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Effectiveness of high inclusion liquid feed for finishing steers[1,2]

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SUMMARY

A finishing phase study was conducted to measure the effectiveness of replacing dry rolled corn with a high inclusion liquid feed for finishing steers. Treatments were based upon 3 supplements: 1) Control 3.3% inclusion meal-type supplement (CO); 2) Typical Liquid Supplement 4.5% inclusion liquid supplement (TLS); and 3) High Liquid Supplement 9.0% inclusion liquid supplement (HLS). Supplements displaced dry rolled corn in finishing diets. Five 5 pens of 7 or 8 yearling steers with an initial BW of 930 lb assigned to each treatment for the 119 d experiment. The assayed supplement inclusion averaged 3.35%, 4.48% and 8.97% for the CO, TLS and HLS treatments, respectively. In general, interim performance periods resulted in similar DMI across diets and the HLS diet generally improved ADG and F:G when compared to the CO diet. On a shrunk live BW basis cumulative F:G was lower for HLS than CO and tended to be lower than when TLS diet was fed. The HLS also tended ($P = 0.08$) to increase ADG compared to the TLS. These responses suggest the caloric value of the HLS exceeded the caloric value of the DRC that it replaced. The liquid supplements had no adverse effects on Quality Grade and tended to improve Yield Grade compared to CO. The high inclusion liquid supplement used in this study was an effective substitute for dry rolled corn in a finishing diet.

INTRODUCTION

Supplemental liquid feeds (SLF) are commonly used in feedlot diets. They may be included as a commodity or as a manufactured supplement containing additional CP, micro-nutrients and additives. Prevalent commodity sources of SLF include molasses, condensed corn distiller's grains, stillage, and glycerin. These ingredients differ in composition and handling characteristics, but all can at times provide cost effective sources of energy and/or CP. They can also serve to improve the physical characteristics, and in some instances, the mix integrity of the diet.

Traditionally the use of SLF as a true supplement has targeted inclusion levels <5% of the diet. When SLF are cost competitive sources of energy and/or CP, lower cost diet formulations could be achieved by increasing the volume of SLF in a manufactured liquid supplement. This approach would also have logistical advantages in that additional SLF could be included in the diet without having to deal with delivery, storage, and batching of an additional ingredient. The objective of this experiment was to determine the feasibility of using a higher inclusion level liquid supplement in high concentrate diets for finishing cattle

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[1] IACUC approval 13-039E.

[2] This study was sponsored by Quality Liquid Feeds, Dodgeville, WI.

MATERIALS AND METHODS

This experiment was conducted at the Ruminant Nutrition Center (RNC) during June through October 2013. Supplements were formulated to be the carrier for required vitamins, minerals, and other micro-ingredients (Table 1) and were included at different levels in the diet: CO) 3.3% inclusion meal-type supplement; TLS) 4.5% inclusion liquid supplement; HLS) 9.0% inclusion liquid supplement. The TLS and HLS supplements were commercial products provided by Quality Liquid Feeds and provided similar contributions of micro-ingredients to the complete diet. The CO dry supplement was manufactured by South Dakota State University. Diets were formulated to utilize commodities common to the area (Table 2). Three transition diets (Table 2) were used for adapting steers to the final diets. Final test diets were first delivered on d 19 of the study. All final diets were formulated to contain 28 g/ton monensin. Diet ingredients were sampled weekly for nutrient analysis. Actual diet formulations and compositions (Table 3) were back calculated based upon weekly assay data and feed batching records. While on the finishing diet it was necessary to replace corn silage with sorghum silage at d 43 and to replace the sorghum silage with ground grass hay at d 92 as these commodity inventories were depleted. Diets were mixed and delivered two times daily (50/50).

Steers for this study (n=117, BW=930 ± 53 lb) were from a single origin and purchased at a SD sale barn. Standard RNC receiving protocols were followed. Body weight was recorded during processing for allotment purposes. For allotment, steers were stratified by BW across 3 treatments and then into 5 replicate pens within each treatment. Individual steer BW was measured again the day after processing as steers were sorted to assigned pens. Initial BW for performance calculations was the average of these 2 consecutive day BW determinations.

