Economic Comparison of Weaning and Feeding Strategies for Beef Production

By Kendall Eisele, John Ritten, Christopher T. Bastian, Steven Paisley, and Scott Lake

Abstract

The current market environment for corn prices place many firms involved with cattle feeding in financial distress. Producers are looking for ways to ease the burden of higher feed costs and uncertainty associated with the grain market. Some options include altering weaning dates and implementing low cost feeding strategies that only utilize high cost feedstuffs at critical life stages. Profitability comparisons are made across alternative feeding and weaning strategies using a Monte Carlo simulation replicating both input and output prices for distributions based on historical data to assess overall profitability of the alternative management strategies analyzed.

Bio-fuel production is driving an unprecedented change in animal agriculture throughout the United States. The growing corn ethanol and soy-diesel industries provide significant economic benefits to grain producers. However, the resulting increases in feed prices and lack of suitable alternative energy-dense feedstuffs present serious challenges for traditional livestock production systems. To offset higher feed costs, alternative production strategies are needed for producers to remain viable and competitive in the beef industry. One potential means of achieving this goal is to use more expensive feeds only during critical stages in the life cycle of beef cattle when a high plane of nutrition is necessary for optimal performance, while utilizing less expensive feedstuffs during less critical periods. Furthermore, adapting a new production system to include grazing crop residues will act to not only decrease reliance on high priced feedstuffs, but it will also utilize inexpensive resources that may be readily available. The objective of this research is to analyze potential alternative production systems which could result in reduced feed cost without sacrificing animal performance.





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Developing a means to improve the efficiency of production and profitability of high quality carcasses is essential to increase beef quality and the economic viability of producers (Wertz et al., 2002). Typical beef cattle production systems in the United States often wean calves in the fall at approximately 205 days of age. However, peak milk production occurs between 45-60 days of lactation in most British and Continental breeds (NRC, 1996). Therefore, declining milk production beyond 60 days coupled with accelerated calf growth, limits energy intake and calf growth (Robinson et al., 1978). Historically, weaned calves were fed mostly forage diets and, as a result, were forced to grow at slower rates until they reached 800-900 pounds, when they were fed high grain-based diets until slaughter (1200-1400 lbs.). This production system maximized skeletal growth and allowed cattle to reach heavier carcass weights while minimizing time in the feed yard. Inexpensive grain prices and the demand for higher quality carcasses caused a paradigm shift towards placing more calves into a feed yard immediately after weaning. This production system reduced cattle age at harvest and increased carcass quality while maintaining acceptable carcass weights, though not as heavy as yearling cattle.

The recent surge in grain prices has placed a heavy financial burden on feedlot operators. While this system has been effective in producing quality carcasses (high marbling) at an acceptable body weight for over a decade, cattle feeders lost an average of over $50 per head in 2006 and 2007 (Cattle Network, 2007). With generally higher feed prices and changes in the price of grains relative to roughages, traditional rations and cattle growth in feedlot settings has become more expensive than cattle growth on pasture or range (Hirschi and Feuz, 2011; Brokken et al., 1976). A philosophical change towards low input systems that produce high quality cattle grown to equivalent market weights is necessary if the U.S. is to remain a leader in world markets. One proposed management strategy for steer calf development is to reduce the amount of high valued feeds fed throughout the life cycle of beef cattle. This can be done by weaning calves early (around 120 days) and placing them on a high quality diet. Although calves still consume a relatively expensive diet for about 80 days, these cattle will only weigh approximately 330 pounds, which means they will consume less total feed compared to heavier cattle fed high concentrate diets. Moreover, feeding less expensive, lower quality feeds during later stages of development, when calf dry matter intake increases, could reduce the cost of feeding developing steers. Additionally, grazing crop residues integrates a feeder calf development and cropping system to supply a feed resource that is inexpensive and in many instances, already on inventory.

