The Elk Carcass

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Useful guidelines for elk carcass care are contained in this bulletin. The amount of boneless meat to expect was determined by processing hunter-harvested carcasses. Factors affecting the flavor of elk meat and the relationship between aging and tenderness are discussed. The new knowledge obtained from this study makes it possible to better utilize meat obtained from harvested elk.

In 2001, a total of 22,772 elk were harvested in Wyoming by 57,314 active hunters, resulting in a 39.7 percent success ratio. The average amount of elk meat available per successful resident hunter has been calculated and is discussed in the following text. Hunters, nutritionists, and those interested in conducting risk assessments for elk consumption may find this information useful.

Information collected

Field-dressed carcasses of six bulls and six cows were delivered to the University of Wyoming meat laboratory. Each was split, and one side of each was skinned immediately. The sides were placed in a 38-degree-Fahrenheit cooler at 70 percent relative humidity. Both sides were aged two weeks except for a loin sample which was removed for tenderness tests. This sample was taken from the skinned side of each carcass the day after harvest.

Weight losses during aging were recorded. After aging, one side of each carcass was cut into retail cuts, and the other side was separated into bone, fat, and lean. Loin roasts from both sides were saved for flavor and tenderness determinations. Lean and fat from the boned side were later ground together and sampled to determine moisture, fat, protein, and ash content. Ground meat samples were also taken for bacterial analysis.

Cutting an elk carcass

The cutting method for boneless retail-cut yield followed the procedure described in University of Wyoming Cooperative Extension Service Bulletin B-884R.

The shoulder was removed at the natural seam and boned. All remaining muscles were removed from each hanging carcass. The knife was kept close to the bone so that more meat could be saved and so that large muscles could be used as steaks and roasts. Natural seams were followed when removing muscles from the round. Major lymph nodes like the prescapular at the point of the shoulder, the prefemoral at the flank and round junction, and the popliteal embedded in seam fat between the major round muscles were removed. Steaks and roasts were wrapped and immediately frozen. Lean trimmings were also frozen the day they were removed from each carcass. Frozen trimmings can be thawed and ground or processed into sausage up to eight months after packaging if they are frozen rapidly and then thawed in a cooler or in plastic bags submerged in 40 to 50-degree-Fahrenheit running water.

Previous printings of this bulletin listed weights of semi-boneless retail cuts, but this printing lists boneless cut weights only. The boneless method of cutting is recommended for elk harvested in areas where chronic wasting disease (CWD) exists and is commonly used by game-meat processors. Additional advice regarding CWD includes avoiding harvest or consumption of sick elk; wearing latex or rubber gloves when dressing elk from CWD areas; avoiding contact with the brain, spinal cord, lymph nodes, spleen, tonsils, and eyes because these organs may contain the greatest amount of CWD agent in infected animals; and thoroughly washing knives and other implements (Williams *et al*. 2002) These precautions are recommended even though CWD has not been linked to any human illness.

Elk carcass weights and meat obtained

The six bull elk studied had an average field-dressed weight of 437 pounds. They ranged in age (determined by the wear of mandibular cheek teeth) from 1.5 to 9.5 years with four bulls being 2.5 or 3.5 years old. The six cows averaged 339 pounds and were 2.5 to 5.5 years old. The field-dressed carcass weight included the head and hide, but the legs were removed at the knees and hocks, and all contents of the abdominal and thoracic cavities including the entire gullet and windpipe were removed.

The figures of Hay, *et al*. (1961) for converting field-dressed to whole weight were used in Table 1. The other factors in Table 1 are based upon data obtained on bull elk in the present study.

The boneless lean yield averaged 50 percent of the field-dressed weight. When one locker plant processed hunter-harvested elk carcasses, the yield averaged 43 percent. Yields for the elk described in this bulletin were higher because the carcasses were kept clean, most of the elk were shot in the ribs, and all edible lean from every cut was included in the boneless meat yield. When elk are shot in the shoulders or hind legs, when more trim is discarded because of fly strike or dirt on cuts like the ribs and flanks, and when most of the fat from excessively fat, barren cows is trimmed, the lean yields are lower. These factors help explain why locker-plant figures are often lower than the 50 percent boneless lean obtained in this study. The 43 percent boneless lean figure was obtained by B. T. Killion (personal communications), past owner of Dubois Cold Storage in Dubois, Wyoming. He used 56 elk carcasses which were delivered to the plant for processing. The clean-dressed weight (field-dressed weight minus the head and hide) of these carcasses, the great majority of which were bulls, was 305 pounds. The weight of boneless cuts was 159 pounds. The weight of boneless cuts is increased if beef or pork fat is added to the ground meat or if products such as salami are made. Elk meat often has fat and other ingredients added to it when it is made into salami or similar products.

