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Effect of zilpaterol hydrochloride on growth performance and carcass characteristics of wether goats

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ABSTRACT

Zilpaterol hydrochloride (ZH) supplementation was evaluated on performance of growing goats for the last 42 days before slaughter. Forty-eight Anglo-Nubian × Criollo animals (12 per treatment) were randomly assigned to one of four treatments (ZH at daily doses of 0.0, 0.1, 0.2 or 0.3 mg/kg of BW in diet) in a complete block design. Basal diet contained 16.3% CP and 2.5 Mcal/kg ME. The ZH supplementation at doses of 0.1, 0.2 and 0.3 mg/kg of BW increased ADG by 22.1, 54.0 and 56.6%, and gain/feed ratio by 20.0, 40.0 and 60.0%, respectively. The DMI (g/kg of $BW^{0.75}$) increased quadratically ($P = 0.037$). Carcass weight and dressing percentage (DP) augmented linearly ($P \leq 0.031$) as level of ZH increased in diet. The ZH supplementation increased ($P \leq 0.023$) longissimus muscle area (LM) and leg perimeter (LP) with a linear improvement ($P < 0.001$) of LM area by 12.2% and 21.0% as ZH level increased in diet. The neck perimeter (NP) observed a quadratic trend ($P < 0.035$) with greater values at 0.1 and 0.2 mg/kg of ZH. For each increment of 0.1 mg/kg in the ZH level, the percentage of fat in kidney, heart and pelvis tended to decrease by 4% ($P = 0.089$). Other carcass characteristics were not significantly affected ($P \geq 0.311$) by ZH administration, but tended to reduce ($P \leq 0.094$) redness (a^*) and chroma (C^*) values in the longissimus muscle. It was observed a linear tendency to diminish pH ($P = 0.072$). However, no differences ($P > 0.05$) or trends ($P > 0.10$) were detected on purge loss (PL) or cooking loss (CKL). Growth differences between wether goats fed ZH doses of 0.2 or 0.3 mg/kg of BW were small, and therefore lower dose of 0.2 mg/kg of BW seems enough to enhance growth. Moreover, the carcass characteristics showed minor differences between levels of ZH supplementation, and therefore could be considered that the lower dose of 0.1 mg/kg of BW of ZH was sufficient to improve these traits. It is concluded that addition of ZH to diets of wether goats increased growth performance and carcass characteristics in a similar manner to that reported for cattle and sheep.

1. Introduction

The goat meat is an important source of nutrients for the consumers, especially in the developing countries (Devendra, 2010). It has been reported that the world population of goats is about 875.5 million head, and over the past 30 years is the livestock species with the greatest annual growth rate (15.9 million head), in comparison to cattle (5.6

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million head), pigs (5.5 million head) or sheep (−3.4 million head). Over 95% of goat population is concentrated in developing countries, especially in Asia (61.6%) and Africa (31.6%), with the largest stocks in India (157.0 million head) and China (142.2 million head). Brazil (9.4 million head) and Mexico (9.0 million head) are the countries with the largest number of goats in America (FAOSTAT, 2013).

From a health perspective, the consumption of goat meat is recommended because of its lower content of saturated fat (Webb and O'Neill, 2008) and greater content of iron, thiamine and riboflavin compared to meat from other farm animal species (Johnson et al., 1995). Goat meat attributes are concordant with present day consumer demands for leaner and nutritious meat (Webb et al., 2005); nevertheless, juiciness, tenderness, and texture are characteristics that goat meat must fulfill in order to achieve consumer satisfaction (Grunert et al., 2004).

Moreover, the specific odour and minor tenderness of goat meat are two important drawbacks that negatively affect its consumption. An alternative is castration of male kids before puberty and feeding with high-energy diets, in order to reduce odour and improve meat flavour and tenderness (Webb et al., 2005). However, consumer acceptability could be affected due to the higher fat content in meat (Goetsch et al., 2011).

Metabolic modifiers are compounds that improve the productivity of commercially important domestic animals, by improving their productive efficiency, increasing muscle mass and concurrently decreasing carcass fat (Dikeman, 2007; NRC, 1994; Sillence, 2004). One of these compounds are the β-adrenergic agonists (β-AA) or phenethanolamines, which are orally active synthetic compounds that reduce adipose tissue deposition and increase muscle mass by stimulating β-adrenergic receptors (β–AR) present on the surface of almost every type of mammalian cell (Johnson and Chung, 2007).

