

## CONSUMER ACCEPTANCE—DOMESTICALLY AND INTERNATIONALLY—OF BEEF FROM CATTLE PRODUCED WITH USE OF GROWTH PROMOTANT IMPLANTS

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### INTRODUCTION

Consumer concern regarding the safety of the U.S. food supply ebbs and flows, depending largely upon the amount of attention being paid by the media to food-safety issues at a given point in time. In 1989, stories about alar in apples and cyanide in grapes heightened consumer awareness of potential foodborne hazards and caused front-page coverage of issues in *Time* and *NewsWeek* under the headlines "How Safe Is Our Food?" and "Is Your Food Safe?" (Smith *et al.*, 1994b). In 1993, foodborne illness caused by an outbreak of *Escherichia coli* O157:H7 in undercooked ground beef prompted *NewsWeek* to again give front-page coverage to that issue under the headline "How Safe Is Our Food?"; a provocative subtitle to that 1993 *Newsweek* story read "Contamination Causes 9,000 Deaths A Year, And New Dangers Are Emerging?" Prominently displayed in a side-bar was beef (Smith *et al.*, 1994b).

Only very rarely are U.S. consumers knowledgeable enough of the chemistry or microbiology involved in food-safety issues to make reasoned judgments of what is or is not a "clear and present danger." To force us to learn—as children—what our elders felt was necessary knowledge, the "written word" was sanctified to the degree that most of us believe—unequivocally—that "if it's written, it's gospel." That latter, incorrect analogy makes the general public highly susceptible to the misinformation which poses as journalism. And, inasmuch as the written word is most often the means by which we seek to correct the incorrect written word, on whom and in whom is one to trust? The horns of the present dilemma regarding food safety most often pit the scientist against the journalist on a playing field that is far from level because of the language barrier created when the scientist seeks to explain issues to the consuming public. Most consumers, through no fault of their own, fall easy prey to the eloquence of the fear-monger who—unfortunately—is seldom bridled by the need for proof, while disbelieving the scientist who can almost never be definite, absolute or conclusive about anything (Smith *et al.*, 1994b). According to Dr. David Meeker (personal communication, 1996) of the National Pork Producer's

Council, "A 1989 study by the National Science Foundation surveyed 2,041 U.S. citizens and found that only 5.6% were 'sufficiently literate' in the sciences to make informed decisions about issues such as nuclear power and toxic wastes!" "Yet," Meeker concluded, "in spite of these findings about the level of public understanding, the fate of agriculture is being determined on the basis of public opinion...and. public opinion is framed by the news media."

### Food Selection Concerns

Each year, the Food Marketing Institute conducts a nationwide consumer survey to identify changing concerns, needs and priorities of supermarket shoppers. Results of the 1996 survey were published in "TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1996" (Food Marketing Institute, 1996). According to TRENDS--1996, the top food selection concerns and the percentages of the shopping public that considered these factors "Very Important" in food selection were as follows: (1) Taste, 88%; (2) Nutrition, 78%; (3) Product Safety, 75%; (4) Price, 66%; and (5) Storability, 43%. Interestingly, worry about product (food) safety has not changed much in the past six years; this issue ranked third in importance in food selection concerns in 1991 (72%) and fourth in importance in food selection concerns in 1992 (71%), 1993 (72%), 1994 (69%) and 1995 (69%), in TRENDS reports for these respective years (Food Marketing Institute, 1991, 1992, 1993, 1994, 1995).

### Safety of the Food Supply

When asked "How important is food safety when you shop for food?" 75% said "Very Important," 17% said "Somewhat Important," 4% said "Not Too Important," 3% said "Not At All Important" and 1% said "Not Sure" (Food Marketing Institute, 1996). When asked "How confident are you that the food in your supermarket is safe?" 20% were "Completely Confident," 64% were "Mostly Confident," 15% were "Somewhat Doubtful," 2% were "Very Doubtful" and none were "Not Sure" (Food Marketing Institute, 1996).

When asked "What, if anything, do you feel are the greatest threats to the safety of the food you eat?", the shopping public (Food Marketing Institute, 1996) identified the following unaided-response items (the number following each item is the percentage of supermarket shoppers who identified that item as a threat to food safety):

- (1) Spoilage, 49%
- (2) Freshness/long-shelflife/expiration-dates, 22%
- (3) Bacteria/contamination/*E. coli*/germs, 17%
- (4) Pesticides/ residues/insecticides/herbicides, 17%
- (5) Quality control/improper shipping, handling/storage, 14%.

Possible food-safety concerns about beef (Smith *et al.*, 1994b) include: (a) Presence on meat of foodborne pathogens (most important would be *Salmonella*, *Listeria monocytogenes*, *Campylobacter jejuni* and *Escherichia coli* O157:H7), (b) Residues, in meat, of pesticides (of either or both of the types--chlorinated hydrocarbons and organophosphates), (c) Antibiotics (fear of residues of the antibiotics, in meat, and/or of development and presence, on meat, of antibiotic-resistant strains of human pathogens because of continued exposure of human pathogens--that have livestock vectors--to feed-grade antibiotics) and (d) Residues of livestock growth-promoting compounds in meat; concern is about the presence, in beef, of residues of naturally occurring growth-promotants (the hormones--estrogen, testosterone, progesterone) as well as of the chemically synthesized growth-promotants (the xenobiotics--trenbolone acetate, melengestrol acetate, zeranol).

When told "I'm going to read a list of food items that may or may not constitute a health hazard; for each one, please tell me if you believe it is a 'serious health hazard,' 'somewhat of a hazard,' or 'not a hazard at all'" the shopping public (Food Marketing Institute, 1996) gave the following aided-response answers (the number following each item is the percentage of supermarket shoppers who identified that item as a "serious health hazard"): (1) Contamination by bacteria or germs, 77%; (2) Residues, such as pesticides and herbicides, 66%; (3) Product tampering, 66%; (4) Antibiotics and hormones in poultry and livestock, 42%; (e) Food handling in supermarkets, 41%.

