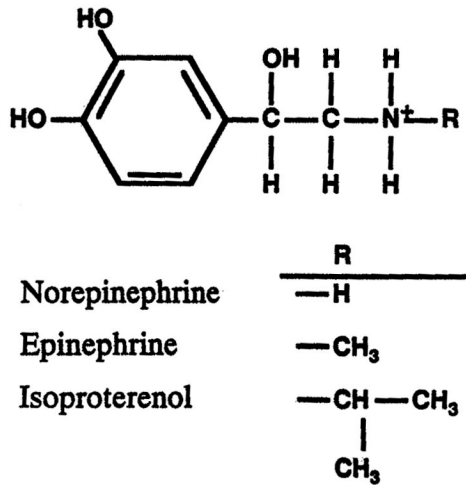
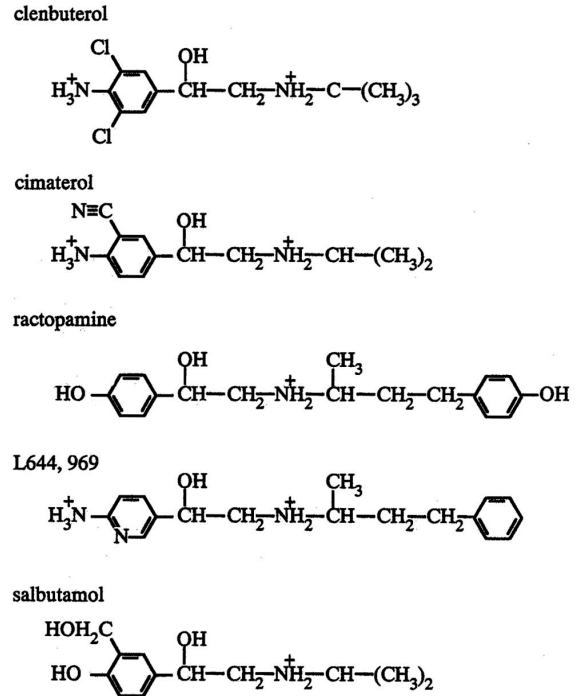


## ANSC/FSTC 607

## Physiology and Biochemistry of Muscle as a Food

 $\beta$ -ADRENERGIC AGONISTS, GENETICS, AND THE RESOLUTION OF RIGORI.  $\beta$ -adrenergic agonists and meat qualityA. Structure of  $\beta$ -adrenergic agonists

**Figure 1.** Structure of norepinephrine and analog.



**Figure 8.** Structure of  $\beta$ -adrenergic agonists evaluated in livestock species.

B.  $\beta$ -Adrenergic agonists increase muscle mass.

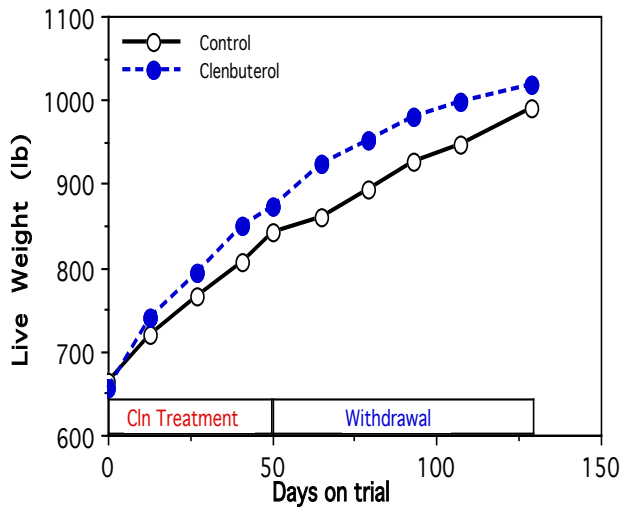
1. Type IIB (FG) fiber diameters always hypertrophy in response to treatment with clenbuterol, cimaterol, ractopamine, etc.
2. Other fiber types infrequently affected.