Thus, this research examines cattle production from birth to slaughter, specifically analyzing alternative production options such as utilizing expensive, high-quality feeds only at critical life stages and introducing cheaper feed options when available. This research utilizes data from cattle feeding experiments coupled with a simulation to assess profitability and variability across various input and output prices for different feeding strategies from different firm perspectives in the beef supply chain. Four alternative management and feeding strategies are analyzed: 1) Early wean, graze on cornstalks followed by a short feeding program (EWCS); 2) Early wean with regular or traditional feeding program (EWF); 3) October wean, then graze cornstalks before a short feeding program (OWCS); and 4) October wean followed by a traditional feeding program (OWF). These alternative production systems are analyzed to provide answers to the following questions:

- Given a producer is to sell a calf at weaning, is early weaning (EW) or normal October weaning (OW) more profitable?
- If a producer is buying calves in order to feed until finished, is
    - (A) EW or normal OC preferred, and
    - (B) cornstalk short fed (CS) or traditional fed (F) preferred?
- If a cow/calf producer retains ownership of calves until slaughter, which strategies are preferred?

Data and Methods

Experimental Design for Feeding Trials

A research project examining these alternative feeding programs was conducted using sixty-eight spring born calves put into four different treatments at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC) near Lingle, WY. The treatments included early weaning (calves were weaned in July and placed on feed immediately following wean date [EW]) or normal weaning (calves were weaned in October and placed on feed immediately following wean date [OW]), and then placed into either of two types of feed groups: corn stock-short fed (CS) or traditional fed (F). Feedstuffs included corn, silage, hay, haylage, cornstalks, and supplement. However, the quantity of each was different across feeding treatments. The CS is a low input management system where the calves are placed on high concentrate diet of corn and hay upon arrival to the feedlot setting (approximately 43 days for OW and 138 day for EW). They were then grazed on cornstalks for approximately two months, and upon completion they returned to a corn-based high concentrated diet until finished. F calves were fed a corn-based high concentrate diet the entire period of the experiment. Thus, the four treatment groups were: early wean-cornstalk-short fed (EWCS); early wean-traditional fed (EWF); normal October wean-cornstalk-short fed (OWCS); and normal October wean-traditional fed (OWF). Table 1 depicts the treatments including important dates and days on feed.

The early wean group had a population of 39 calves and had days on feed (DOF) of the following: Fed group (20 calves) were on feed for 404 days and cornstalk group (19 calves) were on feed for 342 days. The normal October wean group had a population of 29 calves and had days on feed of the following: Fed group (13 calves) were on feed for 307 days and cornstalk group (16 calves) were on feed for 245 days (Table 5)[1]. Calves were assigned to treatment at branding based on calf birth date and age of dam. Calves were removed from the study prior to the initial start date based on previous health records, resulting in unequal treatment numbers. Diets for all treatments and growth phases within each treatment were formulated in order to meet the nutrient requirements for steers at each targeted growth rate.

Group feedlot performance and individual feedlot performance data were collected for steers from the following: 1) ultra-sounding of animals to assess carcass qualities; 2) weigh-ins every 29 days; and 3) actual feed intakes recorded by the GrowSafe system. Ultra-sounding and weigh-ins assisted in the measurement of daily gain and total gain, estimated %IMF (marbling), 12th rib backfat depth and longisimus dorsi muscle area between the 12th and 13th rib. The GrowSafe system allowed for feed intake measurements to be recorded on individual calves despite being in a large group pen. All groups of steers were fed to a common 12th rib fat thickness of 1.1 cm. Data from these measurements were then used in the economic analysis and simulations.

Economic Analysis and Simulation

Our economic analysis and simulation is designed to allow the evaluation of each individual production stage (cow/calf and feeding), as well as the entire process of cow/calf/yearling production based on production practices common for southeastern Wyoming. Generally, cattle production in this area relies on livestock feeds from irrigated farm production supplemented with pasture forage (from both private and public sources). This is not uncommon for a number of areas in the country. The use of a recent Southeast Wyoming cow/calf budget (Eisele et al., 2011) and the differences across feeding experiments are utilized in order to measure the variation across production stages as well as the entire production processes.

For the simulation, budgets representing the alternative weaning and finishing strategies are developed and utilized. Based on a budget by Eisele et al. (2011), the base ranch consists of 200 cows. The budget from Eisele et al. (2011) is also based on October weaning of calves. The early wean scenario is developed from this base budget for the cow/calf operation. These two cow/calf budgets differ mainly in the weaning date, (July and October) calf weights (steers: 330 and 520 pounds, and heifers: 310 and 500 pounds) and associated calf prices. One difference in the early weaning budget is that it includes a cost savings associated with reduced feed requirements, and the cow is able to improve body condition and weight without the burden of a calf. Rush (2011) estimates these cost savings, based on 2003 data, to be $0.19 per cow per day from early weaning dates through normal weaning dates. Therefore, it is assumed cow/calf operations can save $0.25 per day per cow (inflated to 2010 dollars) over the 97-day difference in weaning dates for a total per cow per year savings of $24.51.

