EFFECTS OF DEXAMETHAZONE INJECTIONS ON PERFORMANCES IN FATTENING CATTLE

L. Istasse, E. Rommel, C. Van Eenaeme, B. Buts, P. Baldwin, M. Gielen, D. Demeyer and J.M. Bienfait
Fac. Méd. Vét., rue des Vétérinaires, 45 - 1070 Bruxelles - Belgium
Fac. Landbouwwetenshappen, Proehoevst, 10-12 - 9230 Melle - Belgium

Short title : Dexamethazone in fattening cattle.

INTRODUCTION

Growth promotors have been widely used in livestock production. They are either feed additives, anabolic agents and more recently ß-agonists. Some of them are derived from drugs used in human or veterinary medicine. They increase meat production by improvement of live weight gain, feed conversion ratio or carcass quality. Glucocorticoids are generally considered as growth inhibiting substances. Generally the data were obtained from "in vitro" experiments or experiments in which large doses often well over 1 mg/kg body weight were injected.

The present experiment was carried out to assess the effects of lower doses of dexamethazone on performances in fattening cattle.

MATERIALS AND METHODS

Animals

Two identical cattle twins obtained from a splitted embryo were used. They were from the Belgian White Blue breed - dual purpose type. They were maintained from birth in similar environmental conditions. They were 14 months old on the beginning of the experiment.

Experimental design

The experiment was divided in 2 periods each of 28 days. During the first period, both animals were used as control. During the second period, one animal received 4 intramuscular injections of 12 mg Dexamethazone (Dexafort-Intervet) as a mixture of 5.28 mg phosphate and 10.68 phenylpropionate at a rate of one injection every 7 days.

Measurements

The amounts of feed given was weighed out daily. The liveweight was recorded once weekly. Nitrogen balance was carried out on the last week of the first period and on week 3 of the second period. Blood samples were withdrawn twice a week before the morning feeding for evaluation of blood formula and for determination of glucose, urea, creatinine, free amino nitrogen, non esterified fatty acids and total cortisol. Blood samples were also taken every 20 minutes over a 24 hour period on the last day of the second period. Growth hormone was measured in all the samples while insulin and total cortisol were determined every 2 hours.

The liveweight of the animals and the weight of the warm and cold carcasses were recorded at the slaughterhouse. The 7 to 9 ribs were removed to be dissected in order to separate lean meat, fat and bones. A sample of the longissimus dorsi was taken for chemical analyses and to assess meat quality. Samples from the liver and from the adrenal gland

were immediately placed in 0.10 buffered formalin for histological evaluation.

RESULTS

The performances of the 2 growing fattening bulls are given in Table 1. Each period lasted for 28 days. The initial live weight on the beginning of period 1 (control period for both bulls) was 526 kg respectively. The total liveweight gain was about 27 kg and was quite similar in both animals. During period 2, the control bull gained 37 kg while the liveweight gain in the treated animals was much higher at 64 kg corresponding to 2.29 kg/d. Figure 1 gives the total live weight gain over the whole experiment. The live weight gain of the treated animal was improved directly after the first injection, remained sustained after the second and the third but tended to decrease after the fourth injection. Total feed intake was similar during period 1 and averaged 10.0 kg dry feed per day. During period 2, there was an increase in feed intake with both animals, the increase being higher with the treated bull. The feed conversion ratio was very low at 4.8 kg/kg in the treated bull. The nitrogen retention did not differ in period 1 while in period 2 there was a trend for an decrease in the treated animal. The final liveweight was 596 and 615 kg for the control and the treated bull respectively (Table 2). During the transport to the slaughterhouse, the weight loss was 27 and 22 kg corresponding to 4.5 and 3.6%. The weight of the warm carcass was greater (359 kg) in the dexamethazone treated bull than in the control animal (352 kg). The same trend was observed for the cold carcass. The killing-out percentage calculated from the weight of the cold carcass and the weight at slaughter was 59.1 and 58.0 in the control and the treated bull respectively. There were no differences in the proportion of lean meat or adipose tissue in the carcass.

