

## SOME EFFECTS OF SHOOTING ON LOSSES OF MEAT AND MEAT QUALITY IN SPRINGBOK AND IMPALA

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**OPSOMMING:** DIE INVLOED VAN SKIET OP DIE VERLIESE VAN VLEIS EN VLEISKWALITEIT BY SPRINGBOKKE EN ROOIBOKKE

Die verlies aan vleis wat as gevolg van beskadiging deur die koeëlwonde ongeskik vir menslike gebruik geword het, het gemiddeld 13,9% van die karkasgewig uitgemaak. 'n Groepering volgens die liggaamsdele waar die bokke geskiet is, het aangetoon dat die statisties betekenisvol laagste verliese veroorsaak is deur skote deur die nek en ribbes en dat die gewilde skoot deur die blad groot verliese veroorsaak. Terwyl meeste bokke wat deur die nek geskiet is onmiddellik inmeekargesak het, het skote deur die ribbes en blad dikwels lang lyding veroorsaak. Bepalings van die vleiskleur en waterbindingsvermoë het aangedui dat die voor-doodse spanning veroorsaak deur stuiptrekkings en dikwels deur die gejaag van gewonde diere 'n nadelige invloed op die vleiskwaliteit mag hê.

### SUMMARY

The amount of tissue damaged by bullet wounds and thus unfit for human consumption averaged 13,9% of the total carcass weight. When carcasses were grouped according to the locality hit by the bullet, it was found that shots through the neck and ribs produced significantly lower percentages of damage than the other shots, whereas the popular shot through the shoulder resulted in high losses. Most animals shot through the neck collapsed instantly, whilst animals shot through the ribs or shoulder were frequently subjected to prolonged suffering. Determinations on the meat colour and waterbinding capacity indicated that the *ante-mortem* stress caused by the death struggle and frequently by chasing wounded animals might have a detrimental effect on meat quality.

The development of efficient cropping methods is one of the aspects requiring urgent attention in meat production from wild animals. Losses caused by the shooting of game accrue from three sources, namely the animals shot but not recovered, the wastage of meat unfit for human consumption because of bullet damage, and the decline of meat quality caused by *ante-mortem* stress to which hunted and wounded animals are subjected. Mosmann (1964) recorded that on a large game ranch 8,4% of the 819 animals shot were not recovered. This figure will of course vary considerably under different circumstances as accessibility of terrain, density of vegetation, markmanship, efficiency of tracing wounded animals and species differences, all have influence on the number of animals not recovered. No information on the extent of bullet damage and *ante-mortem* stress in wild animals is to our knowledge available, and the object of the present study was to investigate these aspects.

### Procedure

During three cropping sessions springbok (*Antidorcas marsupialis marsupialis* Zimmermann) and impala (*Aepyceros melampus* Lichtenstein) were shot by experienced marksmen with high velocity bullets from hides at close range as the animals moved past. The S.A. Lombard Nature Reserve, situated in an area classified by Acocks (1953) as dry *Cymbopogon-Themeda* veld type No. 50, is in flat open country interspersed by a few small clumps of bushes and thorn trees. Four-wheel-drive trucks were used to guide the herds towards the marksmen and recover the shot animals without unnecessarily chasing and disturbing the remainder

of the herd.

The shot animals were bled as soon as possible and then transported to the laboratory where they were dressed and the carcasses hung in a cool draughty room for 24 h. The percentage of the cold carcass weight unfit for human consumption was determined by dissecting and weighing all the tissues damaged by the bullet wound as well as the meat which was internally clogged up with blood. Because of the lack of local facilities and distance from the nearest meat laboratory, highly sophisticated techniques to assess meat quality could not be applied. Waterbinding capacity was, however, determined with the technique of Grau & Hamm (1953) on quadruplicate samples and meat colour according to the technique of Hart (1961) on duplicate samples. Several observations were recorded including the approximate distance which the animal moved in the 3 h before shooting, time of shooting, distance travelled after first hit, duration till killing and bleeding, onset of *rigor mortis*, locality of bullet wound, age and sex of animal.

