# The Effect of Coring Method on Beef Longissimus Muscle Shear Force Values

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# THE EFFECT OF CORING METHOD ON BEEF *LONGISSIMUS* MUSCLE SHEAR FORCE VALUES[1]

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**Summary**

Thirty Zebu steer carcasses were selected at Sao Paulo, Brazil commercial slaughter facility on the basis of A, C or E USDA beef carcass maturity standards. The *longissimus* muscle of the short loin was excised 7 days postmortem, and a 2.54-cm steak was removed for Warner-Bratzler shear evaluation. The remaining portion of the meat was vacuum-packaged and stored an additional 14 days. At that time, another 2.54-cm steak was removed for Warner-Bratzler shear evaluation. After cooking, hand cores were taken parallel to the orientation of the majority of the muscle fibers, and another set from the same steak was taken by machine, perpendicular to the steak's cut surface, without regard to muscle fiber orientation. There were no differences ($P>.10$) in shear force values between steaks from different maturity groups, regardless of coring method. Simple correlation coefficients between coring methods across maturity groups were .81 and .80 ($P<.001$) for steaks cut 7 and 21 days postmortem, respectively. Spearman rank correlation coefficients for the same data were .84 and .75 ($P<.001$). Warner-Bratzler shear tests on *longissimus* muscle cores obtained by either coring method resulted in the same relative data interpretation. (**Key Words:** Beef *Longissimus* Muscle, Shear Force, Coring Method.)

## Introduction

Steaks from the *longissimus* muscle, usually cut perpendicular to the long axis of the muscle, are commonly used for evaluating muscle palatability. Since Bratzler (1932) specified that cores for Warner-Bratzler shear evaluation should be taken parallel to the predominant fiber orientation, some investigators have questioned whether values for cores taken without regard to fiber orientation (cored perpendicular to the steak's cut surface) are valid. The American Meat Science Association (AMSA, 1978) recognizes both coring techniques (parallel and perpendicular) as acceptable.

If cores could be taken mechanically without regard to fiber orientation, core diameter would be more nearly uniform (Kastner and Henrickson, 1969) and time and effort could be saved.

Because some investigators have questioned the validity of the mechanical coring method because it disregards muscle fiber orientation, we compared results obtained by the two methods.

## Materials and Methods

Three groups of 10 Zebu steer carcasses in a Sao Paulo, Brazil, commercial slaughter facility were selected on the basis of A, C and E USDA beef carcass maturity standards. One evaluator selected all carcasses. Carcasses were chilled about 20 hr and shipped to the Instituto do Tecnologia de Alimentos (ITAL) in Campinas, Sao Paulo, where they were stored for approximately 48 hr in a 2 C cooler.

*Longissimus* (LD) muscles were excised from one side of each carcass from the 13th rib to that last lumbar vertebra (short loin). Seven days postmortem, one 2.54-cm steak was cut 5.0 cm from the cranial end of each LD. The remainder of the LD was vacuum-packaged and stored at about 2 C for an additional 14 days before an adjacent steak was removed. The steaks, aged 7 and 21 days, were wrapped, frozen and stored (−40 C) for subsequent Warner-Bratzler shear evaluation.

Upon thawing (2 C for 24 hr), all steaks were cooked to a final internal temperature of 70 C in a 170 C oven (AMSA, 1978). Thermocouples were used to monitor steak and oven temperatures. After steaks had cooled for about 2 hr at

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TABLE 1. EXPERIMENTAL DESIGN USED FOR COMPARING CORING METHODS[a]

| Aging treatment, days postmortem | USDA maturity group | No. of steaks per maturity group |
|---|---|---|
| 7 | A | 10 |
| | C | 10 |
| | E | 10 |
| 21 | A | 10 |
| | C | 10 |
| | E | 10 |

[a]Six hand and six machine cores were taken from each steak. Hand cores were taken parallel to the predominant muscle fiber orientation. Machine cores were cut perpendicular to the steak cut surface, without regard to muscle fiber orientation.

TABLE 2. CARCASS CHARACTERISTICS, BY USDA MATURITY GROUP

| Carcass characteristic | USDA maturity groups A | C | E |
|---|---|---|---|
| Hot carcass weight, kg | 251.5 | 275.1 | 281.7 |
| 12th rib loineye area, $cm^2$ | 65.2 | 70.1 | 62.7 |
| 12th rib fat thickness, mm | 4.3 | 6.8 | 8.4 |
| Kidney fat, % | 1.3 | 1.6 | 1.4 |
| USDA yield grade | 2.0 | 2.3 | 2.8 |
| Bone maturity[a] | $A^{71}$ | $C^{22}$ | $E^{26}$ |
| Marbling[b] | $Sl^{40}$ | $Sm^{31}$ | $Sm^{08}$ |

[a]Bone maturity based on 0 to 100% increments within each A, B, C, D or E USDA bone maturity standard.