Zilpaterol hydrochloride (ZH) is a β-AA compound approved for use in animal feed in Brazil, México, United States and South Africa, whose effects on growth performance and carcass composition have been widely studied in feedlot cattle (Avendaño-Reyes et al., 2006; Delmore et al., 2010; Elam et al., 2009; Rathmann et al., 2012), and sheep (Aguilera-Soto et al., 2008; Estrada-Angulo et al., 2008; López-Carlos et al., 2010, 2011, 2012; Macías-Cruz et al., 2013; Robles-Estrada et al., 2009). As in cattle and sheep, it is hypothesized that this compound could improve growth performance and carcass characteristics by increasing feed efficiency and reducing excessive fat in wether goats under feedlot conditions; however, to date there are no scientific reports for β-AA supplemented in goats diet.

The objectives of this study were to evaluate the growth performance and carcass characteristics of wether goats supplemented with ZH in diet for the last 42 days before slaughter.

2. Material and methods

The experiment was conducted in the Small Ruminant Experimental Center of the Faculty of Veterinary Medicine and Animal Science of the Autonomous University of Zacatecas, México (north-central México). Research protocols, animal care, and management procedures were made in accordance with approved local official techniques of animal care (NOM-051-ZOO-1995: Humanitarian care of animals during mobilization of animals; NOM-024-ZOO-1995: Animal health stipulations and characteristics during transportation of animals; NOM-033-ZOO-1995: Humanitarian sacrifice of domestic and wild animals).

Table 1
Composition of diet offered to wether goats during the 42 days prior to slaughter.[a]

Item	%
Ingredient	
Alfalfa hay	32.0
Oat hay	26.7
Ground yellow corn	27.9
Cotton seed meal	12.0
Mineral premix[b]	1.4
Chemical composition[c,d]	
Dry matter, %	89.1
Crude protein, %	16.3
Total digestible nutrients, %	69.4
Digestible energy (Mcal/kg DM)	3.0
Metabolizable energy (Mcal/kg DM)	2.5
Neutral detergent fiber, %	40.4
Acid detergent fiber, %	24.3
Ca, %	1.0
P, %	0.5
Crude fat, %	2.8

[a] As fed basis.
[b] The mineral premix contained the following (DM basis): 50.0% limestone, 35.7% sodium bicarbonate, and 14.3% sodium phosphate.
[c] Values except DM are expressed on a DM basis
[d] Analyzed values, except for TND, DE and ME that were calculated from NRC (2007) feed composition tables.

2.1. Animals, housing and management

Sixty Anglo-Nubian × Criollo wether goats born in May and June of 2010 were acquired from a local flock at approximately 4 to 5 months of age and weaned 1 month earlier. Upon arrival, wethers were randomly assigned to groups of 10 individuals per pen, identified with a sequentially numbered ear tag, dewormed (Cydectin®, Fort Dodge Animal Health, México), and vaccinated against *Clostridium* spp. and *Pasteurella* spp. (Bobact 8, Intervet, México).

Wethers were initially fed with a mixture of good quality alfalfa and oat hay during first week, and then were gradually adapted to consume the basal diet for the next 2 weeks. The basal diet (16.3% CP and 2.5 Mcal/kg ME on a DM basis, Table 1) consisted of approximately 60% forage (mixture of alfalfa and oat hay) and 40% concentrate (corn grain, cottonseed meal, and a mineral premix) and was offered *ad libitum* at approximately 110% of consumption (as fed basis) from the previous d in 3 daily meals at 07:00, 14:00 and 19:00 h.

Animals were fed with the basal diet during 4 weeks more, and then 48 wethers were selected from the original group based on criteria of healthy appearance and uniformity of general condition. Wethers were ranked by weight and divided into three blocks (block 1 = 27.6 ± 1.1, block 2 = 25.1 ± 1.0, block 3 = 22.3 ± 1.0 kg; values represent means ± SD) of 16 wethers each, and randomly assigned