ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0400663 Year: 98 Project Number: 1265-41420-001-00 D
Mode Code: 1265-70-00 STP Codes: 4.1.2.3 60% 4.2.1.3 40%
NATL PROG(S) 108 Food Safety, (animal products) 30%
306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Title: NEW TECHNOLOGIES TO IMPROVE AND ASSESS MEAT QUALITY AND SAFETY

Period Covered From: 02/97 To: 02/02

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

Two of the top priorities and concerns in the meat industry today are food safety issues and inconsistency/lack of uniformity in meat quality (tenderness/palatability). Control of food borne pathogens and the reduction in the potential health risks to consumers from human pathogens in meat products is currently a most important food safety goal. Inconsistent cooked color in relation to internal product temperature poses food safety risks and limits the use and development of color derived assessment systems for safety in cooking ground beef. The tenderness trait is one that most affects a consumer's acceptance of a product secondary to food safety. Inconsistency in tenderness exists from one piece of meat to the next (from one animal to another), but also within the same animal from one muscle to another. Additionally, this inconsistency problem also exists within the same piece of meat/steak. Use of hydrodynamic pressure wave technology is being evaluated as a newly emerging technology to control the quality variation as well as potentially reducing or eliminating food borne pathogen in meat products. Extensive nationwide sampling of ground beef has been conducted for purposes of determining the degree of color variability in cooked beef patties. This information will be used to finalize cooked color-oriented messages for consumers.

2. How serious is the problem? Why does it matter?

The food safety issues associated with meat products is so serious that the recent Food Safety Initiative has highlighted food safety, and, in particular, the control of food borne pathogens, as an important concern of the entire federal government. Determining how to reduce microbial

pathogens in meat products, from the farm to the plate, is the most urgent food safety problem today. Conflicting messages to both the food service industry and consumers regarding reliable indicators of safety in cooked beef patties have raised concern from cattle producers to consumers regarding sales, image and safety of this product. The evolutionary process to improve meat tenderness has been a major focus of the meat industry and research community for over a century. A variety of techniques have been introduced for tenderizing meat--none of which have been successful at eliminating the inconsistency problem. The meat industry is a multi-billion dollar industry that loses its competitive edge to other food products as a

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result of the consumers' acceptance or lack of for particular meat products. The inconsistencies in meat tenderness have forced processors to employ costly, time-consuming procedures to assure as much as possible satisfactory eating quality. Cost to the U.S, meat industry in applying these often inefficient systems could easily exceed two billion dollars annually.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

This research (40 percent) closely relates to the mission of National Program 109: Animal Production, Product Value and Safety which is to ensure that the food supply is safe for consumers and that food and feed meet foreign and domestic regulatory requirements. Newly emerging technologies (e.g., hydrodynamic pressure) may potentially improve food safety of meat products by reducing both pathogens and spoilage organisms. Identification of the most appropriate guidance on cooking beef patties will provide another protective barrier against potential food borne illness from such organisms as E. coli O157:H7. This research (60 percent) closely relates to the mission of National Program 106: Animal Product Development, Quality, and Marketability which is to improve the quality and marketability of animal products by meeting consumer demands for enhanced quality and wholesomeness. Newly emerging technologies (e.g., hydrodynamic pressure) offers scientists a means of: (1) providing quality and consistency to meat products priced to have consistency (branded products), and (2) adding value to muscles/products not previously considered to have acceptable eating quality.

4. What was your most significant accomplishment this past year?

Research has indicated that a hydrodynamic pressure wave generated in a steel chamber (commercial prototype Hydrodyne equipment) is not as effective as a hydrodynamic pressure wave generated in a disposable/plastic container for tenderizing meat. Composition and configuration of the explosive containers appears to influence the magnitude of performance of

this technology to tenderize meat. Use of hydrodynamic pressure wave technology in studies with ground beef products has been shown to create a slightly more brown appearance in cooked patties predisposed to persistent pink color at elevated internal temperatures. A nationwide sampling of ground beef has provided evidence that cooked beef patty color is not a good indicator of internal patty temperature. If bulk ground beef was frozen and then thawed prior to making and cooking patties, approximately two-thirds of the patties appeared brown and fully cooked at less than a food safe internal temperature. Use of infrared thermal imagery revealed the occurrence of considerable temperature variability in cooked beef

