Clenbuterol: Effects and Usage in Livestock and Show Animals

Clenbuterol a beta-adrenergic agonist and the illegal use in food producing animals and show animals to improve lean muscle mass and market value.

Tag Words: Clenbuterol, Growth Promoter, hormones, rbGH, factory farm, beta-adrenergic agonists, Contador, Doping, sports enhancement, livestock

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Summary (Aimee Wood)

This classapedia is on the effects of clenbuterol on livestock such as cattle, poultry and swine. Clenbuterol is and illegal growth promoter illegally used in farms to fatten up animals before sending them to slaughter. In recent news Tour de France winner Alberto Contador has been tested positive for clenbuterol. Clenbuterol can also be used as a sport enhancement drug and is banned by the World Anti-Doping Agency. Our service project was to investigate the chance that the beef he had eaten the night before his urine was tested really poisoned Contador. It is unlawful and unethical for farmers to be using illegal substances on their animals that are harmful to the animals and humans alike. It is a huge injustice to Contador not to mention meat consumers if the meat he had ingested was tainted and he loses his titles and is banned from cycling.

Video Link

Class Project 2010 Fall: http://www.youtube.com/watch?v=ZTeJiBvbLhA

The Issue: Clenbuterol

Introduction (Aimee Wood)
In today's society "the bigger the better" seems to be the way of thinking about most things; houses, cups of coffee, bicep size and farm animals. With the same amount of land we have had in the past 49 years (and beyond) the worlds meat consumption has jumped from 71 million tons to 284 million tons of meat in 49 years while 30% of ice free land is used for livestock production. It has also been estimated that this 284 million tons will double again in the next 50 years (1). With such high demands for meat and limited resources such as land and potable water, livestock farmers needed to increase the efficiency at which they could produce an animal for slaughter. This is where growth-promoters came into play in the livestock industry.

Feed additives such as beta-adrenergic agonists (ß-agonist), have been used to increase the carcasses lean content and reduce the amount of feed needed for animals with increased muscle to fat ratios. Clenbuterol, Paylean and Optaflex have been the most popular ß-agonists used for this purpose. Clenbuterol, specifically, is illegal for the use in animal feed, breeding animals, show animals, and therapeutic drugs in the United States. Since Clenbuterol increases muscle mass, decreases adipose tissue and lowers the amount feed needed for finishing animals it makes a substantially larger profit for livestock farmers per animal. Clenbuterol is easily and quickly eliminated from the body and not easily detectable after a small withdrawal period making it a profitable black market product (2). Given this, livestock farmers are feeding their animals an unregulated amount of Clenbuterol. This leads to problems with the health of the animals themselves and the possibility of toxic residues in the meat they provide for humans and other animals.

Many instances where Clenbuterol was used have been public health concerns and contaminated meat products harming humans in countries such as Spain, France and Ireland. Up to 135 cases have been reported during one instance of Clenbuterol poisoning (3). Just this past year, Tour De France winner Alberto Contador has been accused of doping after the World Anti-Doping Agency found residue of clenbuterol in a urine sample taken during the Tour. Contador claims that he eaten contaminated beef from Spain, which was tainted with clenbuterol unknowingly. Results to this case are still pending today. The Food Safety and Inspection Service has recently started regularly testing random livestock and show animals for Clenbuterol and other groups such as 4H, the Future Farmers of America and the FDA are also working towards the elimination of illegal Clenbuterol use (3).

The use of Beta-adrenergic agonist (Tzeh Keong Foo)
Beta-adrenergic agonists are gaining acceptance amongst the meat-producing industry as meat producers strive to introduce dietary additives into animal feed that would not only improve feed efficiency but also enhance weight gain in animals sent to slaughterhouses. Essentially, metabolic modifiers are used as means to target protein synthesis and turn over in skeletal muscles of animals, lipid synthesis and turn over in fat tissues of the animals and regulation of milk synthesis and secretion in the mammary gland (2).

β2-agonists are often used as a method to repartition use of consumed nutrients, which is achieved as the nutrients gained from animal feed are shifted away from being converted as fat

and instead used in the synthesis of lean muscles. These compounds interact with β2-adrenegic receptors (β-AR), a G protein super family member. Long-term exposure of these anabolic drugs would result in β-AR desensitization that is characterized by functional uncoupling of receptors, physical sequestration of receptor away from the cell surface and down regulation of the total number of receptors. Eventually, such desensitization of the cell membrane receptor would lead to loss of cellular responses to natural and synthetic ligands.

Examples of Beta-adrenegic agonists commonly associated to the practice of enhancing muscle growth in food animals include ractopamine, Clenbuterol, Paylean and Optaflex. Ractopamine was approved by the FDA in 1999 for use in finishing swine and 2003 for finishing cattle. Commercial names of ractopamine (normally exist as ractopamine hydrochloride) are Paylean for swine and Optaflexx for cattle (2). Zilmax or zilpaterol hydrochloride are also used in the practice of repartitioning livestocks as it was approved in 2006 (4, 5). Paylen is mostly administered in swine feed for the last 28 days; Optaflexx is given to cattle their last 28 to 42 days while Tomax, given to turkeys their last 7 to 14 days (6). However, the usage of β2-agonists is strictly monitored in the European Union and can only be authorized for therapeutic purposes. In fact, EU's strict regulation on growth promotants in food animals can be traced from banned growth enhanced beef importation in 1989 (2, 7).

History of Clenbuterol (Mohd Ahmad)

The earliest documented use of clenbuterol is probably involving a German-based company and FDA. On June 15, 1978, FDA granted permission to the company to test its new stimulant drug for treating respiratory ailments in horses (8). A few years after that, in 1988, public health and meat inspection officials suspected the use of clenbuterol in livestock in the United States and Canada. In Texas, it was used in livestock animal shows while in Quebec, the drug was found in veal calves. Because of what happened in Texas, the research to analytically assay clenbuterol residue was initiated (19).

The St. Louis Laboratory of the Food Safety Inspection Service (FSIS), USDA, began the research in 1989. This research was meant to detect clenbuterol but also cimaterol, salbuterol, and fenoterol in the liver of veal swine and calves. By 1991, the method was finalized by the laboratory, which uses mass spectrometry following a gas spectrometry. Later, it became the tool for ensuring that the meat in the US is safe to consume (8). Boehringer-Ingelheim Ltd is the only company in the US and the world licensed by FDA to produce the clenbuterol-based bronchodilator under the name Ventipulmin (R) (10). This medicine treats acute and chronic respiratory illness caused by bronchospasm (sudden constriction of bronchioles muscles walls) and/or mucus accumulation.