Individual BW was also measured on days 28, 56, 84, 105 and 119. Steers were implanted with Revalor® 200 at the time d 28 BW were measured. Weighing of steers occurred prior to the morning feed delivery. Feed records were summarized at intervals corresponding to weigh days. All interim steer performance data were calculated without applying shrink. Once the entire population was estimated to have approximately 0.50” in ribfat thickness (visual appraisal) steers were co-mingled and shipped to a commercial abattoir as a single lot. Individual steer identity was maintained through the abattoir and matched to camera grading data acquired from the packing plant.

Cumulative live performance was calculated in two ways: by applying a 3% shrink to the BW determined on d 119 and also by using a carcass adjusted final BW. The carcass adjusted final BW was calculated as HCW/0.625 (62.5% dress) to account for potential differences in fill.

Data were analyzed on a pen mean basis using PROC GLM procedure of SAS (SAS Inst. Inc., Cary NC) as appropriate for a randomized complete block design experiment with pen as the experimental unit. Means separations were achieved using Fisher’s T Test.

RESULTS AND DISCUSSION

The purchased lot of steers included a subpopulation of highly excitable steers. Nine steers had to be removed from the study early in the feeding period because of disposition related problems. Target goals for feed formulations, specific supplement inclusions, and fatness endpoint were achieved. While on the finishing diets supplement levels averaged 3.35%, 4.48% and 8.97% for the CO, TLS and HLS treatments, respectively (Table 3). The only other ingredient inclusion that varied was the dry rolled corn (DRC), which was displaced by liquid supplements relative to inclusion rate. Treatments did differ slightly (P < 0.01) in CP content (13.5, 14.0 and 14.2%, respectively; Table 3) in response to increased liquid supplement inclusion in the diet. Average ribfat of the carcasses was 0.53 in.

There were no noticeable dietary differences in how the steers started on feed as reflected by similar DMI during the initial 28 d period (Table 4). In general, during the subsequent interim performance periods DMI remained similar across diets and the HLS generally improved ADG and F/G compared to the CO treatment (Table 4). There were no digestive disorders associated with these diets.

On a shrunk live BW basis cumulative F:G was lower (P<0.05) for the HLS than the CO diet. The HLS diet tended (P<0.10) to increase ADG and decrease F:G compared to the TLS diet (Table 5). This suggests that the caloric value of the HLS diet exceeded the caloric value of the DRC that it replaced. It could be argued that this difference in F:G among dietary treatments was due to the lower (13.5 vs 14.0%) CP of the CO treatment. However, there were no differences in cumulative intake among the three treatments and all diets met or exceeded NRC CP requirements (11.3 %).

It was unusual that the carcass adjusted performance data were more variable than live performance data. This may be a consequence of the excitable steers that were pulled from the study. The frequency of problematic steers was similar across treatments, but these steers varied in BW which by their dismissal impacted the initial BW distributions. This probably led to the HCW variation among pens within a treatment when data were analyzed on a pen mean basis.

Carcass data confirm that these were quality cattle fed to a typical industry endpoint. Overall the carcasses graded 86% Choice or better and 46% Premium Choice and Prime. The liquid supplements had no adverse effects on Quality Grade. There was no basis to expect carcass traits to be affected by diet unless diet caused differences in ADG which could impact HCW and carcass fatness. There were trends toward larger REA, lower ribfat thickness, and ultimately a trend towards lower yield grades with TLS and HLS diets.

SUMMARY

There were no adverse events such as metabolic disorders or reduced Quality Grade or Yield Grade associated with feeding typical or high levels of liquid supplements. Liquid supplements improved growth efficiency, which has been observed previously and attributed to improved mix quality and subsequent uniformity of nutrient intake. The high inclusion supplement tended to lead to more efficient production than the typical inclusion supplement. This is probably not due to further improvements in mix quality. The more likely explanation is that the components of the high inclusion supplement contained more useful energy than the DRC that was replaced in the diet. Higher inclusion level of a diluted liquid supplement was an effective and convenient method for including additional liquid byproducts in beef cattle finishing diets.