C. Marbling scores are depressed by treatment with  $\beta$ -adrenergic agonists.

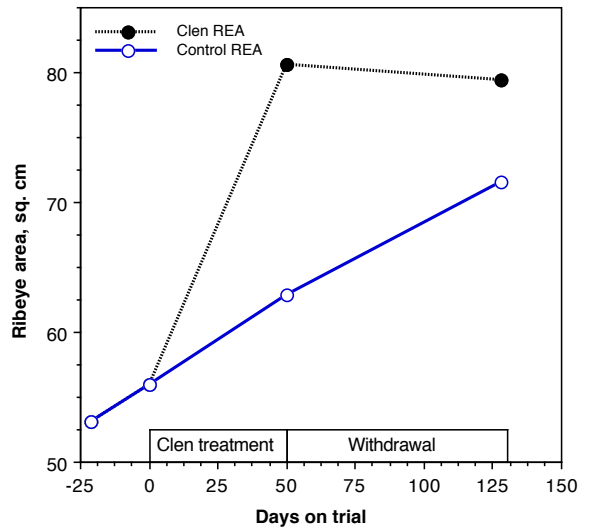
1. Cannot be reversed by extended withdrawal from treatment.
2. Results in the loss of one full quality grade.

## D. Meat tenderness is decreased.

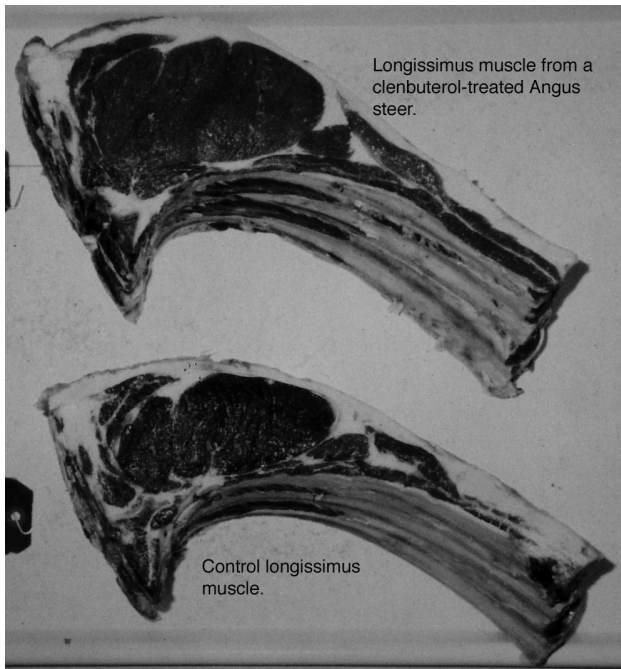
1. Cannot be reversed by extended withdrawal from treatment.
2. Cannot be reversed completely by CaCl<sub>2</sub> infusion.
3. There is little increase in myofibrillar fragmentation index, or decrease in Warner-Bratzler shear force, with aging of longissimus muscle from treated animals.



Changes in live weight in control Angus steers and in Angus steers fed clenbuterol for 50 d.



Changes in ribeye area in control Angus steers and in Angus steers fed clenbuterol for 50 d.



**TABLE 6.6 EFFECT OF CIMATEROL ON MUSCLE FIBER TYPE COMPOSITION IN YOUNG FRIESIAN BULLS.**

Fiber Type (%)	Control	Treated	% Change
Type 1	24.0	20.4	-15
Type 2A	24.2	8.6	-65
Type 2B	51.7	71.1	+38

Vestergaard *et al.* (1994) JAS 72:2298.