#### **Consumer Acceptance—Domestically—of Meat From Livestock Produced with Use of Growth Promotant Implants**

Critics who question the safety of red meat (beef, veal, pork, lamb, mutton) do so by emphasizing concerns about residues of hormones, antibiotics and pesticides, in red meat, and about presence, in and on red meat, of bacteria--especially food-borne pathogens. Results of TRENDS --1996 (Food Marketing Institute, 1996) can be used to determine comparability of concerns of critics vs. concerns of supermarket shoppers. The critics are correct in stating that consumers are concerned about presence of bacteria on red meat; "Spoilage," "Freshness," "Bacteria/contamination," "Quality control" and "Unsanitary store workers" are top-of-mind concerns ranked first, second, third, fifth and sixth in TRENDS--1996. "Pesticides/residues/insecticides/herbicides" are also top-of-mind food-safety threats and ranked fourth in TRENDS--1996. But, critics are not right about residues of "Antibiotics" or "Hormones" being top-of-mind concerns as food-safety threats because "Antibiotics/Hormones" ranked 17th in unaided-response queries in TRENDS—1996 (Food Marketing Institute, 1996).

In the aided-response part of TRENDS--1996 and when forced to respond to a suggestive question, 66% (down 16 percentage points since 1989) of those questioned considered "Pesticides/ residues/ insecticides/ herbicides" a "Serious Hazard" and 42% (down 19 percentage points since 1989) of those interviewed considered "Antibiotics and hormones" a "Serious Hazard" (Food Marketing Institute, 1996). The disparity and dichotomy observed in the aided responses vs. unaided responses, above, can be likened to the situation with worms in apples. When asked to identify their concerns about the quality/safety of apples, unaided responses of consumers would seldom include "worms" (because that is not a top-of-mind concern of apple consumers); yet, if asked the question "Aren't you concerned about worms in your apples?"; a very high percentage of consumers respond, in the affirmative, to this "aided" query. In fact, the only way you could increase the latter ("very high") percentage would be to say "Aren't you concerned when you find half a worm in your apple?"

In the Personal Safety Survey of the "General Public" by CMF&Z (1995), "Safety of Food" ranked third ("Safe Drinking Water" ranked first; "Being Safe From Crime," ranked second) with 80% of those interviewed being "personally concerned about food safety." Comparison of "general public concern" versus "editor concern" over the issue of "use of hormones in meat production" in the CMF&Z Personal Safety Survey revealed ranks of 9<sup>th</sup> for the general public and 7<sup>th</sup> for editors. So, the "use of hormones in meat production" is--when mentioned

specifically—a matter of substantial concern (as an “aided response”) based on results of the CMF&Z (1995) survey.

### Who to Trust About Food Safety

In response to the question “As far as you personally are concerned, on whom do you rely most to be sure that the products you buy are safe?,” the shopping public (Food Marketing Institute, 1996) responded as follows: (a) Yourself as an individual, 25%; (b) Government, 21%; (c) Manufacturers, 21%; (d) Retailers (food stores), 16%; (e) All/Everybody, 8%; (f) Consumer Organizations, 5%; (g) Farmers, 3%; and (h) Not Sure, 1%.

Results of a February 1995 poll conducted by Peter D. Hart Research (National Cattlemen’s Association, 1995) revealed that 82% of the thought leaders expressed confidence in beef’s safety and wholesomeness. These opinion-leaders and consumer-influences assigned cattlemen “mean scores” or “grades” of “B-” for “Providing safe beef, free of chemicals and pesticides” and of “B” for “Providing beef free of bacterial contamination.” National Cattlemen’s Association (1995) further reported that confidence in the safety of U.S. beef is one reason why beef exports have increased. The International Beef Quality Audit, conducted by Colorado State University, surveyed beef purchasers in five regions of the world and revealed that U.S. beef is the safest in the world; it has the world’s highest microbiological quality and the world’s lowest incidence of violative levels of chemical residues (Morgan *et al.*, 1995).

### Consumer Acceptance—Internationally—of Beef from Cattle Produced with Use of Growth Promotant Implants

The 1994 International Beef Quality Audit (Morgan *et al.*, 1995) was conducted via personal Face-To-Face Interviews with traders/wholesalers, retail operators, hotel and restaurant managers/chefs, and personnel from trade/promotion organizations in selected foreign markets. These interviews, conducted in 20 countries with people from 288 businesses and organizations, were completed during the time-period of March 1994 through October 1994. Countries were categorized by geographical region: North America, Asia, UK plus Europe, ASEAN (Association of South East Asian Nations) and the Middle East. These regions had been identified by the U.S. Meat Export Federation (USMEF) as “high-growth” markets for U.S. beef (Morgan *et al.*, 1995).

The International Beef Quality Audit (IBQA) was conducted to quantify the components of quality for which changes can be made to enhance the desirability of U.S. beef in the global marketplace (Morgan *et al.*, 1995). Intense competition to supply the world with beef causes foreign buyers and users of U.S. beef to compare and contrast U.S. products with those of their own country’s domestic production and with products from other beef-exporting countries. “Quality” can be defined in many ways and can include many variables. To understand the needs and wants of its export customers, the U.S. beef industry must be able to identify accurately the parameters used in evaluating “quality” attributes that customers consider when comparing U.S. beef to competitive sources of beef (Morgan *et al.*, 1995).

