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The hygiene practices of three systems of game meat production in South Africa in terms of animal class and health compliance

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ABSTRACT

Three game meat production systems used on game ranches in South Africa are reported on. System one is applied in the game export market and conforms to the hygiene requirements of the European Union (EU). System two and three entail game meat available on the local market not subjected to any regulation. System 2 however, implemented basic meat hygiene values.

Measurements of pH, temperature, Aerobic Plate Count (APC), *E. coli*, *Salmonella* and *S. aureus* were subjected to a 3×2 factorial analysis of variance with factors that involve 3 system compliances in 2 classes of game animals in a completely randomised design.

The measured bacteriological and quality differences between the three systems do not justify EU standards application on the local market but results indicated a significant compliance×class interaction.

1. Introduction

1.1. Introduction: game meat hygiene in South Africa

It is well known that during the hunting season, fresh unapproved game meat (not inspected and approved with an abattoir stamp) is available at butcheries and some of the bigger retail outlets (Carruthers, 2008). Throughout the year game meat from uncontrolled and unregistered facilities is further processed into dry products such as biltong and dry sausage which is made available at all major retailers, outlets and biltong shops in South Africa (Van der Merwe, 2005). A recent annual report from the Professional Hunting Association in South Africa (PHASA) on trophy hunting in South Africa, stated an income of R5.5 billion (R ±8.20 = U$1.00) accruing to biltong hunters (Carroll, 2010). In the past, processing of this meat was mainly performed on formal butchery premises, but recently an increasing number of private processors on uncertified and unapproved premises have been exploring this niche market (Reilly, Sutherland, & Harley, 2003; Van der Merwe, Jagals, & Hoffman, 2009).

Hoffman and Dicks (2011) found that game meat is more resistant to microbiological spoilage than domesticated meat sources such as mutton, beef and pork, but further scientific information to corroborate these findings is not currently available. The safety of game meat in terms of the bacteriological quality during the culling process on the game ranch is unknown and will be discussed. In South Africa, the Meat Safety Act (Act 40 of 2000) (hereafter the MSA) was developed and promulgated to address the meat safety issue of not only animals farmed for their meat, but for five different groups of animals that are required to be regulated in terms of slaughter animals for meat production. The MSA replaced the Abattoir Hygiene Act (Act 121 of 1992), and was developed and based on legal requirements applicable to the red meat industry. The Red Meat-, Poultry- and Ostrich-Regulations have been promulgated, but the Game- and Crocodile Regulations are still in draft format. The requirement in the MSA that game meat inspections should be performed by an independent game meat inspector, led to the postponement of the promulgation of the Game Regulations. The problem is that this service is provided by Government to ensure independence. The Department of Agriculture, Forestry and Fisheries (DAFF), however, cannot render an independent game meat service due to logistical issues such as the distribution of farms and distances to be travelled to the more than 10000 game farms in South Africa (Dry, 2012). Veterinary Procedural Notices, (VPN) based on the export requirements for game meat as required by the European Union (EU) (a major importer of South African game meat) were developed and implemented by DAFF. For this reason, the Draft Game Regulations were intentionally developed

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to ensure safe game meat specifically to the local meat market. This was, however, met with resistance from the game farmers due to the costs involved and the impracticalities in the Regulation.

While meat inspection data is available for the game export market, the current status of game meat (in terms of safety for human consumption) intended for the local market is unknown. This is due to the total lack of recorded meat inspection data. Such information can become part of a database if a similar system to that used currently for the red meat- and export game market is developed and implemented.

According to Gill and Penney (1979), Gill (2005) and Paulsen (2005), the observance of Good Hygiene Practice (GHP) applying to the different modes of game harvesting and processing, will play a decisive role in determining the microbiological safety of the meat. The present study, therefore, has focused on the safe and hygienic production of game meat and evaluates the applicability of legislation from DAFF.

2. Materials and methods

2.1. Experimental design

In order to evaluate the health status of game meat in South Africa, this study focused on comparing the effect of three different systems of game meat production on the hygiene and safety of game meat. The systems compared included game carcasses for export purposes (Sys1); game carcasses intended for the local market, but subjected to specific hygiene and safety guidelines (Sys2) and game carcasses intended for the local market, but not subjected to health and safety guidelines (Sys3). The carcasses in the three systems were tested, and compared on the basis of a range of parameters, namely carcass pH, carcass temperature, the time period from the hunt to chilling of the carcass, Aerobic Plate Count (APC) of the heart blood, shelf-life in terms of the bacterial count, and counts of *E. coli*, *S. aureus* and *Salmonella* in two classes of animal in each of the three systems. The procedures, readings and samples analysed were not concerned with the different game species, but rather with the range of animals that were available during the study period (Van der Merwe, Jooste, & Hoffman, 2011). Currently Sys2 and Sys3 do not adhere to any legislation or standards however, the measurements and results were compared to the export standard as specified in the VPN i.e. in effect the carcasses sampled in Sys1. The variables used included the index and indicator organisms namely: APC (carcass and heart blood), *E. coli*, *Salmonella* and *S. aureus*. Carcass temperature and pH measurements were used to compare possible quality differences in the three systems. In Table 1 the numbers (n) used for the final statistical analyses of the 3×2 factorial structure (three systems with two classes of animal) using SAS statistical software are shown.

