GENETIC ENGINEERING AND CLONING IN ANIMAL AGRICULTURE: BIOETHICAL AND FOOD SAFETY CONCERNS

GENETSKI INŽENJERING I KLONIRANJE U POLJOPRIVREDI ŽIVOTINJA: BIOETIČKA BRIGA I SIGURNOST HRANE

M. W. Fox

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SYNOPSIS FARM ANIMAL CLONING AND GENETIC ENGINEERING

The farming of animals for human medical and other commercial/ /industrial purposes is being intensified through two new biotechnologies. One is genetic engineering that involves the splicing of alien genes into target animal embryos to create 'transgenic' animals, or the deletion of certain genes to create 'knockout' genetically modified animals. The other is cloning, that entails taking cells from the desired type of animal, that may be transgenic or a 'knockout', or from a conventionally bred genotype possessing such qualities as rapid growth or high milk or wool yield, and inserting the nuclei of these cells into the emptied ova from donor animals of the same species. Once activated by electrical fusion of the nucleus to the egg wall, these embryo -developing ova are inserted into surrogate mothers to be gestated.

Successful gene-splicing techniques and lines of transgenic and knockout animals, along with many varieties of transgenic crops, notably corn, cotton, rice, and soy bean, have been patented by the US government, university-biotechnology industry developers and investors, and most notably by the multinational pharmaceutical and 'life science' industries like Monsanto.

The pros and cons, costs and consequences of these forms of extreme biological manipulation for human profit will be examined in terms of who are the primary beneficiaries and losers from an objective, veterinary bioethical perspective.

INTRODUTION: PROS & CONS

Advocates for the creation of genetically engineered and cloned animals claim that this new biotechnology is simply an extension of the process of human-directed natural selection for desired genetic traits that began thousands of years ago when animals were first domesticated. Some of these 'production' traits, coupled with how these animals are husbanded in crowded 'factory' farms, (see synopsis below) are now recognized as causing a host of animal health, welfare, public health, and environmental problems.

Dr. Michael W. Fox BVetMed, PhD, DSc, MRCVS, Consultant veterinarian and bioethicist, web site www.twobitdog.com/DrFox/ Postal; 2135 Indiana Ave N., Golden Valley, MN 55422, USA. E-mail ipan@erols.com

Agricultural biotechnologists also contend that their patented transgenic or GM/GE (genetically modified/genetically engineered) crops are 'substantially equivalent' to conventional crops, and therefore are safe. Investors hope to profit also from the patents they hold on transgenic and cloned animals, just as they seek to monopolize the global market with their patented transgenic seeds.

Critics contend that the creation of transgenic and knockout animals, and cloning, are biologically aberrant (if not abhorrent) technologies that the life science industry and others cannot, from any sound scientific or bioethical basis, claim to be simply an extension of natural selective breeding. Clones are not identical to the original foundation-prototype because of epigenetic environmental influences and different maternal mitochondrial DNA. Likewise, GE crops are substantially different from conventional crops because the biotechnology employed for gene insertions and deletions is unnatural, and the consequences unpredictable by virtue of the inherent uncertainties of gene expression related to inaccurate and relatively crude gene-manipulations, and higher incidence of spontaneous mutations.

ANIMAL HEALTH AND WELFARE

Animal health and welfare advocates have documented the diseases and suffering that occur as a consequence of natural selective breeding to intensify animal productivity in terms of accelerated growth rates, greater body/flesh mass and higher milk production. Cloning such conventionally bred and genetically engineered animals, often raised under inhumane, intensive/confinement conditions, to create flocks and herds of more productive and profitable livestock, is now well under way in several countries. Commercial aims are directed toward developing animals that have leaner and more meat and healthful fats for human consumption (such as pigs that produce omega 3 fatty acids); greater disease resistance, fertility, and fecundity; produce more wool, milk with higher protein, even 'hypoallergenic' and analog human 'infant milk' high in human lactoferrin; and that produce environmentally less harmful wastes containing lower levels of phosphorus. Pigs with transgenes from spinach, jelly fish, and a marine worm, have been cloned. The spinach gene is employed to lower saturated fats and increase linoleic acid levels in body fat; the jellyfish gene to make the pigs fluorescent, thus serving as a genetic marker; and the nematode worm gene to convert omega 6 fatty acids into more consumer-beneficial omega 3 fatty acids. In the US, goats may become the future 'bioreactors', producing proteins in their mammary glands for use in human medicine. Both foundation animals and F1 generation transgenic pigs with spinach desaturase gene (inserted to convert saturated fats into unsaturated linoleic acid) had high mortality rates.

