VENISON QUALITY

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Abstract

Venison quality, as with other meats, encompasses a range of attributes including yield, safety, appearance and palatability. Venison is a highly palatable lean meat and it's fat, iron and cholesterol contents are compared with other meats. Seasonal differences in growth-rate and fat content affect the yield and palatability of venison. Young red deer carcasses have 50-80% less carcass fat than sheep and cattle. Mature red deer stags slaughtered after the breeding season (rut) have lower carcass weights (25 to 30%) than those slaughtered pre-rut. Venison from red deer hinds and young red deer stags is more tender than that from mature stags. The way in which deer are farmed, processed and packaged can also influence venison quality. Processing conditions affect the safety, appearance and palatability of the product. Electrical stimulation of red deer, fallow deer and New Zealand wapiti-type deer carcasses improves tenderness of venison particularly when carcasses are placed in chillers within 2 hours of slaughter. Conditioning and ageing regimes further improve tenderness. Packaging also affects the safety and appearance of the product and hence it's shelf-life. The shelf-life of venison can be markedly increased by vacuum-packaging however, long-term chilled storage results in deteriorated colour stability. Recent evidence suggests that, as with other meat-producing animals, deer behaviour and pre-slaughter stress affect venison appearance, palatability and shelf-life.

Introduction

Venison quality, as with other meats, encompasses a range of attributes including yield (which relates to and covers aspects of productivity and production efficiency), safety (which is of paramount importance in most meat industries today), appearance (how good it looks, which will influence whether customers want to buy it) and palatability or eating quality which relates to the overall enjoyment of the eating experience and how good it tastes, smells, looks, and how juicy, tender and flavoursome it is. Last but certainly not least, is image. This covers aspects such as consumer perception of the product for example healthiness or perceived healthiness, aspects of production such as animal welfare, pasture-raised vs feedlot, and, particularly in the case of venison, a gourmet image.

Yield

Yield has been reported to be affected by condition and age of animal (Blaxter *et al*, 1974; Kay & Staines, 1981; Drew, 1985). Farmed red deer have been found to have carcass yields of 54-59%, increasing with increasing animal age (Drew, 1985) which are higher than those reported for other domestic meat-producing ruminants. Deer have also been found to have a different muscle distribution compared to cattle, with a greater proportion of high value cuts (Drew, 1985). Lean, fat and bone comparisons with Angus bulls have shown that the lean/bone ratio is more favourable in deer and young red deer carcasses have 50-80% less carcass fat than sheep and cattle (Drew, 1985). However, fatness in deer is strongly

influenced by season. In studies of mature red deer stags slaughtered pre- and post rut, those slaughtered immediately after the rut (at the beginning of winter) have 25-30% lower carcass weights than those slaughtered pre-rut (autumn) (Stevenson et al., 1992). The total carcass fat decreases over the rut from 21% to 1.3%. GR measurement (a measure of bodywall thickness above the 12th rib & an excellent indicator of fatness) decreases from 31 mm to 5 mm. The striploin weights decrease by 17% and the percentage of intramuscular fat in the striploin decreases from a lean 2.6 % to a very lean 0.4 %.

Table 1: Seasonal variation in venison carcass and muscle quality from mature red deer stags.

	Pre-rut	Post-rut
Carcass weight (kg)	125	90
Carcass fat (%)	20.8	1.3
GR (mm)	31	5
Striploin weight (kg)	3.0	2.5
Intramuscular fat (%)	2.6	0.4

From: Stevenson *et al.*, 1992.

Safety

Safety of product begins with on-farm practices to ensure that livestock are not diseased or stressed entering the food chain. Animals which are stressed can result in high ultimate pH meat. High ultimate pH can affect meat safety as well as colour, texture and processing quality, especially for vacuum packaged meat (Tarrant & Hood, 1981). Transport can also affect the safety of the meat due to the stressfulness of it and possible faecal contamination due to close contact whilst in transport. Hair from skin of deer is a major source of bacterial contamination (Drew, 1989) and water spraying & misting of animals prior to slaughter is believed to reduce hair dispersal. Inverted dressing of carcasses reduces microbial contamination, particularly of the high value saddle & hind leg cuts. Vacuum packaging of product enables longer shelf life, but requires strict storage and distribution temperature control (Seman et al., 1988 & 1989; Drew, 1989).