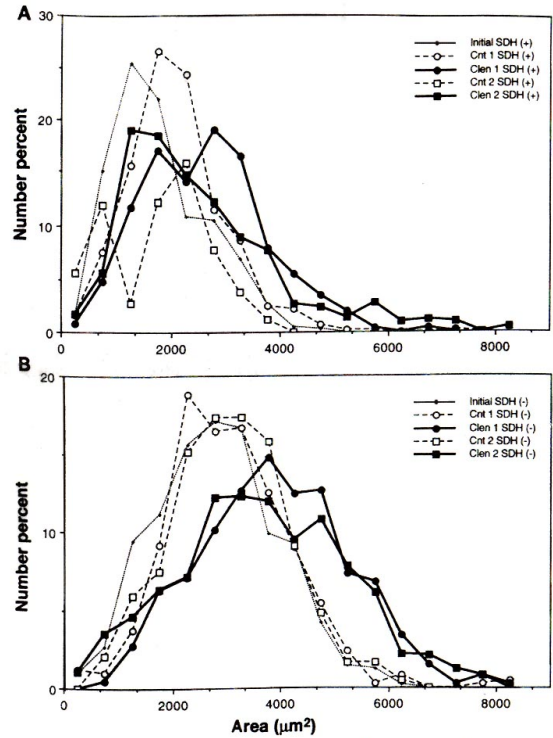
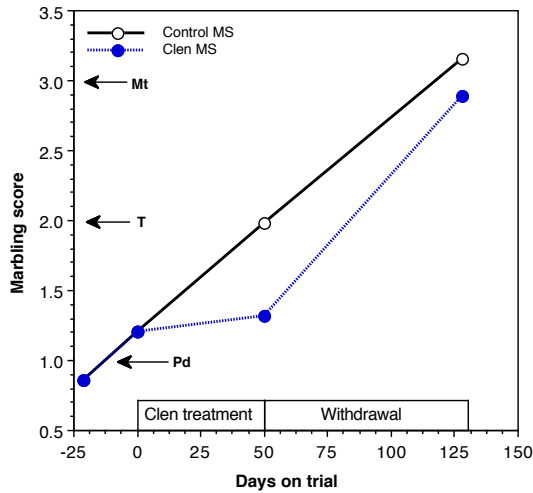
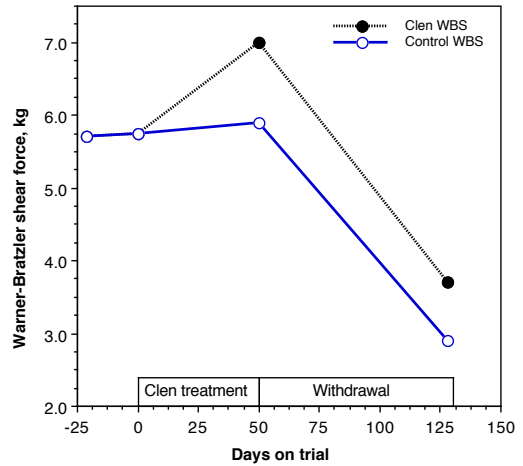


Fig. 5. Cross-sectional area distributions of longissimus dorsi myofibers from control and clenbuterol-treated steers. A: area distributions of succinic dehydrogenase-positive [SDH(+)] myofibers from initial group of steers; from control steers at 50 (Cnt 1) or 128 days (Cnt 2) on trial, and from steers treated with clenbuterol for 50 days (Clen 1) or after 78 days withdrawal (Clen 2). B: area distributions of SDH-negative [SDH(-)] myofibers. Each data point represents mean for 8 animals/treatment and time period.

**Clenbuterol increases the cross-sectional area and proportion of type IIB muscle fibers.**



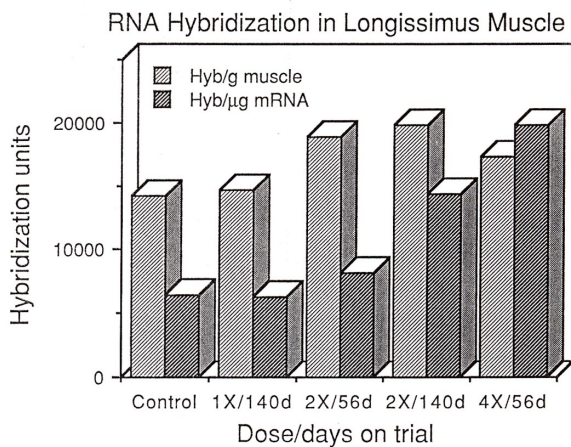
Changes in marbling score (MS) in control Angus steers and in Angus steers fed clenbuterol for 50 d.



