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THE CLENBUTEROL TREATMENT OF HOGGETS: EFFECTS ON CARCASS AND MEAT QUALITY PARAMETERS

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INTRODUCTION

The desire to increase lean muscle deposition and reduce carcass fat has encouraged many investigation to use ß-agonist in domestic animals.

In our previous investigations on fattening lambs, the effect of clenbuterol on growth, feed efficiency and meat quality characteristics was seen to depend on feeding levels (Shindarska et al., 1991). A continuous treatment with clenbuterol was demonstrated to bring about qualitative differences in carcass characteristics between castrated and uncastrated hoggets (Shindarska et al., 1992).

The purpose of the present study was to optimize the treatment regimes for ß-agonist intake. The effect of both a high clenbuterol dose and a two week withdrawal period on carcass characteristics was studied in hoggets.

MATERIALS AND METHODS

Two experiments were carried out on both castrated and entire male hoggets at an age of 18 months. Animals from each experiment were divided into three treatment groups as: control and two experimental treatments. During an experimental period of six weeks animals from all groups received the same diet containing 4.1MJ of energy and 130g of crude protein per kg of complete ration (all-mash ration). Animals from experimental groups received an additional 10mg of clenbuterol per kg of diet. Animals were fed in groups, ad libitum, and had ad libitum access to both feed and water. Feed consumption was measured daily.

At the end of experimental period, four animals from both control and the first experimental group of each treatment were slaughtered and those from the second experimental group were slaughtered two weeks later. Animals in the second experimental group received no clenbuterol during that two week period. A full carcass analysis was carried out. After boning and mincing the left carcass half, representative samples were taken of minced meat as well as samples from the m.longissimus dorsi (LD). In meat and muscle samples both fat and protein contents were determined using routine methods (Soxhlet and Kieldal).

The qualitative appraisal of meat samples included pH, WCC, myoglobin and colour according to methods described in our previous studies (Pinkas et al., 1984). Fatty acid composition of triacylglycerols isolated from lipids of LD was determined by gas-chromatography. Student's t-test was used for statistical evaluation of the results obtained.

RESULTS AND DISCUSSION

During the experiment no deviations were observed in the state of health either in control and in experimental animals. Clenbuterol treatment did not induce significant changes in live weight in both classes of animals nor in the values of carcass weight in uncastrated hoggets (Table 2). Similar results were reported have been obtained after applying the same dose (10mg) and duration of treatment (six weeks) in lambs fed a high-energy diet (Shindarska et al., 1991). Thornton et al. (1985) also found similar results in treated rams.

In castrated hoggets, however, clenbuterol treatment was seem to result in the deposition of more meat and better

dressing percentage.

Our previous investigations on tenfold lower clenbuterol doses, applied in both castrated and uncastrated hoggets, have shown similar trends with respect to changes in meat quality characteristics studied. These data suggest that clenbuterol, when applied in adult animals, depends less on dose and treatment duration.

In the present study both LD and m.semimembranosus (SM) weights increased significantly in experimental animals. It is worth noting however the differential effect of clenbuterol on both muscles (Table 2). Growth of the SM was of the order 7-20%, while in the LD was of 2-4%, this was similar to results seen in lambs treated with 10mg clenbuterol (Shindarska et al.,1991).The current data supports the contention that clenbuterol effects depend on anatomical localisation of single muscles. Further investigations on additional muscles would provide an overall evaluation about the effect of ß-agonists on muscle growth.

Results obtained in the current study show that both an increase in the weight of individual muscles as well as the protein content of LD occur, but at different degrees (Table 3). Earlier investigations of Reeds et al. (1988) report that the ß-agonists mediated increase in nitrogen accumulation is specific for single muscles. In the present study, changes in carcass protein content were lower than those in LD (Table 3). Presumably clenbuterol effects on protein deposition differs among muscles. Clenbuterol included increased metabolic activity of other organs and tissues might have a greater significance on total protein metabolism than direct effects on muscles (Inkster et al., 1989).

A continuous clenbuterol intake was seen to promote the growth rate of animals in the order of 10-12kg (Shindarska et al., 1992). In contrast to the continuous treatment, a high dose of clenbuterol had significantly, lesser effect on protein content in carcass (Table 3). Treating with clenbuterol for six weeks in adult animals had no effect on live weight (Table 2).

Clenbuterol effects were also seen to depend on the physiological state (castrate or entire) of animals. In castrated hoggets, loin eye muscle areas increased by 22%, in contrast to a 9% increase the loin eye of uncastrated animals.

A high clenbuterol dose was seen to induce a drastic decrease in fat content in the LD. This effect was more marked in uncastrated animals (Table 3). Changes of fats in mixed meat samples were significantly less and site specific (Banskalieva et al., 1993).

Data from the current study suggest that animals of high fat deposition rate (high concentrate feeding) or of complete growth (adult hoggets and sheep) are more susceptible to the effect of B-agonists (Williams, 1987).

