CARCASS CHARACTERISTICS AND OPTIMAL SLAUGHTER TIME IN DEER

K.R. DREW, Invermay Agricultural Centre, MAF Technology, Ministry of Agriculture and Fisheries, Private Bag, Mosgiel, New Zealand

Abstract: Unlike traditional livestock, deer show a marked seasonality in growth pattern with a high potential for growth in spring/summer and very limited growth potential in autumn/winter. For reasons of efficiency, deer slaughter is concentrated at the end of summer when animals are about 15 or 27 months of age. Where market demand and price incentives are sufficiently large deer may be slaughtered at ages which are less than 15 or 27 months. Carcasses from deer are much leaner than those from livestock and venison has all the best attributes of red meat in balanced protein, minerals and some B vitamins without any of the perceived bad features such as high fat leveis, saturated fatty acids and cholesterol. Deer carcasses have been shown to be greater than 70% lean and less than 10% fat with a very high lean to bone ratio. The crossbreeding of wapiti (*Cervus elaphus*) with red deer to improve the rate of growth in progeny is developing in New Zealand and the hybrid carcasses are much leaner than those from red deer.

Key Words: age at slaughter, carcass, crossbreeding, deer, fat, food nutrients, leanness, meat, seasonality

Résumé: En contraste avec le bétail traditionnel, les cerfs suivent un cycle de croissance très marqué par les saisons avec un potentiel de croissance élevé au printemps et en été et un potentiel très limité en automne et en hiver. Pour des raisons de productivité, l'abattage des cerfs se concentre à la fin de l'été où les animaux ont environ 15 ou 27 mois d'âge. Lorsque la demande du marché et les prix suffisent, l'abattage des cerfs peut s'effectuer à un âge moins de 15 ou de 27 mois. Les carcasses des cerfs sont beaucoup moins gras que celles du bétail et la venaison possède les meilleures qualités de la viande rouge en protéine balancée, en minéraux et en quelques vitamines B sans les mauvaises caractéristiques telles que des niveaux élevés de gras, d'acides gras saturés ou de cholestérol. Les carcasses des cerfs possèdent plus de 70% de viande maigre et moin de 10% de gras avec une proportion élevée de viande maigre aux os. L'hybridation des wapitis (*Cervus elaphus*) avec les cerfs rouges pour améliorer le taux de croissance se développe en Nouvelle Zélande et les carcasses hybrides sont beaucoup moins gras que celles des cerfs rouges.

Mots-Clés: âge d'abattage, carcasse, cerf, éléments nutritifs, gras, hybridation, viande, saisonnalité

Red meat is the single most important animal food product in western countries. In the USA, about 43% of the calories and 40% of the food protein provided by animal products comes from red meat (N.R.C., 1988). As well as the good features of red meat, such as balanced protein, minerals, and some B vitamins, there are perceived bad features, such as high fat levels, saturated fatty acids and cholesterol. Venison can be shown to have all the best attributes of traditional red meat without any of the perceived disadvantages.

Much of the North American and European meat production depends on feedlot management where animals achieve high rates of growth on high energy rations. The potential for growth in traditional livestock species is always high and the animal growth rate achieved is largely a function of the quantity and quality of feed supplied. Not so in deer which exhibit strong seasonality in breeding, body growth and antler growth. Fennessy (1982) has shown with pen fed red deer stags that there is a massive reduction in feed consumption associated with the onset of the breeding season and that potential winter feed intake is only about 60% of the spring summer value. These facts have profound effects on the optimal management of farmed deer for venison production.

Age at Slaughter

Deer grow at a rapid rate in spring/summer and at a slow rate in autumn/winter. This basic pattern is not a function of the available feed but the seasonal body growth cycle can be exaggerated in grazing deer through winter shortages and low quality feed. Premium quality venison from farmed red (*Cervus elaphus*)and fallow deer (*Dama dama*) (and probably other species) will come from animals which are 2 years of age. Venison from red stags increases in toughness when the animals are older than 2 years (J Stevenson and K Drew, pers. commun.).

Table 1. Fatness in red deer, fallow deer, and ram lambs.

