# AUTHORIZATION REQUEST FOR FY 2022

CBB Budget Category: **Research**

Name of Contractor: **United States Cattlemen's Association**

Name of Organization Subcontracting: **Kansas State University**

Start Date: **10/1/2021**

End Date: **9/30/2024**

## AR OVERVIEW

**AR Purpose and Description:**

The beef industry seemingly is under continuous assault on multiple fronts. These attacks frequently are aimed at consumers of beef, bombarding them on a daily basis with negative commentaries concerning purported contributions of beef to human health disorders such as heart disease, issues with the microbiological safety of beef products, the adverse environmental impact of beef production, its role in the development of antimicrobial resistance, and a myriad of other problems. **This project aims to tackle an important area affecting consumer perceptions of beef by implementing a simple feeding strategy:** Enrichment of beef with omega-3 fatty acids.

| Funding | Direct Costs | Implementation | Total |
|---|---|---|---|
| **CBB/BPOC Funding Request:** | $200,000 | $10,000 | $210,000 |

| Other Potential Funding | Direct Costs | Implementation | Total |
|---|---:|---:|---:|
| Federation of SBCs Pledges: (Informational Only) | $0 | $0 | $0 |
| Other Funding: (Informational Only) | $0 | $0 | $00 |

**Beef Industry Long Range Plan (LRP) Core Strategies Addressed by this AR**

| Drive Growth in Beef Exports | Grow Consumer Trust in Beef Production | Develop & Implement Better Business Models & Value Distribution Across All Segments | Promote & Capitalize on the Multiple Advantage of Beef | Improve the Business & Political Climate of Beef | Safeguard & Cultivate Investment in Beef, Industry Research, Marketing & Innovation |
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**PROGRAM INFORMATION FOR THIS AR**

## Tactic A

**Tactic Name: A Strategy for Improving Consumer Perceptions of Beef and Beef Production Systems**

**Tactic Description:**

The beef industry seemingly is under continuous assault on multiple fronts. These attacks frequently are aimed at consumers of beef, bombarding them on a daily basis with negative commentaries concerning purported contributions of beef to human health disorders such as heart disease, issues with the microbiological safety of beef products, the adverse environmental impact of beef production, its role in the development of antimicrobial resistance, and a myriad of other problems. **This project aims to tackle an important area affecting consumer perceptions of beef by implementing a simple feeding strategy:** Enrichment of beef with omega-3 fatty acids.

***Fatty Acid Profiles***

For decades, beef has been scorned as a source of saturated lipids that contribute to a variety of human disease conditions, including cardiovascular disease and certain types of cancer. As a current example, the USDA *Dietary Guidelines for Americans, 2020-2025* recommends decreasing meat consumption and increasing consumption of foods, such as fish, that contain greater proportions of long-chain polyunsaturated fats, most notably eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The long-chain fatty acids EPA, DHA, and alpha-linolenic acid (ALA), are part of a larger family known as omega-3 fatty acids. Recognized for their anti-inflammatory effects and other health benefits, the omega-3 fatty acids admittedly play important roles as basic building blocks for synthesis of endocrine hormones and signaling molecules that are integral to proper immune function, as in development of infant brain function. Certain species of marine fishes are routinely recommended as sources of omega-3 fatty acids, but beef also can be an excellent source of omega-3 fats when cattle are fed diets containing the appropriate feed ingredients. Immature grasses and legumes that cattle consume contain appreciable quantities of ALA, hence the tendency for grass-fed beef to contain greater proportions of omega-3 fats compared to other sources of animal protein. Additionally, we have repeatedly demonstrated through research (LaBrune et al., 2006) that it is possible to markedly increase omega-3 fat content of beef from grain-fed cattle by altering cattle diets to include ingredients such as flaxseed, which is consistently high in ALA, and marine algae products, which contain substantial amounts of EPA and DHA. All of these fats are deposited within the edible tissues of the beef carcass, favorably impacting the ratio of omega-6:omega-3 fatty acids. We also fed omega-3 enriched beef to rats and observed a variety of health benefits (Medeiros et al., 2007), indicating that beef enriched with omeg-3 fatty acids can be a viable alternative for delivery of desired omega-3 fats in human diets.