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patties. Preliminary research using hydrodynamic pressure waves to reduce microorganisms and food borne pathogens has suggested the potential for, at the very least, reducing microbial spoilage organisms associated with meat within a package.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

Discovery that instantaneous improvement in meat tenderness can be achieved using hydrodynamic shock wave-pressure technology. Extremely tough meat exposed to a hydrodynamic shock wave pressure front was made significantly tender and acceptable. This tenderization involved physical disruption (tearing) of the microscopic ultrastructural components of muscle tissue. Regardless of type of meat cut and level of initial toughness, hydrodynamic pressure technology has been successful at increasing the value of these meat products by improving tenderness instantaneously. When energy, space, and labor costs are considered for aging meat (conventionally employed tenderization process) with or without additional postharvest tenderization treatments, hydrodynamic pressure technology may offer a new alternative for effectively and efficiently tenderizing meat. Furthermore, hydrodynamic pressure appears to offer additional benefits by reducing microorganisms associated with meat. Accomplishments associated with the cooked color problems in beef patties were: (1) cooked beef patty color is an unreliable indicator of internal temperature, (2) high pH muscle (>6.0) can lead to limited myoglobin denaturation during cooking and thus, produce considerable pink color well above 160 deg F, (3) cooking patties from the thawed state can lead to premature brown color, (4) controlled thawing, however, can be a useful tool in preventing the persistent pink color of high pH patties, and (5) considerable temperature variability can exist within patties and between patties cooked under the same conditions. These accomplishments have resulted in new and revised recommendations to food service operations and consumers regarding cooking of beef patties.

6. What do you expect to accomplish during the next year?

During the next year, pressure wave profiles will be examined generated using different containment systems to determine the configuration and compositional characteristics necessary to optimize this technology for tenderizing and making meat more consistent in palatability, in addition to developing this technology for enhancing the food safety benefits (reducing or eliminating pathogens and spoilage organisms). The explosive charge configuration will be evaluated in order to optimize it, as well as looking at alternative sources that can replace the explosive charge in this process. The influence of fat content, product state, patty size and shape, cooking method and holding time post-cooking will be evaluated in studies

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involving internal temperature and color variability in cooked beef patties.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

This technology (hydrodynamic pressure) has not been transferred as yet. Before it can be adopted by the meat industry, the problems described in Question 4 will have to be solved in addition to designing the system to not only provide for instant tenderization but for consistent tenderization from one piece of meat to the next and within the same piece of meat. At present a one-size-fits-all process is not eminent. Additionally, a packaging system for the meat cuts that will withstand this hydrodynamic force will have to be developed. The findings and technologies relative to cooked beef patty color and temperature have been transferred to action/ regulatory agencies, ground beef processors, National Cattlemen's Beef Association, food service industry and consumers through conference calls, reports, public meetings and presentations. The new consumer recommendation from this research which was issued by FSIS is to not rely on cooked beef patty color and instead use a meat thermometer. Constraints to adopting this information is cost of thermometers, lack of interest on the part of consumers to use thermometers and the need for an inexpensive non-invasive, imaging device to determine the wide range in temperature variability in cooked patties.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

"Ka-Boom! A Shockingly Unconventional Meat Tenderizer" by Janet Raloff, Science News 1998, 153:366-367. "Hydrodyne - Exploding Meat Tenderness" by Jill Lee, Agricultural Research, June 1998, pp 9-10. "Occurrence of Premature Brown Color in Cooked Beef Patties Obtained in a Nationwide

Sampling of Ground Beef." USDA Public Meeting on Cooked Beef Patty Color. Presentation--Arlington, Virginia, May 1998.

PUBLICATIONS:

01.

SOLOMON, M.B., CARPENTER, C.E., SNOWDER, G.D. and COCKETT, N.E. 1998. Tenderizing callipyge lamb with the Hydrodyne process. J. Muscle Foods 9:305-311.

02.

BERRY, B.W. 1998. Color of cooked beef patties as influenced by formulation and final internal temperature. Food Research Intl. 30:473-478.

Publications: (Continued)

03.
BERRY, B.W. 1998. Cooked color in high pH beef patties as related to fat content and cooking from the frozen or thawed state. J. Food Sci. 63:797-800.

