greatOplus (Extruded Blend of Flaxseed and *Nannochloropsis oculata* Biomass) Improves Finishing Cattle Performance and Carcass Characteristics

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Abstract

Omega-3 fatty acid supplements such as flaxseed and microalgae in beef cattle diets have shown promising results for increasing the omega-3 fat content of beef, particularly alpha-linolenic acid (ALA) and eicosapentaenoic acid (EPA). This study investigated the effect of supplementing an extruded blend of flaxseed and *Nannochloropsis oculata* microalgae (*greatOplus,* GOP) as a source of omega-3 fatty acids to determine the impact on animal performance and carcass characteristics of finishing steers. Cattle fed GOP had greater ($P < 0.05$) dry matter intake (DMI) and average daily gain (ADG) compared to cattle fed the control diet (CON), but gain: feed (G:F) was not affected by treatment ($P > 0.10$). Cattle fed GOP had greater hot carcass weight (HCW) compared to those fed CON (932.1 versus 902.8 lb; $P < 0.01$) and tended to produce more Prime and Choice carcasses (87.4 versus 83.0%; $P = 0.11$) with greater 12th rib backfat (0.61 versus 0.59 in; $P < 0.02$) and greater U.S. Department of Agriculture (USDA) yield grades (2.91 versus 2.75; $P < 0.01$). Marbling score (488 versus 491), longissimus muscle area (14.6 versus 14.5 in^2), and liver abscess incidence (12 versus 16% for CON and GOP, respectively) were unaffected by treatment ($P > 0.10$). Carcass values were calculated using base prices, premiums, and discounts published by the USDA during the week of harvest, and were greater for cattle fed GOP compared to cattle fed the control diet ($2,122 versus $2,059; $P < 0.01$). Including *greatOplus* at 10% of the diet dry matter improved cattle performance, largely as the result of its impact on DMI and ADG.

Introduction

Replacing saturated fats with polyunsaturated fats has been shown to reduce cardiovascular disease (CVD) risk in humans, and is recommended by the American Heart Association as a preventative for CVD. Cattle diets can be altered to favor deposition of desirable omega-3 polyunsaturated fatty acids in beef, providing an opportunity to address concerns over contributions of beef to overall saturated fatty acid consumption by consumers. Additionally, omega-3 fatty acids are essential for cattle, and providing these fats in balanced amounts can contribute to overall health and productivity of cattle.

Flaxseed contains a relatively high proportion of alpha-linolenic acid, which is an essential omega-3 fatty acid, and has been used successfully to promote health and performance of cattle in previous research. Alpha linolenic acid is a precursor for formation of the longer chain polyunsaturated fat, eicosapentaenoic acid (EPA), which in turn serves as a precursor for the formation of several important reproductive hormones and immune compounds that regulate inflammatory responses in animals. Rate of conversion of linolenic acid to EPA is limited, however. Some species of marine algae, including *Nannochloropsis* species, are known to produce substantial amounts of EPA. This study investigated the effect of supplementing an extruded blend of flaxseed and *Nannochloropsis oculata* microalgae biomass (*greatOplus*) as a source of omega-3 fatty acids on animal performance and carcass characteristics of finishing steers.

Experimental Procedures

Yearling steers (n = 700; 825 ± 18.07 lb initial body weight (BW)) were blocked by initial BW and assigned randomly, within block, to 28 feedlot pens containing 25 animals/pen. Cattle were vaccinated against viral and clostridial pathogens and treated for internal and external parasites (Bovishield Gold 5, Ultrabac 7 Somubac, and Dectomax injectable; Zoetis Animal Health), and implanted with a combination implant (Component TE-200; Elanco USA). The control diet (CON) consisted of 58.3% steam-flaked corn, 20% wet corn gluten feed, 2.56% soybean meal, and 4.17% vitamin/mineral/feed additive premix. For the *greatOplus* (GOP; an extruded blend of flaxseed and *Nannochloropsis oculata* microalgae) diet, a portion of the corn and all the soybean meal were replaced with 10% GOP (dry basis) to create isonitrogenous diets (Table 1). Cattle were fed once daily, *ad libitum*. After 175 days on feed, animals were weighed and transported to a commercial abattoir for harvest. Animal performance measurements included average daily gain (ADG), dry matter intake (DMI), and gain: feed (G:F). Hot carcass weight (HCW) and incidence of abscessed livers were assessed on the day of harvest, and marbling score, 12^{th} rib fat thickness, longissimus muscle area, and U.S. Department of Agriculture (USDA) yield and quality grades were determined following 48 hours of refrigeration. Data were analyzed as a mixed model using diets as the fixed effect, block as the random effect, and feedlot pen as the experimental unit.