Species	Age (mo)	Liveweight		Carcass	
		kg	% mature weight	Hot weight (kg)	Fat (%)
Red deer stags	14/15	100	50	56.5	9.5
	26/27	132	66	78.0	13.1
Fallow deer bucks	13	46	51	25.7	6.1
	25	63	70	36.9	10.0
Ram lambs	6	40	36	17.0	21.8
Wether lambs[1]	-	-	-	14.5-21.0	27.0

[1]Vesely and Peters, 1972

In order to take advantage of the natural seasonal growth cycle (Fennessy, 1982), deer slaughter will be done most efficiently at the end of summer when the animals are either 1 or 2 yr of age. Well fed fallow deer are in danger of being over fat at 2 yr of age and even in the bigger, slower maturing red deer anything up to 30% of 2 yr olds will be downgraded due to overfatness.

The high value venison markets are mainly in the northern hemisphere for the pre-Christmas trade. To meet this market New Zealand and Australian producers need to slaughter their deer in the middle of spring and they have much difficulty in achieving a marketable carcass of at least 55 kg (red deer) and 20 kg (fallow deer) with animals that are 10-11 months of age. Northern hemisphere producers are able to take full advantage of spring and summer growth before slaughtering yearling deer at 15-16 months of age.

Stags which are used for breeding or velvet antler production are eventually slaughtered as old animals and although New Zealand does not yet have a grading system which recognises this class of carcass the matter is under consideration and some action can be expected in the near future. Studies at the Invermay Agricultural Center (J. Stevenson, pers. commun.) suggest that meat from old stags slaughtered after the rut was tougher than those slaughtered before the rut.

Table 2. Subcutaneous fat in mature pre rut red deer stags (n = 9). Mean hot carcass weight = 129.5 kg.

Carcass portion	Subcutaneous fat (as % of whole carcass portion fat)
Saddle	54
Hindquarters	65
Forequarter	40
Neck	16
Ribs	37
Whole carcass	50

Carcass Fatness

Venison has a marketing advantage over traditional livestock in that public perception, where there is any perception, is of a low fat product. Much of this image comes from the feral game harvest where hunted animals shot in the autumn are usually very lean. Farmed deer when well fed do get very fat in late summer when they are more than 2 yr of age.

Table 1 compares fatness in red and fallow deer at two ages with ram lambs. Although both species of deer have reached about 70% of mature weight by 2 yr of age fat comprises only 10-13% of carcass weight. In contrast, ram lambs reach 22% fat in the carcass when one third of mature weight. Seasonal variation in mature red deer fatness has been shown by Drew (1985) to vary from 2.5% in winter to 20.6% in late summer. Carcass fat was mobilised over the rut in such a way that 88% of the fat was lost in a 2 month period. In the spring time, there was a seven fold increase in carcass fat laid down in a two month period.

Much of the fat in mature red stags at the end of summer is subcutaneous and intermuscular in location rather than in-

Table 3. Side primal cut portions of a stag carcass (26 month old red deer). In this study, n = 53; liveweight (kg) = 110; hot carcass weight (kg) = 63; dressing out % = 57.3)[1].

Carcass portion	Primal cut weight (kg)	Primal cut (% of side weight)
Saddle	8.6	15
Hindquarters	23.5	39
Forequarter	11.4	19
Neck	9.7	16
Ribs	6.8	11
Whole carcass	60	

[1]from Drew, 1989

Table 4. Separable lean, fat, and bone from the carcass of different animal species.

Species	Carcass weight (kg)	% Yield			Lean/ bone
		Lean	Fat	Bone	
Beef[1]	239	59.0	23.0	18.0	3.3
Lamb[2]	14.2	54.3	23.5	16.9	3.2
Pork[1]	52.0	48.0	25.0	27.0	1.8
Chicken[3]	1.2	59.0	15.0	24.0	2.5
Red deer[4]	62.6	72.7	7.0	20.3	3.6
Wapiti/red deer[4]	67.6	76.0	4.7	19.3	3.9

[1]Paul and Southgate, 1978
[2]Kirton et al., 1985
[3]Hayse and Marion, 1973
[4]Drew, 1989

tramuscular. Table 2 show that half the fat over the whole carcass is subcutaneous and over the prime value cuts of saddle and hind quarters the percentage is 55-65. Over the neck, ribs and forequarter less of the fat is subcutaneous. In practise, this means that overfat deer carcasses can be readily trimmed of excess fat over the high quality venison cuts but only with difficulty in the lower value parts.