The IBQA determined that the principle reasons U.S. beef is purchased by global customers (Morgan *et al.*, 1995) are as follows: (1) High Ability To Supply Individual Items; (2) Excellent Tenderness And Flavor; (3) High Perception Of Value; (4) Excellent Overall Product Quality; (5 tie) High Perception/Image Of The U.S. And The U.S. Quality Grading System; and (5 tie) Confidence In Product Safety. Relative to item (5 tie), *Confidence In Product Safety* was an important factor in explaining why foreign customers purchase U.S. beef. Both the USDA and the National Cattlemen’s Association (NCA) oversee and promote beef safety throughout the beef production chain. Recognized worldwide, the Food Safety and Inspection Service (FSIS) of USDA and its Residue Monitoring Program give customers in other countries, as well as those in the U.S., an assurance and a feeling of safety about U.S. beef. Foreign beef customers appreciate, and understand the importance of, the controls that the U.S. applies to the processing and handling of the live cattle, carcasses and beef produced in the U.S. A partner with FSIS/USDA has been the Beef Quality Assurance (BQA) program activities of U.S. cattlemen; state and national BQA programs also function to assure that U.S. beef is safe.

Among the 288 people interviewed in the International Beef Quality Audit, 147 were traders/wholesalers, 44 were retail operators, 85 were hotel and restaurant managers/chefs and 12 were personnel from trade or promotion organizations. “Use of hormones in growing/finishing cattle” was not identified among the “Top Ten Concerns About Quality” by traders/wholesalers or of personnel of trade/promotion organizations (no such categorization was done for the latter group), but was the number 3 concern of retail operators and the number 5 concern of managers/chefs (Morgan *et al.*, 1995).

Within Regions, "Use of hormones in growing/finishing cattle" was the number 8 concern (8.1% of those interviewed were "dissatisfied" about this) in Region 1 (North America), but it was not included in the "Top Ten Concerns About Quality" in Regions 2, 3, 4 or 5. In Region 1, more than 1 of every 12 interviewees felt that use of hormones for promoting growth and leanness of slaughter cattle was not acceptable. Although U.S. use of hormones, for growth promotion, has not influenced purchasing decisions of Canadian or Mexican beef buyers nor has it created any regulatory problems, the customers of the businesses operated by some of the interviewees do not understand the use of hormones and consider this practice "unnatural" (Morgan *et al.*, 1995). Although "Use of hormones in growing/finishing cattle" did not make the list of "Top Ten Concerns About Quality" in Region 3 (UK plus Europe) concerns about that issue did surface in the listing made of "We Would Buy More U.S. Beef If..." where four of the six highlighted comments dealt with that issue. The latter comments were: (a) From the Netherlands, "We would buy more U.S. beef if we could buy hormone-free beef that wasn't low in quality (cow) and tasteless (young bull) and so poor in shelf-life (cow, young bull), which is what we get now." (b) From Austria, "We would buy more U.S. beef if the U.S. government convinced the Austrian government to decrease the import tax and that the hormone issue is political (not scientific)." (c) From Belgium, "We would buy more U.S. beef if we could purchase it 100% clean (hormone-free); quality of beef is better with use of hormones but the customer will accept it, only if it is hormone-free." And (d) From The Netherlands, "We would buy more U.S. beef if it was accepted as hormone-safe, supply was constant and prices were competitive" (Morgan *et al.*, 1995).

Although it is well-known, and agreed-upon by all who understand the issue, that the "Hormone Ban" of the EEC (now EU) is a non-tariff trade barrier, it is now also widely believed that if the U.S. wins its court case, with the World Trade Organization, to force the EU to abandon its "Hormone Ban," enough consumers in the EU have now been sensitized to the issue that U.S. beef produced with use of hormones in growing/finishing may not find a ready market among present EU consumers. The U.S. may find that its only hope for selling beef in the EU—in the future—is to sell beef produced without use of the growth promotants.

## Anabolic Steroids/Hormones and the Red-Meat Supply

There are consumers, but not many, who are concerned about use of growth promotants in the feeding of cattle. The rationale usually given by those in the beef industry for use of these chemical compounds is as follows: Beef animals of different genotypes differ quite markedly in size/height/weight at a given point in chronological age. Differences in genetic size are caused by differences in the amount (and/or timing) of release of *Growth Releasing Factor* (GRF) from the *hypothalamus*. GRF causes the *pituitary gland* to release differing amounts of *Growth Hormone* (depending upon the amount of GRF signal received by the pituitary). Increases in Growth Hormone (GH) cause (a) *stature to increase*, (b) *muscle growth to be enhanced*, and (c) *fat deposition to be lessened* (delayed, chronologically). Research, conducted beginning nearly 40 years ago, revealed that minute doses of natural hormones (e.g., *estrogen*, *progesterone* and *testosterone*) and of artificially synthesized growth promotants—called xenobiotics (e.g., *zeranol*, *trenbolone acetate* and *melengestrol acetate*) caused growth and composition changes in cattle that were remarkably similar to those attributed to Growth Hormone (Smith, 1995). In the 1980s, Dr. Bill Tanner and Dr. Tom Welsh of Texas A&M University discovered that administration of estrogen "*tricked*" (in much the same way that a vaccine tricks the animal into developing immunity to a disease) *the animal's pituitary*-- making it believe it was receiving more GRF signal--*into releasing more Growth Hormone* (Smith, 1995). Other growth promotants act in another way that is not related to Growth Hormone; trenbolone acetate, for example, is believed to act by decreasing protein turnover so that more muscle accretion per unit of time takes place (Smith, 1995). "*Implanting*"-- introduction into the animal's ear of a tiny rubber silastic cylinder that contains about 36 milligrams of estrogen, for example--causes the animal (during the 90 or so days it takes for the estrogen to be absorbed and to enter the animal's bloodstream) to *repartition* its use of what it eats. It has now been amply demonstrated that implanted animals produce more muscle and less fat (all other things being equal) than do non-implanted animals.