A more complete breakdown of losses from the field-dressed weight to packaged retail-cut weight is given in Table 2. Some aging loss and some cutting and trimming loss can be eliminated if the aging period is reduced. This in turn would increase the boneless-cut weight.

Average field-dressed weights, boneless meat yield, and the proportion of Wyoming elk harvested in each age class are shown in Table 3. These figures, in addition to the proportion of bulls and cows harvested in 2001, were used to calculate an overall weighted average for field-dressed elk in Wyoming. The weighted average for all elk, including calves, was 328.2 pounds field dressed, which can be converted to 164.1 pounds of boneless elk meat per animal.

Resident hunters harvested 18,005 elk in Wyoming in 2001. Assuming that each successful hunter lives in an average Wyoming household of 2.48 persons (U.S. Census Bureau, 2000), each individual in the household would have had 66.2 pounds of boneless elk available for the year. Over a 365-day period, the amount of boneless elk available in the successful hunter's household would have been .18 pounds or about 3 ounces of boneless elk per person per day. Assuming that the average harvested elk was shared with 2.48 persons per household, 44,652 people in Wyoming out of the state's 493,754 people (9 percent) would have available approximately 3 ounces of elk per person per day. However, cooking loss, plate waste, and meat given to friends or pets would reduce the amount eaten. Violations of game-meat regulations which result in an excessive amount of meat left on a carcass could also reduce the amount of meat actually consumed. Hunters violate the law when they take only the back strap and hind quarters, leaving more than half of the boneless lean on the carcass.

Table 1. Weight conversion figures for bull elk.

Weight	Factor
Whole weight = 568 pounds[a]	1.42 x field-dressed weight
Field-dressed weight = 400 pounds *(viscera and feet removed)*	0.70 x whole weight
Skinned carcass weight = 332 pounds *(skin and head removed)*	0.83 x field-dressed weight
Boneless lean = 166 pounds	0.50 x field-dressed weight

[a] Whole weight is used in place of live weight. Whole weight is slightly less than live weight because it does not include blood loss at the time of harvest.

Table 2. Elk weight loss from carcass to cuts.

	Bulls (N=6) *pounds*	Cows (N=6) *pounds*
Field-dressed weight[a]	437	339
Losses:		
Head	39	19
Skin	34	26
Boneless lean, pounds[b]	218	169

[a] The weight includes the eviscerated carcass with head and hide attached but with the legs cut off at the knees and hocks.
[b] The weight includes 17.7 and 18.6 pounds of boneless lean from the brisket, plate, and flank of bulls and cows, respectively. These cuts are sometimes discarded because of contamination.

Composition and nutritional value of elk

One side of each elk carcass was boned, and the lean and fat were ground and thoroughly mixed together prior to sampling for chemical analysis (Table 4). Elk meat is high in protein and moisture and low in ether extract (fat) and calories when compared to most domestic meat. Elk is even leaner if all fat is trimmed. The USDA (1989) figure for lean trimmed of all fat is 1.4 percent. As would be expected, lower amounts of fat result in fewer calories per 100 grams. When the USDA figures in Table 4 are compared to the values for all lean and fat combined, calories in lean only are lower. A lower level of fat and fewer calories for lean from bull elk when compared to those of cow elk is due in part to the fact that elk are harvested after the rutting period. Rutting reduces the amount of fat in bull elk carcasses. Bull elk were harvested near the first of October. Therefore, they had been through about 40 days of rutting activity.