Changes in Warner-Bratzler shear force (WBS) in control Angus steers and in Angus steers fed clenbuterol for 50 d.

## II. Mechanisms

- A. Myofibrillar protein synthesis increased (should have no effect on tenderness).
- B.  $\mu$ -Calpain and m-calpain activities increased slightly. (Less autolysis?)
- C. Calpastatin activity is doubled.



Expression of myosin light chain-1 in longissimus muscle of steers fed ractopamine at different concentrations and durations.

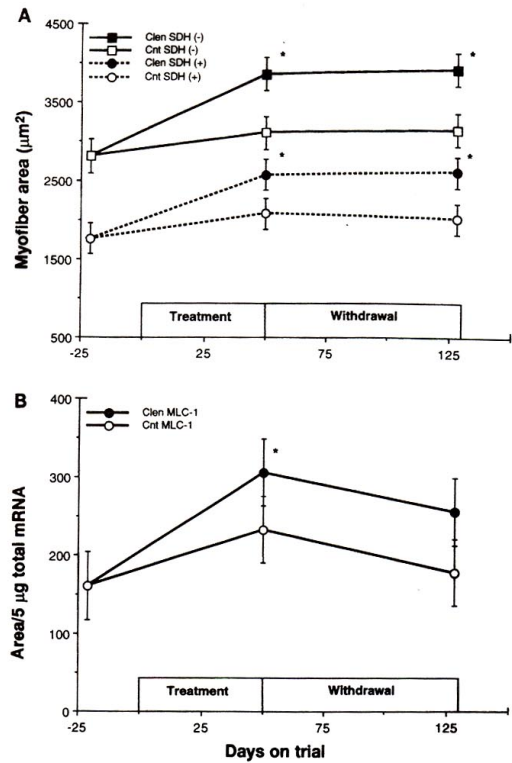


Fig. 6. Changes in longissimus dorsi myofiber cross-sectional areas and MLC-1<sub>f</sub> mRNA amount of control and clenbuterol-treated steers. A: each data point represents mean for 8 animals/treatment and time period for SDH-positive and -negative fibers. Vertical bars, SE for each myofiber type, averaged across treatment and time period. B: mean laser densitometric areas of slot blots of 5  $\mu$ g total RNA from bovine longissimus dorsi muscle hybridized to bovine MLC-1<sub>f</sub> cDNA clone. Each data point represents mean for 7 animals in initial group and 8 animals per subsequent treatment and time period. Control (Cnt MLC-1) and clenbuterol (Clen MLC-1) groups were compared with initial group with two-tailed Student's *t*-test; \*  $P < 0.05$ .

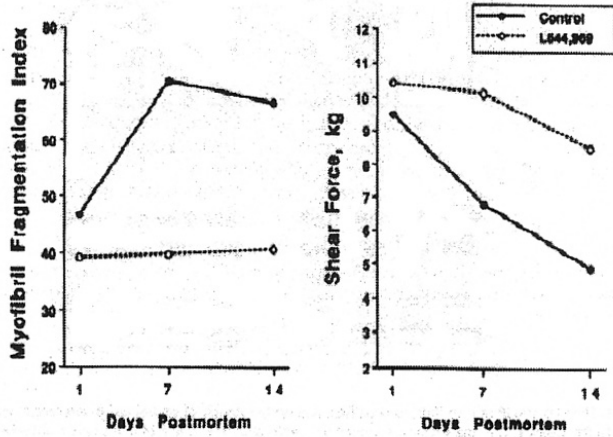


Figure 1. Effects of postmortem storage and  $\beta$ -adrenergic agonist (L-644,969) feeding on the shear force and myofibril fragmentation index (MPI) of longissimus muscle in wether lambs. The SE of the interaction were .8 and 2.9 for shear force and MPI, respectively.