Table 1. Control treatment meal supplement formula for 1 ton batches[1]

Ingredient	**Pounds**
Canola meal	310
Potassium chloride	298
Trace mineralized salt	179
Limestone	1040
Urea	149
Premix[2]	25

[1] As is basis

[2] Premix contained ground corn, monensin, vitamins A & E, $ZnSO_4$, and $CuSO_4$

Table 2. Step-up diets for Control (CO), Typical (TLS), and High (HLS) inclusion liquid supplements fed to yearling steers.[1]

	CO	TLS	HLS
Step 1 - Fed days 1-5		%	
Corn Silage	30.0	30.0	30.0
Grass hay	25.0	25.0	25.0
DRC	23.0	22.0	18.0
HMC	10.0	10.0	10.0
mDGS[2]	9.0	9.0	9.0
Supplement[3]	3.0	4.0	8.0
Step 2 – Fed days 6-11			
Corn Silage	25.0	25.0	25.0
Grass Hay	10.0	10.0	10.0
DRC	29.7	28.5	24.0
HMC	20.0	20.0	20.0
mDGS[2]	12.0	12.0	12.0
Supplement[3]	3.3	4.5	9.0
Step 3 – Fed days 12-18			
Corn Silage	20.0	20.0	20.0
DRC	34.7	33.5	29.0
HMC	27.0	27.0	27.0
mDGS[2]	15.0	15.0	15.0
Supplement[3]	3.3	4.5	9.0

[1] DM basis

[2] modified distiller's grains (50% DM)

[3] Supplements contained monensin and provided minerals and vitamins to meet or exceed NRC requirements.

Table 3. Finishing diet formulations and composition for Control (CO), Typical (TLS), and High (HLS) inclusion liquid supplements for yearling steers.[1, 2]

	Treatment					
	CO[3]		TLS		HLS	
19-42 d						
Corn Silage, %	8.45	(0.36)	8.45	(0.36)	8.45	(0.36)
DRC, %	35.34	(0.30)	34.15	(0.29)	29.70	(0.25)
HMC, %	34.22	(0.78)	34.22	(0.78)	34.22	(0.78)
mDGS, %	18.72	(0.25)	18.72	(0.25)	18.72	(0.25)
Supplement[4], %	3.28	(0.03)	4.46	(0.04)	8.93	(0.07)
DM, %	65.2	(0.53)	64.3	(0.52)	63.6	(0.52)
CP,%	13.3	(0.40)	13.8	(0.40)	13.9	(0.40)
NDF, %	15.9	(1.01)	15.7	(0.97)	15.3	(0.97)
NE_G, Mcal/cwt	64.4	(0.10)	64.7	(0.10)	64.9	(0.10)
43-91 d						
Sorghum Silage, %	7.70	(0.32)	7.71	(0.32)	7.71	(0.32)
DRC, %	35.70	(0.43)	34.53	(0.40)	30.04	(0.37)
HMC, %	35.24	(0.42)	35.27	(0.42)	35.28	(0.43)
mDGS, %	18.01	(0.73)	18.03	(0.73)	18.04	(0.73)
Supplement[4], %	3.34	(0.05)	4.46	(0.06)	8.93	(0.11)
DM, %	65.4	(0.86)	64.5	(0.85)	63.8	(0.83)
CP, %	13.5	(0.35)	14.0	(0.37)	14.2	(0.35)
NDF, %	15.7	(0.35)	15.5	(0.35)	15.1	(0.36)
NE_G, Mcal/cwt	63.2	(0.11)	63.6	(0.11)	63.9	(0.12)
92-119 d						
Grass hay, %	7.93	(0.41)	7.94	(0.41)	7.94	(0.41)
DRC, %	36.18	(0.48)	35.00	(0.47)	30.45	(0.38)
HMC, %	33.99	(0.64)	34.02	(0.65)	34.04	(0.67)
mDGS, %	18.49	(0.70)	18.51	(0.69)	18.52	(0.69)
Supplement[4], %	3.42	(0.12)	4.53	(0.13)	9.07	(0.25)
DM, %	73.6	(2.08)	72.5	(2.03)	71.5	(1.98)
CP, %	13.7	(0.30)	14.3	(.19)	14.5	(0.20)
NDF, %	16.3	(0.40)	16.1	(.39)	15.7	(0.39)
NE_G, Mcal/cwt	63.1	(0.16)	63.5	(.15)	63.7	(0.16)

[1] All values except DM on DM basis.

