

THE EFFECT OF SLAUGHTER METHODS AND AMBIENT TEMPERATURE ON SPRINGBOK (*Antidorcas marsupialis*) MEAT

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In the Republic of South Africa 80% of all the game species harvested annually are Springbok (*Antidorcas marsupialis*). These medium sized antelope are not farmed and shot in mustering yards (killed game) nor can they be handled like domestic slaughter stock (slaughtered deer)⁵. Well planned nature conservation strategies require depopulation of the Springbok herds annually. 849,68 tons of Springbok meat was harvested in 1987, of which 62,25% was exported². In 1988 the corresponding figures were 871,71 tons and 52,58%. The harvesting methods require accurate shooting of the antelope in the head or upper neck from a helicopter or by marksmen on the ground during the day or from a motor vehicle at night. Although the most expensive method, shooting from a helicopter is most efficient and is therefore the method of choice. The table shows the importance of the helicopter compared with the other harvesting methods

	EXPORT	LOCAL	TOTAL
Helicopter	61,0%	12,0%	73,0%
Ground day	5,0%	1,0%	6,0%
Ground night	17,0%	4,0%	21,0%

Of the springbok cropped, 73,0% are harvested by helicopter. After shooting, the Springbok are dressed without skinning at a central location in the field. The carcasses are then hung in refrigerated vehicles and transported to an approved facility for further processing. In complying with the export regulations the relatively small Springbok carcasses are chilled too rapidly mechanically which could have an adverse effect on the quality of the meat.

THE OBJECTIVES OF THE PROJECT were to study:

- * the effect of mechanical refrigeration on the meat temperature and pH of springbok carcasses;
- * the effect of environmental temperature on the meat temperature and pH of springbok carcasses when hung outside;
- * the effect of each slaughter method on meat quality based on an analysis of the meat pH; and
- * the feasibility of replacing mechanical refrigeration by hanging springbok carcasses outside during the primary phase of slaughter so as to provide a more cost-effective field operation in game harvesting and to challenge scientifically the need for such stringent prescribed control criteria on temperature requirements.

MATERIALS AND METHODS

Three experimental categories were designated according to the method of harvesting with fifteen springbok allocated to each group in batches of five over three time phases during the harvesting period.

Each experimental category was divided into three groups:

1. The Control Group: where carcasses were hung in a pre-cooled refrigerated vehicle within three hours of slaughter so as to achieve a deep bone temperature of at least +7°C within 24 hours of shooting.

2. Experimental Group 1: with carcasses hung at ambient temperature for 24 hours prior to being transferred to a refrigerated vehicle.
3. Experimental Group 2: with carcasses hung for 48 hours at ambient prior to mechanical refrigeration.

All carcasses were handled as prescribed in the veterinary export control regulations:

- . animals were shot and then bled in the hanging position;
- . the carcasses were transported to a centralised game abattoir - preferably uneviscerated and before bloating occurs;
- . heads and feet were removed and the carcasses eviscerated, applying basic hygiene requirements; and
- . finally, carcasses were identified with their plucks and weighed

The muscle temperature of each carcass was measured and recorded within 60 minutes after shooting (or ZERO hour) every two hours for twelve hours and then every four hours during daylight hours. The sites:

- . deep bone, adjacent to the femur (*M. vastus intermedius*)³
- . in the costal part of the diaphragm (*pars costalis*)
- . in the psoas muscle under the kidney (*M. psoas major*)
- . in the brisket musculature (posterior deep pectoral muscle).

The muscle pH was measured and recorded within the defined Zero hour, every four hours for twelve hours, and at 24 hours and 48 hours after shooting. The pH readings were obtained from the following muscle groups: *M. longissimus thoracis*, *M. psoas major* and *M. intercostales*⁴.

The ambient temperature was measured and recorded two hourly for 12 hours and the daily maximum and minimum temperatures were recorded.