04.
BERRY, B.W. and LIU, M.N. 1998. Effects of patty perforation during processing and "cook and hold" procedures on properties of low-fat beef patties. J. Food Service Sys. 10:125-138.

05.
LIU, M.N. and BERRY, B.W. 1998. Patty formation method, thickness and weight effects on properties of cooked low-fat beef patties. J. Muscle Foods 9:243-256.

06.
BERRY, B.W. 1997. Sodium alginate plus modified tapioca starch improves properties of low-fat beef patties. J. Food Sci. 62:1245-1249.

07.
GAMBLE, H.R., SOLOMON, M.B. and LONG, J.B. 1998. Effects of hydrodynamic pressure on the viability of Trichinella spiralis in pork. J. Food Prot. 61:637-639.

08.
VAN LAACK, R.L., KAUFFMAN, R.G., POSPIECH, E., GREASER, M., LEE, S. and SOLOMON, M.B. 1998. The effects of prerigor sodium bicarbonate perfusion on the quality of porcine M. semimembranosus. J. Muscle Foods 9:185-191.

09.
ZUCKERMAN, H. and SOLOMON, M.B. 1998. Ultrastructural changes in bovine longissimus muscle caused by the Hydrodyne process. J. Muscle Foods 9:419-426.

10.
VENKITANARAYANAN, K., FAUSTMAN, C., CRIVELLO, J.F., KHAN, M.I., HOAGLAND,
T.A. and BERRY, B.W. 1997. Rapid estimation of spoilage bacterial load in

aerobically stored meat by ... reaction. J. Appl. Microbiol. 82:137-140.

11.
BERRY, B.W., SODERBERG, D.L. and BIGNER, M.E. 1998. Thermography profiles of cooked beef patties. Proc. Amer. Meat Sci. Assn. Reciprocal Meat Conf. 51:182.

12.
BERRY, B.W., LYON, B.G., et al. 1998. Visual and instrumental evaluations of color in beef patties obtained nationwide and cooked to four internal temperatures. Proc. Amer. Meat Sci. Assn. Reciprocal Meat Conf. 51:182.

13.
BIGNER, M.E. and BERRY, B.W. 1998. Effects of thawing prior to cooking on sensory, shear and cooking properties of beef patties. Institute of Food Technologists Book of Abstracts, p. 160.

Publications: (Continued)

14.
SAIR, A.I., BOOREN, A.M., BERRY, B.W. and SMITH, D.M. 1998. Verification of triose phosphate isomerase ... as indicators of the adequate thermal processing of ground beef patties. IFT Book of Abstracts, p. 164.

15.
SOLOMON, M.B. 1998. The Hydrodyne process for tenderizing meat - an update. Proc. Reciprocal Meat Conference 51:171-176.

16.
BERRY, B.W, SOLOMON, M.B., ZUCKERMAN, H., EASTRIDGE, J.S. and LONG, J.B. 1998. Application of Hydrodyne technology for military meat products. Proc. Annual Meeting R&D Assoc. Military Food and Packaging 49:279-284.

17.
SOLOMON, M.B. 1998. The callipyge phenomenon: challenges and opportunities: toughness intervention methods. J. Anim. Sci. (Suppl. 1)76:364.

Approved: D.F. COLE Date: 02/99
Title: ACTING ASSOCIATE DIRECTOR

ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0147906 Year: 98 Project Number: 1265-41420-001-01 T
Mode Code: 1265-70-00 STP Codes: 4.1.1.6 100%
NATL PROG(S) 108 Food Safety, (animal products) 30%
306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Title: COMMERCIAL TENDERIZATION OF MEAT PRODUCTS USING HYDRODYNE PROCESS

Period Covered From: 01/98 To: 09/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

Inconsistency and lack of uniformity in meat tenderness/palatability continues to be a major problem for the meat industry. The tenderness trait is one that most affects a consumer's acceptance of a product. Inconsistency in tenderness exists from one piece of meat to the next (from one animal to another), but also within the same animal from one muscle to another. Additionally, this inconsistency problem also exists within the same piece of meat/steak. Results suggest instantaneous tenderization of meat using hydrodynamic pressure wave technology with the potential for reducing the degree of inconsistency in meat. Hydrodynamic pressure treatment has the ability to tenderize meat of varying levels of initial toughness.