General Effects of Clenbuterol on Animals (Aimee Wood)

Once ingested, Clenbuterol reaches peak levels in 3 hours quickly distributing through the animal including the Central Nervous System. The bioavailability is between 70-80%. Clenbuterol has many different effects on animals primirarly relaxation of smooth muscle such as bronchi and the main reason for it's production. Clenbuterol is used to treat chronic obstructive pulmonary disease in horses. Most useful for livestock farmers, Clenbuterol creates hypertrophy of skeletal muscle, increases lipolysis and decreases lypogenesis all that lead to

enlarged muscular structure. It also relaxes the intestinal walls and the uterus of pregnant cows allowing to hold of birth of calves until the next morning or until the cow reaches a safer place to give birth. Also, being able to cross the blood brain barrier and the placenta affects the Central Nervous System and affects any potential fetuses in cows or humans who ingest clenbuterol.

The use of Clenbuterol also increases the capacity for oxygen and nitrogen in the muscles. Skeletal muscle is more sensitive to insulin when Clenbuterol is used. With long term exposure to Clenbuterol the beta receptors in the skeletal muscles and adipose tissues become desensitized and a reduced number of insulin receptors are available, therefore, increasing insulin resistance in the animal and decreasing the affect of beta-agonists on the further growth in muscle cell size and the further decrease in lipolysis (11). Studies have shown that Clenbuterol can also make swine more aggressive and difficult to handle because the beta-agonists negatively affect the dopamine system and other areas of the brain that handle aggression (12).

Effects of Illegal Use of Clenbuterol in Food Animals (Tzeh Keong Foo)

Nevertheless, like most β2-agonists, there has been growing concerns on the use of Clenbuterol as a repartitioning agent, especially in food animals. Illegal use of the drug has stemmed from β2-agonists' effects on meat-producing animals that were reported to have less fat deposition with a marked increased in protein content. However, illicit treatments of farm animals with Clenbuterol were reported to cause changes in target organs of treated animals such as in the liver, lungs and eyes. Moreover, Clenbuterol can be converted to more active or toxic compounds upon entering the tissues with the toxic compounds be retained in the tissues. The subsequent discussions on the illegal use of Clenbuterol in food animals would be focused on two major supplies of meat for public consumption, namely poultry and beef.

Effects of Clenbuterol on Poultry (Tzeh Keong Foo)

In a study conducted on effects of β2-agonists on the endocrine response of male broiler chickens fed 21 days with Clenbuterol, down regulation were observed in testicular androgen receptors, pulmonary, cardiac and central nervous system β-adrenergic receptors (13). Apart from its effect on the down regulation of androgen receptors in male chickens, female chickens exposed to Clenbuterol are also affected in terms of the estrogen and progesterone receptor expression in their genital tracts.

In general, excessive or prolonged usage of β2-agonists would lead to decreasing target tissue sensitivity that is often associated with failing β-receptors that can act prior to cAMP production. Moreover, dietary Clenbuterol was claimed to impact the central nervous systems of food animals due to the behavioral modifications of feeding behavior as exposed animals have reduced appetite for food while muscle hypertrophy was still observed (13). This reduction in food consumption is a great incentive for the abuse of Clenbuterol as significant improvement of feed efficiency and portioning effects of the drug can be applied directly into revenue generation.

In the struggle to have healthier, more organic food, the use of Clenbuterol when administered orally was mentioned to be correlated with a decrease in calpain (isozymes involved in protein degradation) and an increased in the calpastatin (endogenous inhibitor of calpain) that are mostly observed in poultry genetically selected for growth (14). In other words, as lower consumption of feed by the animals would be entirely acceptable since the accumulation of muscle protein is not affected in manners that would jeopardize the demand for bigger chicken for a consumer population.

Although increased skeletal muscle mass is very encouraged in the poultry industry, we cannot rule out the harm of Clenbuterol in reducing proteolysis (break down of muscle tissues) without affecting the rate of protein synthesis. Studies on the hypertrophic effects of β2-agonists such as Clenbuterol and cimaterol have been linked to a lower protein degradation mediated by β2-adenoreceptors (14).

Effects of Clenbuterol on Cattle (Tzeh Keong Foo)

The cattle industry, due to its large claim on meat and dairy production, cannot be excused from the competition of using growth promoting factors whether it's legally permissible or illegal. β2-agonists up to 20 times the allowed therapeutic dose are known to behave like a re-partitioning agents that increases muscle protein deposition by inhibiting proteolysis and enhancing lipolysis in cows (5). Hence, illegal and legal uses of these drugs are completely understandable as farmers strive to increase their yield to cater to a growing need for lean meat.

An even more shocking discovery of the illegal use of Clenbuterol on the cattle is that β-agonists properties of the drug could lead to significantly increased parameters of coagulation, which in return suggest interference in the coagulation process. Therefore, cattle treated with Clenbuterol have a higher risk of developing hemorrhages during trauma (15).

Similar to findings found on the disruption of the reproductive systems of chickens, cattle fed with Clenbuterol also suffer from a similarly cruel fate (16). Studies indicated that male veal calves with prolonged exposure to Clenbuterol have biochemical modifications in the testicles as the androgen receptor levels were greatly compromised. In other words, as young cattles are ingesting Clenbuterol or any other B-adrenergic agonists, they are experiencing vacuolar degeneration of the urethral epithelium of the prostate and impaired development of the testis (16).

Although the meat producing industry has very little concerns towards milk production of lactating cows, the effects of Clenbuterol as a metabolic modifiers is apparent in residual accumulation of the drug in milk despite no direct correlation was established for milk yield (17). However, this leads to the question of whether female cows tainted with Clenbuterol containing feed would be sent to slaughterhouses and presented as food to consumers. Worse, would the milk be ingested by young calves, which in return gain early exposure of Clenbuterol in their body?

Ractopamine: A Legalized Beta-Agonist (Tzeh Keong Foo)

Elanco technology, producers of Ractopamine, registered the drug under the name Paylean for use with hogs, and Optaflexx for use with cattle. Paylean improves feed efficiency by 13

percent, and average daily weight gain by 10 percent with total lean meat production is boosted by 25 to 37 percent. Paylean use can net a pork producer an extra $5 to 10 per hog, while Optaflexx give a net increase of $8.00 per head cattle fed (18).

Although it does not exhibit any formation of toxicity as in the case of clenbuterol, studies have shown that swine fed with ractopamine hydrochloride undergo behavioral modification. Signs of behavioral abnormalities in the observed swines were difficulty in handling, transport stress and agitation at the sight of humans. The difficulty in handling pigs fed with ractopamine is of great interest as there had been reports on difficulty handling of swines that had elevated heart rate and longer settling time when the animals were transported from one location to another (20). Chris Birky of Birky Farms claimed that Paylean makes animals extremely agitated and miserable as they become aggressive toward each other, and the people raising them. They lose their ability to cope with stress and can turn purple, shake and even fall down dead of heart attacks during any stressful event (18). According to Temple Grandin, Professor of Animal Science at Colorado State University, the "indiscriminant use of Paylean (ractopamine) has contributed to an increase in downer non-ambulatory pigs," and pigs that "are extremely difficult to move and drive." (6). In Holsteins, ractopamine is known for causing hoof problems, says Grandin and feedlot managers report the "outer shell of the hoof fell off" on a related beta agonist drug, zilpateral (6).