The venison carcass grading system in New Zealand is based on weight and fatness. The depth of tissue (GR) over the 12th rib (mm) at a point 16 cm round the carcass from the mid line in red deer is the statistic used to determine overfatness. The allowable depth varies from 10 to 14 mm depending on carcass weight for a top quality grading. The producer is penalised about 40% in returns from deer classified as overfat.

Wholesale Carcass Portions

Historically, the deer carcass has been cut into saddle (or rib/loin), hindquarters, forequarters, neck, and ribs. This division seems to have originated in the way feral deer carcasses were processed for the European market. Table 3 shows the division of the carcass into primal cuts. About 54% of the carcass is in the high value cuts of saddle and hind quarters while the neck and rib sections are boned out for sale. In recent years, and recognising that venison is now sold to many markets outside the traditional European one, there is a growing tendency for further fabrication. The saddle is sometimes boned out into striploins and tenderloins; hind quarters are boned and the muscles "seamed out" to 8 Denver leg cuts while shoulders can be boned and a part rolled into a shepherds steak. Some of these

Table 5. Nutrient composition of uncooked loin portions.

	Species		
	Beef[1] (choice) trimmed	Lamb[2] untrimmed	Venison[3] (farmed) untrimmed
Protein (g/100 g)	22.0	17.4	24.7
Fat (g/100 g)	6.5	18.2	3.3
Energy (kJ/100 g)	754	969	545
Cholesterol (mg/100 g)	72	-	66
Iron (mg/100 g)	1.8	1.4	3.8

[1]Marchello et al., 1985
[2]Chrystall and Winger, 1986
[3]Drew and Seman, 1987

Table 6. Nutrients in 100 g of trimmed feral and farmed red deer leg meat.[1]

	Feral	Farmed	
Age (months)	27	12	27
Carcass weight (kg)	43.1	40.8	75.7
Lean meat (g)	95.6	95.6	88.0
Fat (g)	3.3	3.3	10.9
Minerals (g)	1.1	1.1	1.1
Polyunsaturated fatty acids (g)	0.5	0.3	0.3
Polyunsaturated: Saturated fatty acids (P/S)	0.18	0.10	0.03

[1]From Drew and Seman, 1987

Table 7. Wapiti hybrid and red deer stag carcass composition.[1]

	2 year red deer	11 month wapiti/red deer hybrid
n	53	8
Liveweight (kg)	110	116
Hot carcass weight (kg)	63	68
Dressing %	57	59
Carcass composition (% cold carcass weight)		
Saddle	15	18
Hindquarters	39	40
Forequarters	19	20
Neck	16	14
Ribs	11	8
Fatness (GR in mm)	10	4.7

[1]From Drew and Hogg, 1990

more sophisticated cuts have membranes removed, are vacuum packed, and transported internationally as chilled meat.

Lean, Fat, and Bone Content

The important statistics for deer are compared with some values for livestock in Table 4. It is clear that with a carcass lean content greater than 70% and fat content less than 10% deer are better able to meet consumers' needs in the 1990's than traditional livestock. Although the proportion of bone in deer carcasses is a little higher than in beef and lamb, deer have a more favourable lean/bone ratio than the other species.

Nutrient Composition of Meat

There is a growing consumer demand for nutritional information on meat products but little is available on game meats. Table 5 shows nutrient data about beef, lamb, and venison. In comparison with trimmed choice beef, untrimmed venison has more protein, less fat and energy, and much more iron. Cholesterol levels are comparable. Untrimmed lamb loin is high in fat and energy.

Red meat is an important source of iron in the human diet and iron deficiency is by far the commonest single nutritional disorder in the world. Because the iron in meat is in the haemoglobin it is more efficiently digested than non meat iron.

Wild shot venison is sometimes thought to be a different product than that from farmed deer. Drew and Seman (1987) measured the compositional differences between feral and farmed venison (Table 6). The 27 month old farmed deer have much more fat than feral animals of the same age but almost all the difference is accounted for by carcass weight. The farmed animals at 12 months of age were very similar to 27 month old feral deer and almost identical in meat composition. Although all three groups have similar amounts of polyunsaturates in their meat the P/S ratio in 27 month farmed deer is very low in comparison with the other 2 groups because of the substantial loading of adipose tissue in the heavy farmed deer. Important meat nutritional differences are a function of carcass weight in the deer, not feed environment.