The FDA (US Food & Drug Administration) in 2008 announced that the meat and milk from cloned cattle, pigs, is as safe to eat as food from more conventionally bred animals. But concerns over people eating meat and dairy products from cloned animals have nothing to do with any foreseeable risk to consumers. The inherent danger of *genetic uniformity* in cloned herds selected for production traits that are already linked with various production-related health and welfare problems is a serious ethical issue. Greater genetic uniformity can mean significant economic losses from diseases that become contagious when there is a fatal combination of genetic susceptibility and uniformity. The propagation, by accident or design, of unhealthy traits in cloned and genetically engineered breeds which would result in disease, miscarriages, birth defects etc, have been well documented in the scientific literature. The loss of genetic diversity in the livestock population increasingly displaced and replaced by homozygous clones is a bioethical and potential financial issue that governments and regulatory agencies have not fully addressed.

The treatment and ultimate fate of surrogate and donor cattle and other farmed animals used as mere instruments of biotechnology call for the most rigorous humane standards and their effective enforcement by the US and other governments.

Some of the first farmed animals in non-pharmaceutical production to be cloned have been high-yielding dairy cows. Since animal bioengineers from the US and Japan have collaboratively succeeded in genetically engineered cattle to be resistant to BSE-bovine spongioform encephalopathy, or mad cow disease-animals like theirs may well be the first to be vigorously propagated through artificial insemination and cloning technology. Regardless, BSE was essentially a human-created disease following the livestock industry practice of recycling

dead animals back into the food chain in livestock feed. (This epidemic that devastated the UK's cattle industry may have originated, according to some epidemiologists, from contaminated cattle remains imported from India for incorporation into livestock feed.)

Transgenic farm animals are already being cloned to create flocks and herds for 'gene pharming', many carrying human genes that make them produce various novel proteins in their milk, like antithrombin 111 and alpha-trypsin that the pharmaceutical industry seeks to profit by. The animals are called *mammary bioreactors*. The global market for such recombinant proteins from domestic animals is expected to reach US&18.6 billion by 2013, but similar proteins from transgenic pharm crops producing pharmacologically active proteins may lower this figure considerably.

In the spring of 2009 the US government (FDA) approved GTC Biotherapeutics' transgenic (GE) goat anti-coagulant biopharmaceutical for commercial production from a herd of 200 GE goats, without giving any call for public comment. PharmAthene of Annapolis Maryland is reportedly developing a treatment for nerve gas poisoning from the milk of GE goats.

Genetically altered farm animals are also being created to serve as organ donors for humans; to produce human blood substitutes, and to produce monoclonal and polyclonal antibodies. The presence of retroviruses in pig livers and other organs make the risks of xenotransplantation considerable, some virologists calling for a prohibition on putting immuno-humanized pig organs into human patients. Models of human diseases have also been created in transgenic animals, like Denmark's cloned pigs that have genes for Alzheimer's disease, and pigs in the US being genetically engineered to serve as models for cystic fibrosis in humans .According to a 2005 public survey by the Pew Initiative on Food and biotechnology, 56 percent of Americans *oppose* research into genetic modification of animals.

VETERINARY, ECOLOGICAL, AND BIOLOGICAL ISSUES

The incorporation of other species' genes into farm animals, like the human growth hormone gene into pigs, can have so called *multiple deleterious pleiotropic effects*. These unforeseen consequences on transgenic animals' development and physiology include abnormal and excessive bone growth (acromegaly), arthritis, skin and eye problems, peptic ulcers, pneumonia, pericarditis and diarrhea (implying impaired immune systems), as well as decreased male libido and disruption of estrus cycles. Inserted/spliced genes may be 'overxpressed', meaning overactive, and produce excessive amounts of certain proteins like growth hormone, or create an 'insertional mutation' problem, disrupting the functions of other genes and organ systems.

