The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK

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Advances in the electrical stunning and bleeding of ostriches

LC Hoffman

Department of Animal Sciences, Faculty of AgriSciences, Stellenbosch University, P Bag X1 Matieland, 7602, South Africa;
email: lch@sun.ac.za

Abstract

*The stunning of ostriches (*Struthio camelus*) has traditionally been carried out with hand-held tongs whilst birds are held in a restraining area by applying pressure normally from behind by gently pushing on the tail feathers. The area is often a V-shaped structure, high enough that the stunning operator is not kicked. After stunning, the birds are rocked backwards and a rubberised leg clamp placed over the legs at the tarso-metatarsal bone allowing the birds to be chain-shackled by the big toes. This stunning procedure has been replaced by a new restraining and stunning mechanism which completely envelops the ostrich in a padded clamp holder. Double-padded sides restrain the bird's upper thighs and a rubberised foot clamp holds the feet so there is no physical damage to the bird. As the bird is electrically stunned with electrodes placed both sides of the head, the entire stunning box rotates 180º so that toe clamps can be applied without any danger to the stunning operators. Within 20 s of stunning, the birds are bled by means of a complete ventral cut to the neck and/or by thoracic sticking.*

Keywords: *animal welfare, exsanguination, ostriches, ratites, restraint, stunning*

Introduction

Of the ratites, the ostrich (*Struthio camelus*) has been farmed the longest, followed by the rhea (*Rhea americana*) and emu (*Dromaius novaehollandiae*). As the ostrich industry has changed from feather to skin and thence to meat-production, the type of bird being farmed has also changed. For the feather industry (which came to an end with the advent of World War II), a smaller, tamer bird was selected. Feather plucking was a labour-intensive activity that required close human-bird interaction. However, both the skin and meat industries required larger birds. In an effort to meet these new requirements, Zimbabwe Blue Necks (Blues: *S. c. australis*) and Kenyan Red Necks (Reds: *S. c. massaicus*) have been brought into South Africa to crossbreed with the South African Blacks (*S. c. var domesticus*). The Blues and Reds are known to be more aggressive and may undergo higher levels of anxiety when handled. Cloete and Malecki (2011) noted that temperament is an important attribute during the breeding and collection of eggs, and males in particular can become very aggressive towards the collector. These authors also noted that temperament is heritable, but very little scientific selection for this trait has been conducted or documented. Information on various aspects of ratite welfare is provided by Glatz *et al* (2011). Two activities require close human-bird interactions: (i) egg collection and care of hatchlings; and (ii) the loading, transport, lairage and slaughter of the birds. Deeming (2011) and Glatz (2011) address the first whilst Hoffman and Lambrechts (2011) have discussed the latter.

Transport

In their review, Hoffman and Lambrechts (2011) described the loading and transport of ostriches in detail. There are good guidelines on these activities (eg loading densities, design of facilities, etc, see SAOBC 2001, 2004; Anon 2011) but very little research has been undertaken into transport and lairage times and their effects on welfare and meat quality.

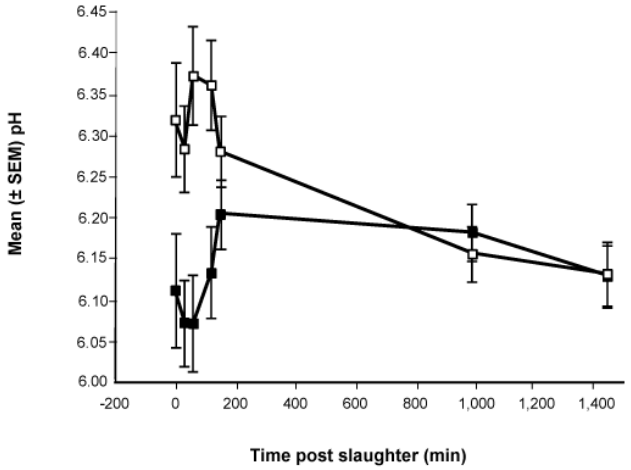
Hoffman *et al* (2010) reported that 25% of 3,153 birds had bruises associated with these activities. In Table 1, where the distribution of bruises on carcases is noted, it is clear that a high incidence of bruising occurs on the neck (53%), with the front of the thighs being a second prominent area. The bruising on the necks is caused by birds rubbing or bumping their necks on the top rails of transport trucks — an indication that truck design is inadequate or incorrect (Hoffman *et al* 2010). The bruises on the thighs are typical of birds bumping into objects, whilst widespread and multiple bruising was probably caused by trampling of birds lying down (Hoffman *et al* 2010).