The characteristics of the longissimus dorsi are given in Table 3. The dexamethazone treatment resulted in a reduction in water losses both at packing and at cooking and in the water holding capacity. There was trend for an increase in the shear force. The main differences between the protein composition at muscular fiber levels were increases in troponine and 34.5 kD components and an decrease in 30 kD components in the injected bull. The chemical composition of the longissimus dorsi of the treated animal was characterized by a lower dry matter content, a slightly lower crude protein content and a much higher ether extract content.

The effects of dexamethazone on the blood cells are given in Table 4. The injections did not change to a large extent the number of white and red cells. By contrast, dexamethazone reduced the proportion of lymphocytes and eosinophils and increased the proportion of neutrophils. The histological evaluation did not show any difference between treated and untreated animals in the adrenalgland and the liver. Many glycogen granules were found in the treated bull when the slices from the liver were stained with Pass.

The effects of dexamethazone injections on plasma samples taken twice weekly are given in Figure 2. In the treated bull, plasma glucose concentration (Figure 2a) was higher the day after each injection than 4 days later. One has to note that the extent of the increase was reduced with the consecutive injections. Urea concentration (Figure 2b) was also higher the day after the injections with the exception of the third. By contrast to the glucose pattern, urea concentration remained higher until the end of the experimental period. Creatinine concentration (Figure 2c) increased constantly in the treated bull while it did not

show any particular pattern in the control animal. There was a trend for alpha amino nitrogen concentration to be lower in the treated animal (Figure 2d). Before treatment and during the first 3 weeks the concentration in non esterified fatty acids was similar for the 2 animals. The concentration decreased to a large extent in the treated animal during the final part of the experiment (Figure 2e). Although the concentration of total cortisol differed slightly between the 2 animals on day 0, total corisol concentration decreased and remained low in the treated bull while it tended to increase in the control animal (Figure 2f).

From the plasma samples taken over a 24 h period on the end of period 2 it appeared that insulin was higher (Figure 3a) and total cortisol lower (Figure 3c) in the treated bull than in the other animal. By contrast there were no differences in the pattern of growth hormone between the 2 animals (Figure 2b). It was of interest to note that no peaks were detected in the growth hormone curves.

DISCUSSION

Dexamethazone obviously improved live weight gain to a large extent (2.29 vs 1.32 kg/day). The increase in carcass weight was much lower since the cold carcass of the treated bull was only 8 kg heavier than that of the control. Such a difference suggested that part of the increase in weight occured at the gastro-intestinal tract level either as increase of gut content indicated by higher food intake or increase in weight of glands and gastro-intestinal tract walls. Since there were no treatment effects on the composition of the carcass, the overall effect was an increase of about 5 kg of lean meat and 3 kg of adipose tissue. The present results therefore did not agree with the generally accepted concept that "glucocorticoids are growth inhibiting steroids" (Sharpe et al., 1986).

Meat composition was affected as indicated by the characteristics of the longissimus dorsi. There was a reduction in dry matter and crude protein content. Assuming that the effect of the treatment was similar in all the carcass muscles, the carcass of the treated animal would have contained 3 kg crude protein less than the control bull (344 x 0.714 x 0.231 x 0.81 vs 336 x 0.716 x 0.245 x 0.83).

Dexamethazone treatment resulted also in a higher water retention in the longissimus dorsi indicated by a higher water holding capacity and a reduction of water losses both at packing and at cooking. Thyrostatic drugs were used some years ago to stimulate meat production. There was also an increase in the water retention but the meat was pale and soft with high water losses (Vanschoubroek, 1963). In the case of dexamethazone, water appeared to be well fixed to the tissues. The treatment increased also the ether extract content of the longissimus dorsi. This effect was opposite to that found with anabolic agents (Lambot et al., 1983; Istasse et al., 1988) and with ß-agonist (Boucqué et al., 1987).