2. How serious is the problem? Why does it matter?

The evolutionary process to improve meat tenderness has been a major focus of the meat industry and research community for over a century. A variety of techniques have been introduced for tenderizing meat - none of which have been successful at instantaneously tenderizing nor eliminating the inconsistency problem. The meat industry is a multi-billion dollar industry that loses its competitive edge to other food products as a result of the consumers' acceptance or lack of for particular meat products as a result of palatability problems.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

This research (100 percent) closely relates to the mission of National Program 106: Animal Product Development, Quality, and Marketability which is to improve the quality and marketability of animal products by meeting consumer demands for enhanced quality and wholesomeness.

4. What was your most significant accomplishment this past year?

Research results have indicated that a pressure wave generated in a steel chamber (commercial prototype Hydrodyne equipment) is not as effective as a pressure wave generated in a disposable/plastic container for tenderizing

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306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

tough meat. Composition and configuration of the explosive containers appears to influence the magnitude of performance of this technology to tenderize meat.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

Discovery that instantaneous improvement in meat tenderness can be achieved using hydrodynamic shock wave-pressure technology. Extremely tough/ unacceptable in tenderness meat exposed to a hydrodynamic shock wave pressure front was made significantly tender and acceptable. This tenderization involved physical disruption (tearing) of the microscopic ultrastructural components of muscle tissue. When energy, space, and labor costs are considered for aging meat (conventionally employed tenderization process) with or without additional postharvest tenderization treatments, the Hydrodyne process may offer a new alternative for tenderizing meat. Hydrodynamic pressure treatment has been shown to tenderize meat of varying levels of initial toughness, with the potential of tenderizing each piece to the same end-point of tenderness.

6. What do you expect to accomplish during the next year?

This CRADA project terminated on 9/30/98 after its maximum 5-year capacity.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

This technology has not been transferred as yet. Before it can be adopted by the meat industry, the problems described in Question 4 will have to be solved in addition to designing the system to not only provide for instant tenderization but for consistent tenderization from one piece of meat to the next and within the same piece of meat. At present a one size fits all process is not eminent for tenderizing different cuts of meat. Additionally

a suitable packaging system for product undergoing this tenderization process will have to be developed.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

"Ka-Boom! A Shockingly Unconventional Meat Tenderizer" by Janet Raloff, Science News 1998, 153:366-367. "Hydrodyne - Exploding Meat Tenderness" by Jill Lee, Agricultural Research, June 1998, pp. 9-10. "Banging Around the

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306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Kitchen" by Kim Camlet, Citytempo Sarasota. Fall 1998, 1:44-45.

PUBLICATIONS:

01.
CARPENTER, C.E., SOLOMON, M.B., et al. 1997. Effects of electrical stimulation and conditioning, ... and aging on the acceptability of callipyge and normal lamb. Sheep and Goat Research Journal 13, No. 3.

02.
SOLOMON, M.B. 1998. Tenderizing beef using the Hydrodyne process. Proc. Intl. Livestock Congress. http://ifse.tamu.edu/ilc/beefproceedings.html.

03.
MEEK, K.I., CLAUS, J.R., MARIOTT, N.G., DUNCAN, S.E. and SOLOMON, M.B. 1998. Hydrodynamic shock wave: decreasing broiler breast aging time. Proc. Reciprocal Meat Conference, p. 192.

04.
MEEK, K.I., CLAUS, J.R., MARIOTT, N.G. and SOLOMON, M.B. 1998. Tenderizing non-aged broiler breasts through hydrodynamic shock waves. Proc. Intl. Cong. Meat Sci. and Techn. S121-124.

05.
EASTRIDGE, J.S., SOLOMON, M.B., WEST, R.L., HAMMOND, A.C. and CHASE, C.C. 1998. Developing Hydrodyne technology parameters for tenderizing meat from Brahman cattle. J. Anim. Sci. (Suppl. 1)76:154.

06.
O'ROURKE, B.M., CALKINS, C.R., ROSARIO, R.T., SOLOMON, M.B. and LONG, J.B. 1998. Hydrodyne-treated beef: aging, proteolysis, and tenderness of strip loins. J. Anim. Sci. (Suppl. 2)76:54.

07.
ZUCKERMAN, H., BERRY, B.W., EASTRIDGE, J.S. and SOLOMON, M.B. 1998. Shear

force mapping: is that the best way for tenderness demonstration? J. Anim. Sci. (Suppl. 1)76:144.