These Russian roulette-like adverse consequences of genetic engineering can result in serious health problems later in life if they do not cause fetal deformities and pre- or early postnatal death. Many transgenic creations are either still-born or are resorbed by the mother; or soon after birth they die from internal organ failure or circulatory, or immune system collapse. This is especially so with cloned animals, the success rate being extremely low in terms of survivability. For example, a US Dept of Agriculture research experiment to create cows resistant to mastitis had a success rate of 1.5 percent, 8 calves being born from 330 transgenic cloned ova, only eight of these being gestated to term as live calves. Three of these died before maturity.

Cloning can result in abnormally large fetuses that can mean suffering and death for the mothers. Abnormal placentas, deformed still-born fetuses, and live offspring with defective lungs, hearts, brains, kidneys, immune systems, and suffering from circulatory problems, deformed faces, feet and tendons, intestinal blockages and diabetes have been documented. Cloning seems more likely to cause problems when the cloned animals have been previously subjected to genetic engineering. Yet it is only through cloning that productive flocks and herds can be quickly built from one or two 'founder' transgenic/knockout stock.

UNACCEPTABLE ANIMAL BIOTECHNOLOGY

The incorporation of cloned and transgenic farm animals into conventional, industrial agriculture is ethically, economically and environmentally unaccep-

table. This is because it is being directed primarily toward making confinement-raised farmed animals (and aquatic species on fish farms, notably transgenic salmon) more 'productive'. This is a myth because the industrialized factory farming of animals is not only inhumane and environmentally damaging; it is also not sustainable economically or ecologically. It is blight across most rural landscapes throughout much of the industrial world, and, according to a recent report by the United Nation's FAO, (Food and Agriculture Organization), it is the number one culprit in global warming, when coupled with the enormous global population of livestock that are creating desert wastelands from over-stocking and over-grazing in less developed countries.

Health and environmental experts, conservationists and economists are calling for a reduction in livestock numbers globally, and for more sustainable, organic and ecological farming practices, including more humane and 'free range' animal production methods. They see no place for cloned livestock and agricultural bioengineering if there is to be a viable future for sustainable agriculture.

The Western market and unhealthy appetite for animal products as a dietary staple, that the inhumane farm animal industry promotes through government subsidies and price supports at tax payer's expense, is now being exported to many developing countries, most notably by the World Bank, at great cost to their natural biodiversity, traditional, sustainable farming practices, and to environmental and public health. We should all ask what farm animal cloning and genetic engineering have to do with feeding the poor and hungry, and in developing a sustainable and socially just agriculture locally and globally, to feed the starving millions of our kind, without further sacrifice of biodiversity, the Earth's wild plant and animal species, and most precious communities, notably those recognized by the UN as Global Biosphere Reserves.

All countries importing genetically engineered seeds, and foods and animal feeds derived there from, as well as meat and dairy products from cloned animals, should, for the above bioethical, scientifically verifiable, environmental, and economic reasons, *immediately boycott* this market sector of agricultural and animal production biotechnology: And cease and desist from further endeavors to develop their own animal and plant biotechnologies that are no substitute for humane, sustainable, socially just, ecologically sound and environmentally beneficial food and fiber production methods.

The use of farm animals as medical models of human diseases, and as sources of new pharmaceutical and other medical products, from livers to hearts for 'xenotransplantation' into humans, raises a host of public health and bioethical questions. It may not be a sustainable or effective path for medicine to take, profitability not withstanding. From a bioethical perspective it puts the human in the role of *genetic parasite*, which, from a cultural and evolutionary perspective, may not make for a better or desirable future.

Cloned, transgenic farm animals created for human consumption are likely to be kept under the same pathogenic husbandry conditions and subjected to the same kinds of inhumane treatment to which conventionally bred livestock and poultry are currently subjected. The reasons include custom, convenience, economies of scale, and prioritizing profit margins over animal health and welfare. Those created to serve as organ-donors and to supply various biologics or pharmaceutical products will be cared for in proportion to their invested value and productive worth.

