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EFFECT OF CLENBUTEROL IN LAMBS GIVEN DIFFERENT ENERGY-PROTEIN, METABOLIC, MUSCLE HISTOLOGY AND MEAT QUALITY EFFECTS

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INTRODUCTION

When fattening lambs to higher live weights for meat production, an accelerated deposition of adipose tissue has been reported in mature animals (Boykovscki *et al.*, 1982; Marinova *et al.*, 1980). In order to reduce the maintenance costs for production, as well to meet the requirements for animal health, a number of authors report a reduction of fat by modifying the feeding and incorporating phenethanolamines. In this respect, both clenbuterol and cimaterol have been unanimously observed to exert a greater effect in sheep (Baker *et al.*, 1984; Beermann *et al.*, 1986).

The present investigation was a part of a study of clenbuterol effects on both feeding efficiency, carcass composition, meat quality and fats in sheep. The objective was to establish its effect on both biological characteristics of muscle cells and meat performance depending on the feeding level in lambs.

MATERIAL AND METHODS

Three experiments were carried out on 66 male lambs subjected to different dietary energy (6.0; 5.1 and 4.3MJ/kg of diet) and protein (200; 200 and 140g/kg of diet) feeding levels. Upon reaching 27kg of live weight, lambs from each experiment were divided in to both control and two experimental groups, the later treatments received Clenbuterol a 10mg/kg diet for 42 days. Both control and the first experimental group were slaughtered immediately after treating and the second experimental groups after seven days, following the period clenbuterol was eliminated from the diet.

Dissection of the left half of the carcass was carried out 24 hours post-mortem, tissues, including the *m.longissimus dorsi* (LD) and *m.semimembranosus* (SM) were separated and measured. Histochemical analysis was carried out cross serial cuts at -25°C, 16mm slices were analyzed for colour and succinatedehydrogenase, - glycero-phosphatdehydrogenase (16) and myiofibralar ATP-ase activity (17). For grading the muscle fibres, the nomenclature of Peter *et al.* (1972) has been used. Diameters of muscle cells, defined as the mean of measurements of each 100 of both FG and Fog types and each 50 of five fields of vision. Protein content was determined on an average meat sample of m.LD using the Kieldhal method.

RESULTS AND DISCUSSION

Results obtained in fattening lambs with clenbuterol supplement have shown that its effect on both the size and metabolic type of muscle fibres is influenced by feeding level (Table 1). Experimental lambs, fed on a high energy-protein diet have been observed to display larger sized muscle cells in all three metabolic types. FG and FoG fibres were also influenced to a great extent, whereby differences were seen to be significant at $P<0.05$ and for So-fibres at $P<0.01$. Similar results have also been obtained and observed in treated lambs fattened on a moderate energy-protein diet. Although less obvious, differences in the diameter of fast fibre type muscles with control animals were significant at $P<0.01$. Certain deviations exist in slow oxidative fibres where differences in their size are not significant. Clenbuterol supplement to low energy-protein diet animals appears to exert significant effects on the size of FoG fibres ($P<0.01$) only. Slaughtering lambs one week after stopping their clenbuterol treatments in all three experiments showed that it is hard to accept a presence of a residual effect on the size of muscle cells.

Clenbuterol effects on the proportion of single metabolic type of fibres also depends on the feeding level. The

higher energy-protein feeding had the effect of reducing the percentage content of So fibres and increasing the of FG fibres. Differences between control and experimental groups for these traits in the first experiment are significant by a greater degree compared to those in the second experiment.

On studying the mode of action and the effect of ß-agonists on muscle tissue, most of authors report a greater meat quantity in treated animals. A hypertrophy of muscle cells has been observed, which, according to Maltin *et al.* (1986) and Beermann *et al.* (1987), would be due to the increase of protein synthesis, and also as discussed by Klasing *et al.* (1985) and Reeds *et al.* (1986) to the inhibition of its breakdown. The results relating to modifying the single metabolic types of fibres are controversial. Results obtained by us in both experiments II and III compare with those of Hamby *et al.* (1986) and Coleman *et al.* (1986), establishing an increased cross surface of II type glucolytic fibres only and a decrease of oxidative type. Beermann *et al.* (1985) and Berge *et al.* (1991) report that calves treated on ß-agonists have an increasing size of all fibre types, this being more limited for type II than for type II muscle fibres. Clenbuterol effects on the size of muscle cells, in this study, seems to be influenced by the feeding level, data of the first experiment being in contrast to those of the last authors. On treating different animals with ß-agonists, researchers also report changes in the part of fibres affecting flavour of glucolytic type muscles (Berge *et al.*, 1991; Kim *et al.*, 1987). As established earlier in our lab, a greater part of FG fibres, mainly in the first and second experiment, confirms the results of Hamby *et al.* (1986) for sheep treated with Clenbuterol. According to this report, glycolysis used by muscles to a greater extent is an indicator for a greater part and hypertrophy of II fibres type. Willeman (1987) also finds that treating with an ß-agonists increases the capacity of muscle to metabolizing glucogen.

Carcass composition when using ß-agonists

Clenbuterol effects in the current study did not differ from those of other authors (Koohmaraie *et al.*, 1991; McElligott *et al.*, 1989; William, 1987). A reduced content of both subcutaneous-, inter- and intramuscular fats and an increased dressing percentage of animals in that study, was reported, and is consistent with our findings (Shindarska *et al.*, 1991). In both high and moderate energy-protein feeding, clenbuterol supplement increases the carcass weight and significantly improves the meat/bones ratio (Table 2). Lower carcass weight and lower percentage of meat content have been established in experimental groups fed on energy-protein diets. A reduced carcass weight in calves treated with clenbuterol has been reported by Miller *et al.* (1988). Analysis of protein content in a common meat sample and in m.LD show higher values in experimental lambs for both the first and second experiments ($P<0.01$, 0.05). In the same experimental group the authors have seen significantly larger surface and weight of m.LD, as well as for the m.SM weight ($P<0.01$-0.025) and ($P<0.01$). Increased m.LD surface observed in this study is significantly less than that reported by other authors (Baker *et al.*, 1984; Hamby *et al.*, 1986; Koohmaraie *et al.*, 1991). According to Beermann *et al.*, (1987), Kim *et al.*, (1987) and Koohmarie *et al.*, (1991), that increased deposition of muscle tissue through ß-agonists is connected with the change in muscle growth by means of increasing the muscle cells, RNA and protein content, without increasing the DNA content.

CONCLUSION

Clenbuterol effect showed on both the size and metabolic type of muscle cells and meat quantity in carcass. These effects depends on the feeding level in lambs. In treated animals, with increasing energy and protein in the diet, the sizes of FoG and FG muscle fibres increase at a greater significance rate, as well as the proportion ratio of FG fibres in *m.longissimus dorsi*. In the same animals, both increases in the percentage of carcass yield and improved meat quality characteristics of *m.longissimus dorsi* and *m.semimembranosus* have been established.

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