AGRICULTURAL RESEARCH FOUNDATION
FINAL REPORT
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TITLE: Effects of Omega-3 and Omega-6 Fatty Acid Supplementation to Late-Gestation Cows on Performance & Health Responses of the Subsequent Offspring

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SUMMARY: Nutritional management of beef cows during late-gestation has direct implications on performance of the subsequent offspring. More specifically, maternal nutrition is a major extrinsic factor programming nutrient partitioning and consequent development/function of fetal organ systems associated with health, production, and reproduction. However, all of the research conducted to date evaluating this subject focused on energy and protein nutrition, and little is known about the potential impacts of supplementing essential fatty acids, such as omega-3 and omega-6, to gestating cows on offspring development and performance.

In humans and other livestock species, omega-3 and omega-6 fatty acids are considered essential by playing critical roles in several body functions. However, these fatty acids cannot be synthesized by the body and have to be consumed through the diet. In pregnant females, dietary essential fatty acids become available in the circulation, and are effectively transferred to the fetus via placenta. Research in humans demonstrated that supplementing pregnant women with essential fatty acids is indispensable for optimal fetal and early-life child development, including nervous and immune systems. Similarly, research with swine reported that supplementing pregnant sows with essential fatty acids improved piglet vitality and pre- and post-weaning growth. Therefore, we hypothesized that providing supplemental omega-3 and omega-6 fatty acids to late-gestating beef cows would benefit development and optimize production efficiency of the subsequent offspring.

OBJECTIVES: Based on the aforementioned hypothesis, we conducted an experiment at the EOARC Burns to evaluate the effects of omega-3 and omega-6 fatty acid supplementation to beef cows during late gestation.

PROCEDURES: In summary, 96 multiparous Angus × Hereford cows at the end of their second trimester of gestation were assigned to this experiment. To ensure that all cows are in the same stage of gestation, we used cows that became pregnant to an estrus synchronization + fixed-time artificial insemination. During the last trimester of gestation, cows received free-choice hay in addition to:

- Treatment **EFA**) 0.22 lbs/day of rumen-protected omega-3 fatty acids + 0.22 lbs/day of rumen-protected omega-6 fatty acids (Strata and Prequel, respectively, from Virtus Nutrition, Corcoran, CA),
- Treatment **CON**) 0.44 lbs/day of a rumen-protected non-essential fatty acid source (EnergII from Virtus Nutrition, Corcoran, CA).

Both fatty acid supplements were mixed with 1 pound/cow of soybean meal and delivered individually to cows until calving. A rumen-protected source of fatty acids was used to prevent rumen modification of essential fatty acids, whereas the rumen-protected non-essential fatty acid source (**CON**)

was included to ensure that cows from both treatments consume the same daily amount of fat and energy (to isolate the expected essential fatty acid effects).

After calving, cow-calf pairs were removed from their experimental diets, returned to the EOARC general herd, and assigned to the same nutritional and general management of the research center (which does not include essential fatty acid supplementation). Approximately 7 months after birth, calves (steers and heifers) were weaned and maintained in a single pasture for a 45-day preconditioning. After preconditioning, calves were moved to commercial feedyards (Top Cut in Echo, OR for growing, and Beef Northwest in Boardman, OR for finishing) where they remained until slaughter.

SIGNIFICANT ACCOMPLISHMENTS: Cow and calf performance were similar among treatments until weaning (Table 1). However, growth performance in the feedlot as well as carcass size and quality were increased in calves born from cows receiving treatment EFA during late-gestation (Table 2).

These results are novel and suggestive of fetal programming effects from supplementing the omega-3 + omega-6 mix to gestating beef cows. Essential fatty acids are known to stimulate cell differentiation and growth in developing tissues. Hence, we speculate that omega-3 + omega-6 supplementation increased hyperplastic (number of cells) development of muscle and intramuscular adipose cells of calves during gestation, which translated into greater cell hypertrophy (cell size) and tissue growth (i.e. ADG, carcass size and marbling) when calves were exposed to a high-concentrate anabolic feedlot diet.

Table 1. Cow and calf parameters up to weaning

Item	CON	EFA	*P =*
Cow body weight, lbs			
Beginning of experiment	1285	1296	0.75
Prior to calving	1355	1351	0.90
Cow body condition score			
Beginning of experiment	5.01	5.02	0.89
Prior to calving	5.41	5.46	0.59
Calf birth body weight, lbs	90	92	0.44
Calf weaning body weight, lbs	530	532	0.82
Calf 205-day adjusted weaning body weight, lbs	568	570	0.86

BENEFITS & IMPACT: Supplementing essential fatty acids to pregnant beef cows during the last trimester of gestation appears to be a novel nutritional alternative to enhance offspring performance, including feedlot growth rates and carcass size/quality upon slaughter. Nevertheless, additional research is being conducted at the EOARC to better understand the role of essential fatty acids on fetal development and beef cattle productivity

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM: None

FUTURE FUNDING POSSIBILITIES: USDA-AFRI grant to investigate the role of essential fatty acids on fetal development, focusing on hyperplastic and hypertrophy growth of muscle and adipose cells prior to birth and during early life.

Table 2. Calf performance from weaning to slaughter

Item	CON	EFA	*P* =
Preconditioning performance			
Morbidity, %	6.8	3.8	0.55
Mortality, %	0.0	2.2	0.36
Preconditioning gain, lbs/day	0.95	1.10	0.31
End of preconditioning body weight, lbs	574	583	0.29
Growing lot performance			
Morbidity, %	38.3	31.8	0.52
Mortality, %	0.0	0.0	-
Initial growing lot body weight, lbs	546	550	0.68
Growing lot gain, lbs/day	2.46	2.68	0.05
Body weight at the end of growing lot, lbs	843	873	0.09
Finishing lot performance			
Morbidity, %	0.52	0.52	0.94
Mortality, %	-	-	-
Finishing lot gain, lbs/day	4.11	4.36	0.05
Body weight at the end of finishing lot, lbs	1366	1421	0.05
Carcass characteristics			
Hot carcass weight, lbs	860	895	0.05
Backfat, in	0.68	0.72	0.38
Ribeye area, in^2	13.9	14.3	0.10
KPH, %	2.15	2.13	0.85
Marbling	489	539	< 0.01
Yield grade	3.50	3.56	0.63
Retail product, %	48.6	48.4	0.56
Choice, %	93.5	100.0	0.09