Plasma glucose rised immediately after the injection and dropped 3 days later; it was generally higher than in the control bull. Plasma free amino nitrogen tended to be lower in the treated animal. Such changes could be associated with a possible sparing effect of glucose for glycogen production in the liver as proposed by Baxter and Forsham (1972) and indicated by the histological evaluation.

At hormonal level, dexamethazone treatment increased insulin concentration, did not change growth hormone and reduced total cortisol concentration. Although the histological evaluation did not reveal any difference between the 2 adrenal glands, the reduction of total cortisol

could be considered as a negative feed back effect on the adrenal gland. According to Toutain et al. (1982), the negative effect on the adrenal gland could last for a period longer than one month. It should however, be noted that in the present study the doses used were relatively low since the treated bull received 4 times 12 mg corresponding to about 0.02 mg/kg body weight. The dosis used with laboratory animals were much higher. For exemple, Kelly and Goldspink (1982) injected rats with 2.5 mg/kg body weight which was about 125 times higher than with the treated bull. The doses used were also lower than 30 mg suggested on the notice of the producer.

REFERENCES

Baxter, J.D. & Forsham, P.H. (1972). American Journal of Medicine **53**, 573-589.

Boucqué, C.V., Fiems, L.O., Sommer, M., Cottyn, B.G. & Buysse, F.X. (1987). Beta-agonistq and their effects on animal growth and carcass quality. pp. 93-105. J.P. Hanrahan editor. Elsevier Applied Science.

Kelly, J.F. & Goldspink, D.F. (1982). Biochemistry Journal **208**, 147-151.

Istasse, L., Evrard, P., Van Eenaeme, C., Gielen, M., Maguin-Rogister, G. & Bienfait J.M. (1988). Journal of Animal Science **66**, 1212-1222.

Lambot, O., Bienfait, J.M., Van Eenaeme, C., Istasse, L. & Gielen, M. (1983). Annales de Médecine Vétérinaire **127**, 103-114.

Sharpe, P.M., Haynes N.B. & Buttery, J.P. (1986). Control and Manipulation of animal growth. Buttery, J.P., Lindsay,D.B. & Haynes, N.B., pp. 201-222. Butterworths.

Toutain, P.L., Brandon, R.A., Alvinerie, M., Garcia-Villar, R. & Ruckebusch, Y. (1982). Journal of Veterinary Pharmacology and Therapy **5**, 33-43.

Vanschoubroek, F. (1968). Tijdschrift van Diergeneekunde **93**, 679-691.

Table I
Animal performances of control bull (bull 1) and a bull injected four times during period 2 with 12 mg dexamethazone (bull 2).

	Period 1		Period 2	
	Bull 1	Bull 2	Bull 1	Bull 2
Total live weight gain (kg)	29	25	37	64
Average daily gain (kg/d)	1.04	0.89	1.32	2.29
Feed intake (kg/d)	10.0	10.0	10.6	11.0
Feed conversion ratio (kg/kg)	9.7	11.2	8.0	4.8
Nitrogen balance (g/d)	54.9	55.7	58.5	50.0

Table II
Carcass traits of a control bull and a bull injected four times with 12 mg dexamethazone.

	Control bull	Injected bull
Final live weight (kg)	596	615
Slaughter weight (kg)	569	593
Warm carcass weight (kg)	352	359
Cold carcass weight (kg)	336	344
Killing-out percentage (%)	59.1	58.0
Boneless carcass		
Lean meat (%)	71.6	71.4
Adipose tissue (%)	28.4	28.6

Table III
Some characteristics of the longissimus dorsi in a control bull and a bull injected four times with 12 mg dexamethazone.