The cavalier attitude toward the widespread use of vaccines to control farmed animal and human diseases, most of which are modified/attenuated live, or genetically modified live strains, is of epidemiological concern. Diseases in non-target species have been documented, and the possibilities of new viral strains evolving through recombination opens a Pandora's box that is the antithesis of preventive medicine, vaccinations being sold under that erroneous banner.

We all need to ask what kind of world are we creating through industrial, biomedical and agricultural biotechnology, splicing and silencing genes, manipulating viruses, inserting artificial chromosomes, and creating clones? To the instrumental rationalist, minimizing, (and even discounting) human health and environmental risks, and avoiding animal suffering whenever possible, are the sole ethical criteria for acceptability Are these new biotechnologies really part of some enlightened vision of a sustainable future, or are they paving the way to an ever more depraved and desperate existence for the next generation?

GLOBAL BIOETHICAL CONCERNS

Now with the globalization of the industrial economy, developing countries affluent consumers want more steaks, chicken and ice cream, so factory farms have proliferated, notably with development loans from the World Bank. Since there is much animal offal coming out of these factories, Western agribusiness subsidiaries - the pet food industry and livestock feed and biological products (from hides to gelatin) companies, are importing such animal industry by-products, and setting up processing facilities and pet food manufacturing plants abroad, where labor is cheap and environmental and health and safety regulations more flexible. And the affluent in these countries are purchasing ever more cat and dog food as the specialty markets for commercially produced purebreds of dog and cat profit from increasing public demand for such status symbols, while their own indigenous dogs and cats suffer on the streets and are rarely adopted from local shelters.

According to figures from the UK's Compassion in World Farming, reported in *The Economist,* (Dec. 2nd 2006, p. 88), over 50 billion animals are killed for food every year, which comes to almost 100,000 a minute 24/7. In the past 40 year meat consumption per person has risen from 56 kg to 89 in Europe, from 89 kg to 124 in America, and from 4 kg to 54 in China, in spite of the nutritionally inefficient conversion of grass or grain to meat, some 10 kg of feed being needed to produce 1 kg of meat. No caring person, once informed, can continue to regard meat, poultry, and sea foods as dietary staples.

It is noteworthy that the UK's Environmental Minister Ben Bradshaw has advised consumers of the hidden costs of meat and dairy consumption, part of an effort to reduce the ecological footprint of agriculture in the British Isles, and to address the issue of global warming/climate change. On a new web site for British shoppers, (www.direct.gov.uk/ /greenerfood) it is stated that the 'production of meat and dairy products has a much bigger effect on climate change and other environmental impacts than of most grains, pulses, and outdoor fruits and vegetables." It is encouraging that at least one developed nation is taking the initiative to change dietary habits by informing shoppers of the risks and costs of foods of animal origin.

FUTURE DIRECTIONS: BIOETHICAL CHOICES

The avaricious quickening of industrialism and consumerism has created a non- sustainable and unethical enterprise system that can only be made to cause less harm by all of we Earth consumers voting with our dollars. We should eschew all manufactured, processed and prepared (pre-pared) foods, and ideally prepare our own meals from organically certified whole foods, or purchase prepared foods that are organic and whole rather than highly processed. This same initiative should be applied to what companion animals are given to eat, for their own health, and indirectly for the health of the environment by supporting more sustainable, and humane farming and food-production methods.

All consumers need to take a stand and use their purchasing power to support humane, sustainable organic food producers and retailers for the good of the environment, farm animals, farmers who care, and for their own health and that of their animal companions. Just as more and more doctors and other human health care professionals are advocating healthier diets and a healthier agriculture, so should all veterinarians and those organizations and individuals concerned about the health and welfare of both companion and farm animals.