Only 24 counties support the use of ractopamine that is banned in 160 countries including the EU, China and Taiwan, where punishment for its use includes fines and imprisonment (20). Although the additive have received approval in countries such as USA, Canada, Japan and Mexico, the EU has yet to give the green light for ractopamine that shared similar metabolic processes in both laboratory animals and in humans. In fact, the European Food Safety Authority (EFSA)’s sub branch, The Panel on Additives and Products or Substances used in Animal Feed (FEEDAP), found positive genotoxicity studies in vitro that are a possible cause of concern for the use or the ractopamine in animal feed. Moreover, the panel also questions the validity of results from most studies that vouch for the safety of the ractopamine. The study also concluded that despite the absence of significant discovery to support the carcinogenic properties of ractopamine, the FEEDAP warned that significant subpopulations, which may be at higher risk for adverse events after ß-adrenergic stimulation, require particular consideration when estimating the safety factor (21). Their report specified that NOAELS (no observable adverse effect levels) derived from pharmacological repeated dose studies should not be regarded as a meaningful basis for establishing an acceptable daily intake (ADI) because of the observed down regulation of lung beta-adrenergic receptors (18). They explained that when evaluating hypothetical risks for consumers, data from acute pharmacological studies would better reflect the consumer situation after intake of a single meal containing ractopamine residues (21, 18).

Moreover, another noticeable problem in the addition of ractopamine in animal feed is the lax regulation when it comes to the necessary withdrawal period for animals exposed to the B-adrenergic agonist (22). In a much more terrifying note, this lack in an agreeable withdrawal period is the indication that animals can be fed on ractopamine right up until they enter the slaughtering chute. Although one might argue that food producers should have at least a certain degree of conscientious reasoning in terms of discontinuing the treatment, we must accept the

harsh truth that a withdrawal period would mean a drop in the animals' unnaturally weight gain and also the extra profits generated from the intake of the drug.

In fact, Barbara Minton, editor of Natural Health claimed that industry research has shown that it takes a full seven days for 97% of Paylean to be excreted following a one-time typical dose in pigs (18). With other drugs used on hogs and cattle require a clearance time of two weeks before the animal can be turned into steaks and chops, the lack of a strict withdrawal period for ractopamine is a daunting story, not only for consumers who are wary of eating "unclean" meat but also its effects on animal growth. Although ractopamine based drugs such as Paylean warn off the illegal consequences of treating the animals longer than 7 weeks of the finishing period, it does not, however, have a very clear description of the necessary withdrawal period (23,22).

An even more ironic story about the legalized use of ractopamine is the warning labels on Paylean that suggests significant hazards for humans using the substance by citing the necessary precaution to prevent exposure to people with cardiovascular diseases (23). If such assertion were to be accurate, would there be a similar effects on animals as well? As human beings are afraid of the effects of just handling Paylean in animal feed, it is irresponsible to even be oblivious of the effects of such a drug would probably have in the body of swines that share an almost similar metabolic pathways as humans.

Despite the lauded legal status of ractopamine, the controversies surrounding the safety of the drug for both animal and humans are not being ignored entirely. In fact, in 2002, three years after Paylean's approval, the FDA's Center for Veterinary Medicine's Office of Surveillance and Compliance accused Elanco of withholding information about "safety and effectiveness" and "adverse animal drug experiences" upon which ractopamine was approved, in a 14-page warning letter (6). Therefore, the question when it comes to addressing issues centering around ractopamine is that should we look upon the strict stance taken by the 160 countries that remained suspicious of the effects of synthetic chemicals as feed addictive or should we place an unwavering support for the effectiveness of products backed by large corporations.

Regulation of Clenbuterol (Aimee Wood)

Clenbuterol is not approved by the FDA for therapeutic use in humans or animals. The EU has also banned all beta-agonists in raising meat animals and importing meat from other countries. In Canada, Clenbuterol is approved for therapeutic use in horses with respiratory problems (2). On body building websites, Clenbuterol is often sold as a weight loss and muscular promotion drug. Farmers are able to buy this drug although, illegal, through online web sites and feed it to their cattle and swine for either meat production of show animals (24). The FSIS through the USDA and many local organization such as 4H and the Future Farmers of America take illegal use of Clenbuterol seriously and test animals suspect of Clenbuterol use and also random animals going through meat production and show animals in competitions (3).

Cases of Clenbuterol Misuses (Mohd Ahmad)

The misuse of clenbuterol in animals is very difficult to detect because it cannot be known that the animals are fed with this chemical just by looking at their physical appearance. There are

other legal growth hormones that are legal to use in livestock that could be used to enhance the growth of the animals. The only way to know whether a meat is contaminated by clenbuterol is to chemically test the meat, which is not practical to be done in every single meat product. Furthermore, once the meat has entered the market, it is impossible to trace back the people who are responsible in producing the meat contaminated with the drug. Therefore, there is very little documented cases of clenbuterol misuse in the US and also all over the world.

Among the several cases, there is one that happened Louisiana in November 2006. Six horses were reported dead and ten others had been seriously affected by clenbuterol, which is believed to have happened after taking just one dose of an illegal product from Belize. That product was reported to be several times more potent than that of Ventapulmin. (18)

Another case involving misuse of clenbuterol happened in December 1995 in Milwaukee. Vitek Supply Corporation president Jannes Doppenberg and office manager Sherry Steffen were arrested for smuggling illegal drugs, one of them being Clenbuterol, into the US and distributed around Kansas, Nebraska, Wisconsin, Minnesota, Pennsylvania, and Illinois. The company had actually begun their illegal operation since 1988 until it was caught about seven years later (11).

Although there is not many cases reported on misuse of Clenbuterol in animals, the effects of uncontrolled use of this drug can still be seen in human. Around the same time Vitek Corp was confiscated, in 1990, 135 people in Spain were hospitalized due to Clenbuterol poisoning between March and July after eating beef liver containing the drug residue. The symptoms identified were increase of heart beat, nausea, fever, dizziness, and chill, which started to show as early as 30 minutes up to six hours, and lasted for almost two days. Four years after the incident, 140 people showed similar symptoms from a similar incident (11).

Similar case happened in Beijing, China in February 2009 where 70 people reported ill after eating contaminated pig organs. Initial investigation by local health official revealed that the pig organs, which were bought at the local markets in the previous week, were contaminated with clenbuterol. The victims said that they experienced stomachaches and diarrhea after consuming the pig organs. Three suspects were arrested to help with the investigation (26).

