BEEF YIELD GRADING: *History, Issues, and Opportunities*

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Beef grading history

The United States beef yield grade arose from industry interest in yield measurement beginning in the 1950's. The landmark data from which the yield grade is derived was presented at the American Society of Animal Production meetings in Chicago in 1960 and consisted of 162 beef carcasses representative of the period (Murphey et al., 1960). Those data were used to develop a multiple-linear prediction equation using 12th rib fat depth, percentage kidney-pelvic-heart fat, hot carcass weight and ribeye area to estimate percentage boneless closely trimmed round loin rib and chuck (BCTRLRC). A second equation, the calculated yield grade, was developed as a 1 through 5 index using the same four carcass variables to estimate ranges of BCTRLRC. Yield grading began as a one-year trial in July 1962 and was put into effect on June 1, 1965.

Since the industry began using the yield grade equation, much research (Abraham et al., 1968; Abraham et al., 1980; Reiling et al., 1992; Farrow et al., 2009) has evaluated the ability of the four chosen variables to estimate boneless lean yield. Subcutaneous fat depth measured at the 12th rib is most closely related (r = -0.53 to -0.66) to boneless lean yield, followed by percentage kidney-pelvic-heart fat (r = -0.18 to -0.58), ribeye area (r = -0.18 to 0.51), and hot carcass weight (r = -0.03 to -0.53).

At inception, the yield grade was either determined from objective measures of 12th rib fat depth (using fat ruler) and ribeye area (using dot grid) or subjectively assessed. By 1978, the GAO reported to the U.S. Congress that yield grade needed to be assessed more accurately (Woerner & Belk, 2008). Development of an electrical instrument grading system began in 1980 and through several iterations of improvement and validation, instrument grading became a reality in 2007. No industry standard exists concerning subjective human versus objective instrument grading; instrument grading use ranges from none to the sole determinant of yield and quality grade.

Economics of yield grading

Value-based sales in which yield grade premiums and discounts may alter the final carcass value are an ever-increasing proportion of beef cattle/carcass marketings. The maximum premium offered for a yield grade 1 equals $8/cwt. whereas a yield grade 5 carcass carries up to a $20/cwt. discount (USDA 2016a). When the maximum reported yield grade premium or discount is applied to a 900-pound carcass, carcass value is altered by +$72, +$45, -$135, and -$180 for yield grades 1, 2, 4, and 5, respectively. Application of the previous values to the annual fed beef population indicates the potential industry value for yield grade valuation is +$108 million, +$326 million, -$309 million, and -$61 million for yield grades 1, 2, 4, and 5, respectively (USDA, 2016a; USDA, 2016b).

Inconsistencies and challenges

The era in which the yield grade was developed was dominated by small-framed early maturing cattle which were primarily purebred Herefords. In contrast, the current fed beef population is a kaleidoscope of genetic diversity that is medium and large in frame; the greatest population of purebred animals is now represented by the Holstein breed. Moreover, cattle feeding technology including growth promoting implants and beta-adrenergic agonists offer cattle feeders the opportunity to maximize growth and manipulate composition of gain. Improvements in genetic selection and growth technology have resulted in annual hot carcass weight gains of 5 pounds for steers and 6 pounds for heifers. Continuation of the current trend suggests that mean hot carcass weights will reach 1000 pounds in the years 2040 and 2046 for fed steers and heifers, respectively. In contrast, the population of cattle from which the yield grade equation was derived ranged from 350-900 pounds with a mean hot carcass weight of approximately 600 pounds.

The relationship between hot carcass weight and rib eye area has been assumed to be linear as denoted in the yield grade equation (USDA, 1997) and displayed on a rib eye measurement dot grid. In contrast, we have demonstrated that relationship is quadratic in total, with a linear portion that is represented by a lesser rate of longissimus muscle growth than assumed (Lawrence et al., 2008). When yield grades derived from the multiple-linear equation are compared to red meat yield, 40% of the variation in red meat yield can be accounted for in beef-type carcasses (Lawrence et al., 2010). However, 0% of the variation in red meat yield can be accounted for when the yield grade equation is applied to Holstein steers (Lawrence et al., 2010). The lack of relation is Holstein steers is most likely due to limited or disproportional subcutaneous fat deposition as compared to other lipid depots combined with a lesser muscle to bone ratio.

Potential modifications and other systems

Camera grading technology has the ability to redefine appropriate linear measures to predict red meat yield of beef carcasses. However, today camera systems continue to use the equation generated from 162 carcasses harvested in the 1950's. Farrow et al. (2009) demonstrated that other variables could be generated to improve predictability of red meat yield. Although no official changes are slated to be made to alter the yield grade equation, this author suspects that individual beef processors have gathered and are using such information in-house.

In considering how to improve upon the USDA system, it is imperative that we reflect on what other nations are doing. Our Canadian neighbors developed their current beef yield system in 1992; that system uses metrics of muscle width (dorsal-ventral distance), muscle length (medial-lateral distance), and subcutaneous fat depth to predict percentage carcass lean. Notably, the Canadian system does not include hot carcass weight or percentage kidney-pelvic-heart fat. Similarly, a system developed to predict yield of Japanese beef carcasses measures subcutaneous fat depth, intermuscular fat depth, and rib eye area – albeit at the 6th rib location as well as a cold carcass weight specific to the left carcass side. Beef producers in Europe have still another method of lean prediction, a subjective evaluation of carcass muscle conformation combined with a subject evaluation of fat deposition.

In summary, we continue to use a yield estimation system developed from a small population of cattle that no longer exist to predict red meat yield of cuts that are increasing leaner. We apply that estimate to carcasses that weigh beyond the inference of which it was designed and we have ignored the opportunity to develop new yield estimates afforded by camera grading. Leadership within the beef community must decide if the status quo is acceptable, or if improvement is warranted.

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