The feed options of either cornstalk - short fed (CS) or traditional fed (F) are included as finishing strategies for each weaning group, and analyses are based on actual animal performance during the feeding trials at SAREC. The feeding budgets are designed to evaluate the 90 steer calves to be finished from the base 200 cow ranch (based on a 50 percent steer ratio and 90 percent weaning rate). To model only the feeding portion of the treatments, partial budgets focusing on the relative profitability of each alternative feeding program were developed. Table 2 shows the differences in feedstuffs consumed by each treatment over the feeding trials at SAREC.

Given the physical data from the experiments and the budgets as described above, a Monte Carlo simulation using Crystal Ball (Crystal Ball, 2001) was used to simulate both input and output prices over historical distributions in order to compare profitability across the cow/calf and feeding stages for the management strategies (EWCS, EWF, OWCS, OWF). The simulations evaluate the four treatments: early wean-cornstalk-short fed (EWCS), early wean-fed (EWF), normal October wean-traditional fed (OWF), and normal October wean-cornstalk-short fed (OWCS). Prices were selected in July to reflect the practice of early weaning and when calves would have been sold if the decision were made not to retain ownership. Prices were selected in October to reflect the practice of normal weaning and when calves would have been sold, once again if retaining ownership is not chosen. Input and output prices are randomly selected for each simulation, causing the total costs, returns over variable costs (ROVC), and net incomes to vary across simulations. Both input and output prices vary in the simulations based on historical data. Live fed steer prices were used in this analysis. The treatments all produced similar carcass quality, therefore there was no use of any price premiums/discounts. An interest charge of seven percent is used to calculate interest charged for ownership of the calves and feed costs. Pounds of feed required and final weight of steers are fixed based on averages of the research trials for each treatment. "Feeding profitability" is defined as the differences of total costs of finishing animals (including the purchase prices of calves), and the revenues of selling finished steers over the various feeding practices. The inclusion of "total profitability" (which is defined as the net income from the cow/calf operation plus the "feeding profitability" of the feeding operation) is also included in this analysis. This information is useful for producers that may be considering retaining ownership of their own calves from the cow/calf operation as a way to increase overall profitability.

The variables selected to be part of the Monte Carlo distributions included feedstuff prices (corn, hay, silage, haylage, and corn stalks, where silage and haylage are based on corn and hay prices, and corn stalk prices are based on pasture lease rates) (July), calf (July) prices for early wean calves, calf (October) prices for normal wean calves, slaughter (October) prices for cows and bulls, and slaughter prices for finished steers (August); all other inputs were fixed values. As there were no long-term data available for haylage or silage, prices for these feedstuffs were based on prices obtained for hay and corn, respectively, for the study area. The equivalence calculation for the value of haylage is 0.4444 of the price of hay on a per ton basis (Agee, 1981). This calculation is based on the relationship of dry matter between the two feedstuffs. Based on the research from Blonde (2010) and Barkley (2009), the price of a ton of silage is assumed to be nine times the corn price on a per bushel basis. The cost of grazing cornstalks is provided in dollars per AUM per head basis and is equivalent to the pasture lease rates as reported for Wyoming rented pasture rates (WASS and USDA-AMS, 2010) and converted to a per pound basis. During the feeding stage, yardage is charged at $.30/head/day while in the feedlot setting.

During the simulation, input and output prices were randomly selected based on the variability that occurs in a 28-year series collected from the Livestock Marketing Information Center (LMIC). Differences across treatments for quantities of feed cause costs between the early and normal weaning enterprises as well as the traditional and cornstalk short fed enterprises to vary. As stated above, the use of early weaning allows cows to bring back body condition while utilizing less forage creating a cost savings (Reiman, 2009; Rush, 2011). The differences in feeding costs are based on the different amounts of feed (and days on feed) across treatments.