In Shanghai three years before the incident in Beijing occurred, over 330 residents were reported ill after eating pork tainted with clenbuterol. The source of the pork is said to come mostly from Zhejiang where farmers rear their pigs. Known as “lean meat powder” or “shouroujing” among locals, clenbuterol was said to have been used for ten years by farmers in the area. What makes the detection of the drug is that the farmers cease the use of it several weeks before the pigs are slaughtered. Although the government banned the drug since 1990, the incident proves that there are many loopholes in food safety inspection in that country (27).

Another case of clenbuterol that captures the attention of many is the one involving Alberto Contador, as mentioned in the beginning. Anti-Doping Agency finally decides that Contandor is not guilty of using the drug due to insignificant amount of clenbuterol found in his urine. The agency believing that the clenbuterol came from the meat he ate before the racing day, is the proof that clenbuterol is still illegally used to enhance growth of livestock in Spain.

Ethics on the use Beta-adrenegic agonists in animals: Questions to ponder about (Tzeh Keong Foo)

A growing trend in the usage of steroids, hormones and other related growth enhancing drugs in animal feed is undoubtedly the cavalier manner, in which, food producers and consumer handle the issues of enhanced growth in animals used for consumption. An even greater irony of the way humans view the application of growth enhancing factors in food animal is the self contradictory example of prohibiting certain drugs such as clenbuterol to be used by humans, while the same drugs that are feared are being slowly introduced in animal feed (28).

Perhaps, it is within human nature to place his or her own benefit first before any motion to gauge the effects of the use of B-adrenergic agonists can be properly suggested and executed. Although animals would have never been treated with the similar degree of respect and rights as an ordinary human patient, the slightest shred of humanity or sympathy towards the weak should still be present as food producers plunge themselves into the dilemma of using growth promoting drugs for profit or reduce its composition in animal feed for a healthier live stock.

Although approval for clenbuterol is only granted for management of horses suffering from the airway obstruction and not for human consumption or livestock feed (6), the number of cases involving farmers and veterinarians who showed contempt towards the strict regulation established by the FDA mirrors the consumer-driven mentality of the meat industry. As the people desire leaner meat on their dinner plates, farmers or factory farm owners would resort to the injection of anabolic drugs to produce bigger farm animals at the expense of disrupted endocrine and other biochemical processes taking place in the animal's body, unbeknown to consumers. With consumers holding the power to ultimately stop any forms of mismanagement with respect to the application of growth enhancers, should we wait as more and more animals are suffering under the hazards of B-adrenergic agonists or should we wait until more and more legalized versions of the drugs are introduced to the market?

In retrospect, what does this sudden increase in protein synthesis signifies for chicken, steers, lambs and even swine fed with the clenbuterol or its counterparts from metabolic modifiers? Could it be a larger body size that eventually affects the movement of the animals themselves? Could it be an uncomfortable condition for animals such as cattle and chicken as they struggle to make of the limited spaces offered to them as they are trapped in confinement as factory animals with clumsy bodies.

How about the disruption of the endocrine system of farm animals as irresponsible food producers resort to the use of B-adrenergic agonists as a quick and effective way to generate revenues? Although animals lack the ability to communicate with humans about the changes in their body function, experiments after experiments have shown that they do suffer from the adverse repercussions of mismanagement. Impaired sexual development is a major concern for humans but as we pause for a minute to think about the similar chemical modifications that were introduced into the animals that we rear for food, shouldn't the same considerations be placed on animal welfare as well?

How about the changes in animal behavior caused by the additives themselves? Should we indiscriminately beat the animals as they should resistance and fear towards human contact in

the process of transporting the animals? Should the animals that are ultimately scarified as our food be subjected to cruelty and brutal treatment even up to the final few days or even hours of their lives?

Although approved beta-adrenergic agonists have been introduced into the market in hopes of curbing unregulated usage of other hazardous growth promoters, we cannot entirely be oblivious to the side effects of the legalized drugs that are often masked by the promise of increased profits. Animals are the ones that are the ultimate sacrifice behind the uneducated use of the drugs. How educated are food producers when it comes to handling the necessary dosage of the additives to be added in the daily dietary consumptions of food animals such as swine and cattle? How sure are we,as consumers and people who care about animal welfare, that food producers are being their best in controlling the amount of additives placed in the animal feed?

Standing from the perspective of farmers and food producers dedicated to fulfilling the demands of the meat market in the most humane way possible for the animals, sufficient information and effective education on the effects of beta-adrenergic are the only ways to ensure that farmers are making the correct choice when they are selecting from the appropriate feed additives from a long list of FDA approved substance. Moreover, would the concerns of the farmers be properly addressed by the company that produces the drugs in the event of dire side effects of the drugs such as hyperactivity, death or seizures? Martha Rosenberg made a very appealing point when she wrote that " Where was mention of the farmer phone calls to Elanco reporting, "hyperactivity," "dying animals," "downer pigs" and "tying up" and "stress" syndromes, asks the FDA letter. Where was the log of phone calls that included farmers saying, "animals are down and shaking," and "pig vomiting after eating feed with Paylean?" (6). As people who would ultimately be using the feed additives in the attempt to " beef up" the animals for slaughter, shouldn't farmers receive an equal amount of assistance as well in terms of selecting the best growth enhancers for their animals. No one likes to deal with uncertainties, and the case is even more evident when safety is of concern for both consumers and the food animals.

The Service Project: Media Coverage (Aimee Wood)

In today's society there is a much higher demand for quality meat products. Livestock farmers are at a maximum capacity with animals in their facilities and are looking for technology to increase their turnover rates and produce more edible meat per animal. Many farmers use growth promotents in the livestock feed to increase their muscle mass and reduce fat deposits. An illegal yet popular growth promotent called Clenbuterol has been brought up recently in the Cycling world. Alberto Contador, a Tour de France winner has been accused of doping after the World Anti Doping Agency found minute levels of Clenbuterol in his sample. Contador claims that beef from Spain he had eaten for dinner the night before he was tested during the Tour de France was tainted with Clenbuterol. The levels of Clenbuterol were 400 times less than the World Anti Doping Agency is required to test for which leads to a plausible case of the growth promoter coming from meat and not from Contador doping.

For our community service project we will investigate the likelihood of the Clenbuterol coming from a contaminated source of meat. All of our research will be sent to the World Anti-Doping Agency in effort to help solve the case.

Description of Service Project (Tzeh Keong Foo)

The main purpose that we hope to achieve through the completion of our community service is to relate the food poisoning claim made by third time Tour champion, Alberto Cantador and the likelihood that meat contaminated with clenbuterol was the primary reason behind the athletes' positive drug test. Because media coverage on the issue is fairly limited and can only be found in cycling-related websites, we used the internet as an effective tool to examine the case from the perspective of concerned students who have gained knowledge on the illegal usage of clenbuterol in meat production. In addition, we also used resources from reputable journals and websites as means to back our claims on the effects of clenbuterol when introduced into animal feed and other related scientific claims in making our argument.

