

## Microbiological Quality of Carcasses from Healthy Slaughtered Ostriches (*Struthio camelus*) in Southern Italy

N. Costanzo<sup>1</sup>, E. Sarno<sup>2</sup> and A.M.L. Santoro<sup>2</sup>

<sup>1</sup>Dipartimento di Scienze della Salute, Università di Catanzaro, Viale Europa Germaneto, 88100 Catanzaro, Italy.

<sup>2</sup>Dipartimento di Scienze Zootecniche e Ispezione degli Alimenti, Università di Napoli, Via F. Delpino 1, 80137 Napoli, Italy.

(Received: 11 June 2013; accepted: 16 August 2013)

To obtain microbiological data from ostrich carcasses at slaughter, a total of 130 samples were collected using the double wet/dry swab technique from the thigh and rib site of 65 carcasses. Total bacterial count (TBC) and *Enterobacteriaceae* were detected at level of 1.35 Log CFU/cm<sup>2</sup> in the thigh site and 1.62 Log CFU/cm<sup>2</sup> in the rib site and 0.57 Log CFU/cm<sup>2</sup> in the thigh site and 0.53 Log CFU/cm<sup>2</sup> in the rib site, respectively. *Campylobacter jejuni* was isolated in one rib sample (0.8%). *Salmonella* derby was isolated in two thigh site samples and one rib site sample (2.3%).

**Key words:** *Campylobacter*, Carcasses, *Enterobacteriaceae*, Ostrich, *Salmonella*, Total bacterial count.

The ostrich (*Struthio camelus* var. *domesticus*) is the largest of all birds and belongs to a small order of birds known as the ratitae or running birds (ostrich, emu, cassowary, rhea, and kiwi). Production and consumption of ostrich meat began in the second half of the last century in South Africa (Paleari *et al.* 1995). Since then, there has been a significant increase in other countries (Israel, USA, Egypt and Australia) and in Italy as well.

Ostrich meat consumption is having good consideration as alternative to other meats because of its tenderness (low fat contents and collagen) and nutritional value (Alonso-Calleja *et al.* 2004).

In this context, sanitary status of carcasses is essential to encounter threats such as prevention of contamination during slaughtering through adherence to good hygienic standards. Contaminating organisms can cause bacterial spoilage of the meat and loss of shelf life. Spreading of food-borne pathogens must also be considered. Little information are available in literature, nevertheless pathogens such as *Salmonella* spp. and *Campylobacter* spp. have been isolated from ostrich carcasses (Ley *et al.* 2001; Gaedirelwe *et al.* 2008). In Italy, where the ostrich industry is developing, birds are usually slaughtered in structures planned for big ruminants. At processing plant, birds are electrically stunned (Paleari *et al.* 1995) and raised by the legs for sticking and bleeding. Feathers are plucked manually and the carcasses are skinned before evisceration.

The aim of the present study was to get an indication of the hygienic status of carcasses and to assess the prevalence of food-borne pathogens from clinically healthy ostrich carcasses.

\* To whom all correspondence should be addressed.  
Tel +39 09613694242;  
E-mail: costanzo.nic@unicz.it

## MATERIALS AND METHODS

This study was carried out within four months (January to April 2010) in a small abattoir in Southern Italy. The plant's slaughter process steps included animal holding, electrical stunning, exsanguinations, fastening of the cloacae and defeathering, mechanical air inflation, skinning, upsetting of the carcass, evisceration, dressing and chilling. Every day 10-20 farmed animals were slaughtered. African Black Ostriches of approximately 95 kg of live weight were about 12 months old. A total of 130 samples were collected from the thigh and rib sites of 65 carcasses post evisceration. The double wet/dry swabbing technique was used over a 100 cm<sup>2</sup> area delimited by a sterile template. Briefly, the wet swabs were rubbed vertically, horizontally, then diagonally across the template surface (20 sec). Swabbing was repeated with dry swabs and subsequently inserted into a sterile transport vials and transported cooled to the laboratory where bacteriological analyses were carried out within 3 hours after sampling.

