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Nutritional Influence on Reproductive Efficiency in Beef Cows

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CHAPTER 4

EFFECT OF MONENSIN ON POSTPARTUM INTERVAL TO FIRST ESTRUS AND SERUM LH RESPONSE TO 0, 1, 2 or 4 MG ESTRADIOL-17β AT 21 DAYS POSTPARTUM.

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ABSTRACT

A 2x4 factorial design was used to evaluate the effects of monensin (0 vs 200 mg) and estradiol-17β (E2) dose (0, 1, 2 vs 4 mg) on postpartum interval (PPI) to first estrus and on serum LH release at 21 days postpartum. Forty-eight spring calving Brangus cows were randomly stratified by calving date and sex of calf into two feeding groups within 24 hr of calving. Each group received 2.7 kg/head/day of a milo:cottonseed meal (4:1) mixture containing either 0 or 200 mg monensin. Coastal bermuda grass hay and water were available ad libitum. During the period of E2 treatment and bi-hourly blood sampling, suckling was controlled at 6-hr intervals.

Mean cow weight and body condition score within cell changed less than 23 kg and 0.5 points, respectively, from day 1 to day 21 postpartum and were unaffected by treatment ($P>0.10$). PPI was reduced ($P<0.01$) and proportion of cows exhibiting estrual behavior by 85 days postpartum was increased ($P<0.05$) by treatment with 200 mg monensin and unaffected by E2 dose. Monensin fed cows had a longer ($P<0.05$) interval to LH response (ILH) and to peak LH (ILHP) at the 4 mg E2 dose. Monensin had no effect ($P>0.10$) on LH variables at 0, 1 or 2 mg E2.

INTRODUCTION

Maintenance of an annual calving interval in a beef herd has been

recognized as a major obstacle in efficient beef production (1, 2). Increased peripartum energy intake has been demonstrated to profoundly affect improvement of postpartum reproductive performance (3, 4). While maximized reproductive performance has been less cost-effective in certain commercial beef production situations, strategic supplementation has improved efficiency of production and reproductive performance in range cows.

Energy intake has been the primary dietary nutrient lacking in postpartum cow nutrition (4, 7). Monensin, an ionophore antibiotic, has reduced maintenance costs of lactating beef cows (8, 9) by reducing hay consumption without reducing performance. McCartor et al. (10) confirmed an earlier report by Moseley et al. (11) by establishing that monensin decreased age at puberty in heifers similar to the decrease incurred by increased levels of grain in the diet. Other effects of monensin on improved gonadal, pituitary and hypothalamic-pituitary response to exogenous hormonal stimulation have been documented in beef heifers (1, 12, 13, 14). Monensin has reduced postpartum interval and altered pituitary response to exogenous GnRH in suckled beef cows (16). However, several researchers have reported that monensin exerted little or no effect on certain reproductive parameters in nonlactating cows (17) and suckled cows exhibiting high fertility on control diets (7). To enhance the current understanding of the effects of monensin on reproductive performance of suckled beef cows, the following study was conducted.

EXPERIMENTAL PROCEDURE

Forty-eight pluriparous Brangus cows were randomly stratified by calving date and sex of calf into a 2x4 factorial design yielding six

animals per cell. All cows received Coastal bermuda grass hay ad libitum and approximately 2.7 kg of a milo:cottonseed meal mixture (Table I) with either 0 mg (C) or 200 mg (M) monensin/head/day.

TABLE I. DAILY COMPOSITION OF EXPERIMENTAL DIETS.

Ingredient	Quantity	
	Control	Monensin
Monensin	0 mg	200 mg
Milo (IFN 4-05-643)	2.27 kg	2.27 kg
Cottonseed meal (IFN 5-01-630)	0.45 kg	0.45 kg
Coastal bermudagrass hay (IFN 1-09-239)	ad libitum	ad libitum

The levels of monensin (0 or 200 mg) and E2 dose (0, 1, 2 or 4 mg) were designated as main effects. Calf weight, calf sex, calf identification,cow weight and cow body condition score were recorded within 24 hr of parturition. Cow-calf pairs were placed in the appropriate feeding dry lots on the day following parturition. Animals assigned to different E2 dose levels were combined within each diet treatment. At 20 days postpartum, cow-calf pairs were moved to a smaller lot adjacent to the handling facilities. Cow weights, cow body condition scores, and calf weights were recorded, and a controlled suckling regimen was instituted.

Calves were allowed access to their dams for 2 hr at 6-hr intervals to approximate ad libitum suckling with adequate control over frequency of the suckling stimuli. At 0800 hr on day 21 postpartum, a single IM injection of either 0, 1, 2, or 4 mg of E2 in 2 cc corn oil was administered. Blood samples were collected via tail vessel puncture at 2 hr intervals for 48 hr after the E2 injection. A jugular venous blood sample was collected if a tail vessel sample was not obtained within 5 min. Cow-calf pairs were returned to the

appropriate feeding group after blood sample collection. All blood samples were processed to yield serum and stored at -20°C until a validated radioimmunoassay (RIA) for LH content (18) could be performed. Visual detection for behavioral estrus, aided by the presence of sterile bulls equipped with chin ball marking harnesses, was conducted twice daily. After the first observed estrus, cow-calf pairs were removed from treatment feeding lots and placed on pasture with fertile bulls.

Postpartum interval was calculated from estrous detection records. Cow weights and cow body scores were compiled from data collected on day 1 and 21 post-partum. Semiconfinement resulted in bacterial diarrhea in several calves in both feeding groups. Therefore, the calf weight change data were considered to be invalid and excluded from further analysis.