Measures used to minimise adverse welfare experiences during transport include: keeping birds calm; keeping to prescribed numbers of birds per truck partition; having handlers travel with the birds on the trucks and employing experienced drivers. The trucks, loading areas and pens are constructed with rounded corners, with no protruding elements and with non-slip flooring. Despite these measures, Wotton and Hewitt (1999) reported that lacerations and bruises on the necks and lower legs were common

Table 1 Distribution of bruises on ostrich carcases (adapted from Hoffman *et al* 2010).

Category	Value
Birds (n)	3,153
Bruises (n)	789
Number of bruises	
Neck (n)	418
Back (n)	9
Thigh front (n)	294
Thigh back (n)	74
Percentage of bruises	
Total (%)	25.21
Neck (%)	52.58
Back (%)	1.13
Thigh front (%)	36.98
Thigh back (%)	9.31

Figure 1



Effect of time in lairage on the post mortem pH of fillet (*M. iliofibularis*) samples of commercial slaughter ostriches, taken 0, 30, 60, 120, 150, 990 and 1,440 min after slaughter. ■ equates to first slaughter (0630-0715h in the morning) and □ equates to last slaughter of the day (1600–1645h). (Adapted from Hoffman & Lambrechts 2011).

in ostriches delivered to South African abattoirs, with the majority of these occurring during loading and transport.

Wotton and Sparrey (2002) reporting on precautionary measures taken during transport and handling at a South African abattoir, highlighted the serious damage that can be inflicted to both skins and meat by kicking, bruising or fresh wounds. They reported that animal welfare was of prime importance and that ostriches with fresh wounds would often be returned to the farms to heal.

Lairage

Lairage is stressful for birds because of the novel environment and the unfamiliar activities which occur in and around the lairage and abattoir areas. In an experiment conducted in our laboratory, the effect of lairage time on the muscle quality of 78 ostriches from the same flock was evaluated (Hoffman & Lambrechts 2011). After spending the night in lairage, thirty-eight of these birds were randomly selected and killed immediately when the shift commenced at 0630h. Killing of these birds was completed by 0715h. The remaining forty birds were kept in the same lairage pen and were the last group to be slaughtered that day. Slaughtering commenced at 1600h and was completed within 45 min. The birds were kept in a pen adjacent to the stunning pen. This meant that the early group was not subjected to the herding of foreign birds past the pen as were the later group. All animals had unrestricted access to clean drinking water throughout the experimental period. After slaughter, various meat-quality characteristics were measured. Although no differences were found in the water-binding capacity of the muscles (using the measurement as described by Honikel 1998), the birds slaughtered later in the day had darker coloured muscles ($P < 0.01$) (closer to saturated red on the red-green axis: a*-value using the CIELab colour ordinates as described by Honikel 1998) — an indication of stress. These birds also had higher initial fillet muscle (*M. iliofibularis*) temperatures. Using a handheld Crison pH/mV-506 pH meter (Crison, Barcelona, Spain) equipped with a glass electrode, it was found that the birds slaughtered early in the morning had lower ($P < 0.05$) initial pH values in the fillet muscle than those slaughtered at the end of the day (Figure 1). By 150 min post slaughter, this difference was not significant. Both these criteria (muscle temperature and pH) are indicative of ante mortem stress.

Sabbioni *et al* (2003) noted that lairage for 2–26 h had a significant effect on carcase weight. Lairage time was also found to affect the *M fibularis longus* fat content and the fat energy to total energy ratio. The authors attributed the increase in fat content to dehydration caused by stress. The pre-slaughter rest also influenced the fat quality (reduced saturated fatty acids and polyunsaturated fatty acids) and increased the sensitivity of the meat to oxidative stress. Van Schalkwyk *et al* (2005) monitored the effect of 2.5 days lairage (to simulate the lairage of ostriches arriving at the abattoir over the weekend and being slaughtered on the Monday) on meat quality and found the main effect was on liveweight. Fasted birds lost 3.23 (± 0.56) compared to 1.04 (± 0.51) kg lost by the birds that were fed up to 24 h prior to slaughter. The weight of the hot and cold drumsticks was independent of the treatment. Treatment did have an effect on the pH of the *iliofibularis* muscle post mortem with the birds fasted for the longest period having the higher readings (6.03 vs 5.81 at 1 h post mortem ($P = 0.07$) and 6.46 vs 6.21 at 26.5 h post mortem ($P = 0.016$), respectively). There were no differences in physical quality attributes (drip loss, cooking loss and shear force) of the meat.