Results and Discussion

Animal performance is summarized in Table 2. Cattle fed GOP had greater DMI and ADG ($P < 0.05$) compared to cattle fed CON, but G:F was not affected by treatment ($P > 0.10$). Carcass characteristics and USDA carcass quality grade, and liver abscess incidence are presented in Table 3, Table 4, and Table 5, respectively. Cattle fed GOP had greater HCW compared to those fed CON (932.11 versus 902.79 lb; $P < 0.01$) and tended to produce more Prime and Choice carcasses (87.4 versus 83.0%; $P = 0.11$) with greater 12^{th} rib backfat (0.61 versus 0.59 in; $P < 0.02$) and greater yield grades (2.91 versus 2.75; $P < 0.01$). Marbling score (488 versus 491), longissimus muscle area (14.6 versus 14.5 in^2) and liver abscess incidence (12 versus 16% for CON and GOP, respectively) were unaffected by treatment ($P > 0.10$). Carcass values were calculated using base prices, premiums, and discounts published by USDA, and were greater for cattle fed GOP compared to cattle fed the control diet ($2,122 versus $2,059; $P < 0.01$).

Implications

Including *greatOPlus* at 10% of the diet dry matter improved cattle performance, largely as the result of its impact on DMI and ADG.

Table 1. Ingredients and nutritional composition of control diet (CON)[1] and diet supplemented with *greatOplus* (GOP)[2]

Item	CON[1]	GOP[2]
Diets, % dry matter		
Steam-flaked corn	58.27	50.84
Corn silage	15.00	15.00
Sweet bran	20.00	20.00
Dehulled soybean meal	2.57	---
greatOplus[3]	---	10.00
Supplement[4]	4.17	4.17
Nutrients, %		
Dry matter	65.41	66.1
Crude protein	14.00	14.00
NDF	16.05	16.28
ADF	8.15	8.36
Ether extract	3.18	5.19
Calcium	0.68	0.70
Phosphorus	0.38	0.42

[1] Control diet.
[2] *greatOplus* diet.
[3] Extruded flaxseed-algae blend supplement.
[4] Supplement was formulated to provide 2,205 IU/kg of vitamin A; 10 mg/kg of copper; 30 mg/kg of zinc; 20 mg/kg of manganese; 0.50 mg/kg iodine; 0.1 mg/kg of selenium; and 0.15 mg/kg of cobalt.

Table 2. Effect of *greatOplus* treatment on animal performance

Item	CON[1]	GOP[2]	SEM[3]	*P*-value
Average daily gain, lb	3.92[a]	4.07[b]	0.03	<0.01
Dry matter intake, lb/day	22.95	24.07	0.36	0.03
Gain:feed	5.85	5.91	0.07	0.53

[1] Control diet.
[2] *greatOplus* diet.
[3] Standard error of the least square mean.
[a,b] Means in the same row without a common superscript are different ($P < 0.01$).

Table 3. Effect of *greatOplus* treatment on carcass characteristics

Item	CON[1]	GOP[2]	SEM[3]	*P*-value
Carcass weight, lb	902.8[a]	931.9[b]	12.27	<0.01
Rib eye area, in^2	12.6	12.5	0.22	0.27
Marbling score	488	491	7.01	0.61
12^{th} rib fat thickness, in	0.58	0.61	0.02	0.02

[1] Control diet.
[2] *greatOplus* diet.
[3] Standard error of the least square mean.
[a,b] means in the same row without a common superscript are different ($P < 0.01$).

Table 4. Effect of *greatOplus* treatment on USDA carcass quality and yield grades

Item	CON[1]	GOP[2]	SEM[3]	*P*-value
Prime, %	2.63[a]	3.74[b]	0.97	<0.01
Choice, %	80.41	83.62	2.13	0.27
Select, %	14.62	11.50	1.91	0.22
Sub-select, %	1.47	0.86	0.62	0.46
Final yield grade	3.26[a]	3.40[b]	0.66	<0.01

[1] Control diet.
[2] *greatOplus* diet.
[3] Standard error of the least square mean.
[a,b] means in the same row without a common superscript are different ($P < 0.01$)

Table 5. Effect of *greatOplus* treatment on liver abscess incidence

Abscess severity	CON[1]	GOP[2]	SEM[3]	*P*-value
A^-	1.8	3.4	0.99	0.16
A^0	5.8	6.6	1.30	0.68
A^+	6.3	6.3	1.25	0.26

[1] Control diet.
[2] *greatOplus* diet.
[3] Standard error of the least square mean.