DENTITION AS A MEASURE OF PHYSIOLOGICAL AGE IN COWS OF DIFFERENT BREED TYPES

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Counting the number of permanent anterior (incisor plus canine) teeth is a well-established method for estimating physiological age in cattle. In this study, 1295 observations were made on cows and heifers representing five breed types and ranging in age from 475 to 2035 days. None of the breed types were identified as having an early- or late-maturing dentition. It was concluded that dental age classifications provide a viable alternative to the physiological maturity classes currently used in the Canadian Beef Carcass Grading System.

Le dénombrement des dents antérieures permanentes (incisives et canines) est une méthode consacrée d'estimation de l'âge physiologique des bovins. Dans cette étude, on a effectué 1295 observations sur des vaches et des génisses appartenant à cinq groupes génétiques et âgées de 475 à 2035 jours. Le degré de précocité de la dentition était sensiblement le même dans tous les groupes génétiques (races) examinés. Il semble donc que les classifications basées sur la dentition constituent une alternative pratique aux classifications d'après la maturité physiologique qu'on utilise actuellement dans le système canadien de classement des carcasses de boeuf.

Key words: Cattle, physiological age, dentition, carcass grading

Allen et al. (1974) referred to physiological maturity as "the relative stage of development of body processes, functions or composition." In beef cattle, estimates of physiological maturity are used for such things as carcass grading and show-ring judging of live cattle, when chronological age is unknown.

In both the Canadian and U.S. beef carcass grading systems physiological age is estimated by subjective appraisal of skeletal characteristics. This is unsatisfactory in that the appraisal becomes arbitrary in borderline cases, can result in very large chronological age ranges within a physiological age class (Graham and Price 1980), and the criteria of age (skeletal characteristics) cannot be observed in the live animal.

One well-established method of estimating physiological age in cattle is to count the number of permanent "incisor" teeth (Simonds 1855). Cattle have four pairs of teeth in the anterior portion of the lower jaw commonly referred to as incisors. However, anatomically only three pairs are incisors, the lateral teeth being canines (Andrews 1980). To avoid confusion the four pairs are referred to collectively as "anterior" teeth. It has been suggested (Graham and Price 1980) that since "dental age" is objective, observable in the live animal and gives a more precise estimate of chronological age, it should replace the present physiological age estimation for Canadian beef carcasses. The present study was undertaken to relate teeth numbers to chronological age in beef cows of widely differing breed types.

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MATERIALS AND METHODS

The cows used in this study were from the University of Alberta herd at Kinsella. Their ages ranged from 475 to 2035 days. The observations were made between January and June 1979; during October 1979; from March to June 1980; and during January 1981. The number of permanent anterior teeth was counted and recorded for each cow. A tooth was considered erupted if it had broken through the gum. Ninety of these observations were made after slaughter, the others were made on the live animal by restraining it in a headgate and examining its mouth. One, two or three observations were made on each cow for a total of 1295 observations. For those cows which were observed more than once, the observations were made at least 150 days apart.

There were five breed types of cows: purebred Hereford (HE), Beef Synthetic (SY), Dairy Synthetic (DY), a group selected for the double muscle syndrome (DM) and a Hereford crossbred group (HX). Each group has been fully described by Berg (1975).

In the analysis of the data, five dental age classes were used, beginning with milk tooth heifers having no permanent anterior teeth and increasing one pair of teeth at a time to four pairs, which is the adult condition (commonly referred to as "full mouth"). Within specific age intervals, chi-squared tests were performed on cross-tabulations of dental age × breed group to determine if these two variables were related in any way.

In an attempt to determine the mean age at which the transition from one dental age classification to another had occurred, it was necessary to sort through the data and find those cows in which the process of eruption was incomplete. These were cows with an odd number of permanent anterior teeth or cows in which the teeth were visible but not fully up. A mean age at eruption and a standard deviation were calculated for each pair of teeth.

