



COMMERCIAL FEED
REGULATORY PROGRAM

QUARTERLY FEED UPDATE

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Note: The following is a summary of results from an industry-funded research trial coordinated by the CDFA Safe Animal Feed Education (SAFE) Program; hemp is not currently an approved commercial feed ingredient in California.

Effects of Feeding a Lipid-Extracted Hemp Residue to Lactating Goats

K.L. Swanson and D.H. Putnam - University of California, Davis Department of Plant Sciences; H.M. Bill, M.D. Zack and E.J. DePeters - University of California, Davis Department of Animal Science

The industrial hemp industry in California has grown rapidly since the passage of the 2018 Farm Bill (Agriculture Improvement Act of 2018). Industrial hemp is being cultivated for fiber, seeds, or cannabidiol (CBD), although the majority of industrial hemp is currently used for CBD extraction. The extraction of CBD from hemp creates a hemp residue that must be disposed of in an environmentally sustainable and safe fashion. Since this residue consists of stems, leaves, and flowers from the hemp plant, one proposed approach is to use the hemp residue as a byproduct feedstuff for livestock. This pilot project aimed to determine the viability of a lipid-extracted hemp residue as a ruminant feed as well as the potential for rumen microbes to degrade cannabinoids in hemp so that they are not found in animal products such as meat and milk.



This study used a lipid-extracted hemp residue.

This study used a lipid-extracted hemp residue. This residue was found to be a good source of neutral detergent fiber (NDF) at 24.1% (Dry Matter basis), which is comparable to that of high-quality alfalfa hay. The hemp residue was low in crude protein at 12.5% and high in fat at 33.8%. The high fat content was due to the method of CBD extraction. In addition, the hemp residue was found to contain 16.6 mg/g of CBD and CBDA (cannabidiolic acid) combined. There was no detectable THC (tetrahydrocannabinol). To determine the viability of hemp residue as a ruminant feed, *in vitro* and *in vivo* approaches were used. The *in vitro* approach involved incubating samples of hemp in rumen fluid that was collected from fistulated cows. Hemp samples included

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hemp plant components (e.g., whole plant, leaf, and flower) as well as the lipid-extracted hemp residue that was rinsed with acetone to remove most of the fat prior to incubation. On average the hemp residue was more digestible on a dry matter basis than the whole plant or flower of hemp plants, but somewhat less digestible than the leaves (36% for whole plant, 39% for flower, 48% for hemp residue, and 55% for leaves measured after 48 hours of incubation in rumen fluid). A similar trend was observed for the NDF digestibility.

The lipid-extracted hemp residue was also fed to lactating goats. There were three treatment groups of four goats each. Treatments were: Control (no hemp residue), Low (0.15 lb. hemp residue/goat/day), and High (0.3 lb. hemp residue/goat/day). The hemp residue was pelleted with a portion of the grain mix and alfalfa to improve palatability. The lipid-extract hemp residue alone was not readily accepted by the goats. The hemp and control pellets were fed in the milking parlor twice daily to ensure each goat consumed her assigned treatment diet. Milk from goats was discarded and not used for human consumption. Alfalfa hay was offered free choice in their housing pens along with free choice water. Feed refusals of the pellets and milk yield were recorded twice each day. Samples of milk, blood, urine, and feces were collected weekly.



Samples of milk, blood, urine, and feces were collected from the goats weekly.



Milk yield was recorded twice each day.

Adipose tissue samples were collected once at the end of the study (day 28). Samples of blood and milk were analyzed for cannabinoid concentration. The protocols to extract and measure cannabinoids in adipose tissue, feces, and urine are still being developed. Milk samples were also analyzed for fat, protein, lactose, total solids, somatic cell count, and urea nitrogen.

Overall, the goats needed some time to adjust to the hemp pellets in their diet. Feeding a lipid-extracted hemp residue did not affect body weight or daily milk yield in goats. The goats consuming the Low and High diets did have lower milk fat percentages, but over time the milk fat percent for all treatment groups increased. Protein, lactose, and total solids did not change over time for any treatment groups, but for all groups, milk urea-nitrogen and somatic cells decreased over time.