An elk carcass contains about the same amount of collagen (connective tissue) as beef and lamb. However, elk contains more connective tissue than antelope or deer as reported in University of Wyoming Cooperative Extension Service Bulletins B-575R and B589R, respectively. Other data collected at the University of Wyoming meat laboratory indicated that elk meat, like other lean meat, is high in the essential amino acids upon which the nutritional value of protein is based. No meaningful differences in essential amino acids were noted between beef and elk. Amino acid values for elk are listed in data published by the USDA (1989).

Table 3. Average field-dressed weight, boneless meat yield, and proportion of harvest in relation to age of elk[1].

Age class *(years)*	Males			Females		
	Weight[2]	Boneless meat[3]	Harvest percent[4]	Weight[2]	Boneless meat[3]	Harvest percent[4]
Calves	184	92	7.4	176	88	15.0
1½	280	140	29.9	244	122	11.5
2½	337	168	23.2	304	152	16.8
3½ to 4½	400	200	21.7	329	164	24.0
5½ to 6½	504	252	10.8	359	179	17.6
7½ to 8½	506	253	3.1	355	177	3.6
9½	509	254	.07	369	184	2.0
10½ and over	540	270	3.1	394	197	9.5
Age-weighted average	353			305		

[1] According to a mail-in survey by the Wyoming Game and Fish Department, the proportion of bulls including spikes, cows, and calves harvested in Wyoming in 2001 was 48.1, 43.7, and 8.2 percent, respectively.

[2] From Hay, et al. (1961)

[3] The field-dressed weight times 50 percent is equal to the weight of boneless meat. Because field-dressed weights often vary within age class, boneless meat yield can also vary as much as 20 pounds from the averages listed.

[4] The percentage of calves and 1½ and 2½-year-old hunter-harvested animals from 115 hunt areas throughout Wyoming in 2001 is based on the age structure of 4,185 field-checked animals. Wyoming Game and Fish laboratory tooth-ring data from hunter-harvested animals 3½ years and older were used to calculate the percentage in each age class over 2½ years because accurate ages for older animals are difficult to determine at check stations.

Table 4. Boneless elk carcass composition.

Chemical analysis of fat and lean combined	Bulls (N=6)[1]	Cows (N=6)[1]	Lean only[2]
Crude protein percent	23	21.8	22.9
Fat percent	4.5	7.8	1.4
Moisture percent	72.4	68.2	74.4
Ash percent	.09	.09	1
Calories (per 100 grams)	155	205	111
Collagen percent	3	2.7	
Muscle pH	5.5	5.5	

[1] Figures are based on the side which was aged two weeks with the hide left on.
[2] USDA (1989)

Muscle pH values of 5.5 in Table 4 for bulls and cows are normal for animals which are in a rested condition at the time of harvest. Meat from domestic animals normally has similar pH values. Fewer bacteria grow on meat from rested animals compared to meat from stressed animals. Ground elk meat in this study averaged 1,600,000 bacteria per gram after the meat had been aged two weeks and then frozen. Counts for deer and antelope were higher (University of Wyoming Cooperative Extension Service Bulletins B589R and B575R). The higher bacterial counts for deer and antelope meat when compared to elk meat are partially due to differences in the pH of the meat and partially due to the larger size of elk carcasses. Larger carcasses usually have fewer bacteria per gram of meat than smaller carcasses because of less surface area per unit of weight. Most of the bacterial contamination occurs on the surface and in gunshot areas.

Evaluation of the skinned and hide sides

On the average, 5 hours and 45 minutes elapsed between the time of harvest and the delivery of the carcasses to the University of Wyoming meat laboratory. The internal temperature in the thickest portion of the round averaged 88.5 degrees Fahrenheit on delivery. The average high temperature on the days the elk were shot was 55.4 degrees Fahrenheit. The high internal temperature of the round at the time of delivery indicates that even on relatively cool days, facilities to speed up the chilling of an elk carcass are beneficial.

One side of each carcass was skinned immediately when the field-dressed elk were brought to the meat laboratory. Chilling curves for the thickest portion of the round for each side are given in Figure 1. The internal temperature of the thickest portion of the round from the skinned side dropped to the 38-degree-Fahrenheit temperature of the cooler after 25 hours. The hide side cooled at a slower rate. The average internal temperature was about 45 degrees Fahrenheit after 25 hours. If the elk sides had not been hung to allow for good air circulation, the cooling rates would have been much slower.