The public is becoming more knowledgeable about "junk" foods and the linkage between good nutrition, good farming practices, and good health. The demand for certified organic produce is increasing as public opposition mounts against conventionally grown and genetically engineered crops and foods, and against animal produce from livestock and poultry raised under stressful, cruel, disease-enhancing, concentrated feeding operations, factory farms and feedlots.. Organic farming methods are highly productive, and, contrary to its detractors and advocates of conventional agriculture, can be sufficiently productive and affordable to feed the hungry world. There is also increasing evidence that organically certified produce contain more nutrients and have higher nutritional value by far than conventionally produced meat, eggs, dairy products, fruits, vegetables, grains and pulses, confirming that 'organic' is the only way to go.

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ADDENDA
USING GENETICALLY ENGINEERED CROPS AS FOOD & LIVESTOCK FEED

The inclusion of genetically engineered crops and feed additives in livestock and poultry feed, in pet foods, and directly into the human food chain, especially in processed foods containing corn and soy ingredients, is a major related concern.

Genetically engineered or genetically modified (GM) plants - "Frankenfoods" to critics - contain artificially inserted genes from viruses, bacteria, other plant species, also from insects, humans, and other animals. This process can result in entirely novel chemicals being produced that were never in our foods or what farmed and companion animals were ever fed before. Also normal nutrients may become deficient as a consequence of alien gene insertion, while other naturally occurring plant substances may become so concentrated as to become toxic.

GM plants are created primarily to increase their resistance to herbicides and insect pests. Both the US government and the multinational corporations patenting and selling these seeds of potential destruction to farmers to plant crops that go to human, pet food and livestock feed manufacturers would have us believe that GE crops and food ingredients are safe, and that to believe otherwise is to not trust in science and progress.

In 2006, an estimated 136 million acres of U.S. cropland was used to grow GM crops. Some 89% of soybeans and 61% of corn crops are now genetically engineered. Canola is also genetically engineered, and vegetable oils (canola and corn) along with soy protein and lecithin, are used widely in a variety of prepared foods for people and their pets. Genetically engineered sugar beet will soon be planted widely as a source of sugar for the food industry. Beet pulp is a common ingredient in pet foods. GM wheat is also on the horizon. Gurian-Sherman (2009) has shown that the claimed higher yields of GM/GE corn and soybean cannot be substantiated.

SOME OF THE RISKS

Numerous issues and unanswered questions surround the "safety" of GM foods. In their recent review, Dona & Arvanitoyannis (2009) conclude that 'The results of most of the rather few studies conducted with GM foods indicate that they may cause hepatic, pancreatic, renal, and reproductive effects and may alter hematological, biochemical, and immunologic parameters the significance of which remains unknown. The above results indicate that many GM foods have some common toxic effects. Therefore, further studies should be conducted in order to elucidate the mechanism dominating this action. Small amounts of ingested DNA may not be broken down under digestive processes and there is a possibility that this DNA may either enter the bloodstream or be excreted, especially in individuals with abnormal digestion as a result of chronic gastrointestinal disease or with immunodeficiency'.

- The insecticidal poison Bt (*Bacillus thuringiensis*) is present in most genetically engineered U.S. commodity crops that go into animal feed and pet foods. High levels of Bt toxin in GM crops have made farmers ill and poisoned farm animals eating crop residues. Bt toxin harms microorganisms in the soil vital to plant health, high levels being created when GM crop residues are mulched or ploughed into the soil.

- Genetic material in GM herbicide resistant soybeans can be transferred to bacteria in our digestive systems. This means that foreign proteins could be manufactured in our own digestive systems by such bacteria, turning them into pesticide factories.

- So called "overexpression" can occur when spliced genes that manufacture chemicals such as Bt become hyperactive inside the plant and result in potentially toxic plant tissues. These are lethal not just to meal worms and other crop pests, but also to, birds, butterflies, other wildlife, and possibly to humans and their pets.

- The herbicides glufosinate and glyphosate are liberally applied across the U.S. and in many other countries to millions of acres of crops genetically engineered to be resistant to these herbicides. These poisons are actually absorbed by the crops, while all else growing in the fields and much of the surrounding aquatic life in rivers and lakes, are wiped out. These widely used herbicides have

caused kidney damage and other health problems in animals.

- These herbicides and other agrichemicals, along with the insecticide Bt, are found in pet foods and the crops and crop by-products fed to cattle, pigs, poultry, and dairy cows.