### Results and Discussion

The carcasses of 74 springbok and impala were used to determine the amount of meat unfit for human consumption because of bullet damage and this wastage averaged 13,9% of the carcass weight. An investigation of this excessive wastage was done by grouping the carcasses into seven lots according to the locality of the bullet wound and these results are presented in Table 1. All those carcasses, where insufficient numbers did not justify the

Table 1

Percentage of carcass weight damaged by bullets

	Neck	Rib	Back	Neck + shoulder	Shoulders	Shoulder & rib	Others
Number	10	13	6	8	14	12	11
Mean	3,18	5,47	12,47	15,66	20,58	22,22	15,61
Highest	9,07	9,31	19,31	31,42	31,60	44,12	27,62
Lowest	0,00	1,61	4,34	8,98	10,75	11,02	2,83
Significant at P = 0,01							
Significant at P = 0,05							
Animals <sup>(1)</sup> collapsing	7-8	5-12	4-5	8-8	8-11	9-12	7-10

(1) Animals collapsing at site where shot indicated by first number with second number giving total observations.

forming of an own group, were pooled under "others", and could thus not be statistically analysed with the majority of carcasses. The data in Table 1 indicate that the shots through the neck caused the lowest wastage, this being significantly lower ( $P < 0,01$ ) than for all the other groups except for those shot through the ribs. As the neck is a joint with little appeal, the damage done with regard to carcass value by shots through this region is almost negligible. In several cases the shots through the neck caused no wastage at all because the wound had only severed the arteries which would have been cut anyway to bleed the carcass. Most animals shot through the neck collapsed instantly (vidé Table 1) and thus suffered little, an aspect which is of importance with regard to humane slaughtering and which also has economic significance because of reduced *ante-mortem* stress.

The second lowest mean wastage was caused by the shot through the ribs if the shoulder was not hit. Again the main damage done was to a low quality cut, and from this point of view this shot could be recommended. Several animals did, however, suffer considerably as they were only recovered a few hundred meters distant from the place where first shot. The popular shot through the shoulders proved to be very wasteful because on average one-fifth of the carcasses had to be discarded. Note should also be taken on the fact that shots through neck and shoulder or rib and shoulder resulted in significantly ( $P < 0,01$ ) greater carcass wastage than from shots straight through the neck or ribs. From the data in Table 1 it is also evident that in all three groups where the shoulder was hit the lowest recorded wastage was never less than approximately 10% of the carcass weight. Moreover, although the shoulder is a joint of only medium quality, carcasses thus shot had an

unattractive appearance and were frequently spoiled with blood. Shots through the back damaged some of the best quality cuts and caused a considerable amount of wastage.

These data seem to indicate that when small antelope are to be cropped by hunting they should be shot through the neck if they cannot be shot through the head. The traditional shot through the shoulders which either hits both shoulders, neck and shoulder or rib and shoulder results in a high percentage of carcass damage and not necessarily in immediate death. Whilst it is true that hitting the neck requires good marksmanship, it should be appreciated that game conservation and efficient cropping demand accurate selection of those animals which are to be cropped, which in turn necessitates shooting from close range.

The effect of *ante-mortem* stress on meat quality has caused considerable anxiety amongst pig breeders the world over, resulting in a vast number of investigations on pale, soft exudative (PSE) pork and dark, firm, dry (DFD) pork and the related stress syndrome. Except for indications by Wismer-Pedersen (1967) no similar evidence has been presented for wild ungulates subjected to extreme *ante-mortem* stress caused by wounding, running and the subsequent death struggle. At the S.A. Lombard Nature Reserve, several hundred antelopes of different species have for research purposes been cropped according to a strict standard routine. It was observed that those carcasses which developed *rigor mortis* rapidly, frequently even before they were offloaded at the laboratory, were obtained from animals which ran a considerable distance after they had been shot. Rapid onset of *rigor mortis* in pigs is accompanied by an increase in lactic acid, fast