A field-dressed carcass can be moved immediately after harvest without chilling. Under ideal conditions a carcass should be taken directly to a cooler where it can be skinned and chilled rapidly. If this is not possible, a hot carcass should be hung. If nights in camp are below freezing, skinning is not recommended because skin

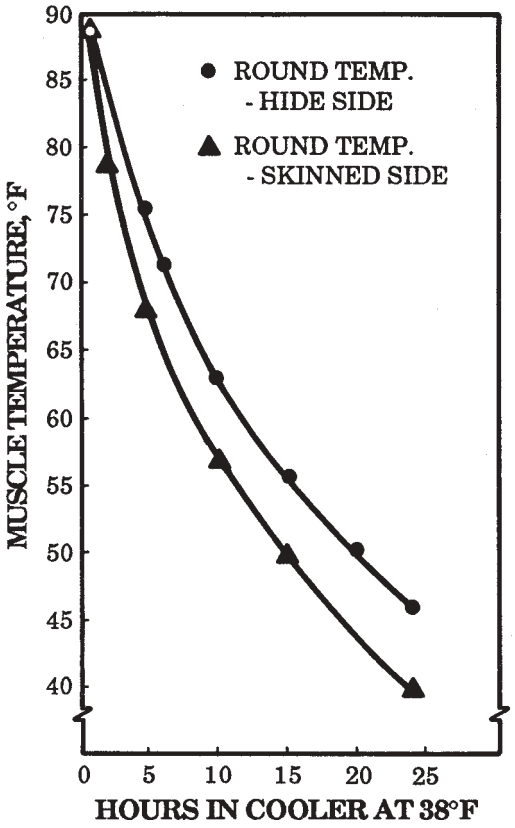

Figure 3. Chilling curves for the skinned and hide-on sides of elk carcasses.

protects a carcass from dirt. If nights are above freezing, skinning will be necessary to prevent spoilage. Cheesecloth or light cotton bags can be used to protect meat from fly strikes and dust. Meat from an elk carcass can sour even on cold days unless good air circulation around the carcass is provided. A carcass should be hung or laid on top of rocks or logs to allow for air circulation. Propping a carcass open also speeds up chilling.

Carcass weights from the skinned and hide-on sides of an elk at different aging periods are given in Table 5. The hide weight is included in the hide-on side weights. These sides lost 6.2 pounds over the aging period while the skinned sides lost 8 pounds of moisture over the same aging period. In addition, the hide prevented some mold and bacterial growth on the outside surface of the carcass and prevented the lean from becoming dark and dry. Therefore, waste from trimming dried and darkened lean should have been lower from the hide side. A comparison of trimming loss from the hide and the skinned sides was not possible because the hide side was ground for chemical and bacteriological analysis.

Table 5. Weight of sides from six bull elk carcasses at different aging intervals.

Aging interval	Hide on sides, *pounds*	Skinned sides, *pounds*
On arrival	197.5	179.5
1 day	195.7	177.3
7 days	192.8	174.0
14 days	191.3	171.5

Table 6. Tenderness differences due to aging.

Aging time	Warner-Bratzler shear values, pounds[a]	
	Bulls (N=6)	Cows (N=6)
1 day	8.33	8.92
14 days	6.65	4.95

[a] Lower values mean more tender meat. Values are in the pounds of force necessary to shear ½-inch diameter cores of rib-eye muscle roasted to an internal temperature of 160 degrees Fahrenheit.

If elk carcasses are to be aged, many of the disadvantages of aging can be eliminated by leaving the hide on. The aging disadvantages of excessive bacterial growth and darkened, dried lean can also be reduced if skinned sides of elk carcasses are aged for shorter periods. Cow meat was slightly but not significantly tougher than bull meat if frozen and later thawed and cooked with only one day of aging after harvest (Table 6). In the case of cow elk, one week of aging probably would have been sufficient from a tenderness standpoint. Cow loin roasts were very tender as indicated by the average shear value of 4.95 pounds after two weeks of aging. Meat from bull elk did not benefit as much from aging as that from cow elk. After two weeks of aging, bull meat was considerably tougher (shear value of 6.65 pounds) than cow meat. However, shear values of 7 pounds or less reflect acceptable tenderness scores. Many locker-plant operators object to aging elk because they are not chilled rapidly and have high bacterial contamination which results in spoiled meat. See University of Wyoming Cooperative Extension Service Bulletin B-513R for more information on aging big game.