- Many nutritionists and health experts are linking the rise in human food allergies - skin problems and inflammatory/irritable bowel syndromes - to the increased consumption of GM foods and food additives, especially genetically engineered soy products that contain novel proteins. The high incidence of skin and food allergies, and other suspected allergies associated with digestive disorders and inflammatory bowel disease in dogs and cats may well be caused or aggravated by these novel proteins and other chemical contaminants in GM crop byproducts. I have seen a dramatic increase in these problems over the past decade in the thousands of letters I receive from cat and dog owners who read my syndicated newspaper column *Animal Doctor.* It is surely no coincidence that the US Centers for Disease Control and Prevention reported, in Oct. 2008, an 18% increase in allergies in children under the age of 18 years, between 1997-2007. Some 3 million children now suffer from food or digestive allergies, their symptoms including vomiting, skin rashes, and breathing problems. They take longer to outgrow milk and egg allergies, and show a doubling of adverse reactions to peanuts.

- Almost every independent animal feeding safety study has shown adverse or unexplained effects of GM foods, including: Inflammation and abnormal cell growth (possibly pre-cancerous) in the stomach and small intestines; abnormal development, inflammation, and cellular changes in the liver, kidney, testicles, heart, pancreas, brain; and poor growth and higher mortalities than normal.

- Researchers have found that unlike conventionally bred crops, GM varieties are intrinsically unstable and prone to spontaneous mutations. When mutations occur, you can never know if what is being grown, harvested, processed and consumed is really safe and nutritious.

- The inserted genes can have unforeseen consequences, so called multiple pleiotropic effects. These unpredictable consequences of introducing a new genetic trait or quality include alterations in existing gene function and relationships with other genes. A dramatic example of this in animals is in the genetically engineered pigs that were created to carry human growth genes at the U.S. government's research facility in Beltsville Maryland. These pigs became cripples, suffering from multiple health problems including arthritis, bone-growth deformities, and had impaired immune and reproductive systems. Multiple pleiotropic effects in GM soy include excesses of certain phytoestrogens, and the presence of anti-nutrient substances, some of which could be a consequence of genomic interaction with mutagenic agrichemicals compounded by the poor nutrition (and nutritive value) of conventionally, rather than organically grown crops.

- GM seeds are genetically unstable because they are more prone than normal to undergo spontaneous mutations. This can mean that GM crops could produce novel, harmful proteins, excessive, even toxic amounts of normal nutrients, or become extremely deficient in same: Spontaneous mutations = genetic roulette.

- The delicate bacterial balance in the digestive systems of man and beast alike is disrupted by herbicide food residues and possibly by the mutagenic, unknown consequences of transgenic DNA segments (from the genes of all GM foods) becoming incorporated into the bacterial DNA.

- The widely employed Cauliflower mosaic virus (CaMV) used as a vector for transgenes in plants has an insertional/recombination 'hot spot' that is prone to break and recombine with other DNA and plant mRNA and RNA viruses. Novel viruses containing transgenes, and bacteria with antibiotic marker transgenes may then develop with potentially devastating consequences to natural and agricultural ecosystems. Some virologists note CaMV is related to and could recombine with Hepatitis B and HIV viruses. Infected people consuming large numbers of virus genes in GM crops could become incubators for new virus strains created through recombination with CaMV.

FARMED ANIMAL HEALTH AND WELFARE CONCERNS: SYNOPSIS

Caged Laying Hens: Extreme overcrowding; lack of movement induced osteoporosis and bone frac-

tures; foot lesions from wire floor, feather-picking and cannibalism.

Broiler Chickens: Extreme overcrowding, lameness, breast blisters, feather picking and cannibalism, 'keel-over' heart-failure from rapid growth. Eye problems, including blindness, from poor ventilation.

Penned Piglets: Overcrowding, boredom, tail-biting, cannibalism, lameness and foot lesions from a life on concrete slatted floors. Circulation and joint problems from rapid growth and large body mass: Chronic respiratory problems from poor ventilation.