The distributions of input and output prices are based on historical data from the Livestock Marketing Information Center (LMIC) spreadsheet of monthly average market price data and reported from 1982-2010 by the USDA-AMS (LMIC, 2010; USDA-AMS, 2010). All costs are adjusted to reflect information provided and indexed to 2010 prices using the Producer Price Index (Federal Reserve Economic Data, 2010). In a simulation of 10,000 random draws using sampling with replacement, the prices were randomly selected each year to determine costs and returns across the alternate management strategies. Distribution parameters are described in Table 3. Distributions were estimated using Crystal Ball's distribution fitting tool, which also incorporated correlations between the variables.

Statistical analyses were conducted to examine the results of the entire cow/calf/yearling production process across treatments from the Crystal Ball output. Treatment outcomes are analyzed for statistical differences regarding overall profitability. A paired t-test is used to compare normal versus early-weaned calves sold at weaning. Multiple means comparisons tests were conducted in SAS (Statistical Analysis System, 2003) using the Tukey-Kramer method in PROC GLM for the other research questions of interest. This test was chosen based on investigations and conclusions by Dunnett (1980), Hayter (1984), and Hayter (1989). While it is useful to compare expected returns (averages), the use of a simulation also allows for the examination of the distribution of potential outcomes as a meaningful way to compare the strategies. Results from this analysis should provide valuable information regarding optimal weaning dates as well as a comparison of profitability of retaining ownership as opposed to selling calves at weaning.

Results

Cow-Calf Stage

Differences in net income and returns over variable costs (ROVC) for the early weaning cow/calf and the October weaning cow/calf budget scenarios are presented in Table 4. Results for these two alternatives facilitate the comparison among the production alternatives of weaning date alone. Differences shown in Table 4 represent the effects of weaning dates on production costs and cattle performance, as well as the resulting market prices and weaning weights. Since there were only two means to compare for this part of the analysis, t-tests are reported and indicate that there is a statistically significant difference among the means for both ROVC and net income.

While the early weaning strategy may be capturing a higher market price for calves, the lighter weights of calves do not improve overall profitability even in the face of some cost savings. Receipts of calves sold are almost $32,000 less than that of the normal weaning strategy on average. Costs for both production practices are equal except for some savings associated with cow costs for early weaning. Net income indicates that normal weaning in cow/calf production provides optimal returns over the long run. As net income appears to be negative on average, we also analyzed ROVC, as most operations are different in their fixed cost structures. Based on the simulation distributions, the EW strategy had positive ROVC only 3.8 percent of the time, while OW was able to cover variable costs (positive ROVC) 71.9 percent of the time. Therefore, EW can be a very risky strategy, especially as compared to OW. A comparison of standard deviations of the two strategies shows less variability for the EW strategy. This may be of interest to a producer that is concerned with reducing variability in returns across years, as early weaning has a much smaller distribution of potential outcomes albeit less profitable.

Feeding Stage

With cow/calf producers preferring the typical October weaning date, it is important to determine if this strategy is also preferred for feeders that buy these calves. As previously stated, "feeding profitability" is designed to compare the profitability of the alternative feeding options, which is especially important given that costs of feedstuffs are increasing. Table 5 reveals the differences among the "feeding profitability" (profitability of just the feeding stage) in all four treatments when in an operation such as a feedlot. "Feeding profitability" across all groups indicates a difference in means across treatments according to the large and significant F-statistic. Furthermore, the Tukey test reveals that all treatments are different from each other as represented by a different letter for each treatment. Mean profit is greatest for early weaning cornstalk-short fed (EWCS) at $8,439. The next highest average profit of $4,379 occurs for the early wean – traditional fed (EWF) strategy. The least profitable strategy is the October wean traditional fed strategy (OWF). This suggests feedlot operations should prefer early weaned calves overall.

If a cow-calf producer were interested in retaining ownership, total profitability from birth to slaughter suggests different results (Table 5). Again, a significant difference is found across all means, and all means are significantly different from each other. The means indicate that in comparison to all treatments OWCS provided the best profit over the simulation (percent total profit greater than zero equals 13.51%). The standard deviation is an important factor in measuring risk in all the treatments as it measures the variability and how spread out the outcomes may be. The treatment with the highest standard deviation associated with total profitability is the EWF followed by OWF. The lowest standard deviation in total profitability is the EWCS, thus emphasizing there is less uncertainty and variability in this treatment compared to the others. However, the standard deviation of OWCS is not much greater than that of EWCS, implying that producers finishing their own calves are more likely to have positive returns with this strategy, while maintaining a lower level of variability across economic situations as compared to either EWF or OWF.