We selected articles that provided valuable information about the mixed responses towards Cantador's tainted meat theory and examined critically the arguments made in response to the positive doping test. Through our research, we realized that there is a strong argument in favor of Cantador's innocence and we made the necessary justification in challenging accusations made against the cyclist. We are not, however, questioning the integrity of the tests made by the World Anti-Doping Agency (WADA). Instead, we are providing suggestions for WADA for a better approach in targeting clenbuterol abuse in the event of any future doping cases that make reference to Cantador's case. Using case studies and previous doping claims, we sought to establish the validity of clenbuterol poisoning as a feasible explanation behind Cantador's below normal clenbuterol in the blood. We admire WADA's strong stand on prosecuting athletes tested positive for clenbuterol, but in the process of engaging deeper with the media coverage of the case and statements released by WADA, we feel that there is a flaw in behind it. We feel that there is a need for the organization to re-evaluate its refusal to accept recommendations of a minimal limit for food poisoning claims in positive doping test.

As a very influential body dedicated to the eradication of malpractices in sports, WADA is an ideal organization that we hope to send our classipedia work as means to educate the public about the harm of clenbuterol in contaminated meat. Moreover, we respect WADA's dedication towards youth education among young athlete through its youth awareness programs that we hope to enrich with the complied information that we have enclosed in our community service project.

Submitted to the World Anti-Doping Agency (WADA)
http://www.wada-ama.org/

Lessons learned from the case of Alberto Cantador's positive clenbuterol test

The scandal surrounding the Triple le tour le France Champion, Alberto Cantador has been a subject of much scrutiny from both scientific and anti-doping regulation perspective. A matter of food safety arises as the cyclist claimed that he was a falsely accused victim of food poisoning who accidentally consumed tainted meat bought by a friend. Unlike most positive testing that would have resulted in severe punishment under the world anti-doping code, the delay in

Cantador's case represents a problem in the testing of cases of food poisoning that in return compromise the innocence of an athlete.

Spanish paper El Paid was quoted mentioning efforts made by WADA in analyzing meat in the town of Irun, a place where the tainted meat was bought from by Contador's friend José Luis López-Cerrón [1] . Although the newspaper reported no signs of clenbuterol were discovered in meat from the butcher and slaughterhouses supplying the meat, the actual details of the investigation were not explicitly mentioned by the media. This discovery, however, is open to questioning as to how certain are we that the meat tested was that of a similar origin as the one consumed by Cantador. The newspaper also claimed that the WADA report also cited the obsolete nature of the usage of clenbuterol in an approximately 300,000 meat samples with no traces found in Spain [1]. However, such a claim is open to interpretation also. We cannot always be 100% certain that the meat tested is of the same source of the contaminating meat and we cannot be 100% certain that there would still be remaining traces of tainted meat months after the cyclist was tested positive for clenbuterol. Moreover, the manner in which WADA conducts its investigation into the meat source is open to question as the Basque Health Department questioned the legitimate status of discoveries made by WADA [7].

Nevertheless, as students who are not well-inform of the number of times livestock are tested for illegal growth enhancing drugs, we still urge the need to re-examine the rationale used behind the testing of tainted meat in the process of proving Cantador's involvement in doping, especially because sport's controls are much more abundant than livestock and are used much more sophisticated detection methods as those used in veterinary medicine.It is commendable, however, that the effects of illegal administration of clenbuterol in food animals that are later retained in the meat were also studied by WADA. However, the newspaper report made an interesting claim that quoted the report as animals are never slaughtered soon after being injected as farmers try to avoid getting caught by testing and to allow the anabolic agonist to take full effect in fattening [1]. Regardless of whether the newspaper article was accurate in its content, it is fallacious to assume that all farmers are educated enough about the repercussion of sending their animals early for slaughter. This is not a case focusing on Contador solely. In fact, throughout the years, athletes from various sports who were tested positive for clenbuterol have used food poisoning as a reasonable excuse behind any alleged wrongdoings.

The case involving Alessandro Colo is a very clear example of the complicated nature of accepting the defense of food poisoning as a source of clenbuterol in the body as the Italian cyclist has been handed a reduced, one-year ban after testing positive for Clenbuterol on the last stage of the Vuelta Mexico, on April 25th [2]. Colo's detected level was reportedly four times higher than that of Cantador's. Due to the high rate of the Clenbuterol use in meat in the Latin American country, investigators have accepted his claim that he ingested the substance unwittingly. Claims on food poisoning as the cause of the clenbuterol are not limited to cycling only. Germany's four-time European team table tennis champion Dimitrij Ovtcharov was also subjected to a positive clenbuterol testing but he was cleared of doping charges on Friday by the German table tennis federation (DTTB) after hair samples showed negative results for abuse [3]. Tainted meat from China was cited as a likely cause of the positive testing and he was given the benefit of the doubt by the DTTB.

Moreover, the amount of clenbuterol tested in Cantador's bloodstream is well below the levels necessary to have an illegal effect on his performance report [5]. In addition, the food contamination remains a reasonable explanation from a scientific point of view to justify the presence of the tiny amount of Clenbuterol in Cantador's body throughout the duration of his involvement in Tour de France in July. Consequently, the question of proving his innocence is a very delicate matter as the low traces of clenbuterol can be attributed to the tainted meat theory that has made people question the provisionally suspension of the athlete. Therefore, WADA needs to set definite guidelines in determining the necessary minimum levels of clenbuterol necessary to be considered as a case of food poisoning and the appropriate punishment to the athletes tested positive for clenbuterol if tainted meat were to be accepted as a valid excuse for consideration. However, we are very cognizant of the fact that under the WADA code, there are no allowable levels of drugs, as stressed by the WADA director general David Howman [5]. However, the directors general also claimed that it is the responsibility of the laboratories to pursue the case regarding Cantador and reach a convincing conclusion about Cantador's innocence. We doubt the manner in which the laboratory investigation could make sufficient claims pertaining to food poisoning theory if a minimal benchmark is not even established in the beginning of the scientific inquiries.

Moreover, an arrest made by Spain's Guardia Civil on 34 people connected to an alleged trafficking ring involving clenbuterol in the Canary Islands, provides legitimate claim for the tainted meat theory to hold true even if no positive meat was tested in the WADA investigation [6]. Since clenbuterol has been banned in European Union for use in livestock for more than a decade, the discovery of the illicit animal-doping ring is a sign that there are a group of people who are using the products and introduce the tainted meat to the beef industry. It is interesting to note that pharmacists, veterinarians, and a rancher were among the people charged for allegedly illicitly prescribing and using Spasmbronchal, a form of clenbuterol [6].