A drastic decrease of fats in the LD (Table 3) was not accompanied by changes in fatty acid composition of triacylglycerols (Table 4). This has also been reported in studies using continuous low dose treatments (Shindarska et al., 1992).

Increased water content of the LD (1-2%) has also been reported earlier both in sheep (Shindarska et al., 1992) and lambs (Shindarska et al., 1991) regardless of both dose and treatment duration.

Physical-chemical composition of the LD meat is presented in Table 3. In uncastrated animals significant differences were seen between control and experimental groups. Treated animals displayed higher pH and WBC, as well as darker meat colour at a lower myoglobin content. Similar results in sheep, treated with ß-agonists have been obtained by Allen et al. (1985a; 1985b), reporting higher pH values by 0.3 units. Castration of animals seems to limit the clenbuterol effect in the first experimental group and entirely neutralise the effect it in the second experimental group having withdrawal of 14 days before slaughtering.

In the current study, results obtained show that a high dose of clenbuterol results in leaner meat (LD), but the effect on fat content in the whole carcass is dose dependent (Shindarska et al., 1992).

In conclusion, the need to use ß-agonists will most likely depend on both market demand for leaner meat and also on more detailed investigations on residue quantities in the carcass.

REFERENCES

ALLEN, P., TARRANT, P., HAURAHAN, J., and FITZSIMSON, T. 1985a. Food Science and Technology. 6.

ALLEN, P., TARRANT, P., HAURAHAN, J., and McEWAN, H. 1985b. Food Science and Technology. 7.

BANSKALIEVA, V., ANGELOV, A., SHINDARSKA, Z., and MARINOVA, P. 1993. 39th Intern. Congr. Meat Techn. Calgary, Canada. (in Press).

INKSTER, J., HOVELL F., KULE D., BROWN D., and LOBLEY, G. 1989. Br. J. Nutr. 56:249.

PINKAS A., and MARINOVA, P. 1984. Improving of Meat Quality. Sofia.

REEDS P., HAY M., DORWOOD P., and PALMER, M. 1986. Br. J. Nutr. 56:249.

SHINDARSKA, Z., BANSKALIEVA, V., DIMOV, V., and DARDJONOV, T. 1991. 37th Intern. Congr. Meat Techn. Kulmbach, Germany. p.188.

SHINDARSKA, Z., BANSKALIEVA, V., MARINOVA, P., and DARDJONOV, T. 1992. 38th Intern. Congr. Meat Techn. Clermot - Ferrand, France.

THORNTON, R., TUME, R., PAYNE, G., LAARSEN, T., JONSON, G., and HOHENNAUS, M. 1985. Proc. N. Z. Soc. Anim. Prod. 45:97.

WILLIAMS, P.E. 1987. Nutr. Abstr. Rev. (Series B) 57:453.

Table 1. Diet Composition.

Ingredients	Per cent
Wheat	12.0
Barley	12.0
Wheat bran	5.0
Salt	0.1
Trace element mixture	
Limestone	0.1
Urea	0.1
Dicalcium phosphate	0.6
Prairie hay	0.1
	70.0
Crude protein (g/kg diet)	
Net energy (MJ/kg diet)	130.0
	4.1
Roughage/con-centrate	
ratio, %	70.0
	30.0

* Kellner, D.

Table 2. Carcass characteristics.

Traits	Uncastrated Control	Exp. 1	Exp. 2
Pre-slaughter Live weight, kg	58.3 ± 2.5	58.7 ± 2.5	54.7 ± 2.5
Carcass weight, kg	24.1 ± 1.9	23.6 ± 1.2	24.7 ± 1.7
Meat, kg	18.5 ± 1.9	17.9 ± 1.1	19.1 ± 1.3
Dressing percentage	41.33	41.90	41.79
m.LD weight, kg	0.47 ± 0.01	0.48 ± 0.01	0.49 ± 0.03
m.LD length, cm	31.5 ± 0.5	33.7 ± 2.0	33.9 ± 1.4
m.LD area, sm	23.7 ± 0.5^{a}	25.8 ± 2.4^{b}	25.9 ± 1.9^{b}
m.SM weight, kg	0.35 ± 0.01^{a}	0.42 ± 0.05^{b}	0.42 ± 0.05^{b}

Table 2 (cont). Carcass characteristics.

Trait	Castrated		
	Control	Exp. 1	Exp. 2
Pre-slaughter Live weight, kg	52.3 ± 2.5	54.7 ± 4.5	53.5 ± 2.5
Carcass weight, kg	19.7 ± 2.9	22.4 ± 2.9	20.1 ± 2.9
Meat, kg	16.9 ± 0.98	18.5 ± 1.4	17.6 ± 1.4
Dressing percentage	37.70	40.95	39.70
m.LD weight, kg	0.46 ± 0.05	0.48 ± 0.03	0.49 ± 0.02
m.LD length, cm	32.2 ± 1.3	34.1 ± 0.9	35.0 ± 1.0
m.LD area. sm	22.4 ± 3.1[a]	27.4 ± 1.6[b]	27.5 ± 1.2[b]
m.SM weight, kg	0.29 ± 0.01[a]	0.34 ± 0.05[b]	0.35 ± 0.01[b]

C = Control; E1 = Experimental group 1; E2 = Experimental group 2

[a,b] Significant differences between control and experimental group (P).