	Control bull	Injected bull
Water losses		
- at packing (%)	10.8	6.7
- at cooking (%)	30.9	24.8
Water holding capacity (cm^2)	32.2	29.9
pH	5.8	5.6
Shear force (N)	26.4	29.4
GOFO	74.67	73.83
Characteristics of muscular fiber		
- sarcomer lenght	1.86	1.92
- titine	33.5	33.2
- filamine	1.0	1.6
- troponine	0.6	2.3
- 30kD	17.6	13.3
- 35.4 kD	5.2	15.0
Chemical composition		
- dry matter (%)	24.5	23.1
- crude protein (% of dry matter)	83.0	81.0
- Ether extract (% of dry matter)	6.1	12.5
- Ash (% of dry matter)	4.2	4.1

Table IV
Effects of dexamethazone injections on blood cells.

	Control bull	Injected bull
White blood cell count (10^9/l)	11.3	12.2
Lymphocytes (%)	53.4	29.7
Neutrophils (%)	35.3	66.5
Eosinophils (%)	9.9	2.2
Monocytes (%)	0.8	1.3
Basophils (%)	0.5	0.1
Red blood cell count (10^{12}/l)	7.27	6.93

Figure I
Total liveweight gain in the control (●) and in the dexamethazone (+) treated bull. Arrows indicate the injection times.

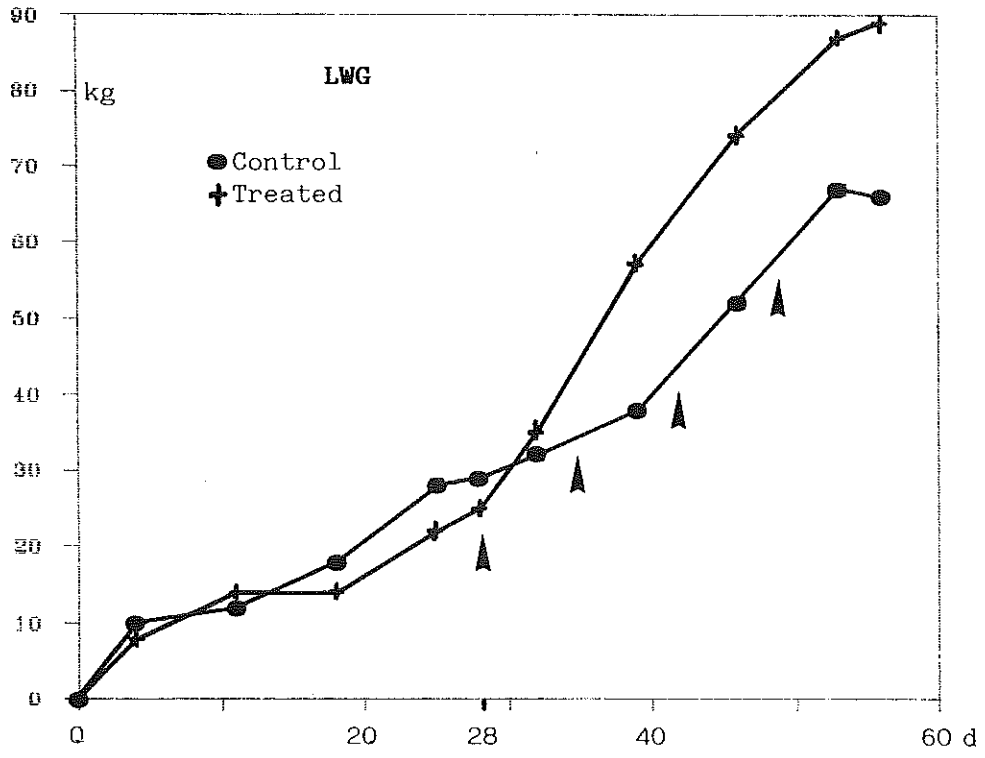

Figure II

Concentrations of glucose (a), urea (b), creatinie (c), alpha-amino-nitrogen (d), non esterified fatty acids (e), and total corisol (f) in the plasma of the control (•) nd in the dexamethazone treated bull(+)Arrows indicate the injection times.