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Stunning

Restraint and stunning require specialised facilities and procedures because of the long neck, head anatomy, and physiology of ostriches. An electrical current in excess of 400 mA at 50 Hz AC applied only to the head prevents recovery in more than 90% of ostriches when bled within 60 s of stunning (Wotton & Sparrey 2002). These authors noted that the first stages of recovery are accompanied by rhythmic breathing. Although observations of breathing could be a useful indicator of the effectiveness of stunning, identification of rhythmic breathing movements in ostriches after stunning is difficult because spinal reflexes which cause limb muscle contractions also result in near-rhythmic body movements which could be confused with rhythmic breathing. The South African regulations (SAOBC 2004; Anon 2011) require that a current of 400–600 mA, 90–110 V is used for a duration of 4–6 s.

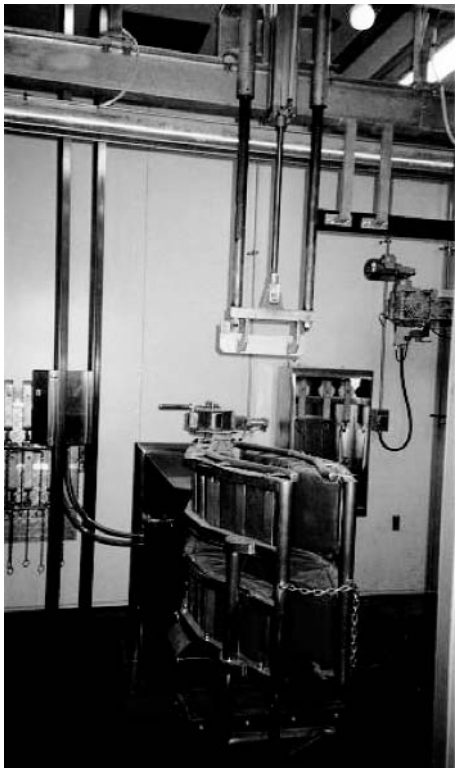
Lambooij *et al* (1999a,b) evaluated the efficiency of different electrical and mechanical (air-powered captive-bolt pistol) stunning procedures and their effects on certain meat-quality parameters. They recommended that at least 500 mA should be applied and that there should be a short stun-stick interval or that birds should be killed using a long stunning duration. They also found that the captive-bolt pistol, using air pressure, can be a suitable alternative to electrical head-only stunning (Lambooij *et al* 1999a).

In the three studies referred to above, the birds were restrained in the stunning 'box' in a gentle manner (pressure normally applied by pushing from behind via the tail feathers) and stunned with hand-held tongs. The stunning box was a V-shaped metal structure, high enough to ensure that the operator could not be kicked. The birds were pushed into the closed corner formed by the V-shaped structure. When using this system, after (and occasionally during) stunning, the birds are rocked backwards and a rubberised leg clamp is placed over the legs at the tarso-metatarsal bone, thereby immobilising them, and allowing ring/chain shackling of the big toes. The birds are then hoisted onto a 3.4 m overhead rail and manually conveyed to the point of slaughter where a high neck cut is performed. The head is normally placed between two horizontal metal bars to minimise blood spillage on the feathers and skin (Hoffman & Lambrechts 2011). Although this method was deemed efficient (ie humane), it was unsatisfactory as the reflex kicking of birds during the clonic phase of the stun was not only unsightly but also very loud.

This conventional stunning procedure has been replaced in many abattoirs with a new restraining and stunning mechanism that completely envelops the ostrich in a padded clamp holder (Hoffman 2005). The box design allows for the whole bird to be restrained. The Divac Ostrich Stunning box® (Divac, PO Box 257, Knysna, 6570, Republic of South Africa) is built from galvanised mild and stainless steel. The ostrich is restrained in a padded clamp-type holder so that no physical damage occurs to the bird (Figure 2). The bird is pushed gently into the box which is then closed manually around it. The double-padded sides restrain the bird by holding the upper thighs. A rubberised pneumatic foot clamp restrains the feet whilst its head is placed manually into the stunning clamp which is then closed. As the bird is stunned (two large oval-shaped electrodes, ensuring a large contact area, are pushed pneumatically against and slightly around the sides of the head and a 400–800 mA current (105–110 V in the abattoir where the procedure was evaluated) is then applied for 10 s; Figure 3). The whole stunning box rotates through 180º to allow the attachment of the toe clamps without any danger to the operators. After stunning, the box is opened and the bird is hoisted for further processing (exsanguination, etc). The time from stunning to exsanguination has also been reduced to less than 20 s. Once released from the clamp, the unit rotates to its initial position, ready for the next ostrich. The effect of the use of this clamp on meat quality is still to be quantified but it has been found to be better for feather quality as it minimises soiling. The leg-clamp in the previous systems not only caused bruising on the shin, but would sometimes also cause skin damage.