Table 3. Chemical composition and quality of meat and m.longissimus dorsi.

Trait	Uncastrated		
	C	E1	E2
Meat, %			
Water	68.12 ± 2.12[a]	70.00 ± 2.05[b]	70.50 ± 1.40[b]
Protein	18.15 ± 0.70[a]	19.82 ± 0.70[b]	19.85 ± 0.86[b]
Fats	14.65 ± 1.25[a]	12.65 ± 2.36[b]	12.30 ± 1.40[b]
Mineral matter	1.01 ± 0.03	0.98 ± 0.10	0.95 ± 0.09
m.longissimus dorsi			
Water	75.46 ± 0.96	76.60 ± 1.08	75.50±0.15
Protein	20.44 ± 0.54[a]	21.49 ± 0.35[b]	21.30±0.60[ab]
Fats	3.29 ± 1.09[a]	1.90 ± 0.85[b]	2.10±0.18[ab]
Mineral matter	1.10 ± 0.05	1.70 ± 0.16	1.10±0.09
pH, 24 hours post-mortem	5.69 ± 0.10[a]	6.13 ± 0.18[b]	6.20±0.09[ab]
Colour 525nm	17.30 ± 1.47[a]	16.74 ± 0.38[b]	16.50±0.26[b]
WBC (%)	39.82 ± 1.03[a]	29.44 ± 2.11[b]	29.00±1.98[b]
Myoglobin (mg/g)	3.37 ± 0.67	2.77 ± 0.12	2.80±0.78

Table 3 (cont). Chemical composition and quality of meat and m.longissimus dorsi.

Trait	Castrated		
	C	E1	E2
Meat, %			
Water	63.28 ± 2.36^{a}	65.76 ± 2.36^{b}	68.00 ± 1.15^{b}
Protein	16.63 ± 0.55^{a}	17.61 ± 2.14^{b}	19.60 ± 1.69^{b}
Fats	19.82 ± 1.30^{a}	16.31 ± 2.50^{b}	12.80 ± 2.95^{b}
Mineral	1.20 ± 0.02	0.93 ± 0.11	0.89 ± 0.07
matter			
m.longissimus dorsi			
Water			
Protein	75.15 ± 0.32	76.43 ± 0.17	76.00 ± 0.19
Fats	21.77 ± 0.92^{a}	22.22 ± 0.30^{b}	22.00 ± 0.45^{b}
Mineral	2.13 ± 0.59^{a}	1.50 ± 0.73^{b} 0.90 ±	2.00 ± 0.16^{b}
matter	1.01 ± 0.02	0.02	0.98 ± 0.03
pH, 24 hours			
post-mortem	5.77 ± 0.14	5.97 ± 0.02	5.70 ± 0.07
Colour,			
525nm	16.27 ± 1.36^{a}	17.28 ± 2.32^{b}	17.50 ± 1.93^{b}
WBC (%)			
Myoglobin	37.52 ± 4.30^{a}	28.25 ± 2.13^{b}	28.40 ± 1.14^{b}
(mg/g)	3.87 ± 0.78	2.81 ± 0.78	3.50 ± 0.63

C = Control; E1, 2 = Experimental groups; ^{a,b} = Significant differences between control and experimental groups (P).

Table 4. Fatty acid composition of triacylglycerols from m.longissimus dorsi of hoggets.

Fatty acid	Uncastrated Control	Uncastrated E1	Uncastrated E2
16:0	28.0± 1.5	25.2 ± 1.3	27.8 ± 1.5
16:1	4.1 ± 0.3	3.9 ± 0.3	3.5 ± 0.1
18:0	20.8 ± 0.8	21.3 ± 1.0	19.0 ± 0.6
18:1	41.0 ± 1.7	42.7 ± 0.7	43.7 ± 2.0
18:2	6.0 ± 0.2	6.8 ± 0.6	6.1 ± 0.6

Fatty acid	Castrated Control	Castrated E1	Castrated E2
16:0	25.8 ± 1.6	25.9 ± 1.1	24.3 ± 0.9
16:1	4.1 ± 0.3	3.7 ± 0.1	3.9 ± 0.3
18:0	18.0 ± 1.3	19.8 ± 0.2	19.9 ± 0.6
18:1	45.0 ± 3.4	43.7 ± 1.9	44.9 ± 0.5
18:2	7.1 ± 1.2	6.8 ± 0.2	7.0 ± 0.8