For a production system in which beef fat could be recognized as having healthful attributes, the fat itself could become an important driver of carcass value. Value of middle meats would increase for recognizable changes in fatty acid profiles. More importantly, trimmable fats, rather than being rendered to produce animal feeds, would become prized components of the carcass, and when combined with lean beef could yield high-value ground beef products, thereby improving overall carcass utilization. This is particularly relevant for today's beef industry, for which a growing percentage of carcasses are merchandised at higher yield grades. Organ meats, such as livers, kidneys, hearts, and tongues, can have notably high concentrations of omega-3 fatty acids when cattle are fed diets high in omega-3 fat sources, and thus take on greater value in this scenario as well.

***Antibiotic Use and Liver Abscesses***

Our early research with omega-3 fat supplementation to cattle focused on controlling bovine respiratory disease in cattle, a condition that is characterized by bacterial infection and ofttimes exaggerated inflammation. Flaxseed is a relatively concentrated source of alpha-linolenic acid (ALA), and portions of the ALA from flax are metabolized in the animal's body to produce EPA. It is EPA that serves as the key intermediate for formation of anti-inflammatory substances involved in the immune response. We later determined it was possible to supplement EPA directly to the diet. The most concentrated sources of EPA (as well as DHA) are the marine algae, including the green microalgae, *Nannochloropsis.* Providing supplemental sources of ALA and EPA attenuated incidence and severity of respiratory disease. Effectively, cattle health was improved through sound nutrition, making it possible to decrease our reliance on therapeutic antibiotic drugs. Antibiotic use in livestock production is a prominent subject, owing to the impact of persistent use on development of antibiotic resistant strains of bacterial pathogens. In feedlot cattle, the most widespread use of in-feed antibiotics (tylosin) is aimed at prevention of liver abscess, an infectious disease condition in which the liver is colonized by *Fusobacterium* necrophorum and other pathogenic bacteria. It is conceivable that dietary supplements of ALA/EPA could play a part in decreasing incidence of liver infections, thus avoiding costly liver condemnations, excess carcass trim loss, and adverse effects on liver function.

***Environmental Impact and Greenhouse Gasses***

Beef is increasingly derided for its purported deleterious effects on the environment, with critics citing poor air quality, production of methane gas, poor feed conversion, and poor water use efficiency as reasons for abandoning beef as a protein source. These messages resonate with some consumers of beef, and clearly can influence demand. Efforts to combat this rhetoric are warranted. Moreover, methane gas represents a significant loss of dietary energy that ranges from 6 to 13% of total energy intake in cattle. Capturing this energy and converting it to edible carcass components likely will yield improvements in feed efficiency, while at the same time demonstrating a concerted effort to mitigate environmental impact of beef production. Past research has demonstrated that long-chain fatty acids can decrease methane production in the rumen. Longer chain fats, such as EPA and DHA, are particularly inhibitory to methanogenic archaea (Fievez et al., 2003). Studies with flax also have revealed potential for attenuating ruminal methane production (Martin et al., 2016), which support by observations of suppressed activity of methanogenic organisms in the rumen (Li et al., 2012; Vargas et al., 2020).

Technologies that increase production efficiency and/or carcass utilization also can have indirect effects on the amount of methane generated per unit of meat produced. In studies with other species, including humans, omega-3 fatty acids have been shown to stimulate skeletal muscle growth (McGlory et al., 2019). Research by Aas and co-workers (2003) suggests that this may be due, in part, to increases in energy assimilation at the cellular level. On a more applied level, research we conducted feeding marine algae to cattle resulted in a 5-10% improvement in feed efficiency with only 50 to 150 grams of algae (roughly 2-5 ounces) fed per animal daily, clearly demonstrating potential for improving sustainability of beef production. As previously discussed, increasing the proportions of carcass tissues that are merchandized as food also can contribute directly to the sustainability equation.

## Objectives

Note: In light of the necessity to reduce the overall project budget, and at the recommendation of the Beef Promotion Operating Committee, scope of this project is now limited to characterization of fatty acid profiles throughout the beef carcass, and impact of dietary supplementation with sources of omega3 fatty acids on carcass attributes. Moreover, we have opted to eliminate several measures of ground beef shelf stability, and will restrict evaluations to two types of packaging systems. The investigators also will pursue alternative sources of funding in an effort to preserve the original scope of this project.

