THE EFFECT OF SUPPLEMENTATION PERIOD OF A BETA-AGONIST (ZILPATEROL) ON GROWTH PERFORMANCE, CARCASS YIELD AND MEAT QUALITY CHARACTERISTICS

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Background

Beta-agonists are one of the most recent approaches to growth promotion in farm animals. These compounds are analogues of a natural group of hormones called catecholamines, adrenaline and nor-adrenaline. They activate certain beta-receptors on fat and muscle cell surfaces and thereby change the biochemical process of tissue growth by increasing lipolysis and decreasing protein degradation. The positive effect of beta-agonists on carcass growth performance and carcass yield has been reported for cattle (Fiems, 1987) sheep (Thorton *et al.,* 1985) and pigs (Jones *et al.* 1985). Their effect on meat quality traits such as tenderness received less attention, yet most results proved that muscle tenderness in particular is negatively affected. Koohmaraie *et al.* (1991) found a reduced degradation of the myofibrillar protein, troponin-T in Cimaterol-treated bulls (beta-agonist), which they linked to the decrease in protein degradation in the live animal, hence the increased performance of treated animals.

Zilpaterol hydrochloride is a beta-2 agonist, pharmacologically speaking, and its action is reflected particularly at the level of muscle metabolism. Its weak affinity for specific receptors indicates moderate activity as repartitioning agent. Therefore, it is expected that the negative effect on muscle tenderness will be less pronounced compared to other beta agents with stronger affinities to receptors and higher activities as repartitioning agents. In a number of trials, an optimum inclusion level and supplementation period which would benefit both the growth performance and meat quality of feedlot animals, were investigated.

Objectives

In this trial, the effects of various supplementation periods of the beta-agonist, Zilpaterol hydrochloride, on growth performance and meat quality characteristics were investigated.

Methods

Two hundred and forty crossbred steers (average weight = 262.6 kg ± 19.2) were selected from a commercial feedlot where they were already fed for approximately 35 days. The animals were blocked by weight (six blocks), separated into 24 feedlot pens (10 animals per pen) and randomly assigned within blocks to one of the following treatment groups: supplementation with 0.15 mg Zilmax®/kg live weight for the final 15 (Z15), 30 (Z30) and 45 days (Z45) in the feedlot, until 48 hours before slaughter; or no supplementation (C) with Zilmax®. Dry matter intake and weight gain were recorded on a weekly basis. Thirty-two animals, eight per treatment, were selected from the group of 240 animals for meat quality evaluation. The animals were slaughtered at the experimental abattoir of the ARC Meat Industry Centre, (Animal Nutrition and Animal Products Institute) according to commercial practice. Electrical stimulation was applied at 500 V for two minutes directly after exsanguination in order to prevent/limit toughening of the muscles through cold shortening. The wingrib containing the *M. longissimus thoracis* (LT) and the *M. semitendinosus* (ST, silverside cut) were sampled and aged for seven days. A 10-member panel of trained judges evaluated cooked samples (70 °C internal endpoint temperature) of the two muscles for aroma intensity, juiciness (2 aspects), tenderness (3 aspects) and flavour intensity. The LT and ST were prepared according to a dry heat and moist heat cooking method, respectively. Shear force resistance, as a mechanical measurement of tenderness, was also measured on the cooked samples by means of Warner Bratzler shear device (Instron Corporation ,1990). The resistance to compression of raw muscle fibre (measure the degree of ageing) was measured at 20% of maximum force by means of a special compression device, developed by INRA, France according to the method of Lepetit (1995). The remaining animals (n=208) were slaughtered at a commercial abattoir. Warm carcass weights and fatcodes were recorded. Average daily gain (ADG) was estimated from first or second order polynomial regressions between live weight and days in the feedlot. An estimated initial carcass weight of 54 % of live weight was used to determine ADG and feed conversion ratio (FCR) on a carcass basis. Sources of variation between treatments were investigated by analyses of variance (Genstat 5, 1993).

Results and discussion

Meat quality characteristics: According to Table 1, the LT muscle was clearly more affected by Zilpaterol than the ST muscle. For the LT, all three sensory attributes for tenderness (first bite, overall tenderness and residual connective tissue), as well as shear force resistance measurements, showed significant differences ($P<0.05$) between the control and Z45. Z15 and Z30 were intermediate to C and Z45 and did not differ significantly from either of them. Numerically, the differences in sensory values for the ST muscle were small, although significant ($P<0.05$), between Z45 and Z30 for initial juiciness and first bite (tenderness) and between Z45 and Z15 for sustained juiciness. Shear force resistance measurements for the ST muscle were the highest for Z45 but not significantly different from C. Compression values (20 % of maximum) for the LT muscle were significantly higher for the three treatment groups compared to C, suggesting a lower level of myofibrillar fragmentation through ageing for the Zilapetrol treated groups. The slightly lower (non-significant) compression value of Z15 (compared to Z30 and Z45), coupled with its higher scores for tenderness, compared to Z45, indicate that the effect of Zilpaterol on myofibrillar fragmentation tend to be reduced with shorter supplementation periods. In contrast to the LT, no significant differences in compression values were found among treatments for the ST, supporting the sensory and shear force resistance measurements for tenderness.

