

GENETIC EVALUATION OF BEEF CARCASS DATA USING DIFFERENT ENDPOINT ADJUSTMENTS

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INTRODUCTION

Estimation of EPD for carcass traits provides cattle breeders with a selection tool for improving carcass traits in breeding animals and their commercial offspring. However, accurate estimation of these values is necessary to make them a useful tool. Currently in the U.S. national cattle evaluation system, carcass trait EPD are calculated at a constant age endpoint; but timing of harvest is usually based on endpoints other than age, such as backfat thickness, marbling score, or carcass weight, or combinations thereof, in an attempt to maximize profitability by minimizing discounts and increasing premiums. Therefore, age may not be the most appropriate adjustment when calculating carcass EPD.

When alternative endpoints are chosen for EPD, reranking of sires is of particular concern because reranking may be indicative of the trait evaluated being changed when the endpoint is changed. Previous studies have suggested that endpoint may affect ranking of sires (i.e., Koch et al., 1995; Shanks et al., 2001; Ríos-Utrera, 2005), which suggests that if the industry does not harvest animals at a constant

age, sires are potentially being ranked incorrectly using current industry standard age adjusted endpoints. Therefore, the objective of the current study was to determine if sire reranking occurs when alternate end points are used.

MATERIALS AND METHODS

Data for this project were made available by the American Simmental Association. Summary statistics are provided in Table 1.

Traits measured included 12th rib backfat thickness (**FAT**, n = 6,546), hot carcass weight (**HCW**, n = 6,795), marbling score (**MRB**, n = 6,368), longissimus muscle area (**LMA**, n = 6,728), and percent retail cuts (**PRC**, n = 5,983). All measurements were collected via USDA graders with PRC being calculated from the component traits of HCW, LMA, and FAT. Percent kidney, pelvic, and heart fat (**KPH**) measurements were not recorded in this data set and were assumed to be 2.5% for all carcasses. These values were used to calculate $PRC = 51.34 - (2.276 \times FAT, \text{ cm}) - (0.0205 \times HCW, \text{ kg}) - (0.462 \times KPH, \%) + (0.1147 \times LMA, \text{ cm}^2)$ (Boggs et al., 1998).

Table 1. Summary statistics for five carcass traits¹

	Trait				
	FAT, cm	HCW, kg	MRB, score	LMA, cm ²	PRC, %
Minimum	0.076	211.3	200	52.26	43.9
Maximum	3.683	509.0	1000	134.84	55.3
Mean	0.356	354.7	498	88.07	50.9
N (sires)	635	643	601	643	581
N (records)	6,546	6,795	6,368	6,728	5,983

¹ FAT = fat thickness; HCW = hot carcass weight; MRB = marbling; LMA = longissimus muscle area; PRC = percent retail cuts

Data for each trait were adjusted to each of four endpoints: age (EPA), backfat (EPF), hot carcass weight (EPC), or marbling (EPM). Adjustments were made by fitting a linear and quadratic covariate for the chosen endpoint. For HCW, MRB, and FAT, heritability estimates were not undertaken when the adjustment was the trait itself. For instance, heritability of HCW was not estimated in a model adjusting for HCW endpoint.

RESULTS AND DISCUSSION

Estimates of heritability for each trait adjusted to each endpoint are shown in Table 2. With the exception of PRC, estimates of heritability within a trait were similar regardless of endpoint chosen, which is in agreement with results from Bergen et al. (2006a, 2006b) and with the review of carcass analyses by Utrera and Van Vleck (2004). However, estimates were smaller than those typically found for carcass traits using field data (i.e., Wilson et al., 1993;

Hirooka et al., 1996; Pariacote et al., 1998). Estimates were 0.12 to 0.14, 0.32 to 0.34, 0.26 to 0.27, and 0.27 for FAT, HCW, LMA, and MRB, respectively. For PRC, the heritability estimate of 0.32 using EPF was significantly larger than heritabilities estimated using the other three endpoints (0.20 to 0.23).

For FAT, HCW, and MRB, there was little difference in ranking of sires when the endpoints were changed. There were moderate differences in ranking for LMA, however, particularly when comparing EPA to EPC as shown in Figure 1. The lower correlation between EPA and EPC is likely due to the fact that these are positively correlated traits (Crews and Kemp, 2001) and adjusting LMA for HCW decreases the genetic variability in LMA, which is in agreement with results shown by Lee et al. (2000). It appears that this adjustment results in an altered definition of LMA EPD that likely does not reflect industry practices.