Approved: D.F. COLE Date: 02/99
Title: ACTING ASSOCIATE DIRECTOR

ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0400018 Year: 98 Project Number: 1265-41420-001-02 S
Mode Code: 1265-70-00 STP Codes: 4.1.2.1 100%
NATL PROG(S) 108 Food Safety, (animal products) 30%
306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Title: SMALL-SCALE GOAT FARMING: INDIGENOUS GOAT MEAT AND SKIN/LEATHER PRODUCTION

Period Covered From: 01/98 To: 09/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

Goats are a traditional source of milk, meat, and skin/leather in Africa. Research has shown that significant differences in reproductive performance, natural immunity and growth and carcass traits exists between native goat breeds and feral goats in Africa, with feral goats being superior in reproductive and natural immunity as well as carcass traits. Combining the superior performance of feral goats with the manageability of native goats may improve the total efficiency (quality and quantity) of the natural rural goat population for the small farmer in Africa. A cooperative international project was developed to evaluate different management/ production practices in indigenous goats for improving meat and skin/ leather production.

2. How serious is the problem? Why does it matter?

For the small rural farmer in Africa, their goat flock is their resource/ revenue for milk, meat, and skin/leather products. Goats (a ruminating animal) survive better than other types of animals under these harsh rural conditions. However, goats that have been domesticated and are more manageable are less productive, and less immune to the environmental conditions that affect their performance.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

This research (100 percent) closely relates to the mission of National Program 106: Animal Product Development, Quality, and Marketability which

is to improve the quality and marketability of animal products.

4. What was your most significant accomplishment this past year?

Project was not funded this past year so no current progress information is available.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

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NATL PROG(S) 108 Food Safety, (animal products) 30%
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This cooperative project has been completed. Research involving the use of exogenous administration of growth hormone (GH) to native goats fed different quality diets suggested that the quality of feed influenced production and carcass meat traits more so than the administration of GH. Administration of GH was intended to boost performance and increase nutrient partitioning toward more lean tissue during growth. Four commodities: meat, milk, leather/skin and hair follicles/mohair were evaluated and GH administration had no significant effect on any commodity. Feeding high quality feed sources compared to low-quality pasture grasses native to Africa were more advantageous to the performance of the indigenous goats.

6. What do you expect to accomplish during the next year?

Project has ended--nothing to expect for next year.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

No technologies have been transferred other than scientific knowledge base for goat production systems.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

Publications exist for this project from the scientific research group from South Africa; however, we have not been provided complete citations for any of the publications or presentations, and all are in foreign journals.

PUBLICATIONS:

Approved: D.F. COLE Date: 02/99

Title: ACTING ASSOCIATE DIRECTOR

OFFICIAL

ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0148840 Year: 98 Project Number: 1265-41420-001-03 S
Mode Code: 1265-70-00 STP Codes: 3.2.3.2 100%
NATL PROG(S) 108 Food Safety, (animal products) 30%
306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Title: MODELS FOR THE TRANSPORT OF DIOXINS TO BEEF UNDER VARIOUS PRODUCTION SYSTEMS

Period Covered From: 01/98 To: 09/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

Persistent organic pollutants like polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs) are ubiquitous environmental pollutants that may cause adverse human health effects at low levels of exposure. The major source of human intake of these chemicals is considered to be foods, especially foods of animal origin. This project consisted of a series of studies with the objective of making contributions to the identification of sources and evaluation of transport rates of these environmental contaminants in animal production systems.

2. How serious is the problem? Why does it matter?

The United States Environmental Protection Agency (EPA) suggested in the draft reassessment of dioxins and related compounds that subtle biological effects of these compounds may occur in humans at intakes near background levels of exposure. EPA has instituted a program to identify and regulate the major environmental sources of dioxins and related compounds, and to identify the most important sources of human exposure. Animal food products appear to be a significant component of human exposure. Thus, it is necessary to evaluate the sources and behavior of these compounds in agricultural production systems in order to insure the safety and public acceptance of animal products.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

This research is closely related to the mission of National Program 109:

Animal Production, Product Value and Safety, which is to insure the food supply is safe for consumers, and that food and feed meet foreign and domestic regulatory requirements. Development of sensitive analytical techniques has allowed the detection of environmental contaminants at concentrations as low as parts per trillion. It is thus necessary that the sources and transport mechanisms of these contaminants be understood so that producers and regulators can adopt policies and practices that will meet the goals of a safe food supply. The project also relates to the mission of National Program 106: Animal Product Development, Quality, and Marketability, which is to improve the quality and marketability of animal

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products by meeting consumer demands for enhanced quality and wholesomeness. Excessive concentrations of chemical residues can lead to product condemnation by regulatory agencies, and the presence of residues in a product even within regulatory guidelines may lead to adverse publicity that lowers consumer acceptance of the product.