Although traces of plasticizer were detected in Cantador's blood sample, suggesting his involvement in blood doping, we are not concerned about this alternative theory as it serves as a distraction in addressing the real problem at hand, which is whether or not food poisoning can be accepted as a valid reason for innocence. As mentioned before, athletes tested positive for clenbuterol or other illegal anabolic drugs often made claims about the possibility of food poisoning that might seem so absurd that the argument made would be struck down immediately by regulatory bodies in sports. However, as advancement in science leads to better detection methods in the effort to curb unethical practices in sports, Cantador's case serve as a wakeup call for the need to have better system of detection and regulatory guidelines to prevent future wrongdoings from happening again. After all, the levels of clenbuterol in Cantador's bloodstream is 40 times lower than WADA-accredited anti-doping laboratories must be capable of detecting, which leads us to the question of whether similar cases in the past have went undetected due to the absence of a precise detection method.

Clenbuterol in food animals:

Dr.Tomás Martín-Jiménez, a doctor in veterinary pharmacology on the faculty of the Universtiy of Tennessee-Knoxville observed that" a 200-gram fillet coming from an animal treated with clenbuterol, it is possible to find the percentage that they detected in his urine on the following day"[11]. Moreover, Ramón Riestra, a board member of Asturias youth farmers association,

provides a separate approach towards seeing the food poisoning dilemma as he asserted that Spain and other European countries import meat from South America, where farmers may use Clenbuterol or any other beta-agonists without strict regulation. He believes the meat team Astana bought for Contador in Irún, Spain, during the Tour de France could have originated from a Mercosur country: Argentina, Brazil, Paraguay and Uruguay[8].The European Union signed an agreement with Mercosur, the South American customs union, to import 20 million tons of meat in three years to 27 European countries. In Spain, which is a country with a shortfall in meat, this is equivalent to a minimum of two million tons.

One of the ironies surrounding the status of the meat that was allegedly bought from Irun was the contradiction made by politicians of the Basque government. As a matter of fact, the Basque Regional Ministry of Agriculture and Rural Development had categorically denied that meat products from the region could have led to Cantador's positive test for Clenbuterol [10]. Yet,Bakartxo Tejería, Nationalist Basque Party spokesman, affirmed that it is certified that in Basque Country people consume meat coming from countries where cattle is fattened with clenbuterol. Tejería, however, retracted the statement afterwards, leaving much room to question the fickleness of official reports made on the matter [21].Moreover, the size of sampling done in preventing further use of clenbuteriol in the EU is open to questions as the small sampling size may hamper any effort to detect the usage of illegal drugs in animal feed. According to the latest official report of the European Union, applicable to 2008, of nearly 27 million cattle slaughtered in the EU, a total of 122,648 samples (0.48%) were analyzed, of which only 22,518 cases searched for traces of beta agonists, including clenbuterol [9]. According to AP, tests on 83,203 animal samples in Europe between 2008 and 2009 showed just one positive test. During the same period, Spain tested 19,431 samples with no traces of the drug were found [10]. But can we really trust the results given?

As a body that is dedicated to the preservation of clean games spurred by a healthy sense of sportsmanship, the severity of the usage of clenbuterol in the meat industry is not a matter to be easily brushed aside. The misuse of clenbuterol in animals is very difficult to detect because it cannot be known that the animals are fed with this chemical just by looking at their physical appearance. There are other legal growth hormones that are legal to use in livestock that could be used to enhance the growth of the animals. The only way to know whether meat is contaminated by clenbuterol is to chemically test the meat, which is not practical to be done in every single meat product. Furthermore, once the meat has entered the market, it is impossible to trace back the people who are responsible in producing the meat contaminated with the drug. Therefore, there's very little documented cases of clenbuterol misuse in the US and also all over the world.

The misuse of clenbuterol have been an on-going the practice for decades and negligence in tackling the problem would only result in more and more cases of food poisonings in the sports arena. With the meat industry in major regions of the world such as the united states of America, the European Union, China and the South American countries growing at a faster rate to cater to increase in consumer demand, we cannot lower our guard when it comes to be on the constant alert of any future cases of clenbuterol used in the meat that athletes consume.

One of the most publicized misuse of clenbuterol happened in December 1995 in Milwaukee, Wisconsin, USA when Vitek Supply Corporation president Jannes Doppenberg and office

manager Sherry Steffen were arrested for smuggling illegal drugs, one of them being Clenbuterol, into the US and distributed around Kansas, Nebraska, Wisconsin, Minnesota, Pennsylvania, and Illinois[12]. The company had actually begun their illegal operation since 1988 until it was caught about seven years later. Around the same time Vitek Corp was confiscated, in 1990, 135 people in Spain were hospitalized due to Clenbuterol poisoning between March and July after eating beef liver containing the drug residue[12]. The symptoms identified were increase of heart beat, nausea, fever, dizziness, and chill, which started to show as early as 30 minutes up to six hours, and lasted for almost two days. Four years after the incident, 140 people showed similar symptoms from a similar incident.

A similar case happened in Beijing, China in February 2009 where 70 people reported ill after eating contaminated pig organs. Initial investigation by local health official revealed that the pig organs, which were bought at the local markets in the previous week, were contaminated with clenbuterol [13]. The victims said that they experienced stomachaches and diarrhea after consuming the pig organs. Three suspects were arrested to help with the investigation. In Shanghai three years before the incident in Beijing occured, over 330 residents were reported ill after eating pork tainted with clenbuterol. The source of the pork is said to come mostly from Zhejiang where farmers rear their pigs. Known as “lean meat powder” or “shouroujing” among locals, clenbuterol was said to have been used for ten years by farmers in the area [14]. The detection of traces of the drug in meat is insufficient when the farmers cease the use of it several weeks before the pigs are slaughtered, hoping to reduce the drug as minimal as possible to avoid detection. Although the Chinese government banned the drug since 1990, the recurring cases of clenbuterol poisoning serve as a grim reminder of the many loopholes in food safety inspection in that country that the same can be said to the meat inspection in Spain.

At first glance, all of the food poisoning cases do not seem to share a direct connection with the work of WADA in strictly regulating the world-anti-doping code. However, a closer understanding on the abuse of clenbuterol or any other illegal growth promotants would actually underline the severity of illegal practices in the meat industry as the number of food contamination cases supports the widespread malpractices. Apart from clenbuterol, other growth hormones or drugs used in the process of “ buffing up’ live stocks might also be a part of the WADA list for banned drug. Cantador’s case could be harbinger of an increase in other anti-doping dispute involving other banned drugs as well. Hence, it is crucial for the people to be educated about the universal nature of illegal use of growth enhancers in food production and the loopholes or lack in pro-active enforcement that would only further fuel even more irresponsible actions by farmers. Moreover, other legalized Beta-adrenergic agonists in animal feed that have yet to be studied extensively might incur a similar effect as clenbuterol. As a result, constant monitoring of traces of these legalized drugs should also be of concern to WADA’s dedication to research in the sciences.