Table 2. Estimates of heritability for five carcass traits¹ adjusted to four different endpoints²

Endpoint	Trait				
	FAT	HCW	MRB	LMA	PRC
EPA	0.13 ± 0.03	0.33 ± 0.05	0.27 ± 0.04	0.26 ± 0.05	0.23 ± 0.05
EPF		0.34 ± 0.05	0.27 ± 0.04	0.26 ± 0.05	0.32 ± 0.05
EPC	0.14 ± 0.04		0.27 ± 0.04	0.27 ± 0.05	0.21 ± 0.05
EPM	0.12 ± 0.03	0.32 ± 0.05		0.26 ± 0.05	0.20 ± 0.04

¹ FAT = fat thickness; HCW = hot carcass weight; MRB = marbling; LMA = longissimus muscle area; PRC = percent retail cuts

² EPA = age endpoint; EPF = fat thickness endpoint; EPC = carcass weight endpoint; EPM = marbling endpoint

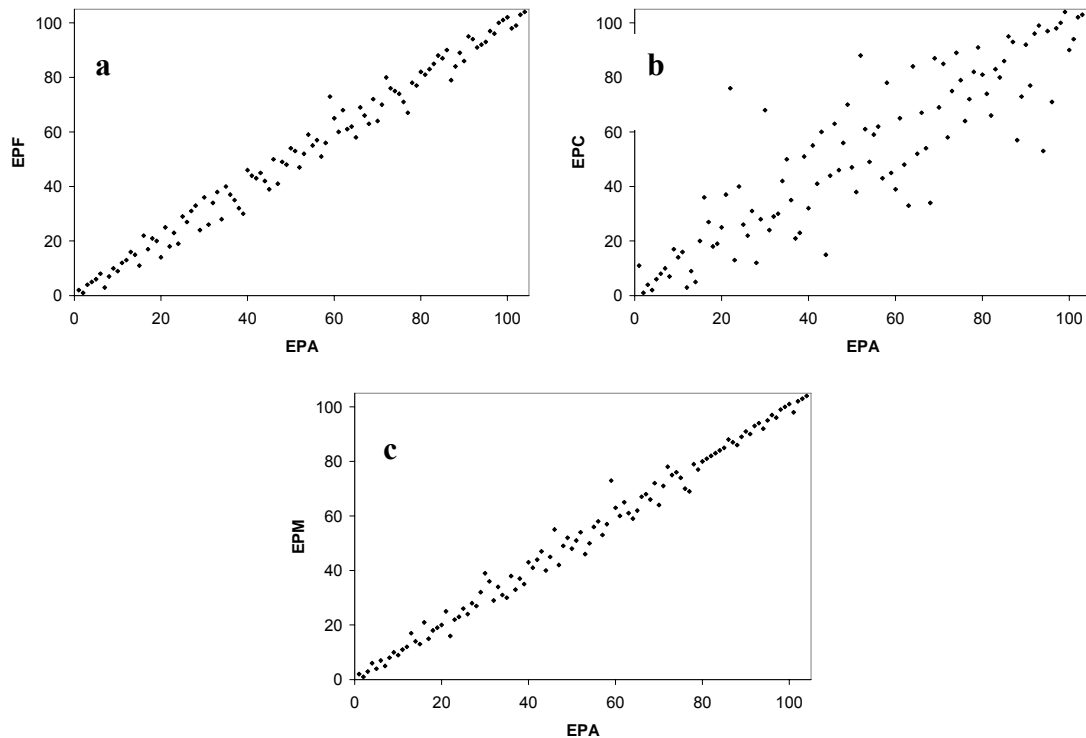


Figure 1. Rank of high accuracy bulls for longissimus muscle area at an age endpoint (EPA) compared to alternative endpoints. (a) Backfat thickness (EPF), (b) hot carcass weight (EPC), and (c) marling score (EPM) endpoints.

In Figure 1a, the ranking of the 100 highest accuracy sires for LMA using EPA and EPF is shown. Ranking is very similar between these two endpoints. However, as shown in Figure 1b, there is a greater amount of reranking when comparing EPA and EPC. As discussed previously, EPC does result in more reranking than other endpoints and likely should not be used for calculation of national cattle evaluations. In Figure 1c, the comparison of EPA and EPM is shown to result in little reranking among these high accuracy sires.

Although there was reranking for LMA, it was not as extreme as what was found in PRC. Because FAT, HCW, and LMA are all component traits of PRC, adjusting for FAT essentially eliminated the effect of that trait in the PRC calculation. This adjustment, in turn, changes the PRC from a trait partially influenced by backfat to a trait solely dependent on HCW and LMA and whose meaning is different than the original concept of PRC. This

is supported by the fact that the estimate of heritability was similar to those obtained for HCW at all endpoints.

Unlike the other traits, PRC was sensitive to endpoint adjustment. Compared to EPA, estimates of genetic variance were 65%, 84%, and 82% for EPF, EPC, and EPM, respectively. Although all adjustments relative to EPA resulted in reduced genetic variance, the adjustment for EPF was of most concern with the adjustment removing more than one third of the genetic variation. This is similar, but more extreme than the reduction by 16% found by Devitt and Wilton (2001). The reduction is partially due to FAT being a component trait of PRC. The reduction in genetic variation using EPC is also due to the fact that HCW is a component trait of PRC, although the reduction seen using this adjustment is not as extreme as for EPF.