[2] Based on weekly ingredient analyses.

[3] Mean (Std Dev).

[4] Supplements contained monensin and provided minerals and vitamins to meet or exceed NRC requirements.

Table 4. Interim periods steer performance responses to Control (CO), Typical (TLS), and High (HLS) inclusion liquid supplement treatments.[1]

	Treatment			
	CO	**TLS**	**HLS**	**SEM**
Initial BW, lb	915	918	913	2.2
1 to 28d				
d 28 BW, lb	1007	1009	1006	2.3
ADG, lb	3.28	3.24	3.31	0.077
DMI, lb	19.95	19.93	19.91	0.107
F:G	6.13	6.19	6.03	0.137
29 to 56 d				
d 56 BW, lb	1129	1141	1145	6.1
ADG, lb	4.37^{a}	4.74^{a}	4.95^{b}	0.142
DMI, lb	23.15	23.17	23.23	0.386
F:G	5.31^{a}	4.89^{b}	4.71^{b}	0.116
57 to 84 d				
d 84 BW, lb	1235	1235	1239	7.0
ADG, lb	3.76	3.36	3.36	0.142
DMI, lb	24.17^{a}	22.98^{b}	23.00^{b}	0.356
F:G	6.43	6.97	6.86	0.280
85 to 105 d				
d 105 BW, lb	1345	1347	1358	7.4
ADG, lb	5.24^{a}	5.33^{ab}	5.68^{b}	0.126
DMI, lb	28.28	27.14	27.95	0.446
F:G	5.42^{a}	5.10^{ab}	4.93^{b}	0.149
106 to 119 d				
d 119 BW, lb	1381	1387	1404	7.8
ADG, lb	2.59^{a}	2.81^{a}	3.24^{b}	0.131
DMI, lb	27.60	26.22	27.15	0.487
F:G	10.89^{a}	9.36^{b}	8.40^{b}	0.426

[1] Non-shrunk BW basis.

^{a,b}Means within a row without a common superscripts differ (P<0.05).

Table 5. Cumulative steer performance responses to Control (CO), Typical (TLS), and High (HLS) inclusion liquid supplement treatments.

	Treatment			
	CO	**TLS**	**HLS**	**SEM**
Shrunk Basis[1]				
Final BW, lb	1339^{y}	1345^{yz}	1361^{z}	7.6
ADG[1], lb	3.56^{y}	3.59^{y}	3.77^{z}	0.062
DMI, lb	24.07	23.42	23.69	0.279
F:G	6.75^{a}	$6.53^{ab‡}$	$6.29^{b‡}$	0.084
Carcass Adjusted Basis[2]				
Final BW, lb	1343	1352	1360	10.0
ADG, lb	3.60	3.65	3.76	0.085
F:G	6.70	6.44	6.32	0.154

[1] 3% shrink applied to d119 BW.

[2] Calculated Final BW = HCW/0.625.

^{a,b}Means within a row without a common superscript differ ($P<0.05$).

^{y,z}Means within a row without a common superscript differ ($P<0.10$).

‡ TLS and HLS means differ (*P*=0.09)

Table 6. Carcass traits, quality grade, and yield grade distributions when Control (CO), Typical (TLS), and High (HLS) inclusion liquid supplement treatments were fed.[1]

	Treatment			
	CO	TLS	HLS	SEM
Dress, %[3]	62.66	62.80	62.46	0.327
HCW, lb	839	845	851	6.2
REA, in^2	12.62^{y}	12.77^{yz}	13.13^{z}	0.162
Ribfat, in	0.56^{ay}	0.53^{abz}	0.49^{b}	0.013
KPH, %	1.99	1.95	1.97	0.022
Marbling[4]	594	602	587	16.3
Yield Grade	3.49^{a}	3.38^{ab}	3.25^{b}	0.068

[1] Pen mean basis

[3] HCW as % shrunk BW

[4] 400 = slight°; 500 = Small°

[a,b] Means within a row without a common superscript differ ($P<0.05$).

[x,y,z] Means within a row without a common superscript differ ($P<0.10$).