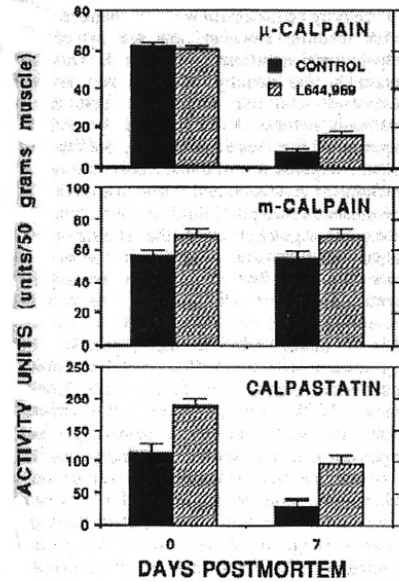
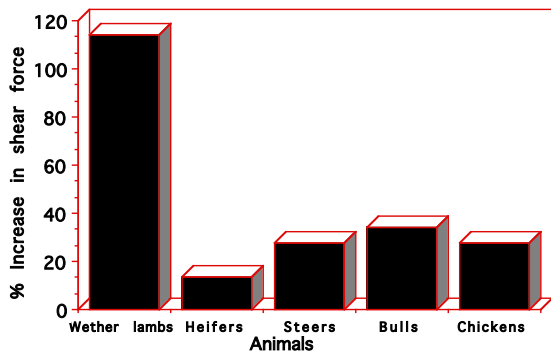
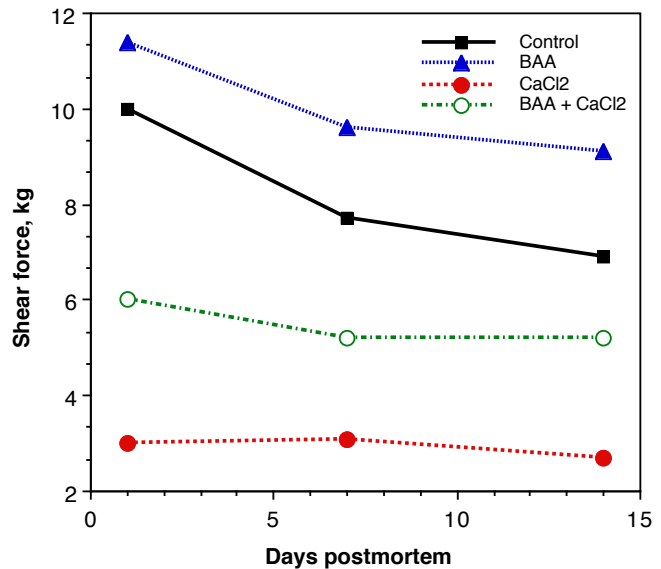


Figure 3. The  $\mu$ -calpain, m-calpain, and calpastatin activity (total activity/50 g of muscle) isolated from longissimus muscle of control and  $\beta$ -adrenergic agonist (L-644,969)-fed lambs immediately after slaughter (d 0) and after 7 d of postmortem storage.



Effects of  $\beta$ -adrenergic agonists on shear force values of meat from wether lambs, heifers, steers, bulls and chickens. Data are expressed as percentage change from control for clenbuterol-fed lambs, heifers and steers and cimaterol-fed bulls and chickens. Significant increases in shear force were observed in all experiments.

Effect of L-644,969 and calcium chloride infusion on lamb meat tenderness



Calcium chloride infusion reduces shear force in control and  $\beta$ -adrenergic agonist-fed sheep.