Concern is registered by a few people who have observed that there is *58% more estrogen* in a serving of beef steak, for example, from an animal implanted with estrogen than in a steak of equal size from an animal that was not implanted (3-ounce portions contain 1.9 nanograms of estrogen if from an implanted animal and 1.2 nanograms of estrogen if from a non-implanted animal). Such concerns disappear when it is realized that

the normal daily *in vivo* (within the person's body) production of estrogen by an average male is 136,000 nanograms and by a normal non-pregnant female is 480,000 nanograms. Experts conclude that there would be no physiological effect on humans caused by the difference (1.9 billionths of a gram) between 480,001.9 and 480,001.2 or 480,000.0 nanograms in daily estrogen supply (Smith, 1995).

Much of the present consumer concern regarding use of growth promotants in beef production arose when the European Economic Community (EEC) banned importation of beef from the U.S. on grounds of our use of anabolic steroid hormones. In truth, the EEC -- drowning at the time in excess beef -- used the hormone issue to create a non-tariff trade barrier to preclude importation of U. S. beef into those 12 countries. According to Smith (1995), since imposition of the "EEC Hormone Ban," (a) a committee of scientists appointed by the EEC (and chaired by Dr. Eric Lamming of the United Kingdom), (b) Codex Alimentarius, and (c) the Food and Agriculture Organization of the World Health Organization, all have gone on record as stating "there is no risk to the public health or well-being as a result of properly administered growth-promoting, anabolic steroid hormones to beef cattle."

Smith (1992), in a position paper prepared for the U.S. Meat Export Federation, stated "If the EEC agrees to accept the Joint FAO/WHO Expert Committee Report of 1988 and the EEC Scientific Advisory Committee Report by Lamming in 1987 confirming no risk to human health from proper use of anabolic and xenobiotic agents and if the EEC will change the wording in EEC Council Directives from "residues" to "violative residues" (as delineated by FDA, FSIS or the JECFA of FAO/WHO)...then, the U.S.A. will request of FSIS/USDA that it test beef for presence of residues of diethylstilbestrol, estradiol-17B, estradiol benzoate, testosterone propionate, progesterone, zeranol, melengestrol acetate and trenbolone acetate, on a continual, annual basis." According to Smith (1995), Dr. H. Russell Cross, then Administrator of FSIS-USDA, agreed to implement the latter process--as a part of the National Residue Program; EEC officials agreed on July 7, 1992 to consider the proposal presented in the position paper, and there is still hope (in 1996) that the EEC (now called the European Union) will rescind its ban on importation of beef and beef products from cattle that were administered natural or artificial growth-promotants.

An article in KRF/Global News (1996) said that a German federal health institute had advised the Health Ministry that meat imports from Australia and Uruguay

should increasingly be tested for the carcinogens diethylstilbestrol (DES) and ethinyloestradiol (EE2). These growth enhancers are banned in the European Union (EU) but have increasingly been detected in Australian and Uruguayan meat. In 1995, seven cases of animals for slaughter containing the hormone DES were found in Uruguay (KRF/Global News, 1996). So, a black market for growth enhancers in other countries makes reasonable the concerns of people in the EU about use of growth promotants in beef production.

U.S. beef producers are trying very hard to produce leaner beef. As they proceed from producing flagrantly fat, to sensibly slim, beef, attempting to reduce the amounts of external and seam fat, on and in beef cuts, use of growth promotants that repartition consumed nutrients--toward muscle and away from fat--is a vital tool for accomplishing desired modifications in body composition. To lose the use of these immensely valuable chemical compounds, especially based on trumped-up charges and greatly exaggerated consequences, would be a setback to recent success in "the leaning of the U.S. beef supply."

#### Chemical Residues in "Conventional," "Natural" and "Organic" Beef

Some marketers have tried to position "natural" or "organic" beef as superior to "conventional" beef in terms of safety (National Live Stock and Meat Board, 1995). The wording of the advertisements for beef of the "other kind"—nonconventionally produced product—is clearly designed to frighten, to alarm, to provoke, or—at the least—to concern, consumers. "What would beef be...WITHOUT HORMONES, STEROIDS OR ANTIBIOTICS? ...It would be Coleman Natural Meats, Inc....Raised At The Head Of The Creek... Man Hasn't Messed With It," reads one ad. "Honest To Goodness Beef...No Added Hormones or Chemicals...ALL BEEF, NO BULL...Raised on Natural Grains at the Harris Ranch"...reads another ad. "The Beef Behind the U.S. Olympic Athletes...Naturalite BEEF...Maverick Ranch" reads yet another advertisement. Point-of-purchase materials from Coleman Natural Meats, Inc. that are distributed at retail stores say "Every box of Coleman Natural Beef shipped to your butcher carries the USDA definition of "natural," plus our own, much stronger statement of purity "Our animals never receive any antibiotics or growth hormones from the time they are born. Any animal requiring therapeutic treatment is treated and removed from the herd. No antibiotics were ever added to the feed."

Confusion exists in the marketplace as to what the terms "natural" and "organic" mean when applied to red

meat; both terms imply a difference from "conventional" beef. Following implementation of a USDA National Organic Program (which is supposed to occur anytime — perhaps in 1997) the "organic" meat label will have an official meaning (as opposed to the present definitions applied by those who market beef as "organic") and—according to knowledgeable sources—will indicate those products that are derived from animals raised on certified organic farms and processed by certified handlers in ways that minimally impact the environment (Kinsman, 1994). In efforts, though, to position "natural" beef uniquely in the marketplace, some marketers have argued that the term connotes beef from cattle raised in specific geographic locations on uncontaminated land, never treated for disease or illness, containing no additives, with a unique taste, and produced differently during finishing.