RESULTS AND DISCUSSION

Within the experiment there was an uneven distribution of ages. This was caused by the fact that all of the cows had been born in the spring and the observation periods were not randomly distributed throughout the year. This is illustrated in Fig. 1. The ages of the cattle in the present study ranged from about 15 mo to about 6 yr. Most beef cattle in Canada are slaughtered within this age range and identifying the physiological age of cattle outside this range is not currently a problem. Within this age range, however, the correlation between Maturity division and chronological age is poor. The youngest cow with at least one permanent incisor in the present study was 648 days of age. The oldest cow with less than a full set of permanent anterior teeth was 1837 days of age. Ten 50-day intervals, corresponding to the pop-

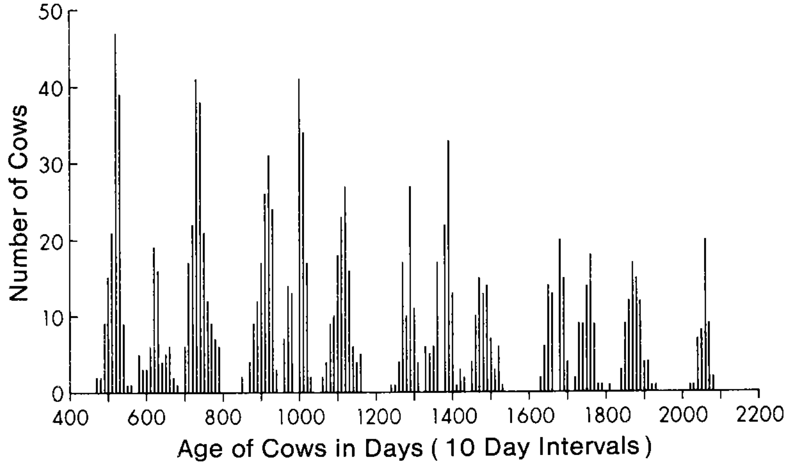

Fig. 1. The age distribution of 1295 observations of dental maturity in cows.

ulation peaks within this range of ages (as shown in Fig. 1) were selected for analysis. Within any 50-day interval, each animal was represented by only one observation. An overall summary of the chi-square tests, performed within these time intervals is presented in Table 1. Only one of these tests indicated a significant ($P<0.05$) relationship between breed and dental maturity within a chronological age group, and the contingency table for this age group (700–749 days of age) is shown in Table 2. It can be seen that in all breeds the majority of cows of this chronological age were in dental age class I (no permanent incisor teeth), and the minority in class III (3–4 incisors) with class II (1–2 incisors) intermediate. The significant effect is not, therefore, considered to be of biological importance. The overall conclusion is that, for most practical purposes, the relationship between dental maturity and chronological age is similar among the breed groups examined here.

There have been conflicting reports of the influence of breed on tooth eruption. Brown et al. (1960) examined Holstein-Friesian, Guernsey, Jersey, Brown Swiss, Ayrshire, Hereford, Angus and Shorthorn cattle and concluded that there were no breed differences in the age at eruption of the permanent anterior teeth; Bonsma and Neser (1951) found no differences between Afrikander and crossbred cattle. Other researchers have reported a breed effect: Tulloh (1962), using 36 steers and making observations at 21, 22, 23 and 24 mo of age reported the mean age at which the first pair of permanent incisors was observed. He found that Shorthorns (681.2 ± 11.5 (SE) days) were earlier than Herefords (724.9 ± 14.9 days), while Angus (708 ± 10.7 (SE) days) were not significantly different from either group. After a cross-sectional survey, Andrews and Wedderburn (1977) concluded that Herefords cut their first permanent incisors later than either Angus or Friesian. However, only 78 observations out of a total of 718

Table 1. The population distribution of cows on the basis of chronological age and dental maturity

Number of permanent anterior teeth	Age ranges (days)										
	700–749	880–929	960–1009	1070–1119	1250–1299	1330–1379	1430–1479	1610–1659	1690–1739	1800–1849	Total
	Number of cows in each age group										
0	83	—	—	—	—	—	—	—	—	—	83
1-2	55	87	53	3	—	—	—	—	—	—	198
3-4	1	23	66	75	10	6	1	—	—	—	182
5-6	—	—	—	15	54	73	29	7	—	—	180
7-8	—	—	—	1	5	12	29	61	59	63	230
Total	139	110	119	94	69	91	59	68	59	65	873
	Cross-tabulation of dental maturity by breed										
Chi square	17.434	4.875	3.549	20.453	12.348	5.610	13.177	3.940	—	1.250	
Degrees of freedom	8	4	4	12	8	8	8	4	—	4	
Significance	0.03	0.30	0.47	0.06	0.14	0.69	0.11	0.41	—	0.87	