1. Characterize changes in fat profiles throughout the beef carcass in response to feeding a mixture of flaxseed and Nannochloropsis microalgae as sources of omega-3 fatty acids.
2. Evaluate impact of omega-3 fatty acids on post-mortem changes in muscle tissue.
3. Evaluate sensory attributes and retail display characteristics of beef containing elevated concentrations of long-chain omega-3 fatty acids.

## Materials and Methods

### Live Animal Phase

***Cattle and Treatments***. The study will utilize 28 feedlot pens, each containing 1 yearling steer. Cattle will be identified with uniquely numbered ear tags and RFID tags; vaccinated against common viral and clostridial pathogens, treated for internal and external parasites, and implanted with a combination trenbolone acetate/estradiol implant. Cattle will be blocked by initial body weight and allocated randomly within blocks to feedlot pens. Pens then will be assigned to one of two dietary treatments. Basal diets will consist of steam-flaked corn, a roughage source, vitamins, minerals, and Rumensin. Treatments will consist of a control diet and an omega-3 enriched diet containing an extruded blend of flaxseed and dried Nannochloropsis microalgae. Diets will contain no Tylosin or other antibiotics, and will be fed twice daily. Cattle will be reimplanted after approximately 75 days using a trenbolone acetate/estradiol implant. All cattle will be fed a beta adrenergic agonist for the final phase of finishing. After approximately 150 days on feed, cattle will be harvested at a commercial abattoir. Live animal performance measurements will include weight gain, feed consumption, and feed efficiency.

***Diet Characterization.*** Dietary ingredients will be sampled daily, composited by month, and monthly samples will be analyzed for contents of dry matter, total nitrogen, starch, total lipid, fatty acid profile, acid detergent fiber, calcium, potassium, and phosphorus.

### Harvest Phase

***Carcass Evaluation and Liver Abscess Incidence and Severity***. After approximately 150 days on feed, cattle will be harvested at a commercial abattoir. Incidence and severity of liver abscesses and hot carcass weight will be assessed on the day of harvest. Livers will be characterized with respect to incidence and severity using the scoring system described by Brown et al. (1975), where a score of 0 is assigned to livers with no abscess, A- to a mild abscessed liver (one or two small abscesses or with inactive scars), $A^0$ to a moderate abscessed liver (with one or two large abscesses or multiple small abscesses), or A+ to a severely abscessed liver, defined as containing various large abscesses, with inflammation surrounding the abscess, and often seen adhered to adjacent tissue. After approximately 24-48 of refrigeration, marbling score, 12-th rib fat thickness, ribeye area, percentage of dark cutting beef, and USDA yield and quality grades will be determined for each carcass.

### Post-Harvest Evaluation of Carcass Tissues.

One side of each chilled carcass will be transported to the Kansas State University Meats Laboratory for fabrication, and components of the sides will be distributed among collaborators at North Dakota State University, University of Georgia, and Kansas State University. Striploins will be sent to North Dakota State University; rib sections, briskets, and tenderloins will be retained by Kansas State University; and the remaining portions (chucks, plates, and rounds, and trim) will be sent to the University of Georgia. Analyses of carcass tissues at each location are described below.

***Kansas State University*** researchers will focus on characterization of fatty acids profiles in 20 different meat cuts, grinds, and fat depots across the carcass, including: ground chuck (80% lean, 20% fat); ground round (90% lean, 10% fat); brisket flat; brisket point; chuck (3 muscles); rib steaks; striploin steaks; tenderloin; sirloin cap; top sirloin; bottom sirloin; flank; skirt; diaphragm; top round; bottom round; internal fat; and belly fat. Tissue samples will be ground, freeze dried, lipids will be extracted; and profiles of long-chain fatty acids will be determined by gas chromatography.