Appearance

Appearance of venison can be affected by the product presentation, e.g. vacuum packaging, the colour of the background and lighting. Colour and purge or drip can be affected by vacuum packaging and storage conditions, particularly frozen versus chilled. Venison which has been frozen then allowed to thaw will be darker in colour, and have greater amounts of drip or purge which is also darker in colour. The ultimate pH of the meat will also affect the appearance since high pH meat is darker in colour than normal or low pH meat.

The stability of the colour, the time it takes to go from red to brown, is affected by the amount of time product is held in a vacuum package and the temperature the product is held at. In studies with venison held at -1°C in a vacuum package, the number of days before the venison turned brown decreases with storage time as shown in table 2.

Table 2: Days of acceptable display colour at 1°C after storage at -1°C in a vacuum package.

Number of weeks at -1°C	Number of days acceptable colour
1	5
6	4
12	3
18	2

From: Seman *et al.*, 1988.

With each six weeks spent in a vacuum package in storage (often in transit), one day of retail display life is lost. Often after 18 weeks, when the packs are opened and steaks cut, they bloom up to a lovely red colour and then turn brown just a few hours later. When meat is held at 5°C, which is a much more common retail display temperature, the rate of colour change is about 3 times more rapid than it is at -1°C. At a display temperature of 5°C, the colour changes much more rapidly and venison turns brown much faster than other meats (Table 3).

Table 3: Days of acceptable display colour at 5°C.

SPECIES	Number of days acceptable colour
Venison	1.6
Lamb	3.1
Beef	4.7
Pork	5.7

From: Trout & Gutzke, 1995.

There is considerable variability between animals both in venison and other species. But with regard to venison, some animals have as little as ½ a day good colour under the same conditions where average is about 2 days and some animals have up to 8 days good colour. We are currently researching the mechanisms behind this and believe that we may be able to select for animals with premium colour stability which is important for retail sale of venison. Colour is a very important attribute since consumers make their initial decision to buy a product based on appearance. Repeat purchase is generally based on palatability.

Palatability

Palatability is generally thought of in terms of tenderness, juiciness, flavour and texture and each of these attributes can be affected by a number of factors. Studies in other species have indicated that tenderness is the most important palatability attribute for acceptance of meat. Tenderness is affected by the growth rate of the animal, age of the animal, sex of the animal as well as the slaughter and processing protocols. Mature stags slaughtered after the rut are tougher than those slaughtered before the rut (Stevenson *et al.*, 1992), and toughness has been found to increase with animal age (Stevenson *et al.*, 1989). Table 4 shows comparative tenderness data from longissimus dorsi (striploin or saddle) muscles over a range of age of red deer slaughtered in the same manner at a commercial slaughter plant in New Zealand. All carcasses were electrically stimulated since previous studies have shown that electrical stimulation ensures rapid tenderisation of carcasses (Drew *et al.*, 1988). Five animals were

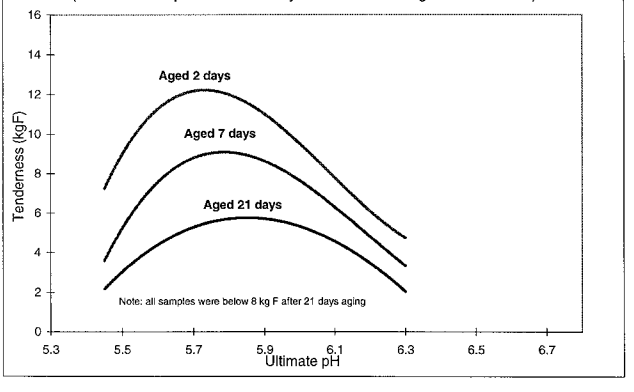
assessed in each age group for this study except for 2 year old stags where their were 15 animals (five light, medium and heavy weight 2 year olds were assessed and there was no significant difference in tenderness between the three weight groups). A tenderness or force score value of less than 5 kgF indicates very tender meat, values above 6 kgF indicate slightly to moderately tough meat and values above 8 kgF indicate very tough meat. This data indicates that as animal age increases, venison toughness increases, particularly in the case of stags, and variability in tenderness increases in stags beyond 2 years of age.