Cannabinoids (CBD, CBDA, THC) and their metabolites (6-OH-CBD, 6-hydroxy-cannabidiol; 7-OH-CBD, 7-hydroxy-cannabidiol; 7-COOH-CBD, 7-carboxy-cannabidiol) were found in both the blood and milk samples (measured in ng/mL) collected from the Low and High treatment goats. The metabolite 7-COOH-CBD was the most concentrated compound found in the blood, but it was found

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in much lower concentrations in the milk. The 6-OH-CBD was only found in small quantities in the milk, and it was not present in blood. Both the 7-COOH-CBD and 7-OH-CBD were found in greater quantities in the Low group compared with the High group for milk samples. CBDA, an acidic precursor to CBD, was found in the blood of goats for both the Low and High treatments, but CBDA was not found in the milk for either treatment groups. CBD and THC were both found in the blood and milk, with higher concentrations in samples from the High treatment and in milk samples for both Low and High treatment groups. It was surprising that THC was found in the blood and milk of goats consuming hemp residue since there was no detectable THC in the hemp residue. This could be due to the THC concentration being very low (below 1.2 mg/g detection limit of the method) in the hemp residue or it could be that a portion of the CBD in the hemp residue was being converted to THC in the abomasum of the goats. Previous *in vitro* and *in vivo* studies by other researchers have shown this conversion is possible in acidic conditions, but we are not able to determine definitively why THC was found in the blood and milk in the goats in our study.

The research reported here is the first animal study that assessed the potential transfer of cannabinoids from hemp into animal products. While this work is an important starting point, the small number of animals used, the use of goats instead of lactating dairy cows, and the use of lipid-extracted instead of an ethanol-extracted hemp residue indicate that more research information is required to assess the potential of feeding hemp residue to livestock. Future research will involve the feeding of an ethanol-extracted hemp residue to lactating dairy cows to gain a better understanding of implications of feeding hemp residue as a byproduct feedstuff on the potential safety of animal products for human consumption.



A study participant.

Preventive Controls Qualified Individual (PCQI) Training

The Safe Animal Feed Education (SAFE) Program hosted a Food Safety Preventive Controls Alliance Preventive Controls Qualified Individual (PCQI) for Animal Food Training session in December. Seven participants completed the course. The blended two-part course is composed of Part 1, completed online, and Part 2, which is instructor-led. Although Part 2 is typically completed in person, the session was held virtually using the Zoom video conferencing platform due to COVID-19 restrictions. This is the seventh PCQI Training that SAFE has hosted since 2017. No additional training dates are scheduled at this time; please email the SAFE program at safe@cdfa.ca.gov if you are interested in attending a future session.

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Technical Advisory Subcommittee Update

The Technical Advisory Subcommittee (TASC) of the Feed Inspection Advisory Board (FIAB) serves as an expert scientific panel on matters concerning animal nutrition, feed labeling, and environmental effects related to human food diversion to livestock feed. The TASC advises the FIAB on feed/food safety issues, as well as matters related to the funding of research projects by the Safe Animal Feed Education (SAFE) Program. The TASC advises the FIAB on research priorities, evaluates the scientific merit of research proposals, and makes recommendations to the FIAB on projects selected for grant funding.

New Research Grant Proposals

On October 22, 2021, the TASC met to assess the merits of two research grant proposals. The proposals were evaluated based on their utility to the Commercial Feed Regulatory Program (CFRP) and the potential to address current knowledge gaps in the body of literature associated with hemp by-product feeding and the importance of by-product feed utilization in California as it relates to feed availability and its role in decreasing the amount of human food going to landfills. The following two proposals were accepted and recommended for funding by the TASC. Both research projects will begin in quarter one of 2022 and continue into 2023.

Title: Assessing the Importance of By-product Feedstuffs to Livestock and Environment in California



Submitted by: University of California (UC) Davis Department of Animal Science and UC Cooperative Extension

Budget: \$95,590

Study Goals:

- Identify the by-product feedstuffs produced in California
- Identify the region of by-product production and quantity produced
- Identify any seasonal production and availability of by-products
- Identify the end use of by-products (e.g., livestock feed, compost, anaerobic digester, landfill, land application, etc.)
- Determine an estimate of the total quantity of each by-product produced
- Obtain estimates of the economic value (\$/ton dry matter) of each by-product
- Quantify the amount of individual by-products fed by category of livestock (e.g., dairy, beef, poultry, swine, etc.)