***North Dakota State University*** researchers will focus on postmortem changes in skeletal muscle tenderness, as well as color stability of meat during a simulated retail display. Analysis for Warner-Bratzler shear force to determine cooked meat tenderness will be conducted on consecutive strip steaks from 72 hours and 10 days of aging. Analysis will be conducted on fresh steaks that have not been frozen. Strip steaks (2.5 cm thick) will be cooked on clam shell grills to 71ºC in accordance to American Meat Science Association cookery guidelines (AMSA, 1995). Steaks will be chilled before coring and shearing. Six 1.7 cm cores will be taken parallel to muscle fibers and sheared once through with a Warner-Bratzler machine. Peak force will be recorded for each core and averaged for each steak.

Color shelf-life will be determined in accordance with AMSA guidelines (2012). Briefly, d-10 aged strip steaks (2.5 cm) will be placed in foam trays and overwrapped with PVC film and placed on flat shelving at 2ºC under continuous LED light for 8 days. Shelf placement will be rotated daily. Objective color (L*, a*, and b*) values will be taken from the average of two readings on the cut surface of the steak. Additionally, visual appraisal of percentage of discoloration with be recorded. Also, steaks will be imaged every second day with a spectral camera utilizing visible and near-infrared wavelengths and submitted for hyperspectral analysis to the NDSU Meat quality lab (Sun et al., 2018). Results of analysis will include changes in color, texture, and reflectance over storage time.

SDS-PAGE and Western blot procedures for detection of troponin-t and desmin degradation and calpain 1 autolysis will be conducted on aged samples in accordance with Howard 2016. Procedures for SDS-PAGE and western blot will be conducted on p70-S6K1 and PDG1-α to evaluate skeletal muscle protein accretion pathways. Briefly, homogenate samples will be loaded onto polyacrylamide gels where proteins will be separated by molecular weights. Separated proteins will be transferred onto PVDF membranes for antibody incubation and detection. Each antibody used will be optimized for dilution factor, sample protein load, and incubation times to ensure detection within linear ranges of standard controls.

Casein zymograms will be conducted on samples from 72 hrs and 10 days of age to evaluate residual calpain 1 and calpain 2 activity in accordance with Hayes at al. 2016. Briefly, the sarcoplasmic fraction of skeletal muscle proteins will be separated on non-denaturing gels infused with casein as a substrate. Gels will be submersed in an incubation buffer containing calcium that will activate any residual calpain. Clear zone size will be indicative of residual calpain activity indicating if calpain had been activated during aging.

Proteasome activity assay will be determined in muscle samples using a 20S proteasome activity assay kit (Sigma-Aldrich, Temecula, CA, USA) based on the detection of the fluorophore 7-amino-4-methylcoumarin after its cleavage from a labeled substrate.

***University of Georgia*** researchers will focus on evaluation of different ground beef products after harvest. In the United States ground beef accounts for approximately 60% of total beef sales (consumption) including the retail and HRI segments. Ground beef's position in the market and price point make it an ideal target for value added utilization with wide and rapid adoption. However, the same market positioning of ground beef dictates that value added technologies must also maintain or improve the consumer's perception of product quality. Ground beef can be found in various package forms (chubs, case ready master pack, vacuum packaged, modified atmosphere packaged, small or large packaged frozen patties, and retail prepared oxygen permeable packages), fat contents (96/4, 90/10, 85/15, 80/20, 73/27, 70/30), and anatomical locations (ground chuck, ground round, custom blends, and general ground beef from whole carcass trim). Packaging style has large impact on ground beef quality preservation, oxidation, and color stability with IQF, boxed patties (retail and HRI) > vacuum package (primarily retail) > master pack case/cook ready (retail and HRI) > retail prepared oxygen permeable. Fat content of ground beef impacts eating satisfaction, rate of oxidation, and color stability. Ground beef fat content influences consumer purchase decisions relating to price point (greater fat content is usually lower cost), eating satisfaction, and perceived health benefits/implications (lower fat content) with 80/20 and 90/10 blends being common in both retail and HRI having the ability to meet both palatability and perceived health concerns. Furthermore, anatomical location of ground beef is also intrinsically tied to fat content (chuck having a greater proportion of fat than round), color and color stability (different proportions of red:white fiber type, and OCR), and lipid composition profiles (saturated:unsaturated, and n6:n3). Previous research examining the feeding of different microalgae products to cattle has shown that it was able to decrease the saturated:unsaturated and n6:n3 ratios of the longissimus lumborum, but subsequently hastened the rate of lipid oxidation and reduced the color stability of longissimus steaks in simulated retail display. To date, a comprehensive study has not been conducted to examine the interaction of packaging method, fat content, and anatomical location on beef fed a microalgae product during the finishing phase. Ground beef's market position, packaging options, and blend formulations (both anatomical and fat content) warrant further investigation.