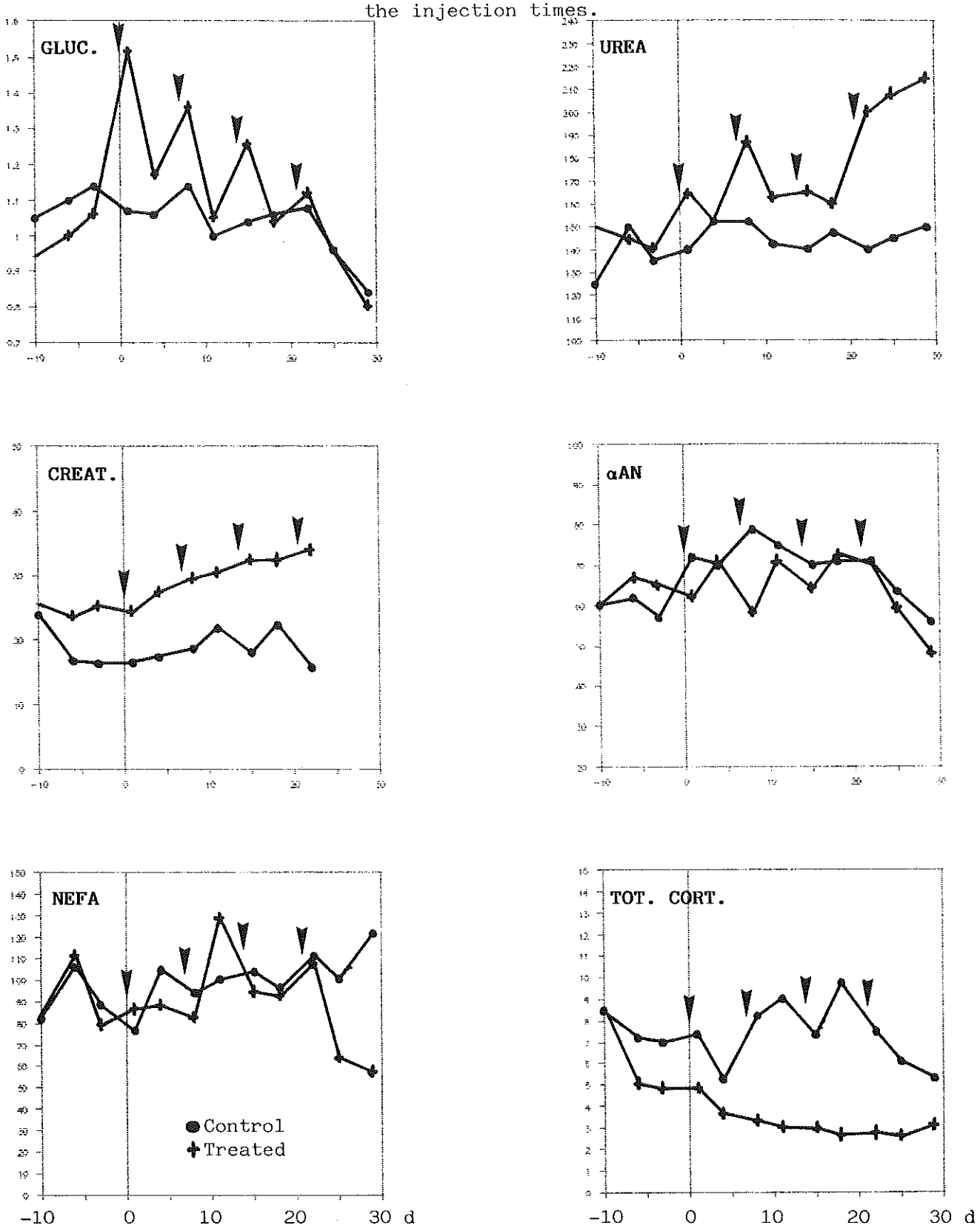

Figure III

Concentrations of insulin (a), growth hormone (b) and total cortisol (c) in the plasma samples taken over a 24 hour period in the control (●) and in the dexamethazone treated bull (+). Arrows indicate feeding time.