<u>Educating the general public by understanding more about the effects of clenbuterol in tainted meat</u>

Effects of clenbuterol or any other beta-adrenergic agonists is worth sharing to the general public, especially in youth in line with WADA’s strong position in effective values-based education as a long-term solution to preventing doping anti-doping behaviors and create a strong anti-doping culture. One of the best ways towards educating the general public about the hazards

of clenbuterol or any other drugs is the increased understanding of the effects of such a drug. Although the effects of clenbuterol on livestocks cannot be equated to its possible effects in humans, the effects of the drug on animals are still important for the purpose of educating the public since the most livestocks share similar metabolic mechanisms as humans.

Beta-adrenergic agonists (ß-agonist) are a group of metabolic modifiers that are gaining acceptance amongst the meat-producing industry as meat producers strive to introduce dietary additives into animal feed that would not only improve feed efficiency but also enhance weight gain in animals sent to slaughter houses. Essentially, metabolic modifiers are used as means to target protein synthesis and turn over in skeletal muscles of animals, lipd synthesis and turn over in fat tissues of the animals and regulation of milk synthesis and secretion in the mammary gland [15].

This type of drugs are often used as a method to repartition use of consumed nutrients, which is achieved as the nutrients gained from animal feed are shifted away from being converted as fat and instead used in the synthesis of lean muscles [16]. These compounds interact with β2-adrenegic receptors (β-AR), a G protein super family member. Long-term exposure of these anabolic drugs would result in β-AR desensitization that is characterized by functional uncoupling of receptors, physical sequestration of receptor away from the cell surface and down regulation of the total number of receptors [15]. Eventually, such desensitization of the cell membrane receptor would lead to loss of cellular responses to natural and synthetic ligands.

Clenbuterol is a member of ß-agonists used illegally in animal feed. On body building websites and Internet selling website such as amazon, Clenbuterol is readily available as a weight loss and muscular promotion drug [17]. Farmers are able to buy this drug although, illegal, through online web sites and feed it to their cattle and swine for either meat production of show animals. Once ingested, Clenbuterol reaches peak levels in 3 hours and is quickly distributed throughout the animal including the Central Nervous System. Clenbuterol's effect smooth muscle relaxation is used to treat chronic obstructive pulmonary disease in horses. In addition to relaxing bronchi, it also relaxes the intestinal walls and the uterus of pregnant cows allowing the hold on birth of calves until the next morning or until the cow reaches a safer place to give birth [19,20]. Also, being able to cross the blood brain barrier and the placenta is also an effect of Clenbuterol affecting the Central Nervous System and affecting any potential fetuses.

Clenbuterol creates hypertrophy of skeletal muscle, increases lipolysis and decreases lipogenesis, protein degradation all leading to enlarged muscular structure. The use of Clenbuterol also increases the capacity for oxygen and nitrogen in the muscles. Skeletal muscle is more sensitive to insulin when Clenbuterol is used. With long-term exposure to Clenbuterol the beta receptors in the skeletal muscles and adipose tissues become desensitized and a reduced number of insulin receptors are available. Consequently increasing insulin resistance in the animal and decreasing the affect of beta-agonists on the further growth in muscle cell size and the further decrease in lipolysis. Studies have shown that Clenbuterol can also make swine more aggressive and difficult to handle because the use of beta-agonists negatively affects the dopamine system and other areas of the brain that handle aggression [18].

<u>Why it is Possible Tainted Meat to Be the Source of Contador's Test Results.</u>

When clenbuterol is used for the therapeutic purposes the normal dosage is 0.8ug/kg for a maximum of 10 days (22). For the propose of growth promoting 5 to 10 more than the recommended dosage is 0.8ug/kg is used (22). In it may take up to 27 days for clenbuterol to be completely eliminated from the plasma of cattle. Since clenbuterol is unregulated and illegal for the use in livestock, there is no withdrawal period standard. Cattle maybe put to slaughter immediately after being fed clenbuterol.

Cooking meat does not take negate to amount of clenbuterol that can be present since it is heat stable at normal cooking temperatures. The full physiological effect of clenbuterol is expected in humans after consuming 100-200g of contaminated meat which would mean the meat had contained more than 5 times the 0.8ug/kg amount legally allowed for therapeutic purposes (22). With the minute level of clenbuterol found in Contador's blood and the steady number of tests previously preformed on him before and after the tainted sample it would be very difficult to rid oneself of the physical side effects and the actual amount he would have had to had injected for performance purposes. 50 picograms/milliliter was the amount found in his urine sample, that is 40 times less than WADA's minimum detection level of 2 nanograms/milliliter (23).

How can Contador's urine sample from July 21 be 50 picograms/milliliter when on the 20th it was not detectable when the half-life of clenbuterol is 25-39 hours (24)? It scientifically makes no sense that Contador injected himself with somewhere around 100 picograms/milliliter between the 20th and the 21st, especially since that amount would have no sport performance enhancement.

In conclusion, although it is an illegal drug for the purposes of fattening livestock and bodybuilding in humans it is obviously still a problem in our food system and in the sport enhancement world. With the recent arrests in Spain from a clenbuterol ring involving a rancher, cyclist, multiple veterinarians and pharmacists there is no doubt that clenbuterol is still being used in cattle farms. With evidence such as this, Alberto Contador's innocence has a brighter appeal. Clenbuterol doping in farm animals will make it's way into our bodies and can ruin the life and image of an international sports superstar such as Contador. It is imperative to make consumers aware of this illegal practice and put a stop to farmers using clenbuterol on their animals. It is unethical and harmful to animals, humans and our environment.

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Editorials

1. Aimee Wood submitted to www.NPR.org to Talk of the Nation Science Friday

Since When has Eating Food become a Hazard to Your Health?

In recent new it has be brought to the publics attention that Tour De France winner Alberto Contador has been under investigation for doping after his urine samples came back with a positive result for Clenbuterol. Clenbuterol is a growth promoting synthetic drug that circulates mostly around bodybuilding website and for veterinary use in horses as a bronchodilator for breathing problems. When Clenbuterol is brought into the body it acts very similar to but more intense than the better-known drug epinephrine. Consider it Stacker diet pills for cows. Contador claims that the drug must have come from tainted beef he ate while on the Tour that came from a farm in Spain. While Clenbuterol and all other growth promoting drugs are illegal for use in livestock intended for human consumption in the European Union farmers are quietly using them to slim down their livestock for better market value and faster turnover rates. Often farmers do not give the livestock enough of a withdrawal period before slaughter to allow the substances to leave the muscle tissue. Just in 1996 over 130 people in Spain were treated for Clenbuterol poisoning after eating tainted meat. This practice of feeding cattle, swine and poultry growth promoters is widely used not only in the European Union but also right here in the U.S.A. Two products used for the same purpose with similar side effects are legally used in the U.S.A: Paylean and Optaflex. The average consumer is unaware of this and it is not advertised on any of the labels your food is packaged in.