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Title: Hemp Residue as a Lactating Cow Feed

Submitted by: UC Davis, Department of Animal Science

Budget: \$149,074

Study Goals:

- Determine if Cannabinoids are present in milk, adipose and blood of lactating dairy cattle fed hemp by-product
- This project builds on the UC Davis Hemp By-Product Goat Trial previously coordinated by SAFE

New TASC Members

The FIAB met on October 27, 2021, and moved to recommend the acceptance of two new members to the TASC - Dr. Robert Poppenga and Jennifer Heguy.

Dr. Robert Poppenga is the Head of the Toxicology Section at the California Animal Health and Food Safety Laboratory. Dr. Poppenga brings to the TASC over 30 years of experience in the field of animal health, veterinary medicine, and veterinary clinical and diagnostic toxicology. Dr. Poppenga's areas of interest within clinical and diagnostic toxicology include wildlife toxicology, development of biomarkers of exposure to environmental contaminants and issues related to the safety of foods and feeds (both human and animal) from a chemical contamination perspective. Dr. Poppenga is actively involved with the Food Emergency and Response Network (a U.S. Food and Drug Administration - U.S. Department of Agriculture program).

Jennifer Heguy is a registered Professional Animal Scientist and is the UC Cooperative



A new project at UC Davis will study hemp residue as a lactating cow feed.

Extension Dairy Farm Advisor and Director for Merced, Stanislaus, and San Joaquin counties. Heguy obtained a B.S. and M.S. from UC Davis in the field of Animal Science. The program focus of Heguy's research is dairy cattle nutrition, including work in traditional and alternative forages, by-products and feeding practices. Heguy is a member of several professional organizations including the American Dairy Science Association, American Registry of Professional Animal Scientists, and served as the 2021 California Animal Nutrition Conference Chair.

CFRP and the SAFE Program welcome Dr. Poppenga and Jennifer Heguy to the TASC and thank them for their participation.

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Animal Health Branch Secure Food Supply Program Feed Mill Tour

Members of the Animal Health Branch Secure Food Supply Program attended a tour of a California livestock feed mill on October 28, 2021, with Mike Davidson, Supervising Special Investigator for the Commercial Feed Regulatory Program. The group wanted to learn more about how a California feed mill operates to help them better understand how a quarantine could work in the event of an animal disease threat. Dr. Marit Arana, head nutritionist for the firm, accompanied the group and assisted with answering questions to help the team better understand the feed manufacturing and distribution process.



From left, Dr. Dan Hagerty, Robb Lalum, Thomas Parrish and Jessica Blankenship.

2021/2022 FDA Contract

The Commercial Feed Regulatory Program (CFRP) has finalized its 2021/2022 Animal Food Safety Contract with the U.S. Food and Drug Administration totaling \$134,734.44. The contract year began on September 24, 2021, and will end on September 23, 2022.

CFRP staff will perform comprehensive inspections at livestock feed facilities during this contract year. Staff will verify compliance with the federal animal food requirements applicable to each firm, including the Food Safety Modernization Act (FSMA) and the Bovine Spongiform Encephalopathy (BSE), Veterinary Feed Directive (VFD) and Medicated Feed rules.

Diversion Strategies Webinars

The Commercial Feed Regulatory Program (CFRP) participated in presenting information at Diversion Strategies' two-part webinar series, "Traditional Organics Recycling Solutions for SB 1383." The series emphasized recycling solutions for Senate Bill (SB) 1383, including utilizing livestock feed as a means to divert products from landfills to their highest and best use as a livestock feed.

The first session was held on November 4, 2021, and covered agriculture-based organics recycling infrastructure and pathways. View the recording at: <https://youtu.be/2XhUhCBrDpo>.

The second session was held on December 16, 2021, and featured presentations from industry experts on implementation of these traditional and innovative solutions and how they can help jurisdictions achieve SB 1383 compliance. View the recording at: https://youtu.be/oDCyYxhcf_c.

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