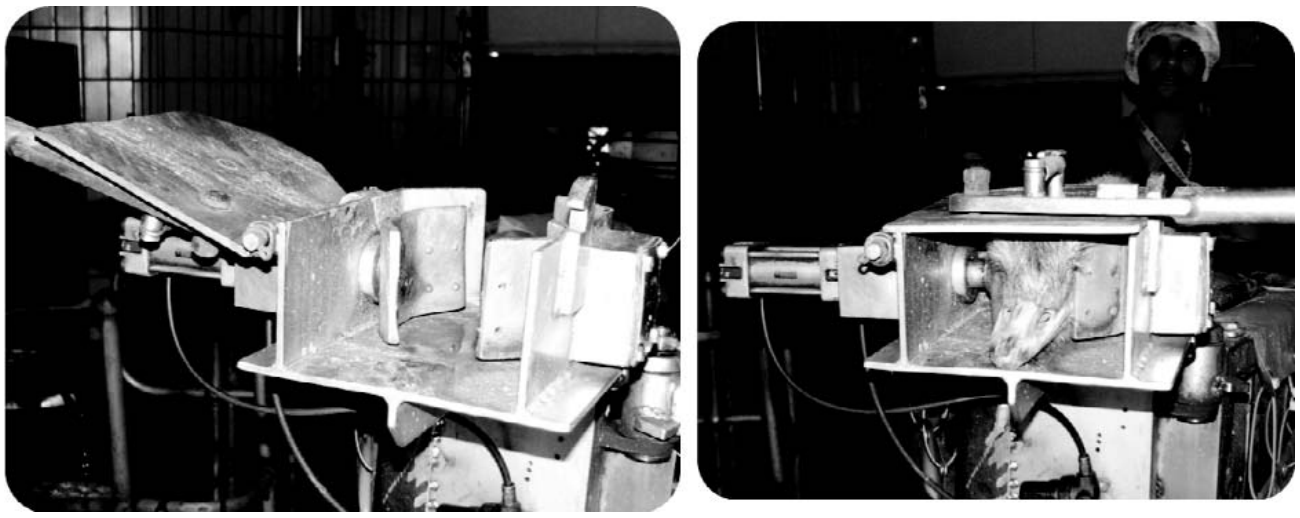
An added advantage of this new stunning box is operator safety, as the flailing legs are restrained. The use of this restraint device makes the stunning procedure more acceptable aesthetically.

Figure 2



The Divac® restraining and stunning box. Note the padded sides that hold the bird in place.

Figure 3



The Divac® head-stunning apparatus showing the oval-shaped electrodes (left photograph with lid open) that immobilise the bird's head from the side when the current is applied (right photograph).

Bleeding

According to the updated *Code of Conduct for the Commercial Production of Ostriches* (Anon 2011), within 60 s of stunning, birds should be bled by means of a complete ventral cut to the neck and/or by thoracic sticking (TS). The head is normally held between two horizontal metal bars to minimise blood spillage onto the feathers and skin. The effect of additional TS to the normal ventral throat cut on muscle quality was evaluated by Hoffman *et al* (2009). The author recommends the use of thoracic sticking because it appears to give a better bleed out and a more rapid onset of death.

Emergency killing

As with other livestock industries, it is sometimes necessary to cull whole flocks due to the occurrence of diseases (eg avian influenza). The following procedure has been developed for culling ostriches in South Africa: the birds are placed in a feather-plucking box (for more details of this structure and the restraint used, see Hoffman & Lambrechts 2011) and shot in the head with a captive bolt. Thereafter, the carcases are buried in a lime-filled pit and covered with soil (> 2 m soil above the carcases).

Conclusion

Although existing guidelines are adequate to ensure that ostriches are handled humanely, and that stressors are minimised, there are a number of issues which need to be researched and addressed. A major concern is the weight lost by slaughter stock en route to the abattoir. Research is needed into others aspects of stress experienced during transport and into suitable stocking densities during transport (for chicks, slaughter weight and mature breeding birds). Currently, abattoirs do not follow fixed procedures with regard to lairage times — the periods are determined by abattoir throughput, rather than by animal welfare considerations. Because it is easy to use, the South African *Code of Conduct for the Commercial Production of Ostriches* recommended that the Divac® stunning box is used in all ostrich abattoirs. Further research is needed into welfare aspects of stun-to-stick intervals but it is recommended that a thoracic stick is applied immediately after the ventral cut to ensure a fast bleed out.

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