Table 4: Tenderness change with animal age (means with standard deviations in brackets).

	Tenderness (kgF)	
Animal Age (years)	Stags	Hinds
1	4.7 (0.9)	4.0 (1.2)
2	4.7 (1.0)	3.9 (0.4)
3	5.0 (1.8)	4.0 (1.1)
5	6.5 (2.0)	4.6 (0.5)
>5	7.5 (3.4)	4.6 (0.6)

Recent evidence suggests that, as with other meat-producing animals, deer behaviour and pre-slaughter and stress affect venison appearance, palatability and shelf-life. Stress can affect the meat ultimate pH which influences tenderness. Normal ultimate pH is around 5.5 and as pH increases, toughness increases to a maximum around 6.0 as indicated in figure 1. Beyond pH 6.0, toughness decreases, but meat with pH above 6.0 is darker in colour and has decreased shelf-life due to more rapid microbial spoilage. The toughness with intermediate pH can be modified somewhat with conditioning and ageing of product (i.e. chilled storage), but even after 21 days chilled storage, intermediate pH meat is still tougher than normal pH meat.

Figure 1: Effect of Ultimate pH on Venison Tenderness
(Data from striploins of 18 1-3 yr old red deer stags stored at 4 C)



Image

Last and certainly not least is image. For venison, image encompasses it's lean and healthy image. Venison from yearling deer has been analysed for nutrient content and compares very favourably to other meats (Drew & Seman, 1987). Venison has less than one quarter the amount of fat and 35% more protein per 100g tissue than lamb. Venison has only 22% of the meat energy derived from fat compared to 33-47% for beef, lamb and pork and therefore fits into a health conscious diet. Venison triglyceride fatty acid composition has been found to be not greatly different from lamb (table 5), but because there is very little adipose tissue in venison, the ratio of polyunsaturates (high in phospholipid) to saturates and monounsaturates is much higher in venison than lamb. Venison is very high in iron content with a 100g portion providing almost 40% of the recommended dietary allowance and it is a very low cholesterol meat (table 6). Other aspects of image include aspects of production such as animal welfare, pasture-raised vs feedlot, and, particularly in the case of venison, a gourmet image.

Table 5: Triglyceride composition of venison compared with lamb (means only presented).

	Total fatty acid (g/100 g)						
	14:0	16:0	16:1	18:0	18:1	18:2	18:3
Venison Leg[1]							
Feral	6.5	34.7	6.9	29.5	20.6	2.1	1.1
Grassfed	6.1	31.2	9.2	25.4	26.6	1.4	0.4
Feedlot	7.3	37.2	14.1	13.4	25.8	1.8	0.9
Venison Loin[2]	7.0	39.4	13.3	10.8	27.1	1.3	1.0
Lamb Loin[2]	5.0	20.2	3.4	24.5	38.1	1.3	1.0

[1]Data from Manley & Forss, 1979; mean of five 12, 18 and 27 month old red deer stags.
[2]Data from Drew & Seman, 1987; mean of ten very well grown yearling red deer stags and thirty ram lambs.

Table 6: Mineral and cholesterol composition of venison compared with lamb (mean per 100).

	Venison Loin	Venison Leg	Lamb Loin
Calcium (mg)	5	3	14
Magnesium (mg)	25	29	19
Sodium (mg)	51	47	77
Potassium (mg)	352	367	314
Copper(mg)	190	216	88
Iron (mg)	3820	3900	1403
Zinc (mg)	2820	2510	2629
Selenium (mg)	2.2	2.2	15.6
Cholesterol (mg)	66	74	

Data from Drew & Seman, 1987; mean of ten very well grown yearling red deer stags and thirty ram lambs.

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