Grinds will be prepared from the carcass sides (*n* = 14/treatment) to evaluate ground beef quality and shelf-life color stability analyses. Cuts from the chuck (IMPS 115 or 114 + 116A/C +116B) and round (IMPS 159/163 or 167 + 168 + 171) will be collected in a manner to maintain individual animal ID, vacuum packaged and shipped to the University of Georgia Meat Science Technology Center. Upon arrival to the UGA MSTC cuts from the chuck and round from each animal will be formulated to meet ground chuck 80/20 and ground round 90/10 standards. Patties will be formed using a Patty-O-Matic (114g and 1.27 cm thick) and will be randomly assigned to packaging style including case ready master pack (patties in Styrofoam trays with polyvinyl chloride overwrap placed in impermeable bags flushed with 80% $N_2$/20% $O_2$), and retail prepared Styrofoam trays with polyvinyl chloride overwrap. From each animal*feed treatment*anatomical source, patties will be frozen for subsequent fatty acid analysis and consumer sensory analysis (N = 200).

Mother pack patties will be boxed and placed in cold (0 ± 1°C) dark storage for 10 days. Master packs will be sampled for gas concentrations, opened, and a patty from each pack (N = 60) will be selected for $CO_2$ saturation. Another patty from each pack (N = 60) will be frozen (-80°C), vacuum packaged, and used for consumer panel evaluation. Subsequently, trays containing the patties will placed in retail coffin meat display cases (0 ± 2°C). On day 0, 1, 2, 3, and 4 packages designated for TBARS analysis will be opened. The TBARS patties will then be vacuum packaged and frozen (-20°) until analysis.

To simulate retail manufacturing of ground beef the patties randomly assigned to polyvinyl chloride overwrap will be placed in 2S trays, wrapped, and placed in coffin retail display cases (0 ± 2°C) for 0, 1, 2, 3, 4, and 5 days. On the respective days samples marked for TBARS analysis will be stored (-20°) until further analysis.

## Application to the Beef Industry

In this project we propose to evaluate a novel feeding strategy aimed at overcoming a key obstacle for beef demand. The project will characterize fat profiles across a broad range of beef cuts and grinds in an effort to identify fat depots with fatty acid profiles that are perceived as more desirable. Additionally, by altering composition of the finishing diet we will alter fat deposition, thus producing carcasses containing greater proportions of omega-3 fatty acids, which are perceived as more healthful. If objections to beef fat can be overcome, carcass utilization will increase, thus contributing directly to sustainability by improving food output.

## References

Aas, V., M.H. Rokling-Andersen, E.T. Kase, G.H. Thoresen, and A.C. Rustan. 2006. Eicosapentaenoic acid (20:5 n-3) increases fatty acid and glucose uptake in cultured human skeletal muscle cells. J. Lipid Res. 47:366-374. ISSN 0022-2275. https://doi.org/10.1194/jlr.M500300-JLR200.

American Meat Science Association. 1995. Research guidelines for cookery, sensory evaluation, and instrumental tenderness measurements of fresh meat. Chicago, IL; AMSA.

Fievez, V., F. Dohme, M. Danneels, K. Raes, and DD Demeyer. 2003. Fish oils as potent rumen methane inhibitors and associated effects on rumen fermentation in vitro and in vivo. Anim. Feed Sci. Technol. 104:41-58. ISSN 0377-8401. https://doi.org/10.1016/S0377-8401(02)00330-9.

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Li, L., K.E. Schoenhals, P.A. Brady, C.T. Estill, S. Perumbakkam, A.M. Craig. 2012. Flaxseed supplementation decreases methanogenic gene abundance in the rumen of dairy cows. Animal. 6:1784-1787. doi: 10.1017/S175173111200078X. Epub 2012 Apr 12. PMID: 22717375.

