscles expressed as mean percentage (% ± s.d.) on a leg weight basis for different ostrich genotypes

Muscles	South African Black (n = 34)	South African Black X Zimbabwean Blue Neck (n = 10)	Zimbabwean Blue Neck (n = 2)
M. femorotibialis accessorius	4.7 ± 0.5	4.9 ± 0.4	4.8 ± 0.5
M. fibularis longus	2.0 ± 0.3	1.8 ± 0.1	2.0 ± 0.0
M. flexor cruris lateralis	2.1 ± 0.3	2.0 ± 0.3	1.9± 0.3
M. gastrocnemius pars externa	4.0 ± 0.7	3.5 ± 0.2	4.0 ± 0.2
M. gastrocnemius pars interna	5.7 ± 0.8	5.6 ± 0.3	5.5 ± 0.7
M. iliofemoralis	2.8 ± 0.4	2.6 ± 0.4	2.7 ± 0.1
M. iliofemoralis externus	1.3 ± 0.2	1.2 ± 0.1	1.1 ± 0.0
M. femorotibialis internus	0.8 ± 0.2	0.8 ± 0.1	0.7 ± 0.0
M. iliofibularis	9.6 ± 1.1	9.1 ± 0.7	9.7 ± 1.0
M. iliotibialis cranialis	3.4 ± 0.6	3.3 ± 0.4	3.1 ± 0.2
M. iliotibialis lateralis	7.5 ± 0.9	7.1 ± 0.5	7.4 ± 0.0
M. obturatorius medialis	3.8 [a] ± 0.7	3.2 [ab] ± 0.6	3.0 [b] ± 0.0

[ab] Means in rows with different superscripts are different (P < 0.05)

© South African Society for Animal Science

The remainder of the muscles were not influenced by genotype. However, *M. obturatorius medialis* yielded a higher (P < 0.05) percentage of the total leg weight in South African Black ostriches than in Zimbabwean Blue Necks (Table 3). No differences (P > 0.05) between genotypes were found for the other muscles. *M. gastrocnemius, M. iliofibularis* and *M. iliotibialis lateralis* made up almost 27% of the ostrich leg weight. According to Mellett (1992), the individual muscles with the highest income include the *M. iliofibularis, M. iliofemoralis* and the *M. iliotibialis lateralis.* Although various researchers have reported the weights for individual ostrich muscles (Morris *et al.*, 1995b; Sales, 1996; Pollok *et al.*, 1997b), irrespective of the effect of genotype, comparisons are complicated due to different carcass and muscle dressing methodologies used by different processing plants.

It can be concluded from this study that Zimbabwean Blue Necks and crosses between Zimbabwean Blue Necks and South African Black ostriches present a higher absolute carcass and muscle weight than South African Black ostriches of the same age, although carcass yields as a proportion generally do not differ (P < 0.05) between genotypes. Other than South African Black ostriches, the compared genotypes were represented by small sample sizes. Further studies are recommended to validate expected crossbred performances for long term breeding plans.

Acknowledgements

We express our sincerest gratitude to all those responsible for the maintenance and recording of the experimental flock at the Oudtshoorn Experimental Farm. We are grateful to the Klein Karoo Co-operation for financial and technical support and the usage of the South African Black resource flock, as well as to the commercial producer for entrusting his Zimbabwean Blue Neck breeding stock to us. The study was partially funded by the Technology and Human Resources for Industry Programme of the South African Department of Trade and Industry, as well as the National Research Foundation (NRF).

References

Brown, L.H., Urban, E.K. & Newman, K., 1982. The Birds of Africa, Vol. 1. Academic Press, London, UK.

Cloete, S.W.P., Bunter, K.L. & Van Schalkwyk, S.J., 2002. Progress towards a scientific breeding strategy for ostriches. Proc. 7th World Congress on Genetics Applied to Livestock Production. Montpellier, France. pp. 561-568.

Duerden, J.E., 1919. Crossing the North African and South African ostrich. J. Gen. 8, 155-198.