SUMMARY OF RESULTS AND DISCUSSION

The effect of mechanical refrigeration on the meat temperature of springbok carcasses:

- . a deep bone temperature of below +7°C was reached and maintained in all the harvesting methods within twenty four hours post-mortem
- . carcasses placed in an active, pre-chilled loadspace within three hours of slaughter were below +10°C at the bone within ten hours post-mortem (7,83°C ±1,799), temperatures which enhance the release of calcium ions

from the sarcoplasmic reticulum and the muscle mitochondria, predisposing to cold shortening

irrespective of the status of the loadspace on initial loading of carcasses, the superficial musculature had reached a superchill range within ten hours of shooting: range 1,40°C to 2,40°C over the three harvesting methods

The effect of environmental refrigeration on the meat temperature of springbok carcasses:

the Codex Alimentarius Commission's prescription of +15°C or lower at the centre of the round within twenty hours post-mortem is met within all harvesting methods, this being reached within eight hours in all but the night harvesting method⁶

the Australian regulation requirement of +20°C or lower within eight hours post-mortem for animals under 40 kg is met in all the harvesting methods¹

initial environmental temperatures differed markedly within each harvesting method (range 5,5°C, night harvesting, to 22,5°C, helicopter method) and affected PM₀ and PM₁₀ readings significantly

maximum mean temperature values of the *M. vastus intermedius* did not exceed 18,5°C in any of the slaughter methods, a temperature level which enhances the activity of the sarco-tubular system and improves tenderness

the mean maximum temperature range in the core area is from 15°C to 20°C in June, July and August. Minimum temperatures over the same period average 2°C

animals harvested later in the day showed a very similar pattern of chilling between the two methods of refrigeration up to PM₁₂, with a difference in mean values of as little as 0,1°C

The effect of each slaughter method on meat quality based on pH analysis:

the ground day harvesting method is the most stressful of the three methods

mean pH values below 6,0 in the ground night and helicopter harvesting methods at zero hour suggest a degree of exertional rhabdomyolysis caused by the slaughter method

an ultimate pH can be reached in springbok within twelve hours post-mortem and is in the range 5,4 to 5,8 which is conducive to sarcoplasmic protein precipitation and denaturation of actomyosin

in all instances mean pH values had dropped to at least 6,0 within ten hours post-mortem, but measurement and calibration were difficult with falling temperatures over this period

The feasibility of replacing mechanical with environmental refrigeration:

Pursuit of game over a short distance results in metabolic acidosis as lactate and hydrogen ions are rapidly produced whilst glycogen, creatine phosphate and adenosine triphosphate reserves fall. This results in a lower than expected initial pH, but it safeguards the meat from cold shortening. The additional stress and the retardation in the pH value decline under mechanical refrigeration in ground day harvesting could result in cold shortening.

Based on the requirements of +7°C or lower within twenty four hours post-mortem, as demanded by the European Commission, environmental refrigeration cannot replace mechanical chilling of carcasses. In the interests of meat tenderness and palatability a higher deep bone temperature can be maintained over the first four hours post-mortem by loading the small springbok carcase into a warm, inactive loadspace initially.

Environmental temperature was used successfully to achieve the prescriptions of the Codex Alimentarius Commission⁶ and the Australian regulation requirements¹. A mean temperature value of under 10°C at the bone can be achieved using environmental refrigeration. Currently the majority of harvesting is conducted in June, July and August when maximum mean temperatures do not exceed 20°C and when minimum mean temperatures are as low as 2°C. Mean deep bone temperature values are significantly influenced by the relevant environmental temperatures during harvesting. Helicopter day harvesting and night harvesting can successfully utilise environmental temperature to chill carcasses in the primary production phase. In the former, harvesting starts closer to midday and in the latter should not exceed midnight if a deep bone mean value temperature increase is to be avoided at PM₁₀ in the absence of sun protection. The research proves that environmental refrigeration can be used successfully to chill springbok carcasses for up to 28 hours post-mortem and that this method of chilling can be utilised for local marketing in the months June to August.

Thus far ambient temperature has been very successful in chilling Springbok carcasses in the peak months of the harvesting season. A more satisfactory temperature gradient drop and a more rapid pH drop has been found within the first ten hours. Both features will ensure that cold shortening does not take place and the meat is tender and tasty.

REFERENCES

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