So how do you protect yourself and your family from this kind of food poisoning? Investigate where the meat you buy comes from and contact the farm if any growth promoters are used in the raising of their livestock. This of course would only help in the identification of legal growth promoters. Certified, organically raised meats are not allowed to use even the legal growth promoters, therefore eating organic meats lessen your change of toxic food poisoning. When it comes to illegal substances such as Clenbuterol there is no way but the hard way to find out, once you have gotten sick from eating tainted meat. The best way to prevent this from happening is to reduce your and your family's meat consumption or eliminate meat entirely. Not only would this personally benefit you but also the less demand for meat would decrease the demand on factory farmers to grow the leanest animals in the least amount of time therefore decreasing the need to feed their animal's growth promoters.

The FDA has recently taken further action as this problem increases. Random testing is now being done of livestock and show animals for illegal use of Clenbuterol. Smaller organizations such as 4H and the Future Farmers of America are also taking part to make sure that animals are not fed Clenbuterol to win competitions at livestock shows.

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2. Tzeh Keong Foo , submitted to the New York Times Op-ed page
The story of a Spanish Cyclist, beta-adrenergic agonists and animal feed

In July 21, Alberto Contador was tested positive for clenbuterol, an illegal anabolic steroid strictly prohibited under the World Anti Doping Code. A three time winner of Tour de France, Contador made the headlines when he contested results from the anti-doping test. The cyclist claimed that traces of clenbuterol in his urine sample were, as a result of food contamination, from the meat he ate prior to the testing. A detailed investigation coupled with

scientific inquiries was conducted following Cantador's allegations and the Union Cycliste Internationale (UCI) has yet to announce a verdict after provisional suspension of the athlete.

For sports enthusiasts, Contador's plight might seem to be an example of the incorrigible transgressions rampant in professional sports with athletes resorting to illegal means to outlast and outplay their fellow competitors. However, there is a far greater concern behind the case against Contador. What if Contador was innocent? There had been reports on the illegal use of clenbuterol as repartitioning agent in food animals, while unethical meat producer strive to increase their profit by selling contaminated meat to credulous customers. What if there was clenbuterol contaminated meat circulating around supermarkets in Europe or USA due to illegal introduction of the growth enhancer in livestock? As we sit down to savor the juicy taste of steak in front of us, can we staunchly vouch that the meat that we consume is free from any hormones or drugs that were used to increase weight gain in cattle? The answer remained ambiguous.

Clenbuterol is an example of beta-adrenergic agonists (ß-agonist) that has been illegally used by meat-producers who are in the constant struggle for faster meat production and improved feed efficiency. The US Drug Enforcement Administration (DEA) even reported outbreaks of food poisoning in Spain, France, Italy, China, and Portugal as a result of meat contaminated with clenbuterol. Although clenbuterol is still illegal for feed addictives, other members of the ß-agonist family are approved for wide usage in animal feed. Instead of converting nutrients from feed into fat, animals feed with ß-agonist would have a higher muscle to fat ratio due to the repartition properties of the drug. Consequently, with its ability to target lipid synthesis and induce protein synthesis, legalized ß-agonists such as Paylean, Optaflexx and Zilmax are often used in finishing liverstocks that are later introduced into the market after slaughter. However, ß-agonists are not recognized as growth hormones such as the often disputed Bovine Growth Hormone (rGBH). In fact, their "off-label" statuses indirectly hinder efforts in calling for a fair, informative decision making by health-conscious consumers. Ironically, the use of such medicated feed additives is strictly regulated in the European Union and other countries that are wary of the unknown effects of such metabolic modifier upon consumption of tainted meat.

As we address the problem of possible food poisoning from the tainted meat from ß-agonists, we should also consider the grave effects of ß-agonists in the food animals themselves as well. Since compassionate treatment of food animals has been garnering tremendous support throughout the years, consumers should be more educated about the effects of legal and illegal use of beta-adrenergic agonists such as clenbuterol or its legal counterparts in the diet of animals. After long exposure to ß-agonists, food animals such as veal cattles, chickens, swines and even lamb will suffer from loss of cellular responses to natural and synthetic ligands. Moreover, illicit treatments of farm animals with clenbuterol were reported to cause changes in target organs such as in the liver, lungs and eyes where accumulation of clenbuterol is highest. The compound can even be converted to more toxic compounds that can be retained in the tissues. Clenbuterol was reported to cause disrupted reproductive characteristics in both poultry and cattle as testicle impairment were noticeable. Although it does not exhibit any formation of toxicity as in the case of clenbuterol, swine fed with legalized ß-agonist, Paylean, still suffer from the effects of the metabolic modifier as they experienced difficulty in handling, transport stress and agitation at the sight of humans. Even if ß-agonists such Paylean or Optaflexx gained FDA approval and have specific withdrawal periods before slaughter, there is very limited research conducted on the negative effects of these legal drugs on animals that have accelerated growth after exposure to the drugs. When we as consumers are calling for healthier food in our local grocery stores, we

should also consider the repercussions of using metabolic modifiers in food animals that also suffer from health complications engendered by the growth enhancers.

The story of Alberto Contador is not only a story about a dope test that generated mixed responses on the integrity of an athlete, but also a wakeup call for better understanding of our food sources. Sometimes, consumers are not well informed of the presence of growth enhancers in the process of raising meat animals. We could either choose to continue such an oblivious outlook in understanding the origin of food or we can make a difference in our lives by being an educated consumer. The use of ß-agonists in finishing animals may seem to be an economically beneficial way to satisfy consumers' appetite for meat. However, similar to any arguments by animal rights activists in the matter of growth enhancers, should animals be subjected to compromised welfare in the name of profitability? Although the ultimate fate of food animal would inevitably be slaughter, it is a shared responsibility by both consumers and producers to ensure a more humane treatment of the animals that provide us with the food we eat.

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3. Modh Ahmad, The Seattle Times

It is difficult to say that the meat we eat today is safe to consume because so far, there is no major outbreak happening in this country. We consider our meat suppliers have done a great job in keeping the shelves and fridges from "out-of-stock" by continuously supplying every single shop with sufficient supply of various meat products, from raw meats to processed ones such as canned corned beef and instant meatloaf in a microwaveable lunchbox. However, do we ever wonder how they can keep up with such amount of products, not only to feed the people in this country but also to export to other countries?

We should realize by now that using traditional methods of feeding the cows and pigs with natural organic foods is almost not happening, especially by major meat suppliers who think only about profit. Clenbuterol, for example, is a beta-agonist drug that was initially used to treat asthma in animals. The side effect of it is that the muscle growth increases and the fat content decreases, making it a suitable mask for growth hormone. Fortunately, USDA has banned the use of this drug in animals and humans, but we are not sure whether it is still fed to the animals. There have been cases of misuse the hormone, which caused 330 people in Shanghai got sick from eating the clenbuterol-contaminated pork. If the FDA is still taking easy the supervision on the drugs used in the animals, we can just sit down and wait until somebody gets sick or we can advocate the government to increase the surveillance. To say that the meat we eat today is safe from clenbuterol, no one knows!