Spearman rank correlations were 0.73 ($P < 0.01$), 0.93 ($P < 0.01$), and 0.95 ($P < 0.01$) for

EPF, EPC, and EPM, respectively. Although all three endpoints result in decreased genetic variance relative to EPA, rankings were similar for EPC and EPM. The much lower correlation of 0.73 indicates that adjustment for FAT produces a change in the defined trait likely due to the fact that FAT is a component trait for PRC and the EPF is altering the trait so that it can no longer be considered PRC. Although both HCW and FAT are component traits of PRC, the difference when adjusting to EPC is not as extreme as when adjusting to EPF, compared with the traditional EPA. This difference may be explained by the increased

coefficient of variation seen in the FAT vs. HCW phenotypes used to calculate PRC. The coefficient of variation for FAT is 41.3% and for HCW is 11.6%. Therefore there is greater chance of change in FAT than in HCW within the PRC equation.

Figure 2 depicts the ranking of high accuracy sires for PRC using EPA compared to EPF, EPC, and EPM. Reranking among these high accuracy sires is the greatest in PRC, particularly using EPF in support of the Spearman rank correlations calculated using all animals in the pedigree.

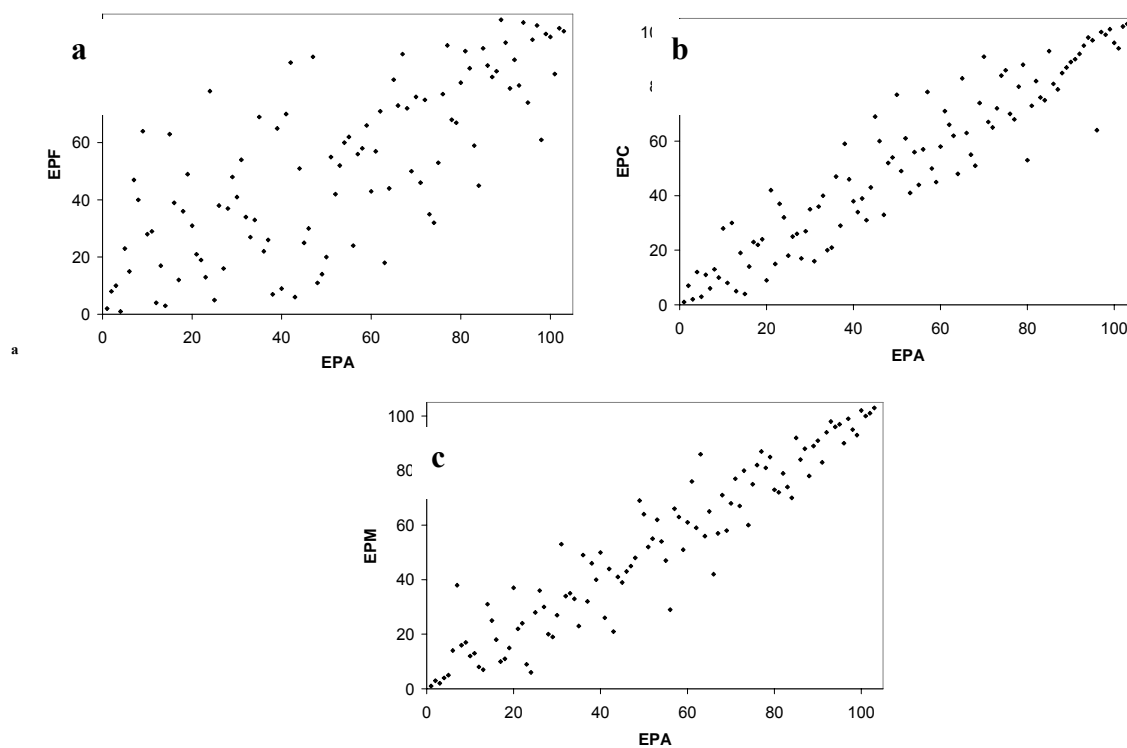


Figure 2. Rank of high accuracy bulls for percent retail cuts at an age endpoint (EPA) compared to alternative endpoints. (a) Backfat thickness (EPF), (b) hot carcass weight (EPC), and (c) marling score (EPM) endpoints.

For FAT, HCW, LMA, and MRB, endpoint does not appear to influence sire rank, so EPD calculated to EPA, EPF, EPC, and EPM should essentially result in similar outcomes regardless of the endpoint used to decide harvest date. Choice of endpoint would be a concern for PRC as the EPF significantly reranks sires relative to the current EPA adjustment. Further

investigation is necessary to determine which adjustment is most predictive of PRC based on the way cattle are currently slaughtered in the United States.

IMPLICATIONS

For most traits, there is little reranking of sires when evaluated at alternate endpoints.

However, endpoint has a large effect on the ranking of sires for percent retail cuts and longissimus muscle area. Adjusting percent retail cuts for backfat and longissimus muscle for carcass weight appears to change the definition of these traits. It has been shown that these traits rerank sires across varying endpoints, but it is unclear as to which endpoint is the most predictive of future progeny performance. Further investigation is needed to determine whether these alternative endpoints result in a more predictive estimate of expected progeny differences than the traditional age endpoint.

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