ANIMAL GROWTH BIOTECHNOLOGY IN A QUANDARY
ISSUE DIMENSIONS & OPTIONS

ABSTRACT

Agriculture has enjoyed dramatic successes through biotechnology in recent decades and consumers have come to expect a bountiful, appealing, nutritious, healthful, economic, convenient and safe food supply. Consumers now demand products which are desirable in composition and value, and safe and wholesome.

In order to meet these demands, several types of animal growth biotechnologies have been safely employed in food production systems for several decades and technologies now in several stages of development involve new types of growth regulators and recombinant approaches. While the "new" biotechnologies have been positioned as somehow different from those currently in use, attention and concern in producer, consumer, political and activist arenas has arisen regarding both present and emerging growth regulating technologies, whether or not they involve recombinant technology. The European Economic Community (EEC) ban on anabolic growth regulators for economic and trade purposes under the guise of other issues (i.e., safety) and moratoriums on the use of somatotropins for meat and milk production are examples of concerns and actions which have targeted animal growth technologies. Perceptions and facts are widely divergent on these issues. Production of foods in systems untampered by humans surfaces as a common denominator in the discussions surrounding these issues.

To increase lean tissue and reduce fat deposition in animals, diet and health concerns along with animal efficiency in producing quality, safe, lean and healthful animal products all require immediate attention. The ability to produce highly palatable acceptable lean animal products is a

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critical priority for the animal industry. Consumer calorie-consciousness requires a sincere effort on the part of the animal products industry to produce leaner animal products.

All technology implemented in the production system must be concurrently marketed to the final consumer as well as producers; this is seldom accomplished. We can no longer use technologies which are inconsistent with consumers' quality of life, and in the future, both the product as well as the systems used to produce it will need to be reflect consumers' needs and attitudes.

This paper explores the current status of the issues surrounding animal growth technologies and identify options and strategies through which these technologies may be successfully advanced in concert with the interests and perceptions of the diverse parties affected by these issues. Discussion papers on these issues were developed through a colloquia sponsored by the Texas A&M University Center for Biotechnology Policy and Ethics; these are excerpted below.

Some of the questions considered for discussion concerning animal growth regulating biotechnologies include:

—What are the implications in implementation or restriction of growth regulating technologies; will humans be better served?

—Why should these technologies be used? What are the benefits and who benefits?

—Who should be involved in the decisions and interchange involving use of these technologies for animals in food production? Should it involve those that do not use or consume foods produced with these products?

—How can all dimensions of the issues surrounding decisions on use of these technologies be communicated?

—What patterns and strategies might be useful in developing new approaches to deal with the development and implementation of growth regulation technologies?

INTRODUCTION

Understanding the issues surrounding animal growth biotechnologies requires a look back at the issues that have developed, how they developed over time, the basis for the issues as well as how and why they are important.

The target of animal industries is toward producing products that have a better consumer image and are aligned with consumer needs. For this discussion, the focus is on the use of biotechnology and other technologies to achieve these ends. The current aim is to produce what we call consumer-driven products—in composition and value—and systems which will be used to produce them. We are faced with the dilemma of choosing to use either traditional systems or biotechnology of some kind or a combination of both. Another question is, *"Can* we use them?" The concern of consumers is shifting from food itself to examining how it is produced.

Biotechnology might appear in food or it may be used to produce food. Consumers and other interested groups have certain expectations if we look at the growth area and animal products, most recently asking the question "Should biotechnology be used in food production?" and "Can we use biotechnology in a sustainable system or are we unable to develop an integrated system using biotechnology?"

The working group at Texas A&M studied some of the animal biotechnologies available and decided that certain technical issues, economic issues and ethical issues associated with the specific technology and those associated with change resulting from technology use would be addressed. Some very important political ramifications need to be addressed as well as food safety implications, diet and health implications and the issue of perception vs reality.

Contributors to this paper included Drs. Martin Terry, Jeff Burkhardt, Cathy Lemieux, Dave Hutchinson and Gordon Carstens. Most contributors gave seminars which raised questions concerning biotechnology use and suggested some of the possible implications of its use. They also asked who should be involved in making decisions about technology use and acceptability, and what benefits would be accrued from biotechnology use. Excerpts from the seminar papers are included to discuss our findings.