Microbiological analyses were done by culture after a dilution step. For enumeration of total bacterial count (TBC) an aliquot of each dilution (1 ml) was inoculated onto Plate Count Agar (Oxoid Ltd., Hampshire, UK.) and incubated at 32°C for 48h. *Enterobacteriaceae* enumeration was obtained by spreading 1 ml of diluted samples in Violet Red Bile Glucose Agar (Oxoid Ltd.) incubated at 37°C for 24 h. Based on their morphology round purple colonies surrounded by a purple halo were considered *Enterobacteriaceae* colonies. To investigate the presence of *Campylobacter* spp. a subset (1ml) of sample was inoculated into 10 ml of *Campylobacter* selective enrichment broth (Oxoid Ltd.) incubated at 42°C for 48 h. Subsequently, a loopful was streaked onto *Campylobacter* blood-free selective agar (Oxoid Ltd.) supplemented with CCDA Selective Supplement (Oxoid Ltd.) incubated at 42°C for 24 h under microaerophilic conditions (CampyGen, Oxoid Ltd.). Suspicious colonies were subcultured on sheep blood agar (Difco™ Laboratories; 5% sheep blood, Oxoid Ltd.) incubated at 42°C for 24 h. After Gram staining, slim, gram-negative rods were tested for oxidase and catalase test. Isolates were identified biochemically by using API Campy

identification kit in accordance with the manufacturer's instructions (bioMérieux SA, Marcy-l'Etoile, F). Examination for *Salmonella* spp. was done using a two-step enrichment procedure. Briefly, 1 ml of diluted sample was pre-enriched in 10 ml of Buffered Peptone Water (Oxoid Ltd.) incubated at 37 °C for 24 h. Then, 1 ml of the pre-enriched broth was incubated at 37 °C for 24 h in 10 ml of Selenite Cystine Broth Base (Oxoid Ltd.) and 0.1 ml was incubated at 41.5 °C for 24 h in 10 ml of Rappaport-Vassiliadis Soya Pepton Broth (Oxoid Ltd.). Subsequently one loopful from each enriched broth was spread onto *Salmonella* Chromogenic Medium (Oxoid Ltd.) supplemented with *Salmonella* Selective Supplement (Oxoid Ltd.) and onto Xylose-Lysine-Desoxycholate Agar (Oxoid Ltd.). Plates were incubated at 37 °C for 24 h. Suspicious colonies were biochemically tested by using the API 20E System in accordance with the manufacturer's instructions (bioMérieux SA). Isolated strains identified as *Salmonella*-like colonies were then serotyped. The detection of the somatic O antigen and the flagellar H antigen was done by slide agglutination technique with monovalent and polyvalent antisera (Difco, Fischer Scientific) following the Kauffmann-White scheme (Grimont and Weill 2007). Differences for sampling site and contamination level were evaluated using T test. Data were analyzed using GraphPad Prism version 5.00 for Windows, GraphPad Software, San Diego California USA.

## RESULTS AND DISCUSSION

Using the double wet/dry sampling technique for TBCs, the average contamination post evisceration found in the present study was 1.35 Log CFU/cm<sup>2</sup> in the thigh site and 1.62 Log CFU/cm<sup>2</sup> in the rib site with significant differences between sites ( $p < 0.05$ ) (Table 1). The *Enterobacteriaceae* contamination was found to be 0.57 Log CFU/cm<sup>2</sup> in the thigh site and 0.53 Log CFU/cm<sup>2</sup> in the rib site without significant differences ( $p < 0.05$ ) (Table 2). Very little is known in literature about microbiological conditions of ostrich carcasses, nevertheless TBCs found are very low compared with those found by Karama *et al.* (2003) who reported an average surface counts of 4.21 Log CFU/cm<sup>2</sup> post evisceration. Differently, TBC reported by Hoffman *et al.* (2010) was 219.47

**Table 1.** Total bacterial count (TBC) detected from ostrich carcass surfaces and expressed as Log CFU/cm<sup>2</sup>

Site	Mean Log <sup>2</sup> CFU/cm	Standard Deviation	Min	Max
Thigh	1.35 <sup>a</sup>	1.65	0.7	5.3
Rib	1.62 <sup>b</sup>	1.29	0.6	4.8

Values within a row without a common superscript are significantly different at a=0.05

CFU/gr on carcasses from a EU export-approved abattoir in South Africa. Carcasses dressed at small abattoirs are reported to carry TBC at mean values of about 10<sup>3</sup>/cm<sup>2</sup>, and *Enterobacteriaceae* or coliforms at mean numbers ≤ 10/cm<sup>2</sup> (Forte *et al.* 2003; Gill *et al.* 2000; Severini *et al.* 2003). The low contamination found in the present study was likely due to good hygiene standards and to the small numbers of processed birds/day.