Table 2

Effect of ante-mortem stress on meat colour and waterbinding capacity

	Arbitrary stress grouping				
	0,5	1,0	2,0	3,0	4,0
<i>Young animals (40)</i>					
Colour	5,78	6,07	6,71	6,04	5,93
Unbound water	109,61	97,07	121,76	82,54	94,02
<i>Mature animals (21)</i>					
Colour	6,96	7,08	7,45	6,80	—
Unbound water *	147,98	93,27	122,40	133,54	—

\*cm<sup>2</sup> covered by unbound water divided by g meat sample.

decline of meat pH and frequently resulted in PSE pork (Wismer-Pedersen & Briskey, 1961). Table 2 presents some data on the meat colour and unbound water in springbok and impala grouped according to a scale of estimated *ante-mortem* stress and subdivided into mature animals and young animals between six and ten months of age.

In an attempt to differentiate between animals that experienced little stress and those undergoing severe *ante-mortem* stress, arbitrary stress ratings were made. Animals killed instantly when shot as they were peacefully grazing were classed at a stress rating of 0,5. Those that had been continuously moving around before shooting or that suffered for a few minutes after being shot were given 1,0 ratings. Extreme cases which ran several hundred yards and were followed by searchers or chased by trucks and sometimes shot again were rated at 4,0 with 2,0 and 3,0 covering the less extreme cases inbetween.

Whilst an explicable tendency was noticed in all stress groups for the mature animals to have darker meat than the young ones, there was also a similarity between the two age categories as the turning points for increased meat colour was reached at the 2,0 stress rating. On the other hand no tendency could be observed in waterbinding capacity from the average values in Table 2. Analogous to the PSE and DFD pork found in stressed pigs (Weiss, 1967; Hoppenbrock, 1968 and Hedrick, Bailey, Parrish & Naumann, 1963) several carcasses in the present study were found to have light coloured (less than 5,5) and exudative meat (140 or more) whereas seven carcasses could be classed as DFD (7 + and 84 or less respectively). The correlations between stress and colour or stress and waterbinding capacity were not statistically significant.

A variety of factors appear to be responsible for the failure of the present data to provide statistically significant proof of the influence of *ante-mortem* stress. The most obvious reasons are the limited number of animals, lack of carcass cooling facilities, unsophisticated techniques for determining colour and waterbinding capaci-

ty, arbitrary stress ratings and the complexity of *ante-mortem* stress. The complex nature of such stress is due to several factors being involved including the amount of exercise and the quantity of feed ingested before shooting. In addition the effect of different shots caused profuse bleeding in some cases and prolonged pain in others. Seifart (1962) has indicated that adrenalin injections 3 h prior to slaughter could cause DFD pork, whereas if done immediately prior to slaughter the injections could result in PSE pork. Different reactions may thus in the present study have been caused by excitement where in some cases the antelopes had moved around all day before being shot and in other cases they suffered from stress immediately prior to death after they had been wounded. The analogy in pigs again shows that PSE pork can be the result of either stress immediately prior to death (fighting, chasing, killing methods) or of stress a few hours prior to death (transport to abattoir, temperature stress).

It is of considerable practical significance that cases of rapid onset of *rigor mortis* as well as of PSE and DFD meat were recorded in carcasses of antelopes shot under almost ideal hunting conditions. The detrimental effect of such meat quality changes on the keeping quality and ultimate acceptability of such carcasses cannot be ignored, especially as the main game producing areas are not close to the important consumer markets.

### Conclusions

The present data revealed that losses of meat and meat quality can be considerable when small antelopes are shot, and that there is an urgent need for improving cropping techniques. The traditional shot through the shoulders cannot be recommended as the best results can be obtained by shots through the neck should head shots be impossible. Effects of *ante-mortem* stress on meat quality of antelopes requires further investigation and may also be relevant to future investigations on the occurrence of low meat quality in aerobic and anaerobic type muscles of domestic stock.

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