Martin, C., A. Ferlay, P. Mosoni, Y. Rochette, Y. Chilliard, and M. Doreau. 2016. Increasing linseed supply in dairy cow diets based on hay or corn silage: Effect on enteric methane emission, rumen microbial fermentation, and digestion. J. Dairy Sci. 99:3445-3456. ISSN 0022-0302. https://doi.org/10.3168/jds.2015-10110.

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Medeiros, D.M., M. Hampton, K. Kurtzer, M. Parelman, E. Al-Tamimi, and J. S. Drouillard. 2007. Feeding enriched omega-3 fatty acid beef to rats increases omega-3 fatty acid content of heart and liver membranes and decreases serum vascular cell adhesion molecule-1 and cholesterol levels. Nutrition Research. 27:295-299. ISSN 0271-5317. https://doi.org/10.1016/j.nutres.2007.04.003.

Vargas, J.E., S. Andrés, L. López-Ferreras, T.J. Snelling, D.R. Yanez-Ruiz, C. Garcia-Estrada, and S. Lopez. 2020. Dietary supplemental plant oils reduce methanogenesis from anaerobic microbial fermentation in the rumen. *Sci Rep.* 10:1613. https://doi.org/10.1038/s41598-020-58401-z

**Measurable Objectives**

*(For tactics $100,000 or less two measurable objectives are required, and for tactics over $100,000 at least three to five measurable objectives are required by the Checkoff Evaluation Committee)*:

1. Characterize changes in fat profiles throughout the beef carcass in response to feeding a mixture of flaxseed and Nannochloropsis microalgae as sources of omega-3 fatty acids.
2. Evaluate impact of long-chain fatty acids on skeletal muscle metabolism (live animal).
3. Evaluate impact of omega-3 fatty acids on post-mortem changes in muscle tissue.
4. Evaluate sensory attributes and retail display characteristics of beef containing elevated concentrations of long-chain omega-3 fatty acids.
5. Evaluate potential for decreasing incidence of liver abscess in feedlot cattle response to feeding a mixture of flaxseed and microalgae.

**Performance Efficiency Measures**

**Consumer Reach Goal:** 10,000

**Consumer Engagement Goal:** 1,000

**Producer Reach Goal:** 19,700

**Producer Engagement Goal:** 1,900

**Key Opinion Leader Reach Goal:** 500

**Key Opinion Leader Engagement Goal:** 50

As a new project, these goals are hard to precisely outline. That said, the fact this novel project focuses on sustainability and builds upon well-recognized research efforts conducted by Kansas State University, it is anticipated that monthly, quarterly, and annual reports will be of high interest leading to substantial Performance Efficiency.

## LRP Initiatives Addressed by this Tactic

| Drive Growth in Beef Exports | Grow Consumer Trust in Beef Production | Develop & Implement Better Business Models & Value Distribution Across All Segments | Promote & Capitalize on the Multiple Advantage of Beef | Improve the Business & Political Climate of Beef | Safeguard & Cultivate Investment in Beef, Industry Research, Marketing & Innovation |
|---|---|---|---|---|---|
| ☐ Drive adoption of traceability<br>☐ Identify & address export customer needs and values<br>☐ Collaborate with targeted partners to promote U.S. beef in foreign markets<br>☐ Invest in research, marketing & education programs | ■ Measure, document, improve & communicate the net environment impact of beef production<br>☐ Educate medical, diet & health professionals about beef & beef production<br>☐ Align and collaborate with traditional & nontraditional partners to tell the positive story of beef production<br>☐ Engage positively in the sustainable nutrition conversation<br>☐ Expand efforts in education the general public about BQA program & it's impact on animal well-being<br>☐ Expand BQA program to include verification<br>☐ Develop a direct-to-consumer beef safety campaign | ☐ Use innovative methods & technologies to value carcasses based on eating satisfaction & red meat yield | ■ Promote the role of beef in a health & sustainable diet<br>☐ Implement a marketing campaign that communicates beef's advantage compared to alternative proteins<br>☐ Develop targeted marketing programs focused on the highest opportunity market segments<br>☐ Cultivate collaborative promotion partnerships<br>☐ Promote innovative online marketing, packaging & shipping solutions to enable the direct marketing of beef<br>☐ Engage consumers in a memorable beef eating experience<br>☐ Develop a more interactive & exciting beef purchasing experience<br>☐ Promote underutilized beef cuts & new variety meat product | ■ Demonstrate beef's positive sustainability message & key role in regenerative agriculture<br>☐ Defend beef's product identity<br>☐ Ensure beef's inclusion in dietary recommendations<br>☐ Drive continuous improvement in food safety<br>☐ Develop crisis management plans | ■ Attract innovative & intellectual capital into the beef industry<br>■ Encourage the cooperation & collaboration of existing industry advisory committees to identify & prioritize research efforts |