Table 2. Cross-tabulation of dental age × breed for cows greater than 700 days of age and less than 750 days of age†

Number of permanent anterior teeth	Breed					
	HE	SY	DY	DM	HX	Total
	Number of cows					
0	11	32	16	6	18	83 (60)‡
1 or 2	8	26	12	2	7	55 (39)
3 or 4	0	0	0	1	0	1 (1)
Total	19 (12)‡	58 (42)	28 (20)	9 (6)	25 (18)	139 (100)

†Raw chi square = 17.434; 8 df; P = 0.0259.
‡Numbers in parentheses are percentages.

were made on Hereford cattle and the study included bulls, steers and heifers. Brookes and Hodges (1979), using Hereford, Dairy Shorthorn, Friesian and Hereford × Dairy Shorthorn were able to detect a significant effect of breed in the eruption times of the first permanent incisors (Herefords were 36 days later than Dairy Shorthorns) although level of nutrition was found to have at least as great an effect as breed. Thus, there is some inconclusive evidence to suggest that Herefords are somewhat later maturing in this trait than other breeds.

In Table 3, the time intervals studied have been increased to 200 days to allow inclusion of all the data gathered. The dental age classifications were the same as the ones used in Table 1. A considerable variation among animals was observed in the relationship between dental maturity and chronological age although within an age group a majority of the cows tended to be concentrated in one particular maturity class.

Mean age at eruption for each pair of teeth, calculated from cows with partially erupted teeth or odd numbers of teeth, are shown in Table 4. The uneven distribution of ages (Fig. 1) may introduce a bias into these results.

Andrews (1974) calculated the mean ages for the eruption of the first, second and third pairs of incisors and the canine teeth, (both members of a pair newly emerged) to be 690 ± 53.6 (SD) days, 840 ± 65.9 days, 1052 ± 84.1 days and 1302 ± 132.8 days, respectively. The estimates presented in the current study (Table 4) were based on a wider range of tooth development, representing an age range from the eruption of the first member of a pair to the time when the second member of the pair was considered fully developed. These values are all slightly greater than Andrews figures. The comparatively large size of the standard deviations associated with these values is partly due to the time interval between eruption and complete emergence. These intervals were reported by Wiener and Donald (1955) to be 5.9, 4.4, 5.3, and 9.8 wk for the first through fourth pairs of permanent anterior teeth, respectively.

CONCLUSIONS

The most important potential use of dental age classifications is in beef carcass grading and, outside North America, it is commonly used for this purpose. In the current Canadian beef grading system there are three physiological maturity classes based on skeletal traits. Under this system many cows can qualify for the youthful maturity class at any age up to 5 yr (Graham and Price 1980). The use of dental age would ensure a more accurate identification of youthful carcasses and so ensure a more uniform standard of meat quality, among these carcasses. Dental age would similarly reduce the considerable overlap of chronological ages found among the maturity classes in the present Canadian Beef

Table 3. The relationship between dental maturity and chronological age

Number of permanent anterior teeth	Age range (days) 475–599	600–799	800–999	1000–1199	1200–1399	1400–1599	1600–1799	1800–2035	Total
	Number of cows in each age group								
0	155	152	—	—	—	—	—	—	307
1-2	—	88	153	13	—	—	—	—	254
3-4	—	1	84	111	19	2	—	—	217
5-6	—	—	—	19	145	34	7	2	207
7-8	—	—	—	1	17	39	134	119	310
Total	155	241	237	144	181	75	141	121	1295

Table 4. Mean age at eruption for the permanent anterior teeth of 109 beef cows

Pair of permanent anterior teeth	No. of observations	Mean ages at eruption	SD
First	35	732	22.5
Second	21	977	76.5
Third	19	1220	129.9
Fourth	34	1512	170.4

Carcass Grading System (Price and Graham 1980). The problem of positively matching heads with carcasses in the packing plant would need to be solved, but many examples of achieving this are available from other parts of the world. Because the anterior teeth are visible in the live animal, dental age classification would also give more guidance to producers and packer buyers trading in cull cows and heifers. Although at least five dental age classes are possible, the amount of biological variation suggests that using four or less may prove more practical. When cattle of equal chronological age fall into more than two different maturity classifications, those people using the system may have good reason to question its accuracy. By combining all cattle having from three to six permanent incisors into a single class, this problem is almost completely eliminated.

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