The bacteriological sampling method used for Sys1 (by the export market) was the excision method. Sys 2 and Sys3 were sampled with the EU recommended Biotrace swabbing method. A pilot study was conducted to verify the results of the excision- versus the swabbing technique for the sampling of game carcasses (Van der Merwe et al., in press). The excision sampling technique is motivated by the hypothesis of bacteria migrating deeper into the tissues to more favourable conditions when the exposed, drying meat surface restricts bacterial growth. However, this theorem was researched and refuted by Capita, Prieto, and Alonso-Calleja (2004), Hutchison, Thomas, Small, Buncic, and Howell (2007) and Pepperell et al. (2005). The argument in terms of game meat possessing a dryer surface than meat from domesticated animals (Hoffman & Dicks, 2011) motivated the utilization of the EU approved method (Zweifel, Baltzer, & Stephan, 2005) of swabbing for Sys2 and Sys3.

In accordance with the method of Andrin (2008) brisket tissue collected from each of the 12 beef carcasses from a certified butchery were spiked with a purified *E. coli* strain. The spiked tissue was sampled using the two methods on each carcass and the samples were submitted to the same laboratories for analysis. The spiked beef samples used in the pilot study that was reported on, confirmed that a very good correlation existed between the results of the two techniques in spite of the different sampling methods and that the data so obtained would statistically be correlated (Van der Merwe et al., in press). Furthermore, the bacterial counts using the swab technique are to be preferred because it is consistently a more stringent measurement tool in determining the microbiological hygiene status of game carcasses than the excision required in the VPN. It is also non-destructive and does not damage the carcass. The better recovery of organisms can be explained by the bigger more representative sampling area, but also by the method of swabbing several times across the sample surface (10 times horizontally and 10 times vertically). It can be argued that the swabbing technique can have an unfair advantage in terms of the recovery rate of micro-organisms and that the game carcasses intended for the local market may present with higher bacterial counts than the game carcasses intended for the export market which were sampled with the excision technique. It was concluded by Van der Merwe et al. (in press) that the sampling of game carcasses by either the excision or the swabbing technique may be comparatively used for determining the bacterial quality of export (Sys1) and local carcasses (Sys2 and Sys3).

2.2. Experimental procedures

2.2.1. Three systems of game meat production in South Africa

Sys1 comprises of the game animals intended for the export market (n = 295). Sys1 is a high intensity cropping system and at least 20 animals are targeted per day to make the cropping project financially viable. It should be noted that cropping and export of game meat from South Africa is done in strict accordance with the guidelines of the VPN (South Africa, 2007, 2010a, 2010b, 2010c, 2010d) which are issued and amended annually by DAFF in conjunction with the EU (ICMSF, 1996). Under these provisos, Sys1 carcasses were transported unskinned and refrigerated (transportation time <72 h) from the ranch where the animals had been shot, and where primary carcass inspection was done (South Africa, 2010c) to the export abattoir where the carcasses were skinned. The secondary and final inspection was done at these export abattoirs (South Africa, 2010e). According to DAFF, such ranches have to be registered for export harvesting (South Africa, 2010a). Samples and measurements were made on carcasses obtained from registered and planned cropping activities for the export market and from the specific export abattoirs. Sys2 comprises of game carcasses intended for the local market, but subjected to specific hygiene and safety guidelines (n = 165). Approved training modules (SAQA accredited service provider for Wildlife Ranching South Arica-WRSA) for game meat hygiene and carcass inspection were implemented on a selected game ranch that mainly produces trophy carcasses for the local market. The main difference between Sys2 and Sys3 is that hunters, ranch workers and management on the ranch for implementing the Sys2 system were subjected to modules of basic training in meat hygiene, good hygiene practices and good slaughtering techniques (Bergh, 2007). The management team completed training as game meat examiners, to conduct initial

Table 1
Summary of animals within the 3×2 (Systems×Class) factorial structure (class B bigger game, weight = 225 kg and class C smaller game weight = 60 kg).

		Class B n = 331	Class C n = 281	Total
Compliance	Sys1	125	170	295
	Sys2	121	44	165
	Sys3	85	67	152
	Total	331	281	612