**Committee(s) to Score this Tactic**

| Consumer Trust | Domestic Marketing | International Marketing | Nutrition & Health | Safety & Product Innovation | Stakeholder Engagement |
|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | ■ | ☐ |

**SUPPLEMENTAL INFORMATION FOR THIS AR**

1. **Please explain changes from FY 2021 approved AR:**

   Not applicable, this is a new Authorization Request for Fiscal Year 2022.

2. **List any proposed vendors/agencies that will be used to complete the work in this AR.**

   Kansas State University

3. **Will all work with vendors/agencies be competitively bid?**
   ***If not, why not?***

   No, Dr. James Drouillard at Kansas State University is uniquely positioned to carry out this research. He has dedicated a career to advancing both the health and well-being of feedlot animals, and finding ways to address and offset those animals' carbon emissions – while also creating a healthful and nutritious beef product.

4. **Please list any relationships between this AR and projects previously funded by the Beef Promotion Operating Committee (BPOC):**

   No previously-funded project has examined the issue from this perspective, however the results of this research will pair seamlessly with the Beef Promotion Operating Committee's work in showcasing the nutritional and environmental benefits of beef.

5. **If applicable, explain how this AR can be extended by State Beef Councils.**

   Research reports will be provided to State Beef Councils, who may then pass the information along to producers in their state. Further, Dr. Drouillard, our principal investigator, will be available for any in-person industry meetings or events to outline the outcomes of his work, and how it may benefit the beef industry at-large.

## DETAILED BUDGET SUMMARY

**AR# 2212-R**

**CBB/BPOC Funding Request:**

| Committee Name | Tactic | Tactic Name | Funding Source | Direct | Impl. | Total |
|---|---|---|---|---|---|---|
| *Safety & Product Innovation* | A | A Strategy for Improving Consumer Perceptions of Beef and Beef Production Systems | BPOC | $ 200,000 | $ 10,000 | $ 210,000 |
| **AR Totals** | | | | $ 200,000 | $ 10,000 | $ 210,000 |

**Federation of SBCs Pledges/Other Funding:** ***(Informational Only)***

| Committee | Tactic | Tactic Name | Funding Source | Direct | Impl. | Total |
|---|---|---|---|---|---|---|
| *Safety & Product Innovation* | A | A Strategy for Improving Consumer Perceptions of Beef and Beef Production Systems | North Dakota Oilseed Council | $ - | | $ - |
| *Safety & Product Innovation* | A | A Strategy for Improving Consumer Perceptions of Beef and Beef Production Systems | NBO3 Technologies | $ - | | $ - |
| **AR Totals** | | | | $ - | $ - | $ - |

## Summary of Prior Year AR Budgets and Expenses:

| **FY 2021 Approved Budgets** | CBB/BPOC | FSBCs | Other Source(s) | Total | Direct Cost | Impl. | Total |
|---|---|---|---|---|---|---|---|
| AR Totals | NA | | | NA | | | $ - |

| **FY 2021 Actual Expenses** **(through June 30, 2021)** | CBB/BPOC | FSBCs | Other Source(s) | Total | Direct Cost | Impl. | Total |
|---|---|---|---|---|---|---|---|
| AR Totals | $ - | | | $ - | | $ - | $ - |

## Historical Summary of Budgets and Expense: *(includes all funding sources listed in original AR)*

| | **Total Approved Budgets** | | | **Total Actual Expenses** | | |
|---|---|---|---|---|---|---|
| | FY 2020 | FY 2019 | FY 2018 | FY 2020 | FY 2019 | FY 2018 |
| AR Totals | NA | NA | NA | NA | NA | NA |