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Effect of Exogenous Hormones on Growth, Carcass Composition and Quality

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Abstract

Health-conscious human beings are now in search of animal origin food that has low fat, cholesterol. Therefore different feed additives are used in animal ration to improve carcass composition and quality. Certain hormones are used as feed additives in animal ration to achieve a particular goal. Some of the exogenous hormones have a growth stimulant effect as well as act as carcass modifiers. Examples of hormone feed additives are Zeranol, TBA, growth hormone, melatonin etc. It is necessary to use hormones in the animal ration at a minimal dose that improves carcass composition and quality without leaving residue in the meat. These hormones reduce fat synthesis and deposition in the animal body with improving protein synthesis. It is therefore inferred that use of hormones at minimal dose could improve growth rate in animals as well as modifies carcass composition and quality.

Keywords: Carcass, Composition, Hormones, Growth, Quality

Introduction

Some oestrogenic activity is present in some clovers, soybean, sesbania etc; some are synthesized chemically. These are exogenous sources of hormones. These are administered orally as feed additives, subcut implants or parenteral injections.

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In two comparisons of males and females, it was found that ewes were significantly fatter at the same empty body weight. It has been documented that intact males produce less fat and leaner from a given feed than either the females or the castrate males. When comparisons were made between steers and bulls, bulls contained less subcutaneous fat and intermuscular fat than steers.

Anabolic agents enhance nitrogen retention in the body and particularly in the muscle, by way of significantly decreasing blood and urinary urea and urinary nitrogen and result in the production of leaner carcasses. Androgens are mainly used in females and castrated males while oestrogens are used in males. The combination of oestrogens and androgens gave a higher average daily gain than when a single agent was used. The mode of action of androgens and oestrogens in increasing nitrogen retention and average daily gain is different (Dikeman, 2007).

Anabolic steroids

These are banned in European Union since 1989, because of health problems they might cause. E.g.Oestadiol, Trenbolone acetate (TBA) + Oestradiol, Zeranol+TBA. Oestradiol-17 β is a natural oestrogen produced by ovaries and testes.

Zearanol: Non-steroid anabolic agent with oestrogenic properties. It is a fermentation product and is a chemical derivative of resorcyclic acid lactone. It is produced Gibberellazeae, zearalenone and found to be a chemical derivative of Fusarium mould toxin. Zeranol implants in steers and lambs increase apparent absorption of Ca, P, Mg and Zn. These increases in apparent absorption were accompanied by increased retention of Ca, Mg and Zn (Castillo *et al.*, 2014).

TBA: It has androgenic properties similar to testosterone without any side effect and acts as a synthetic anabolic agent used for promoting growth rate but with no side effect. TBA interferes with the catabolic action of glucocorticoids on muscle protein thereby enhancing the rate of protein synthesis; 82% increase in daily carcass protein.

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TBA+estradiol (E2) implant: Daily gain increase of 16% and feed efficiency increase of 13% are observed.Hormone implants are legal and routinely used in the USA.

B) Growth and feed efficiency

- Implanting of calves not kept for breeding is a sound management programme and is cost-effective.
- Diethylstilbesterol (DES): Increase rate of gain and feed efficiency.
- Dose: Lambs 2 to 5 mg/day; steers 10mg/day. Steers 15 to 30 mg implant. Larger implants (60 to 120 mg) show undesirable side effects. Mammary development in steers and wethers, pelvic changes in cattle, vaginal and rectal prolapse, difficult urination and changes in the organs of the urogenital system.

Many widely used natural foods, including soybeans, contain higher oestrogenic activity than those found in animal tissues.It has been reported that traces of oestrogenic activity remained in the meat of cockerels/ animals implanted with DES. These traces are harmful. Hence DES has been banned since 1979. This was based on its known carcinogenicity as well as the lack of an acceptable analytical method for the compound in meat (Johnson *et al.*, 2013).Hexesterol is synthetic oestrogen. Melengesterol is synthetic progesterone.

Zeranol: Implanted (12 mg pellet) subcutaneously on the backside of the ear. It stimulates the pituitary gland to secreted increased amounts of somatotropin growth hormone. It is used as an implantable form for promoting growth in cattle.

Trebolone acetate (TBA): It is a very effective growth promoter especially in ruminants. Implanting steers with TBA and oestradiol-17 β made their growth rate comparable to that of bulls but, rather surprisingly, their carcass composition was still essentially that of the steer.

Synovex plus: This implant contains 20 mg of oestradiol and 200 mg of TBA which is a 1:10 ratio of the drugs. Implanted steers gained more rapidly and converted more efficiently than unimplanted animals. Re-implanted cattle gained more rapidly than cattle implanted only

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once and they also tended to convert more efficiently. Implanting did increase the weight of saleable lean beef without increasing trimmable fat.