4. What was your most significant accomplishment this past year?

Two studies were carried out in an attempt to identify the site of formation of hepta and octa PCDDS in cows dosed with pentachlorophenol treated wood as had been reported in the literature. The microbial populations present when high concentrate, high forage, or typical diet did not differentially influence the formation or metabolic transformations of PCDD or PCDF in in vitro fermentations with treated wood. These results suggested that the rumen microorganisms may be responsible for PCDD and PCDF breakdown and not their synthesis. A bile duct ligation procedure was developed to allow for complete bile sampling of a steer dosed with pentachlorophenol treated wood. The results of the study suggested that one oral dose of treated wood was not sufficient for the production of PCDD and PCDF. No PCDD or PCDF were detected in any of the bile or feces samples obtained from the in vivo portion of the experiment.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

In addition to the findings listed for the previous question, a major effort on this project was to identify individual PCB congeners in archived samples from a previous PCB feeding experiment. The "total PCB" quantitation methods are inadequate when used to predict the safety of food products because each congener has a particular pharmacokinetic behavior including absorption from the gut, tissue distribution, and ultimately excretion. The congeners in samples like milk, fat tissue, blood serum, and feces differed in relative proportion depending on: 1. whether the animals have PCBs in the diet; or 2. clearance has progressed. The similarities between the congeners present in milk and blood plasma were striking, but

important differences seen between the congeners absorbed to adipose tissue and excreted in feces. Once positive identifications of the remaining congeners can be completed, this data should provide some very useful information on the kinetic behavior of particular halogenation patterns on the aromatic nucleus. This information should be very helpful in the prediction of the behavior of not only PCBs but polybrominated biphenyls, dioxins, and furans.

6. What do you expect to accomplish during the next year?

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This project terminated September 30, 1998. Work related to the project is continuing in ARS and in the cooperators laboratory.

7. What technologies have been transferred and to whom? When is the technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

No specific technology from this work has been transferred. This work fills gaps and removes some of the uncertainties surrounding the transfer of persistent chemicals from agricultural environments through animal production systems to human foods. As such, the results will be incorporated into exposure assessments and other guidance for regulators and producers in evaluating and managing risks posed by environmental contaminants.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

The portions of the study involving potential formation of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans from pentachlorophenol by rumen microorganisms and by liver enzymes were the basis of a graduate student thesis. The thesis by Ms. Suzanne McKay Whitaker, entitled "THE METABOLIC FATE OF PENTACHLOROPHENOL IN CATTLE," was submitted to the Graduate School of The Ohio State University in August 1998.

PUBLICATIONS:

Approved: D.F. COLE Date: 02/99
Title: ACTING ASSOCIATE DIRECTOR

OFFICIAL

ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

Accession: 0148936 Year: 98 Project Number: 1265-41420-001-04 S
Mode Code: 1265-70-00 STP Codes: 4.1.1.1 50% 4.1.2.1 50%
NATL PROG(S) 108 Food Safety, (animal products) 30%
306 New Uses, Quality & Marketability of Plant & Animal Pro 70%

Title: DEVELOP PROCESSING PROCEDURES TO REDUCE FAT AND ENHANCE QUAL. OF MEAT PROD. USED BY THE MILITARY

Period Covered From: 01/98 To: 12/98

Progress and Outcomes:

1. What major problem or issue is being resolved and how are you resolving it?

The U.S. military has need of high calorie meat products for troops engaged in physically demanding field operations. It has been determined that in terms of enhanced troop performance, fat should be a major part of the caloric intake. However, retaining high levels of fat in meat products, especially intermediate moisture products, is often difficult under elevated temperature storage. Various non-meat ingredients have been evaluated in meat systems for their potential of binding fat during elevated temperature processing. Among the potential ingredients, inner pea fiber has provided the best fat binding properties.