Deer Crossbreeding

The traditional sheep and cattle industries have long made use of crossbreeding to improve performance and efficiency. Deer farming as a new industry is only beginning to look at this technique. The fallow deer from Europe and Asia Minor can be crossed with the larger and rare Persian or Mesopotamian fallow. A more important programme in New Zealand is the use of wapiti (*Cervus elaphus nelsoni*) bulls to crossbreed with red deer. Both groups belong to the genus *Cervus*, will readily crossbreed and the hybrid progeny are fertile. Because the wapiti bull is a very large animal and the red deer hind quite small, crossbreeding at mating and calving is a very specialized job. The F1 hybrid bull is now widely sought in New Zealand to use as a sire over red deer hinds with the progeny being 3/4 red and 1/4 wapiti. Some of the crossbreeding advantages for venison production are seen in Table 7. Since it is possible to get hybrid (F_1) stags up to a commercial weight at 11 months of age, data is given with 2 yr old red deer of comparable weight. The hybrid stags have a greater proportion of their carcass as high value saddle and hindquarter. An outstanding feature of the hybrid is the very low GR fat measurement. The commercial venison trade is seeking out larger, leaner carcasses and even if the hybrid animals are taken through to 15 months of age when the carcasses will be around 80 kg fat levels will not approach the overfatness limits.

Literature Cited

CHRYSTALL, B.B. and R.J. WINGER. 1986. Composition of New Zealand lambs as influenced by geographical area, sex of animal and cut. Meat Industry Research Institute of New Zealand, Inc., MIRINZ 842.

DREW, K.R. 1985. Meat production from farmed deer. *In:* The Biology of Deer Production. P.F. Fennessy and K.R. Drew, eds., The Royal Soc. of New Zealand Bull. 22: 285-290.

DREW, K.R. 1989. Venison research and development. *In:* Proc. of the Deer Branch of The New Zealand Veterinary Assoc. No. 6. P. Wilson, ed., Palmerston North p. 181-186.

DREW, K.R. and B.W. HOGG. 1990. comparative carcass production from red, wapiti and fallow deer. *In:* Proc. of the 8th Conf. of the Australian Assoc. of Animal Breeding and Genetics. H.T. Blair, ed., Simon Printing Coy, Palmerston North 8:491-496.

DREW, K.R. and D.L. SEMAN. 1987. The nutrient content of venison. *In:* Proc. of the Nutrition Soc. of New Zealand. M. Ulyatt, ed., Palmerston North 12: 49-55.

FENNESSY, P.F. 1982. Growth and nutrition. *In:* The Farming of Deer. D. Yerex, ed., Agricultural Promotion

Associates Ltd, Wellington p. 105-114.
HAYSE, P.L. and W.M. MARION. 1973. Eviscerated yield, component parts, and meat, skin and bone ratios in the chicken broiler. Poultry Sci. 52: 718-722.
KIRTON, A.H., D.M. DUGANZICH, C.L. FEIST, G.L. BENNETT, and E.G. WOODS. 1985. Prediction of lamb carcass composition from GR and carcass weight. *In:* Proc. New Zealand Soc. of Animal Production. T.F. Reardon, ed., Hamilton 45: 63-65.
MARCHELLO, M.J., P.T. BERG, W.D. SLANGER, and R.L. HAROLD. 1985. Cutability and nutrient content of whitetail deer. J. Food Qual. 7: 267.
N.R.C. 1988. Current trends in consumption of animal products. *In:* Designing Foods. C. Carlson, ed., National Academy Press, Washington, D.C. p. 20-36.
PAUL, A.A. and D.A.T. SOUTHGATE. 1978. The Composition of Foods. Elsevier/North-Holland Biomedical Press, Oxford.
VESELY, J.A. and H.F. PETERS. 1972 Muscle, bone and fat and their interrelations in five breeds of lamb. Can. J. Anim. Sci. 52: 629-636.