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Our food production systems were developed under the premise of scarcity. In developed countries where technology is used, innovation and technology have fostered an abundance of food and with it, a new set of societal values and expectations have emerged. The contemporary consciousness concerning biotechnology and resource use in food production systems worldwide reflects the dramatic success of our food production systems which provide an abundance of food with little involvement on the part of most consumers. This independence from the drudgery of searching for food provides much of society with the opportunity to pursue more fruitful endeavors toward advancement of humankind. A direct result of this dissociation is longer-term concern for the technology use in, and sustainability of, food production systems for future generations and maintaining and improving quality of life on the planet. Overriding issues concern application of biotechnology in food production, perceptions of resource use, and stewardship for resources planet-wide. Certainly, it was expected that different concerns would emerge when abundance rather than scarcity of food becomes the norm. Animal growth regulation biotechnologies have contributed to the abundance of desired animal products in our food supply.

As a consequence, the entire social contract between consumers and agriculture is now as never before in transition. The 1990s have become the decade of food safety and environmental awareness and consumers are demanding a safe, environmentally-sensitive and resource-conscious food supply and production system. Consumer-driven food products of desirable composition and value, that are assuredly safe and wholesome and that are produced in technologically, sociologically, and environmentally acceptable fashions are required. Consumers have an increasing interest in the diverse issues facing civilization, particularly those involving our food. How food is produced and the implications of biotechnology in food choices have surfaced as key issues about which the public now insists on being informed.

While science has responded with what is commonly described as an "information overload," little of this reaches consumers in easily under-

stood ten second sound bites, resulting in an information vacuum on issues surrounding key aspects of food production. Since a vacuum will be filled, an ever expanding array of spokespersons representing key societal concerns and purportedly representing "consumers" are "carpet bombing" the communications media with targeted-simplified information (i.e., eat lower on the food chain, hormone-free, natural, etc.) to achieve specific and egalitarian objectives involving animal, cultural, environmental and ethical dimensions of food production. In todays' communication systems, perceptions gained through watching media messages using sounds, shapes and images take precedence over facts concerning food production issues, of which animal growth regulators are a component. In this forum, the credibility of the messenger has increasingly become a focus for discerning and forming perceptions and judgements on these issues. It would certainly be unfortunate if safe, efficacious technologies for producing safer and healthier consumer-desirable animal products were rejected by, or unavailable to, consumers on the basis of misinformation, disinformation and perceptions. Unfortunately, the value of these technologies, in use and in development, was not or has not been communicated to consumers with the same message penetration as the emotional appeal for "natural" food production systems, untampered by humans.

Current technologies used in animal (beef) production, for example (anabolic implants), modify (repartition) growth to allow production of leaner beef products with less fat. Similar technology does not yet exist in practice for other species. Emerging technologies, however, promise effective growth regulation options for beef, lamb, pork and poultry with possible applications for fish as well. Repartitioning of growth and consequent modification of animal products has received major attention in recent years, and clearly provides the most direct and efficacious mechanism to change the protein and fat content of animal tissues. The objective is to modify the patterns of growth in animals to produce less fat in animals and more lean animal products. While this is the eventual target of genetic engineering initiatives, systems employing these concepts (i.e., transgenic animals) are not likely to surface in the marketplace soon. A number of options are feasible in developing systems employing growth regulating biotechnology in several forms to produce leaner animal products, and include estrogens, zeranol, androgens (i.e., TBA), growth hor-

mone, beta agonists, immunization and growth hormone releasing factor. All of these options have been investigated to varying degrees across animal species in developing targeted growth management systems to most efficiently produce desired leaner animal products.

The mechanisms involved in redirection of growth include modification of priorities for nutrient use for protein vs fat deposition, alteration of tissue turnover, modification of daily tissue deposition limits and modification of nutrient supply. Eventually, growth hormone, releasing factors for growth hormone, beta agonists and/or immunization strategies to remove negative feedback on growth (i.e., somatostatin) may provide additional mechanisms with which to regulate growth. They may work in concert with or replace current growth regulation technology, and these alternatives are currently in development.

Currently used estrogenic growth regulators (i.e., beef cattle), like growth hormone and beta agonists in development for several animal species, are effective repartitioning agents modifying growth by shifting nutrients from fat to protein accretion. Carcass animal products reflect accumulative growth from birth to slaughter. As a consequence, use of growth regulation biotechnologies from birth to slaughter provides lifetime growth regulation and provides the maximal redirection of nutrients from fat to protein and lean tissue production. The longer growth regulators are provided, the greater is the increase in total animal product lean with a simultaneous reduction in fat. Across several recent studies, the percentage of carcass fat was reduced by - n percent with current anabolic repartitioning implants (zeranol, estradiol 176). Concurrent with this reduction in carcass fat, the percentage of lean retail product was increased by 3.3 to 5.0 percent with these implant growth regulators. Reflecting the change in carcass composition and percentage retail product, the percentage of fat in the rib-eye muscle was reduced by 30 percent (from 3.8 to 2.6 percent). Trim fat (subcutaneous) and internal fat were similarly reduced.