In view of food-borne pathogen detection, the isolation of *Campylobacter* spp. was recorded in only one sample from the rib site out of 130 (0.8%) collected samples. The isolate was biochemically identified as *Campylobacter jejuni*. Reports on the thermotolerant *Campylobacter* isolation have already been described in our Region where 48 (32%) out 150 cloacal swabs were found to be positive for *Campylobacter jejuni* (Cuomo *et al.* 2007). Few reports are reported on *Campylobacter* spp. on ostrich meat, with the organisms being recovered from 10% of about 200 carcasses (Ley *et al.* 2001). *Salmonella* spp. were found in three (2.3%) out of 130 collected samples that is, two from the thigh and one from the rib site. The serotype identified was *Salmonella* derby. Our results are in accordance with Ley *et al.* (2001) who found a low prevalence of *Salmonellae* recovered from ostrich, however such contamination maybe more frequent than those available considering that birds can be infected both on farm and during transportation, and high *Salmonella*-prevalence has been reported on feather and skin (Gobo and Banda, 1997). To sum up, low contamination of TBC and *Enterobacteriaceae* was found in the present study from clinically health ostriches at slaughter with good hygiene standards, nevertheless the detection of food-borne pathogens from the

**Table 2.** Enterobacteriaceae detected from ostrich carcass surfaces and expressed as Log CFU/cm<sup>2</sup>

Site	Mean Log <sup>2</sup> CFU/cm	Standard Deviation	Min	Max
Thigh	0.57a	1.05	0	4.2
Rib	0.53 a	0.61	0	2.3

Values within a row without a common superscript are significantly different at a=0.05

carcass surfaces must be elucidated in view of public health aspects.

## REFERENCES

- Alonso-Calleja, C., Martinez-Fernandez, B., Prieto, M. and Capita, R. Microbiological quality of vacuum-packed retail ostrich meat in Spain. *Food Microbiol.*, 2004; **21**: 241-246.
- Forte, V.T., Novello, L., Conversano, M.C., Tantillo, M.G., Girasoli F.E.. Valutazione della contaminazione microbica di carcasce di struzzi. *Industrie Alimentari* 2003; **42**: 1256-1261.
- Grimont, P.A., Weill, F.X. Antigenic formulae of the *Salmonella* serovars. 2007 WHO collaborating Centre for Reference and Research on Salmonella, Institut Pasteur.
- Cuomo, A., Dipineto, L., Santaniello, A., Matteoli, G., Sarli, T., Della Vecchia, D., Fioretti, A., Menna, L.F. Detection of thermotolerant *Campylobacter* in ostriches (*Struthio camelus*) in Italy. *Vet. J.*, 2007; **174**: 439-441.
- Gaedirelwe, O.G., Sebunya, T.K. The prevalence and antibiotic susceptibility of *Salmonella* sp. in poultry and ostrich samples from slaughter houses in Gaborone, Botswana. *J. Anim. Vet. Adv.*, 2008; **7**: 1151-1154.
- Gill, C.O., Jones, T., Bryant, J., Brerenton, A.D.. The microbiological condition of the carcasses of six species after dressing at a small abattoir. *Food Microbiol.*, 2000; **17**: 233-239.
- Gobo, J.M., Banda, G.N. Occurrence of *Salmonella* on meat and products in an ostrich abattoir as determined with a DNA probe. *S. Afr. J. A. Sci.* 1997; **27**: 1-6.
- Hoffman, L.C., Britz, T.J., Schnetler, D.C. Prevalent organisms on ostrich carcasses found in a commercial abattoir. *Jl. S. Afr. Vet. Ass.*, 2010; **81**:151-155.
- Karama, M., De Jesus, A.E., Veary, C.M.. Microbial quality of ostrich carcasses produced at an export-approved South African abattoir.

- J. Food Prot.*, 2003; **66**: 878-881.
10. Ley, E.C., Morishita, T.Y., Brisker, T., Harr, B.S.. Prevalence of *Salmonella*, *Campylobacter*, and *Escherichia coli* on ostrich carcasses and the susceptibility of ostrich-origin *E. coli* isolates to various antibiotics. *Avian Dis.*, 2001 ;**45**: 696-700.
  11. Paleari, M.A., Corsico, P., Beretta, G. The ostrich: breeding, reproduction, slaughtering and nutritional value of the meat. *Fleischwirtsch* 2003; **75** (9): 1120-1123.
  12. Severini, M., Ranucci, D., Miraglia, D., Branciarri, R. Preliminary study of the microbiological quality of ostrich (*Struthio camelus*) carcasses dressed in small Italian abattoirs. *Ital. J. Food. Sci.* 2003; **15**: 295-300.