Conclusion

Comparison of the two weaning strategies for cow/calf producers suggests October weaning is more profitable than early weaning. Cost savings of early weaning presented a per cow savings on a yearly basis of $24.51. However, even though the early weaning strategy presented a higher market price for calves, the lighter weights counter the higher prices, and the reduction in revenues offsets the cost savings. Normal weaning is therefore preferred to early weaning based on net income and ROVC if a producer was to sell at weaning. A comparison of standard deviations of the two strategies shows a lower standard deviation for the EW strategy. However, the drastic differences in profitability across the two scenarios are likely to ensure most (if not all) producers would prefer normal fall weaning.

Analysis of feeding options assists in answering the second question of whether a producer who purchases calves to feed until finished would select cornstalk short fed (CS) or traditionally fed (F) methods, and whether a producer prefers early (EW) or October weaned (OW) calves. Based on results of the simulation and analysis, "feeding profitability" reveals that CS is the best feeding strategy for a producer who is looking to cut costs on feedstuffs when finishing calves. Also, if the producer was to select a group of calves based on weaning time, the results also reveal that early weaning (EW) is preferred over October weaning (OW) for the feeding program. This feeding strategy and weaning time is confirmed with relative profitability greater than zero 66.97 percent of the time for the EWCS treatment in comparison to the EWF, OWF, and OWCS (52.37%, 23.90%, and 37.83% respectively). This is in part driven by the overall cheaper cost of the calf going into the feeding program.

In order to answer what strategy producers retaining calves would prefer, the simulation output for total profitability for the combinations of weaning dates and feeding strategies were analyzed. The simulation results show that OWCS is the most profitable option overall, and in the long run, it has the highest likelihood of returns greater than zero. However, the standard deviation was the lowest for the EWCS. Despite the lower standard deviation and the potential cost saving in the early weaning strategy, OWCS was superior. This result is different from the feeding only comparison because the cow-calf producer faces the opportunity cost associated with lighter weight calves coupled with feeding costs of each scenario. Thus, October weaning is superior for the cow-calf producer retaining calves into the feedlot.

These results suggest some potential merits for feeding concentrates during critical life stages and utilizing cheaper feedstuffs such as grazing residue. This would likely be most attractive to those feedlots able to buy early-weaned calves. Early weaned calves may be attractive to feedlots from a profitability standpoint, but our results suggest cow-calf producers will generally have improved profitability with normal weaning strategies. If feedlots want to attract earlier weaned calves, prices would likely have to be substantially higher (roughly $0.55 per pound[2]) than prices used in our analysis. While the calves in our experiments did not show differences from a carcass quality standpoint, if further studies found such differences, potential premium prices for earlier weaned calves could improve profits from retained ownership and the overall attractiveness of early weaned calves.

Endnote

[1] We understand this is a relatively small sample size. However, limitations in funding constrained the project to be conducted over such a small number of animals and over a single year. While treatment differences are expected to be similar in nature, additional animals could improve estimates of treatment means and variability around those means. Moreover, our treatment differences are in line with results from previous studies reported by Meyer et al., 2005, and Parish et al., 2009.

[2] This is the premium needed to equate profitability from early weaning and traditionally weaning operations, with early weaning operations selling 90 each of 330 pound steer calves and 310 pound heifer calves in July. It should be noted this would require a paradigm shift for feeders to pay such premiums in the current market environment.

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Table 1. Description of treatment and important dates

Treatment	Wean Dates	Slaughter Dates	Days on Feed (DOF)1	Feed Type and Days
Early Wean Cornstalks (EWCS)	July 16	August 25	404	342 days on grain and forage; 62 days on cornstalks
Early Wean Fed (EWF)	July 16	August 25	404	404 days on grain and forage
October Wean Cornstalks (OWCS)	October 22	August 25	307	245 days on grain and forage; 62 days on cornstalks
October Wean Fed (OWF)	October 22	August 25	307	307 days on grain and forage

[1]Longer days on feed in the current study compared to cattle finished in typical Midwest feedlots are likely contributed to higher elevations and harsher winters in Southeastern Wyoming, which resulted in moderate performance (average of 2.68 ADG across treatments).