In March 1991, one producer of "natural" beef launched a 12-week advertising campaign in the *Boston Globe* (1991) promoting the idea that "natural" beef is "pure" as opposed to the "adulterated kind" raised by cattlemen who use antibiotics or hormones, and that cattle which have been exposed to antibiotics and hormones should be labeled as "chemical cattle." The primary problem with such ads is that they may raise questions in consumers' minds regarding the safety and wholesomeness of the generic beef supply (Wilkinson, 1991). In 1982, the USDA approved use of the term "natural" for beef that is minimally processed and that contains no additives—a definition that allows *all* conventionally prepared fresh beef to bear the "natural" label (USDA, 1982).

In efforts, to position "natural" beef uniquely in the marketplace, overzealous marketers have argued that the term "natural" connotes beef from cattle raised in specific geographic locations (e.g., "up high in the mountains, way up at the head of the creek, where the water is clean and pure," *Boston Globe*, 1991), on uncontaminated land (e.g., "on rangeland untainted by pesticides or fertilizers," *Boston Globe*, 1991), never treated for disease or illness (e.g., "kept off drugs," *Boston Globe*, 1991), containing no additives (e.g., "totally free of chemical additives," *Boston Globe*, 1991), with a unique taste (e.g., "it tastes clean, like all beef would taste if man hadn't come along and messed with it," *Boston Globe*, 1991) and produced differently during finishing (e.g., not given "growth hormones, not unlike the steroids employed by athletes"; not given "antibiotics to prevent illness or to treat it"; "chemical cattle" gain faster but "a large proportion of that is just fat, which you don't want anyway," *Boston Globe*, 1991).

FSIS/USDA (USDA, 1993, 1994, 1996) does not report separately the residue monitoring results for samples from cattle raised under different management systems (i.e., "conventional," "natural," "organic"). The Cattlemen's Beef Promotion and Research Board provided funds for determining the incidence of chemical residues in beef tissues to the National Live Stock and Meat Board, who awarded funding to conduct two such studies to the Center For Red Meat Safety at Colorado State University. Results of the two studies conducted by the Center For Red Meat Safety (Heaton *et al.*, 1993a; Smith *et al.*, 1994c) confirm that beef is safe based on an exceptionally low incidence of violative chemical residues. One of those studies (Smith *et al.*, 1992, 1994a) involving 80 samples of muscle, fat, liver and kidney from "conventional," "natural," "organic" and "realizer" (chronically ill) steers and heifers as well as "cull (beef/dairy) cows," detected no violative residues of the five anabolic steroids, the two heavy metals, the three stress reducers, the six thyrostats/sulfa-drugs and the 25 chlorinated hydrocarbon and organophosphate pesticides being assayed. A second study (Smith *et al.*, 1997) of muscle, fat, liver and kidney samples from "conventional," "natural" and "organic" steers and heifers detected zero violative residues in 558 tests for three anabolic steroids, zero violative residues in 558 tests for three xenobiotics, zero violative residues in 1,860 tests for 10 sulfa-drugs/antibiotics and 15 violative residues (three in "conventional" beef, six in "natural" beef, six in "organic" beef; all residues were in liver samples and none in muscle, fat or kidney samples) in 4,650 tests for the 25 chlorinated hydrocarbon and organophosphate pesticides.

Data from the two studies conducted by the Center For Red Meat Safety revealed an exceptionally low incidence of violative chemical residues in U.S. beef produced under "conventional" production/management conditions (Smith *et al.*, 1992; 1994a; 1994c; 1997). There were no violative residues of anabolic steroids (estrus suppressants; growth promotants), xenobiotics (growth promotants), heavy metals (environmental contaminants), stress reducers (tranquilizers), thyrostats/sulfa-drugs (growth promotants; health aids), beta-lactams (health aids), or tetracyclines (health aids). In one of the CSU studies in which violative residues occurred, the residues were of pesticides, and the highest incidence was in livers from beef cattle produced under "natural" (six of 1,575 tests; 0.38%) and "organic" (six of 1,575 tests; 0.38%) management conditions. The only violative residues of any chemical found in these two studies were in livers and not in meat *per se* (Smith *et al.*, 1997).

Results of the two studies conducted by the Center For Red Meat Safety reveal that it is highly unlikely that there is any difference in presence of harmful chemical residues of vaccines, pesticides, drugs, antibiotics and/or growth promotants between "conventional," "natural" and "organic" beef (National Live Stock and Meat Board, 1995). Beef companies that attempt to position a "natural" or "organic" product as safer or less dangerous to personal or public health by claiming that "conventional" beef contains violative chemical residues must be held accountable for conducting research studies of the type conducted by the Center For Red Meat Safety, to document their claims. To the best of our knowledge they have never done so (National Live Stock and Meat Board, 1995).

#### Tests of Chemical Residues in Red Meat for (in order to Sell to) Other Countries

A memorandum (ECD No. 90-22-EEC), sent by FSIS/USDA on March 29, 1990 to slaughter plants in the U.S. that were approved for export by the European Economic Community (EEC), detailed guidelines involved with the 1990 EEC Residue Testing Program for meat, and described "an expanded Residue Testing Program" consisting of five requirements; requirement number four identified 10 "residue compounds" (compounds/compound classes/elements) for which residue levels must be determined for meat to be exported to EEC countries (Fetzner, 1990). For dairy/beef breeding cows, these "residue compounds" were listed as (a) diethylstilbestrol, (b) zeranol, (c) thyrostat(s), (d) trenbolone acetate, (e) melengestrol acetate, (f) tranquilizer(s), (g) beta-blocker(s), (h) lead, (i) cadmium and (j) clenbuterol; for "nontreated beef" (presumably feedlot steers and heifers that had not been given growth-promotants or heat-suppressants), no analyses were required for items a, b, d, or e, above (Fetzner, 1990). For swine, USDA-FSIS-ECD No. 90-22-EEC Residue Testing Requirements for 1990 also are a barrier to exports of U.S. pork to Europe. The latter directive describes a residue testing program consisting of five requirements; requirement number four lists 10 compounds/compound classes/elements (later reduced to six—eliminating thyrostats, lead, cadmium and melengestrol acetate) for which residue levels must be determined. Residue compounds to be assayed in pork products and variety meats include: (a) diethylstilbestrol, (b) zeranol, (c) trenbolone acetate, (d) tranquilizers, (e) beta-blocker and (f) clenbuterol.