2. How serious is the problem? Why does it matter?

Without the capability of retaining fat in meat products, the abilities of incorporating considerable amounts of fat in specialized diets are severely limited. Release of fat from meat products during elevated storage results in reduced acceptability and diminished storage life.

3. How does it relate to the National Program(s) and National Program Component(s) to which it has been assigned?

This research relates to the mission of National Program 106: Animal Product Development, Quality and Marketability which is to improve the quality and marketability of animal products by meeting consumer demands for enhanced quality and wholesomeness. Identification of ingredients with unique fat binding capabilities will enable potential application in a variety of meat products, thus enhancing eating quality, controlling

composition and stabilizing storability.

4. What was your most significant accomplishment this past year?

During the past year, use of inner pea fiber in low-fat beef patties was studied for purposes of determining if limited fat retention in a low-fat product would improve tenderness, juiciness and flavor properties, which are often deficient in this product. Tenderness properties were improved by addition of inner pea fiber in either of three forms: (1) dry powder, (2) raw meat-pea fiber mixture, or (3) cooked meat-pea fiber mixture. Juiciness

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and beef flavor were unaffected by the use of pea fiber. Fat retention in this low-fat product was not enhanced by the addition of pea fiber in any form. Microscopy studies conducted to elucidate the fat binding/attraction properties of inner pea fiber in cooked ground meats proved inconclusive. While the swelled structure of cooked pea fiber appears to serve as a physical barrier preventing coalescence and loss of fat during heating, interactions between pea fiber, meat protein and fat were not evident. Use of inner pea fiber as an ingredient to hold fat during the extrusion of shelf-stable meat snacks proved promising in tests conducted with the U.S. Army Natick RD&E Center. Sensory evaluation indicated high acceptance for textural and flavor properties of this product. Several commercial companies are now utilizing the inner pea fiber in the processing of meat products.

5. Describe your major accomplishments over the life of the project, including their predicted or actual impact

Development of a rapid procedure for testing the fat binding capability of non-meat ingredients in a meat system during the application of heat will serve as a valuable tool for selection of ingredients for both fat and moisture-binding properties. Identification of inner pea fiber as an ingredient with extremely good binding capabilities for high amounts of fat offers processors the possibility of closer regulation of composition during formulation and cooking.

6. What do you expect to accomplish during the next year?

In the final year of this project, evaluation of the fat binding properties of inner pea fiber in meat systems will be conducted in commercial establishments in conjunction with the U.S. Army Natick RD&E Center. If successful, this technology will be used in military purchase specifications. Manuscripts from the bench top studies will be developed this year.

7. What technologies have been transferred and to whom? When is the

technology likely to become available to the end user (industry, farmer, other scientists)? What are the constraints, if known, to the adoption durability of the technology?

As a result of presentations given at the IFT annual meeting, numerous contacts arose from meat processors regarding use of inner pea fiber in meat products. Information regarding application and distributors of this product was provided. To the best of our knowledge, at least three processors in the U.S. are now using the product in meat applications. Constraints to wider use of this ingredient are cost of the ingredient and

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lack of a U.S. supplier. Current major suppliers are in Canada and Europe. The Canadian supplier is very interested in the potential new use of this ingredient provided trade barriers do not exist.

8. List your most important publications and presentations, and articles written about your work (up to three total--NOTE: this does not replace your reviewed publications which are listed below)

Sensory, shear and cooking properties of low-fat beef patties processed with inner pea fiber. IFT meeting Book of Abstracts. p. 160. June, 1998.

PUBLICATIONS:

01.
ANDERSON, E.T. and BERRY, B.W. 1997. Effects of inner pea fiber and endpoint temperature on fat retention and water activity in ground beef. Proc. 1997 Meeting R&D Assoc. Military Food and Packaging 49:251-255.

02.
ANDERSON, E.T. and BERRY, B.W. 1998. Sensory, shear and cooking properties of low-fat beef patties processed with inner pea fiber. IFT Meeting Book p. 160.

03.
ANDERSON, E.T. 1998. Fat retention performance of inner pea fiber and its potential application in high and low fat ground beef. Thesis. Univ. of MD 120 pp.

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