[b]Marbling based on 0 to 100% increments within each USDA marbling degree.

room temperature, sample cores for the Warner-Bratzler shear tests were taken. Six 1.27-cm cores were taken by hand (hand cores) from each steak parallel to the predominant muscle fiber orientation. Six 1.27-cm cores were then taken by machine (machine cores), perpendicular to the steak cut surface, without regard to muscle fiber orientation (Kastner and Henrickson, 1969). Each core was sheared once. The experimental design is presented in table 1.

Analysis of variance was used to determine whether both coring methods detected the same relative differences between maturity groups and aging treatments. In addition, simple and Spearman rank correlation coefficients were calculated for the two coring methods (Snedecor and Cochran, 1967).

### Results and Discussion

Carcass composition and quality indicators based on USDA quality and yield grade criteria are presented in table 2. Mean maturity scores for each group, as selected, were $A^{71}$, $C^{22}$ and $E^{26}$.

No mean shear value differences (P>.10) between the three maturity groups were detected by analysis of variance for each coring method and aging treatment (table 3). This finding is in general agreement with those of Romans *et al.* (1965) and Reagan *et al.* (1976), who observed no significant shear value differences with advancing maturity, but, unlike in this study, did find a trend toward lower shear values for younger carcasses.

TABLE 3. MEAN SHEAR VALUES (KILOGRAMS), BY DAYS AGED, USDA MATURITY GROUP AND CORING METHOD

| Coring method[a] | USDA maturity groups A | C | E | F statistic |
|---|---|---|---|---|
| | | 7 days aging | | |
| Hand | 5.74 ± 1.67 | 5.16 ± 1.25 | 5.34 ± 1.38 | $.43^{NS}$ |
| Machine | 5.00 ± 1.27 | 4.70 ± 1.04 | 5.11 ± .95 | $.38^{NS}$ |
| | | 21 days aging | | |
| Hand | 4.16 ± 1.29 | 4.57 ± .68 | 4.49 ± .84 | $.04^{NS}$ |
| Machine | 4.48 ± 1.03 | 4.56 ± .85 | 4.34 ± .80 | $.06^{NS}$ |

[a]Hand cores taken parallel to predominant muscle fiber orientation; machine cores taken perpendicular to cut surface of steak without regard to fiber orientation.

$^{NS}$Nonsignificant (P>.10) differences between maturity group means within coring method and days aging.

Our findings disagree with those of King *et al.* (1958), Breidenstein *et al.* (1968) and Tuma *et al.* (1971), who reported a significant increase in shear values with advancing carcass maturity. However, the steaks used in our study were from animals of Zebu origin that had been finished on grass and not grain. In addition, there may have been a complicating effect of cold-induced toughening due to differences in fat cover between maturity groups. More mature cattle had more fat cover (table 1), which could have masked differences due to degree of maturity (Marsh, 1977).

The absence of any differences (P>.10) between maturity groups allowed us to pool data to calculate correlation coefficients between hand and machine coring methods. Simple correlation coefficients between coring methods were .81 for steaks aged 7 days and .80 for those aged 21 days (P<.001; table 4).

To compare the shear force ranking of steaks sampled by the machine coring method with that of steaks sampled by the hand coring procedure, we calculated Spearman rank correlation coefficients. The pooled coefficients (table 5) were .84 for steaks aged 7 days and .75 for those aged 21 days (P<.001). Within maturity groups, all coefficients were significant (P<.01 and below), with the exception of those for 21-day aged steaks in maturity groups C and E (.73, P<.02; .56, P<.10). These lower correlation coefficients may have been due to less variation in shear values within those groups (table 3).

For machine coring, precautions should be taken to ensure that *longissimus* muscle steaks are cut perpendicular to the long axis of the muscle. In addition, steak location within the *longissimus* muscle and core location within the steak should be standardized as much as possible. This will help ensure core uniformity and facilitate the comparison of treatments.

Comparison of absolute shear values from different experiments is extremely difficult since the values are influenced by such factors as coring method and size, cookery method, initial and final temperature, steak location in the muscle and machine differences. However, if relative differences are of primary interest, results of this study indicate that machine and hand coring procedures give comparable results.

TABLE 4. SIMPLE CORRELATION COEFFICIENTS FOR HAND *VERSUS* MACHINE CORE SHEAR VALUES, BY DAYS AGED, POOLED ACROSS MATURITY GROUPS AND BY MATURITY GROUP

| USDA maturity | 7 days aging | 21 days aging |
|---|---|---|
| Pooled | .81*** | .80*** |
| A | .92*** | .91*** |
| C | .67* | .79** |
| E | .81** | .64* |

*P<.05.
**P<.01.
***P<.001.

TABLE 5. SPEARMAN RANK CORRELATION COEFFICIENTS FOR HAND *VERSUS* MACHING CORE SHEAR VALUES, BY DAYS AGED, POOLED ACROSS MATURITY GROUPS AND BY MATURITY GROUP

| USDA maturity | 7 days aging | 21 days aging |
|---|---|---|
| Pooled | .84*** | .75*** |
| A | .90*** | .92*** |
| C | .84** | .73' |
| E | .85** | .56+ |

**P<.01.
***P<.001.
'P<.02.
+P<.10.

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