Table 2. Feed differences across treatment

Feed Group	Days on feed	Total corn (lbs)	Total silage (lbs)	Total hay (lbs)	Total haylage (lbs)	Total supplement (lbs)	Total cornstalks (AU days)	Total Feed (lbs)
EWCS	342	5830	514	1071	1682	277	62	9435
EWF	404	6981	722	1233	2592	350	0	11878
OWCS	245	4327	497	894	800	236	62	6816
OWF	307	4924	655	975	1404	299	0	8258

Table 3. Distributions and correlation of data series

Data Series:	**Corn**	**Hay**	**EW Steer**	**TW Steer**	**EW Heifer**	**TW Heifer**	**Slaughter Steer**	**Cull Cow**	**Cull Bull**	**Corn Stalks**
Mean:	3.67	132.05	141.87	129.95	129.47	120.33	103.58	60.38	79.75	16.6
Best Fit:	Lognormal	Beta	Beta	Beta	Beta	Triangular	Pareto	Lognormal	Uniform	Logistic

Correlations:	**Corn**	**Hay**	**EW Steer**	**TW Steer**	**EW Heifer**	**TW Heifer**	**Slaughter Steer**	**Cull Cow**	**Cull Bull**	**Corn Stalks**
Corn	1.0000	0.4217	-0.4632	-0.3611	-0.6357	-0.3611	0.2867	0.1752	0.0013	-0.3289
Hay		1.0000	0.0782	-0.0581	-0.0607	-0.0463	0.0236	-0.0928	-0.0403	0.0288
EW Steer			1.0000	0.9263	0.9286	0.9083	0.3594	0.3375	0.5253	-0.0384
TW Steer				1.0000	0.9036	0.9906	0.5419	0.6215	0.7532	-0.1705
EW Heifer					1.0000	0.8821	0.2750	0.3846	0.5273	0.0571
TW Heifer						1.0000	0.4956	0.6117	0.7455	-0.1387
Slaughter Steer							1.0000	0.9109	0.9000	-0.4535
Cull Cow								1.0000	0.9584	-0.4161
Cull Bull									1.0000	-0.3896
Corn Stalks										1.0000

Table 4. Net income, return over variable costs, and cost savings with weaning practices in the cow/calf budget

Forecast	**Treatment EW**	**Treatment OW**
% Net income greater than zero	0.03%	4.81%
% ROVC greater than zero	3.76%	71.89%
Cost savings on EW	$4,902.00	$0.00

Scenario	**Superscript (t-test)**	**Mean ($)**	**Standard Deviation ($)**	**F- test**	**P-value**
ROVC EW	A	-21,372.17	10,572.84	28122.6	<0.0001
ROVC OW	B	10,381.86	16,159.80		
Net Income EW	A	-58,254.24	10,348.91	27038.2	<0.0001
Net Income OW	B	-26,500.20	15,856.99		

Note: Means with a different superscript letter indicate there is a statistically significant difference using the t-test, $\alpha = 0.05$.

Table 5. Relative profitability for feeding and total profit for production practices

Forecast			Treatment			
			EWF	**EWCS**	**OWF**	**OWCS**
% Total profit greater than zero			5.03%	5.20%	11.21%	13.51%
% Feeding profit greater than zero			52.37%	66.97%	23.90%	37.83%

Scenario	**Superscript (Tukey)**	**Mean ($)**	**Standard Deviation ($)**	**F-test**	**P-value**
Feeding Profit EWCS	A	8,438.75	20,636.52	762.30	<0.0001
Feeding Profit EWF	B	4,378.68	22,327.84		
Feeding Profit OWCS	C	682.67	18,848.58		
Feeding Profit OWF	D	-4,739.28	19,148.58		
Total Profit EWCS	C	-49,815.5	28,604.01	2133.81	<0.0001
Total Profit EWF	D	-53,875.57	30,451.85		
Total Profit OWCS	A	-25,817.53	29,731.10		
Total Profit OWF	B	-31,239.48	30,185.44		

Note: Means with a different superscript letter indicate there is a statistically significant difference using the Tukey test, $\alpha = 0.05$.