The Center For Red Meat Safety, in the Department of Animal Sciences at Colorado State University, has conducted several studies to determine the safety of U.S.

beef and pork relative to presence/absence of violative chemical residues (as defined by EPA, FDA or USDA).

The first study involved Canadian bacon, chorizo sausage, ham, bacon, beef trim and pork fat; these products were produced by two packing/processing plants in Colorado and the investigation was funded by the Federal Agricultural Extension Service (USDA-ES). Results of that study (Sofos *et al.*, 1992; Kukay *et al.*, 1996) revealed no violative residues of anabolic steroids (zeranol, melengestrol acetate), heavy metals, tetracycline, sulfa drugs, chlorinated hydrocarbons or organophosphate pesticides. The second study involved muscle, fat, kidney and liver samples from steers, heifers and cows and included "organic," "natural," "conventional," "realizer" (chronically ill) and "cull cow" cattle. Analyses revealed no violative residues of anabolic steroids/xenobiotics (diethylstilbestrol, zeranol, trenbolone acetate, melengestrol acetate, clenbuterol), heavy metals, stress reducers, thyrostats/sulfa-drugs, chlorinated hydrocarbons or organophosphate pesticides (Smith *et al.*, 1994).

The third study involved muscle, fat, kidney and liver samples from steers and heifers and included "organic," "natural" and "conventional" beef. Analyses revealed no violative residues in muscle or fat, of anabolic steroids (estradiol, testosterone, progesterone), xenobiotics (zeranol, melengestrol acetate, trenbolone acetate), beta-lactam antibiotics, sulfa drugs, tetracycline antibiotics, chlorinated hydrocarbons or organophosphate pesticides (Smith *et al.*, 1997). The fourth study involved pork carcass fat, ham and fresh pork sausage collected from pork carcasses and from supermarkets or retail meat markets in the eastern, central and western portions of the United States. Analyses revealed no violative residues of chlorinated hydrocarbons or organophosphate pesticides (Smith *et al.*, 1993; Heaton *et al.*, 1993b; Heaton *et al.*, 1996). The fifth study involved muscle, fat, liver and kidney tissues from slaughter hogs and were used to assay levels of the six compounds/compound-classes specified for testing by the European Community. Analyses revealed no violative residues of anabolic steroids/xenobiotics (diethylstilbestrol, trenbolone acetate, zeranol, clenbuterol) or stress reducers (Smith *et al.*, 1993; Heaton *et al.*, 1993b; Heaton *et al.*, 1996).

A recent study by Schnell *et al.* (1995) revealed that there were no significant pesticide residues in beef carcass tissues or organs from cattle fed fruits, vegetables or fruit/vegetable byproducts during feedlot finishing.

## Test of Chemical Residues in Red Meat in Other Countries.

Usborne (1994) compared "natural" and "conventional" beef, purchased as such in retail supermarkets in Canada, and reported no violative residues of sulfa-drugs, antibiotics, heavy metals, polychlorinated biphenyls, growth promotants, parasiticides, pentachlorophenol (a wood fungicide) or pesticides, in either kind of beef. Potthast (1993), of the German Meat Research Institute in Kulmbach, concluded--based upon studies of beef and pork from the European Union--that: (a) environmental residue contaminants (i.e., lead, mercury, cadmium) were hardly ever found, (b) pesticides had concentrations considerably below established limits such that complaints about pesticide contamination are becoming rare, (c) toxic dioxins, which arise mostly from combustion processes have not--so far--been detected in meat, and (d) random sampling and residue testing for antibiotics, drugs, anabolics and thyrostats effectively protect the consumer and assure that chemical residues in meat will not be harmful to the public health.

## Present Status of Meat and Poultry Safety in the U. S.

Each year, the National Residue Program of the Food Safety and Inspection Service of the U.S. Department of Agriculture releases results of its nationwide residue monitoring efforts in U.S. meat and poultry (Carnevale, 1991). The National Residue Program for 1994 (USDA, 1996) tested for 42 chemicals in 12 classes of animal drug and pesticide compounds. FSIS/USDA, in announcing results for FY-1994 (in August, 1996), said, "Only 0.18% of the 38,894 samples of livestock and poultry meats tested in 1994 by FSIS/USDA during our domestic routine residue-monitoring program showed illegal levels (violative concentrations) of pesticide, hormone, antibiotic, drug and other chemical residues, down from 0.26% in the 1991 samples, 0.29% in the 1992 samples and 0.26% in the 1993 samples" (USDA, 1996). Nevertheless, producers, processors, wholesalers, retailers, scientists and agents of Federal/State governments must be constantly vigilant and do all that is possible to maintain and improve the safety of our food supply (Smith, 1995).

Sofos *et al.* (1992) conducted a study of residues of heavy metals (lead; cadmium), hormones (zeranol; melengestrol acetate), antibiotic (tetracycline), sulfa drugs (six specific sulfonamides) and pesticides (15 chlorinated hydrocarbons and 10 organophosphates) and did not find a single violative residue in Canadian bacon, Chorizo

sausage, ham, bacon, beef trim or pork trim. The latter study, "National Extension Service--HACCP for Small- and Medium-Size Meat Plants," concluded that there were no problematic or violative residues of heavy metals, hormones, antibiotics or pesticides in samples of six kinds of meat products (Sofos *et al.*, 1992).

