



Beta-Agonists: What Are They and Why Do We Use Them in Livestock Production?

What are beta-adrenergic receptor agonists?

Beta-adrenergic receptor agonists (beta-agonists, for short) are synthetic compounds that mimic some of the effects of naturally-occurring compounds by binding to beta-receptors on the surface of cells within the muscle, fat and other tissues of animals [1, 4]. Beta-agonists are used in human medicine for the treatment of conditions such as asthma [5]. However, other types of beta-agonists are used in livestock production to enhance growth and alter body composition.

How do they work?

Beta-agonists used in livestock production are mixed into animal feeds at precise levels [3]. They are consumed by animals during the last few weeks of life prior to marketing. Once they are absorbed into the bloodstream from the digestive tract, beta-agonists bind to a specific type of receptors on the surface of cells called beta-adrenergic receptors [4]. They stimulate the activity of these receptors leading to their name-beta-adrenergic receptor agonists. This stimulation results in a chain of events within the cell that alter metabolism, growth and other cellular events resulting in changes in the growth of muscle and fat tissue within the animal [1].

What beta-agonists are available for use in livestock production? In what species?

There are two beta-agonists compounds approved by the FDA for use in food animal species in the United States —ractopamine hydrochloride and zilpaterol hydrochloride. Ractopamine is approved for use in swine, turkeys and cattle, while zilpaterol is only approved for use in cattle [1, 3]. There are no beta-agonists approved for use in chicken or sheep. Ractopamine and zilpaterol are also approved for use in other countries around the world such a Brazil, Canada, South Korea and Mexico.

People are worried about antibiotic resistance due to the use of antibiotics in livestock production. Should we worry that the use of beta-agonists in livestock production will make the beta-agonists used in human medicine less effective?

Resistance to beta-agonists is not a concern for two reasons.

First, the goal of beta-agonist use in livestock is very different from that of antibiotics. Antibiotics are used to stop the growth of or kill bacteria. Antibiotic resistance develops due to changes in bacteria that make them able to survive antibiotic treatment. This makes certain bacteria resistant to certain antibiotics, decreasing the effectiveness of antibiotics to treat bacterial infections in humans and in animals. Beta-agonists, in contrast, target the cells of the individual animal that consumes them and not foreign cells within that animal. Bacteria are not affected by beta-agonists and therefore, cannot develop any resistance to them.

Second, the beta-agonists used in livestock production are different from those used in human medicine. The compounds ractopamine and zilpaterol are not used to treat any human condition or disease.

What are the benefits of using beta-agonists for livestock production?

Beta-agonists, like other technologies used in livestock production, increase the efficiency of production of lean meat. In swine, the use of ractopamine increases weight gain and reduces the amount of feed needed for that gain. It also leads to an increase in lean meat and at times, a reduction in fat in the carcass, there-

fore increasing lean meat yield [2]. Zilpaterol and ractopamine in cattle both increase weight gain and improve the efficiency of gain. Lean meat yield is also increased in cattle fed beta-agonists [1].

These improvements in production have many positive outcomes. Improved efficiency reduces the resources (grains, water, land) needed to produce meat. This improves the overall sustainability of livestock production by allowing more meat to be produced with less inputs [1].

How are beta-agonists different from steroid implants?

Implants contain natural and synthetic hormones and alter the hormone status of the animal to promote growth. Implants are placed in the ear of the cattle and require no withdrawal time prior to slaughter. Steroids are not approved for use in swine or poultry. Beta agonists, on the other hand, do not affect the hor-

mon status of the animal. They are administered as medicated feed additives. Withdrawal times vary among products.

References

1. Anderson, D. B., D. E. Moody, and D. L. Hancock. Beta adrenergic agonists. Encyclopedia of Animal Science, 2004. p. 104-108.
2. Arp, T. S., S. T. Howard, D. R. Woerner, J. A. Scanga, D. R. McKenna, W. H. Kolath, P. L. Chapman, J. D. Tatum, and K. E. Belk. Effects of dietary ractopamine hydrochloride and zilpaterol hydrochloride supplementation of performance, carcass traits, and carcass cutability in beef steers. Journal of Animal Science, 2014. 92(2):836-843.
3. Centner, T. J., J. C. Alvey, and A. M. Stelzleni. Beta agonists in livestock feed: Status, health concerns, and international trade, 2014. 92(9):4234-4240.
4. Mersmann, H.J., Overview of the effects of beta-adrenergic receptor agonists on animal growth including mechanisms of action. Journal of Animal Science, 1998. 76(1):160-172.
5. Moore, R.H., A. Khan, and B.F. Dickey, Long-acting inhaled β 2-agonists in asthma therapy. Chest, 1998. 113(4):1095-1108.

*This fact sheet was written by Anna Dilger, Ph.D., University of Illinois
and edited by the AMSA Scientific Information Committee*