Freitag, S., 1992. Intraspesific mitochondrial DNA phylogeography of the ostrich, *Struthio camelus*. MSc thesis, University of Pretoria, South Africa.

Harris, S.D., Morris, C.A., May, S.G., Lucia, L.M., Jackson, T.C., Hale, D.S., Miller, R.K., Keeton, J.T., Savell, J.W. & Acuff, G.R., 1993. Ostrich Meat Industry Final Report. American Ostrich Association, Fort Worth, Texas, USA

Hoffman, L.C., 2005. A review of the research conducted on ostrich meat. Proc. 3rd Int. Ratite Sci. Symp. World's Poultry Science Association. Madrid, Spain. pp. 107-119.

Jarvis, M.J.F., 1998. The subspecies and races of ostriches and their present status in the wild. Proc. 2nd Int. Ratite Congress. Oudtshoorn, South Africa. pp. 4-8.

Jones, S.D.M., Robertson, W.M. & Brereton, D.A., 1994. The ostrich as a meat animal. Report for the Canadian Ostrich Association, Agriculture and Agri-Food, Canada, Lacombe, Alberta. 20 pp.

Mellett, F.D., 1992. Die volstruis as slagdier: Aspekte van groei. PhD thesis, University of Stellenbosch, South Africa.

Morris, C.A., Harris, S.D., May, S.G., Jackson, T.C., Hale, D.S., Miller, R.K., Keeton, J.T., Acuff, G.R., Lucia, L.M. & Savell, J.W., 1995a. Ostrich slaughter and fabrication. 1. Slaughter yields of carcasses and effects of electrical stimulation and post-mortem pH. Poult. Sci. 74, 1683-1687.

Morris, C.A., Harris, S.D., May, S.G., Jackson, T.C., Hale, D.S., Miller, R.K., Keeton, J.T., Acuff, G.R., Lucia, L.M. & Savell, J.W., 1995b. Carcass weights, fabrication yields and muscle colour evaluation. Poult. Sci. 74, 1688-1692.

National Agricultural Marketing Council, 2003. Report on the investigation into the effect of deregulation on the South African ostrich industry, Section 7 Committee, South Africa. pp. 13-36.

Ott, R.L., 1998. An Introduction to Statistical Methods and Data Analysis. Duxbury Press, Belmont, California, USA.

© South African Society for Animal Science

Petitte, J.N. & Davis, G., 1999. Breeding and genetics. In The Ostrich: Biology, Production and Health. Ed. Deeming, D.C., CABI Publishing, Oxon, Wallingford, UK. pp. 275-292.

Pollok, K.D., Hale, D.S., Miller, R.K., Angel, R., Blue-McLendon, A., Baltmanis, B. & Keeton, J.T., 1997a. Ostrich slaughter and by-product yields. Am. Ostrich. 4, 31-35.

Pollok, K.D., Miller, R.K., Hale, D.S., Angel, R., Blue-McLendon, A., Baltmanis, B., Keeton, J.T. & Maca, J.V., 1997b. Ostrich carcass and meat yields. Am. Ostrich. 4, 36-38.

Sales, J., 1996. Histological, biophysical, physical and chemical characteristics of different ostrich muscles. J. Sci. Food Agric. 70, 109-114.

Sauer, E.G.F., 1968. Calculations of struthious egg sizes from measurements of shell fragments and their correlation with phylogenetic aspects. Cimbebasia 1, 25-55.

Shapiro, S.S. & Wilk, M.B., 1965. An analysis of variance test for normality (complete samples). Biometrika 52, 591-611.

Swart, D., 1981. Die evaluering van die ekonomiese waarde van die vel, vleis en vere op die lewende slagvolstruis. Dept. Agric. and Fisheries. Oudtshoorn Experimental Farm, Oudtshoorn, South Africa.

Van Zyl, P.L., 2001. ’n Ekonomiese evaluering van volstruisboerdery in die Oudtshoorn-omgewing. MSc thesis, University of Stellenbosch, South Africa.