Role of thyroid in meat composition and quality

The relatively great activity in this field is probably atleast partially attributable to the presence of iodine in thyroxine since iodine acts as a built-in marker for studies on the thyroid gland. Studies indicate that thyroxine and GH act synergistically on the growth of rats, and would suggest that endogenous thyroxine status may provide a useful indication of growth potential. However, such a suggestion is not supported by the results of experiments in which meat animals have been treated with thyroid hormones or with thyroid depressant substances. It follows that administration of thyroxine to an animal with suboptimal thyroid activity should increase growth rates, but if the animal's thyroid activity is already optimal, then exogenous thyroxine administration may decrease growth rates. Therefore, the effect of thyroid on carcass composition or meat quality is not fully investigated. Increased fatness was observed due to the symptoms of hypo- and hyperthyroidism. Promising results were not reported on thyroxine administration (Bernal, 2015).

Growth hormone

Growth hormone is a peptide hormone produced by the anterior pituitary and is involved in the processes of development and growth that includes skeletal muscle, bone and adipose tissue. Increased plasma GH has the effect of redirecting nutrients away from adipose tissue and toward muscle and bone. The effect of GH is to stimulate the production of insulin-like growth factor (IGF-1) from the liver. On the basis of these observations, the hypothesis was put forth that the growth was particularly affected by GH and was mediated by IGF-1 originating from the liver. However, GH can stimulate IGF-1 expression in bone and skeletal muscle. In the circulation, IGF-1 is associated with insulin-like growth factor binding proteins (IGFBP) which prolong its half-life. The effect of IGF-1 can be mediated through dimers of the IGF-1 receptor as well as IGF-1 receptor/insulin receptor hybrids and subsequently activates multiple signalling pathways. In muscle, the mitogen-activated protein kinase/extracellular signal-regulated kinase (MEK/ERK) is the predominant pathway is associated with proliferative growth, whereas the protein kinase B-mechanistic target of

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rapamycin-ribosomal protein S6 kinase (Akt–mTOR–S6K) pathway is related to protein synthesis and protein degradation (Vijayakumar *et al.*, 2010).

Its action on pig growth has been well characterized by reducing feed intake whilst simultaneously increasing lean and reducing fat deposition. In pigs on treatment with GH it was found that the signalling pathway activated by GH-IGF-1 axis, increased protein accretion is improved by protein synthesis. However there are inconsistent reports in the literature with some reporting similar increases in protein synthesis and breakdown but overall net increased nitrogen balance, whilst others have reported that protein synthesis is increased but protein degradation appears not to be affected and some have described even a decrease in degradation. The effect of Exogenous GH administration results in a reduction in backfat due to a reduction in fat synthesis in adipose tissue. The 12% decrease in intramuscular fat and 9% increase in shear force on the administration of GH were reported by different researchers. Therefore, Changes in temperature leads to the increased shear force transferred to the meat, either during chilling the carcass, thereby affecting rigour development.

Effect of melatonin on meat quality and chemical composition of muscle

Few effects of the melatonin treatment on meat quality indices were reported. Melatonin implantation for one month increases the rate of water loss and mean shear force of *Longissimus dorsi* muscles leads to a reduction in cooking yield and crude fat content of *Gluteus* muscles in comparison with the corresponding muscles from goats. The cooking yield of *Gluteus* muscles remained significantly reduced at 1 month. One month of melatonin treatment in goats leads to an increased rate of water loss of *Biceps femoris* muscles. The 1 month of melatonin implantation reduced muscle crude protein content than that of controls and reduced crude protein content of *Longissimus dorsi* and *Biceps femoris* muscles than a group of goats implanted with melatonin for 2 months (Duan, *et al.*, 2019).

Effect of melatonin on amino acids and fatty acids in Longissimus dorsi muscle

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The content of various amino acids in *Longissimus dorsi* muscles of these goats was not affected by melatonin implantation. Melatonin implantation has no significant effect on either 7 types of essential amino acids, 10 types of non-essential acids or total-amino acids, essential amino acid content and the ratio of essential amino acid to total amino acids.

Goats implanted with melatonin have minimal effect on the fatty acid composition of the *Longissimus dorsi* muscles. In melatonin implanted goats in June had elevated proportions of C14:1, C15:1, C20:4(*n*-6) and ∑*n*-6PUFA fatty acids and lower proportions of C12:0, C18:2C, C18:3(*n*-3) and ∑*n*-3PUFA in *Longissimus dorsi* muscles.

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