Methods other than aging for tenderizing elk meat

Aging elk meat is not necessary if the meat is to be ground or made into a cooked sausage such as salami. Pot roasting or stewing elk meat will also render it tender without aging. Moist-heat methods of cooking (stewing, pot roasting, or braising) in place of dry-heat methods (roasting or broiling) are particularly beneficial in tenderizing tough meat. Therefore, moist-heat methods of cooking should be followed whenever meat is tough. Moist-heat cooking with spices and herbs can also be used to enhance or mask game-meat flavor. Game recipes which use a variety of spices and herbs are available in University of Wyoming Cooperative Extension Service Bulletin B-613R.

Summary

Elk should be eviscerated and hung to drain as soon after harvest as possible. The wearing of latex or rubber gloves when dressing an elk from CWD areas is recommended. These precautions are recommended even though CWD has not been linked to any human illness. Approximately 50 percent of a field-dressed carcass is boneless meat. The amount of gunshot trim,

the amount of meat left on discarded bones, and / or the length of aging time can alter the yield. Proper care and processing of the meat, as recommended in this bulletin, is the best way to avoid objectionable flavor. Approximately 3 ounces of elk per person per day are available to the average successful elk hunter and to each person in the household.

Consult the following publications for more information: *You and Your Wild Game*, B-613R; *Nutritional Content of Game Meat*, B-920R; *Skinning and Boning Big Game* B-884R; *The Mule Deer Carcass*, B-589R; *The Pronghorn Antelope Carcass*, B-565R; *Deer and Antelope Yield*, AS-102; and *Aging Big Game*, B-513R. To obtain these publications, call the UW CES Resource Center at (307)766-2115 or view the bulletins free of charge at www.uwyo.edu / ces / ansci.htm.

Literature cited

Hay, K. G., G. N. Hunter, and L. Robbins. 1961. *Big Game Management in Colorado, 1949-58*. Colorado Department of Game and Fish.

USDA 1989. "Composition of Foods: Lamb, Veal, and Game Products Raw, Processed, and Prepared." Human Nutrition Information Service, *Agriculture Handbook*: 8-17.

Williams, E. S., M. W. Miller, T. G. Kruger, R. H. Kahn, and E. T. Thorne, 2002. "Chronic Wasting Disease of Deer and Elk: A Review with Recommendations for Management." *Journal of Wildlife Management*, 66:551

Recommended procedure for handling elk carcasses from harvest to freezer

- Be certain an animal is dead.
- Bleed an animal by cutting the throat or sticking it. Caution: Do not cut the throat when the head is to be mounted and consult with a taxidermist before skinning.
- Eviscerate as soon as possible.
- Hang an animal to drain and wash the inside with clean water. Put the carcass on logs or rocks to allow for maximum air circulation if it cannot be hung.
- In warm weather, when possible, it is strongly recommended that a carcass be taken to a cooler the day of the kill. If this cannot be done, transport it to camp and skin it if the nighttime temperature is expected to be above freezing.
- If it is skinned, use cheesecloth or light cotton bags to keep a carcass clean and to protect the meat from insects.
- Make sure the internal temperature of the lean is cooled to 40 degrees Fahrenheit or below within 24 hours. This will often require cooling facilities.
- Trim fat, gunshot, and other inedible areas from a carcass when it is cut.
- Cut a carcass within seven days after harvest if it was chilled rapidly (see above) and sooner if warmer temperatures prevailed. Do not age an elk carcass if it was shot during warm weather and not chilled rapidly, if the animal was severely stressed prior to harvest, if gunshot areas are severe, or if the animal was under 1 year old.
- Mix 15 percent beef fat with ground elk and 35 percent beef or pork fat with fresh elk sausage.
- Wrap all cuts (fresh or cured) in good-quality freezer paper and store at 0 degrees Fahrenheit or below.
- Limit fresh elk to eight months of frozen storage and seasoned or cured elk to four months of frozen storage.

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