Another study (Smith *et al.*, 1994a) determined that "tests prescribed by European Economic Community import-statutes confirm that U.S. beef does not contain violative or problematic residues of anabolic steroids, thyrostat, tranquilizers, beta-blocker, beta-agonist, heavy metals, sulfa-drugs, chlorinated hydrocarbons, or organophosphate pesticides."

Finally, in summarizing results of all of the studies conducted between 1990 and 1995 by the Center For Red Meat Safety at Colorado State University, Smith *et al.* (1994b) at the Reciprocal Meat Conference of the American Meat Science Association said, "Data of these five studies reveal that the incidence of violative chemical residues in U.S. beef and pork produced under 'conventional' production/management conditions is exceptionally low; beef and pork are 'safe' based on absence of violative chemical residues."

## CONCLUSIONS

Why do we continue to use all these chemicals? Smith (1995) reported that Dr. Lowell Schake (of the University of Connecticut) said in September 1990. "Had humankind remained hunters and gatherers, the maximum human population that could have been sustained on planet Earth would be 30 million. As of this date, we have 5 billion people on Earth, and, we expect to have another 5 billion here in the early part of the 21st century. We can and will feed all of those people because we have developed and used science and technology for food production" (Smith, 1995).

The United States of America has the most abundant, the cheapest, and the safest food supply in the world. According to Smith (1995), Dr. Dixie Lee Ray (then, a scientist at the University of Washington and former Governor of Washington, said, in *Priorities* magazine in 1989, "Despite all the evidence of our physical well-being, beyond the dreams of all previous generations, we seem to have become a nation of easily frightened people--the healthiest hypochondriacs in the world."



## LITERATURE CITED

- Boston Globe. 1991. "We're So Sure You'll Think Our Beef Is Better, We Bet The Ranch On It." Boston Globe Newspaper. (March 15, 1991 Issue) page 32. Boston MA.
- Carnevale, R. 1991. Residues In Tissues From Livestock and Poultry Collected In The National Residue Monitoring Program. Food Processing (September 1991 Issue).
- CMF&Z. 1995. Results of the Personal Safety Survey of The General Public and of Editors. CMF&Z Public Relations, Inc., Chicago IL.
- Fetzner, R. 1990. Memorandum to: All Plants That Are Currently EEC Approved for the Slaughter of Swine, Lamb, Horse, non-treated Beef, and Veal. Subject: Participation in EEC Residue Testing Program. USDA-FSIS, March 29, 1990.
- Food Marketing Institute. 1991. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1991. Food Marketing Institute, Washington, DC.
- Food Marketing Institute. 1992. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1992. Food Marketing Institute, Washington, DC.
- Food Marketing Institute. 1993. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1993. Food Marketing Institute, Washington, DC.
- Food Marketing Institute. 1994. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1994. Food Marketing Institute, Washington, DC.
- Food Marketing Institute. 1995. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1995. Food Marketing Institute, Washington, DC.
- Food Marketing Institute. 1996. TRENDS IN THE UNITED STATES--Consumer Attitudes & The Supermarket 1996. Food Marketing Institute, Washington, DC.
- Heaton, K.L., G.C. Smith, M.J. Aaronson, J.N. Sofos and R.P. Clayton. 1993a. Residues of Antibiotics, Hormones and Pesticides in Conventional, Natural and Organic Beef. Final Report to the National Live Stock and Meat Board. Center for Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Heaton, K.L., G.C. Smith, J.B. Morgan, J.N. Sofos, D.K. Jones, M.J. Aaronson, R.P. Clayton, J.D. Tatum and G.R. Schmidt. 1993b. Determination of Extent of Compliance of U.S. Pork With USDA-FSIS-ECD No. 90-22-EEC Residue Testing Requirements For 1990. Final Report to the National Live Stock and Meat Board. Center For Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Heaton, K.L., G.C. Smith, J.N. Sofos, M.J. Aaronson and D.K. Jones. 1996. Analysis of Pork Products for Chemical Residues. *Journal of Muscle Foods* 7:213-224.
- Kinsman, D., 1994. USDA National Organic Standards Board. Personal Correspondence.
- Kukay, C.C., L.H. Holcomb, J.N. Sofos, J.B. Morgan, J.D. Tatum, R.P. Clayton and G.C. Smith. 1996. Application of HACCP by Small-Scale and Medium-Scale Meat Processors. *Dairy, Food and Environmental Sanitation* 16(2): 74-80.
- KRF/Global News. 1996. Meat Imports Contain Estrogenic Carcinogens. KRF Press Release, September 2, 1996. London UK.
- Morgan, J.B., G.C. Smith, J.A. Sherbeck, S.K. Fitzgerald and C.C. Kukay. 1995. A Foreign Market Audit of U.S. Beef. The Final Report of the International Beef Quality Audit--1994. Meat Science Program, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- National Cattlemen's Association. 1995. Thought-Leader Survey: Cattlemen Are Given Good Grades. The Beef Brief (April 1995 Issue). National Cattlemen's Association, Englewood CO.
- National Live Stock and Meat Board. 1995. "Conventional," "Natural" and "Organic" Beef: No Scientific Differences. Facts From The Meat Board: Product Technology. Series FS/PT 007. Chicago IL.
- Pothast, K. 1993. Residues in Meat and Meat Products. *Fleischwirtschaft International* 4:26.
- Schnell, T.D., G.C. Smith, M.J. Aaronson, J.N. Sofos, J.D. Tatum and J.B. Morgan. 1995. No Significant Pesticide Residues By Feeding Fruits, Vegetables To Cattle. Meat Science Research Update. (February/March 1995 Issue; Volume 2, Number 1) National Live Stock and Meat Board, Chicago IL.
- Smith, G.C. 1992. Position of the USA Regarding Acceptability of Proper Administration of Certain Specific Anabolic and Xenobiotic Agents To Beef Cattle and Relative To The Safety Of Muscle/Organ Meats, From Such Animals, For Human Consumption. Prepared for presentation by officials of the U.S. Meat Export Federation to officials of the European Economic Community (EEC) in London, England on July 6, 1992. Center For Red Meat Safety, Colorado State University, Fort Collins CO.