Growth performance and carcass characteristics: Significantly higher ($P<0.05$) carcass weights resulting in higher ($P<0.05$) dressing percentages were recorded for all three Zilpaterol treatments compared to C, while Z45 produced larger carcasses ($P<0.05$) than Z15 (Table 2). Both ADG and FCR on a carcass basis, were significantly better ($P<0.05$) for the three Zilpaterol treatments

compared to C. Z45 also gained carcass weight at a higher rate ($P<0.05$) than Z15, while both Z30 and Z45 were more efficient ($P<0.05$) in carcass weight gain than Z15. Daily feed intake was not significantly affected by treatment. According to Table 2, animal performance increased with an increase in supplementation period, although supplementation beyond 30 days did not have a significant effect on growth performance or carcass yield.

Conclusions

1. The effect of Zilpaterol seems to be muscle specific with the LT muscle tenderness being more affected than the ST muscle, with no statistical differences for supplementation periods of 30 days or less (Table 1).
2. According to Table 2 it is clear that animal growth performance improved, and carcass yield increased with increasing exposure to Zilpaterol hydrochloride, but at a diminishing rate from 30 to 45 days.
3. According to both the growth performance and meat quality results, 30 days inclusion period seems to be the optimum for favourable growth rates and feed conversion ratios without impairing muscle tenderness under the slaughter (electrical stimulation) and post slaughter regime (seven days ageing) of this trial.

Table 1: The effect of different periods of Zilpaterol intake on meat quality characteristics of two muscles

	M semitendinosus					*M. longissimus thoracis*				
Trait	*[2]Control*	*[2]Z15*	*[2]Z30*	*[2]Z45*	*SEM[3]*	*Control*	*Z15*	*Z30*	*Z45*	*SEM[3]*
Sensory attributes:[1]										
Aroma	4.6	4.7	4.5	4.6	0.099	4.9	4.8	4.7	4.9	0.107
Initial juiciness	4.6^{ab}	4.6^{ab}	4.7^{b}	4.2^{a}	0.109	4.8	4.8	4.9	4.7	0.082
First bite	4.3^{ab}	4.6^{ab}	4.7^{b}	4.0^{a}	0.149	4.8^{b}	4.4^{ab}	4.5^{ab}	3.8^{a}	0.203
Sustained Juiciness	3.9^{ab}	4.1^{b}	4.0^{ab}	3.5^{a}	0.134	4.6^{b}	4.3^{ab}	4.3^{ab}	3.9^{a}	0.137
Overall tenderness	4.3	4.7	4.6	4.1	0.155	4.8^{a}	4.4^{ab}	4.5^{ab}	3.9^{b}	0.169
Residual tissue	4.4	4.7	4.7	4.2	0.138	4.9^{b}	4.6^{ab}	4.6^{ab}	4.0^{a}	0.143
Flavour intensity	4.4	4.7	4.4	4.5	0.070	4.9	4.7	4.7	4.5	0.099
Shear force resistance (N/25 mm ø)	93.7	90.8	92.6	100.8	3.230	97.9^{a}	114.3^{ab}	110.7^{ab}	125.5^{b}	5.600
Compression test (N):20 % level	16.6	16.4	21.1	21.1	0.573	11.7^{a}	16.9^{b}	19.9^{b}	19.4^{b}	0.483

^{a,b,c} Means in the same row and within the same muscle with different superscripts differ significantly ($P<0.05$; Bonferroni test).

1 A score of 8 describes the sample as extremely intense in aroma/flavour, extremely juicy, extremely tender with no connective tissue residue, while a score of 1 describes it as extremely bland in aroma and flavour intensity, extremely dry, extremely tough with abundant connective tissue residue.

2 Control received no Zilpaterol; Z15, Z30, Z45 received Zilpaterol for the final 15, 30 and 45 days in feedlot, respectively.

Table 2: The effect of different periods of Zilpaterol intake on growth performance and carcass characteristics

Trait	*[2]Control*	*[2]Z15*	*[2]Z30*	*[2]Z45*	*SEM[1]*
Initial weight (kg)	262.5	262.5	262.4	262.9	0.63
Slaughter weight (kg)	382.4	386.3	388.4	389.6	2.04
Carcass weight (kg)	214.2^{a}	222.2^{b}	226.2^{bc}	227.6^{c}	1.35
Dressing %	56.0^{a}	57.6^{b}	58.2^{bc}	58.7^{c}	0.22
Dry matter intake (kg/day)	8.91	8.99	8.82	8.74	0.18
Average daily gain (kg/day)					
Live	1.79	1.84	1.88	1.89	0.03
Carcass	1.08^{a}	1.20^{b}	1.26^{bc}	1.28^{c}	0.02
Feed conversion ratio (kg/kg)					
Live	4.98^{a}	4.87^{ab}	4.70^{bc}	4.62^{c}	0.06
Carcas	8.24^{a}	7.63^{b}	7.13^{c}	7.06^{c}	0.13
Fatness score	2.32^{a}	2.56^{b}	2.22^{a}	2.26^{a}	0.07

^{a,b,c} Means in the same row and within the same muscle with different superscripts differ significantly ($P<0.05$; Bonferroni test).

1 Standard error of least square mean.

2 Control received no Zilpaterol; Z15, Z30, Z45 received Zilpaterol for the final 15, 30 and 45 days in feedlot, respectively.

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