The use of current growth regulators thus results in beef products with less trim fat (which consumers may eat or leave as plate waste) and with substantially less fat in trimmed lean muscle (i.e., rib steak) food products. Concurrent with this reduction in fat, cholesterol delivered to consumers will also be reduced, reflecting the two-fold higher cholesterol content of fat vs lean muscle. These growth regulation biotechnologies are

therefore important components of integrated growth management systems to allow production of consumer-driven lean-diet health-desirable animal food products.

The growth regulators currently approved for use (for beef cattle) are either endogenous compounds already present in man and animals (estrogen, testosterone, progesterone) or are compounds developed through biotechnology to mimic these endogenous substances (zeranol, trenbolone acetate). These growth regulators are currently used in over 95 percent of all cattle on feed in the U.S. and in 50 to 75 percent of these same cattle during growth as calves and as stockers prior to feeding. None of these are ever fed to animals in the U.S.; they are instead placed in the ear, which does not normally enter the food chain. When used in cattle production, residues in meat are extremely low and less than naturally occurring levels in meat from cows and bulls. Levels of these substances (hormones) produced in people every day are many thousands to millions times greater than present in meat either naturally or as a result of use of a growth regulator in cattle. Also, other foods, especially vegetables, salad oil, etc. provide thousands of times more estrogen than meat from cattle whether receiving growth regulators or not, and less than 10 percent of what is consumed is absorbed by humans, so the contribution from beef is truly negligible.

The EEC imposed a ban on import of beef from the U.S. and other countries using anabolic growth regulators commonly referred to as "hormones." While the ban was originally launched under the guise of a "safety" issue the directive for the ban has been adopted by the EEC although all safety issues were dismissed long ago by both the EEC's own commission "The Lamming Commission" and by the U.S. governments regulatory agencies (the Food Safety and Inspection Service (FSIS) branch of the Department of Agriculture (USDA) and by the Food and Drug Administration (FDA)).

In contrast to the U.S., where biotechnology is tightly and efficiently regulated such that no violative residues were found in the past four years of USDA-FSIS' National Residue Program, a fraction of meat produced in the EEC contains unacceptable residues of compounds never cleared for use, some of which are known carcinogens. A safety issue exists with EEC animal products because of unapproved "cocktails" of many potent drugs

directly injected into the muscle of growing animals on EEC farms, as a result of the ban on use of approved products instated during the past several years.

Recent data were summarized to assess the impact on the U.S. industry. In a summary of growth regulation studies at Texas A&M, the change in net return on a lean retail product basis averaged $96.68 per animal. This represents a net value to the U.S. beef products industry of approximately $2.5 billion. These data are consistent with results of a recent USDA study indicating a $2.4 to $4.1 billion reduction in net return on a retail product basis if currently approved growth regulators were not used in the U.S., depending on feeding and marketing management alternatives. Worldwide implications would obviously be much greater and this is borne out in the USDA study.

Clearly, when safe, approved efficacious biotechnology is banned to serve popular, protectionist or political purposes, only unapproved technology will be available for use. Use of approved safe growth regulators allows application of biotechnology to produce leaner animal products consistent with diet health needs of consumers. The ban on this technology in the EEC has resulted in the delivery of fatter beef products to European consumers, a situation inconsistent with the needs of U.S. (and other) consumers. Similar restrictions are forthcoming or are currently in place regarding the use of growth hormone based technology currently in development to modify meat animal products (i.e., EEC) or quantity of milk produced per animal (Minnesota, Wisconsin).

In producing environmentally sensitive animal products, the adoption of technology to reduce methane directly or growth regulators to enhance lean tissue growth reduce feed resources per unit of animal product and reduce the methane per unit of beef produced. Eliminating these technologies (i.e., growth regulation ban-EEC) results in a decrease in rates of lean tissue growth, more feed resources used and more methane per unit of beef or milk produced. Disallowing efficient meat production technology (i.e., growth regulators ban-EEC) or as suggested for milk or meat production (i.e., BST ban-EEC) would have unwanted resource (feed, energy, water, etc.) and environmental implications.