Breeding Sows in crates: Extreme physical constraint, lameness, arthritis, boredom and stereotypic behaviors indicative of stress and distress.

Veal Calves in crates: Extreme physical constraint, social deprivation, iron-deficient diet causing anemia and weakness.

Feedlot Beef Cattle: Exposure-lack of shade and shelter, lameness and foot rot, liver disease from improper, high-energy 'fattening/finishing' diets and lack of roughage.

Confined Dairy Cows: lack of exercise related lameness, metabolic, and liver diseases from high energy/concentrate diets and lack of roughage.

All the above concentrated animal feeding operations cause stress, distress, and increased disease susceptibility especially to enteric and respiratory infections, and to udder/mammary gland infections in dairy cows.

The following *procedures* need to be addressed and where appropriate, either phased out, or only the most humane methods permitted: Castrating, branding, and dehorning cattle without anesthetic; hot-iron de-beaking of chickens; disposal of unwanted chickens & pre-slaughter collecting and handling of poultry; tail docking and castration of piglets and lambs; tail docking of dairy cows; treatment of unwanted 'bobby' calves and 'downer cows;' and of sick and injured poultry and piglets. Use of the 'Stock-still' electrical immobilization of cattle should be prohibited. Humane methods for the mass 'depopulating/killing of diseased livestock and poultry also need to be implemented.

Livestock and poultry transportation, handling, and slaughter methods need significant improvements in most counties.

Dairy and beef cattle fed rations high in cereal grains are prone to acidosis, digestive and metabolic problems, and lameness from laminitis. Such diets create ideal conditions for the proliferation of *E. coli* 0157, thus putting consumers at risk (also from crops contaminated with infected manure and slurry run-off). Feeding a more natural, grass or hay-based diet results in a drastic reduction in E.coli 0157 within a few days.

Cruel, intensive confinement systems of livestock and poultry production, called CAFOs - concentrated animal feeding operations, are a legacy of our inhumanity. The price of CAFOs include major public health problems associated with the wholesale use of antibiotics to help these animals grow and be productive and stay alive, leading to the rise of highly resistant strains of bacteria. They cause widespread air, surface and groundwater pollution. World wide, the livestock industry is the leading human-created cause of climate change/global warming.

Produce from organically certified, and free-range animals, are generally more healthful, nutritious, humanely derived, and with less environmental harm and drug-dependence than similar produce from CAFOs.

EXAMPLES OF RECENT RESEARCH & REVIEWS ON GE & CLONED FARMED ANIMALS

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SINOPSIS: KLONIRANJE DOMAĆIH ŽIVOTINJA I GENETSKI INŽENJERING

Uzgajanje životinja za humane medicinske i ostale komercijalne/industrijske svrhe povećava se putem dvije nove biotehnologije. Jedna je genetski inženjering, što obuhvaća razdvajanje tuđih gena u embrije ciljane životinje radi stvaranja "transgenih" životinja ili brisanje određenih gena radi stvaranja "izuzetnih" genetski modificiranih životinja. Druga je kloniranje, što uključuje uzimanje stanica iz željenog tipa životinje, koje mogu biti transgenske ili "izuzetne", ili iz konvencionalno uzgojenog genotipa koji posjeduje takva svojstva kao što su brzi rast, visoki prinos mlijeka ili vune, te umetanje jezgara ovih stanica u ispražnjena jajašca životinja donora iste vrste. Kad se električnom fuzijom aktiviraju jezgre za stijenku jajeta, ova jajašca u kojima se razvija embrij, umeću se u zamjenske majke radi oplodnje.

Uspješne tehnike razdvajanja i linije transgenih i izuzetnih životinja kao i mnoge vrste transgenih usjeva, osobito žitarica, pamuka, riže i soje patentirali su vlada SAD-a, sveučilišta i biotehnološka industrija, poduzetnici i investitori, a naročito multinacionalne farmaceutske industrije i industrije kao Monsanto.

Za i protiv, troškovi i posljedice ovih oblika ekstremnih bioloških manipulacija za dobrobit ljudi, istražit će se u smislu tko su prvenstveni dobitnici i gubitnici iz objektivne veterinarske bioetičke perspektive.