- Smith, G.C. 1995. Food Safety. Meat Minutes (January 1995 Issue). Meat Science Group, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Smith, G.C., J.N. Sofos, M.J. Aaronson, J.B. Morgan, J.D. Tatum and G.R. Schmidt. 1992. Incidence of Pesticide Residues and of Residues of Chemicals Specified For Testing in U.S. Beef by the European Community. Final Report to the National Live Stock and Meat Board. Center For Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Smith, G.C., K.L. Heaton, J.N. Sofos, M.J. Aaronson, J.B. Morgan, J.D. Tatum and R.P. Clayton. 1993. Characterization and Quantification of Chlorinated Hydrocarbons and Organophosphate Pesticides in Pork Products Produced and Sold in the USA. Final Report to the National Live Stock and Meat Board. Center For Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Smith, G.C., J.N. Sofos, M.J. Aaronson, J.B. Morgan, J.D. Tatum and G.R. Schmidt. 1994a. Incidence of Pesticide Residues and Residues of Chemicals Specified for Testing in U.S. Beef by the European Community. *Journal of Muscle Foods* 5:271-284.
- Smith, G.C., J.N. Sofos, J.B. Morgan, M.J. Aaronson, R.P. Clayton, D.K. Jones, J.D. Tatum and G.R. Schmidt. 1994b. Ensuring the Safety of the Meat Supply. *Proceedings of the Reciprocal Meat Conference* 47:31-36. American Meat Science Association, Chicago IL.
- Smith, G.C., J.N. Sofos, J.B. Morgan, M.J. Aaronson, R.P. Clayton, D.K. Jones, J.D. Tatum and G.R. Schmidt. 1994c. Ensuring the Safety of the Meat Supply--Chemical Residues in "Conventional," "Natural" and "Organic" Beef. Final Report to the National Live Stock and Meat Board, Center for Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins, CO and Warren Analytical Laboratory and Product Integrity and Food Safety Division, ConAgra Red Meat Companies, Inc., Greeley, CO.
- Smith, G.C., K.L. Heaton, J.N. Sofos, M.J. Aaronson and R.P. Clayton. 1997. Residues of Antibiotics, Hormones and Pesticides in Conventional, Natural and Organic Beef. *Journal of Muscle Foods* (In Press).
- Sofos, J.N., L. Holcomb, J.D. Tatum, R.P. Clayton, J.B. Morgan, S.K. Sanders, J.D. Eilers, M.J. Aaronson and G.C. Smith. 1992. Model H.A.C.C.P. Plans For Smaller Meat Plants. Technical Bulletin No. CRMS-7. Center For Red Meat Safety, Department of Animal Sciences, Colorado State University, Fort Collins CO.
- Usborne, W.R. 1994. Natural vs. Regular Beef. Mimeographed Report from the University of Guelph. Guelph, Ontario, Canada.
- USDA. 1982. Policy Memo 055:Natural Claims, USDA-FSIS, Washington DC.
- USDA. 1993. Compound Evaluation and Analytical Capability--National Residue Program Plan. USDA-FSIS, Washington, DC.
- USDA. 1994. Domestic Residue Program Results--1993. USDA-FSIS, Washington, DC.
- USDA. 1996. Domestic Residue Program Results--1994. USDA-FSIS, Washington, DC.
- Wilkinson, B. 1991. Coleman Advertising Campaign in Boston. National Cattlemen's Association. Issue Update. (May 1991 Issue) page 5.

## QUESTIONS & ANSWERS

- Eng:** We have focused on the implant issue in Europe which represents one fear. But hasn't there been a structural change in Europe in the last several years toward over-civilization and against biotechnology?
- A:** Yes. Among the countries I've visited, European countries are the most radical in terms of animal welfare, handling issues, and proper animal treatment. Australia is growing that way; certainly, Australians are far more concerned about such things than we are. We are on our way toward greater concern about those issues. I think we do a pretty good job of explaining those issues - but it is coming. A time will come when we will have to identify for others, all the production systems that we use to make sure that we treat animals fairly. I have a class of twenty-three students from all over campus. We have just spent a week they know that discussing the Oprah Winfrey show. You can not imagine what people who do not know of Gary Weber say about Gary Weber. "I thought that man looked stupid." In truth, he looked like he didn't know anything about the issue because of the way the tape was edited. They could not believe that we feed cow parts (from rendering) back to cows! They agree with Oprah. These issues will grow larger and larger in time. We must handle each one as we go and try to do the best we can to avoid criticism. I do not tell a dietitian that something is safe. I show them tables of data. Show them the data to make the point. Then, we're safe from

criticism. I have had a very revealing experience working with the young people who will physicians for the next generation lack of general knowledge of anything practical! These people know anatomy, disease, and health, but most don't know anything about agriculture, where meat comes from, or what farmers and ranchers do. They think that food appears at the back of the grocery store. We must do whatever is necessary to teach them. It is hard to get entree into this group - very difficult to get your spokesmen to speak to them. But the young people that I have spoken to have lots of interest and questions. Usually, I spend an extra hour or hour and a half discussing agriculture with them after the seminar has ended. They don't know anything about such subjects, yet they want to be able to inform their patients correctly. If we keep fighting for such audiences we can present the facts that support our case.