Interval from E2 injection to initial LH response (ILH), interval to peak LH (ILPH), duration of LH peak (DLHP), LH peak height (LHP), and area under LH peak (LHA) were calculated for individual cows and used to compute cell means. All previously described data were analyzed by a factorial analysis of variance (19). A chi-square test was used to evaluate the effect of the main effects on proportion of cows in estrus by 85 days postpartum.

RESULTS AND DISCUSSION

Cow body weights and condition scores were similar between treatments at the initiation of the trial and were unaffected (P>0.10) by diet, E2 dose or day postpartum. The ability of the C diet to maintain cow weight and condition score was partially responsible for the C cows achieving an average postpartum interval of 86 days.

However, the addition of 200 mg monensin to the diet resulted in a reduction (P<0.01) of the postpartum interval to 65 days and increased the proportion of cows expressing estrus by 85 days postpartum (Table II). These results support the previously reported effects of monensin to improve postpartum estrous response of suckled beef cows

TABLE II. EFFECT OF MONENSIN ON POSTPARTUM INTERVAL TO ESTRUS (PPI).

Diet	n	PPI	Proportion (%) with PPI less than 85 days
Monensin	24	65 ± 5[a]	19/24[c] (79%)
Control	24	86 ± 6[b]	12/24[d] (50%)

[a,b]Mean (± S.E.) with different superscripts differ (P<0.01) (t-test).
[c,d]Proportions with different superscripts differ (P<0.05) X^2.

in marginal body condition receiving minimum supplemental grain (90% NRC) from parturition to first estrus (16). The cows in our study received only Coastal bermuda grass hay and liquid protein supplement prepartum. Prepartum management or level of milk production, or both, may have contributed to the discrepancies between results from this and other reports (7, 17).

While postpartum interval was shortened (P<0.01) by the addition of monensin to the diet, serum LH response to 0, 1, or 2 mg E2 (Figures 1, 2, 3) was unaffected by diet. Serum LH in M and C cows receiving 0 mg E2 was unchanged throughout the sampling period (Figure 1). Only ILH and ILHP parameters from M cows challenged with 4 mg E2 (Figure 4) were altered (P<0.01; Table III). Randel et al. (14) observed an enhanced LH response of the prepuberal pituitary to exogenous E2 in monensin-fed beef heifers. The basic mechanisms contributing to the differential response between the prepubertal

heifer and postpartum cow remain obscure. The effects of suckling and lactation on pituitary LH release is a major area for continuing research. Additionally, the mechanism by which E2 elicits an LH response has been described as a qualitative system by Short et al. (20) and Forrest et al. (21). The difference in LH response to 1, 2, or 4 mg E2 in the current study and a previous report (22) provide evidence for a quantitative role of exogenous E2 in LH release or an interaction between suckling and exogenous E2 in the release of LH, or both, in the intact postpartum beef cow.

The physiological inputs which modulate LH release in the bovine are diverse. Maturity, lactation, suckling, monensin and season have independently altered serum LH response to either endogenous or exogenous stimuli. Reports of monensin effects on LH release in response to GnRH (13) or E2 (14) in heifers vary from observations of similar parameters in lactating suckled or nonsuckled cows receiving GnRH (16) or our report of cows receiving E2. Mason and Randel (16) concluded that the effects of suckling and monensin on serum LH response to GnRH were independent and additive. Forrest (23) indicated effects of suckling on E2-induced LH surge similar to the data on monensin effects on E2-induced LH release in this research (Figure 5). The serum LH response to exogenous E2 following removal of the suckling stimuli (23) apparently altered in much the same manner as M treatment. Collectively, the data reported herein and by Forrest (23) present similar independent actions of monensin and suckling as in the single report of Mason and Randel (16). The reported effects of season (15), suckling (16, 22, 23) and monensin (16) presumably interact to modulate the endocrine status and response

of beef cows in this and other studies.

Inclusion of 200 mg of monensin in the diet of beef cows from calving through first estrus shortened postpartum interval to estrus effectively. This could be an economically sound management tool if a herd is supplemented during the postcalving period.

TABLE II. EFFECT OF DIET, E2 DOSE AND DAYS POSTPARTUM ON COW BODY WEIGHT.

Diet	Day PP	Cow body weight (kg) E2 Dose 0	1	2	4
Monensin	1	447 ± 13[a]	456 ± 13	452 ± 23	436 ± 18
	21	469 ± 18	467 ± 10	471 ± 32	430 ± 16
Control	1	443 ± 14	453 ± 17	458 ± 18	434 ± 12
	21	440 ± 18	458 ± 18	467 ± 19	451 ± 13

[a]Mean (± S.E.) n = 6.

TABLE III. ANALYSIS OF VARIANCE FOR EFFECTS OF DIET, E2 DOSE AND DAY POSTPARTUM ON COW CONDITION SCORE AND COW BODY WEIGHT.

Source	df	Mean square[a] CS	BW
Diet	1	1.04	231.26
E2 dose	3	.89	2830.54
Diet x E2 dose	3	1.08	720.73
Day PP (1 vs 21)	1	.17	2118.76
Day PP x diet	1	.26	168.01
Day PP x E2 dose	3	.02	75.73
Day PP x diet x E2 dose	3	.10	593.32
Error	80	1.36	1973.19

[a]CS = condition scores (1-9), BW (kg)

TABLE IV. ANALYSIS OF VARIANCE FOR EFFECTS OF DIET AND E2 DOSE ON POSTPARTUM INTERVAL TO ESTRUS (PPI).

Source	df	MS[a] PPI
Diet	1	5376.33**
E2 dose	3	384.58
Diet x E2 dose	3	551.50
Error	40	760.37

**P<.01.
[a]Mean square (days).

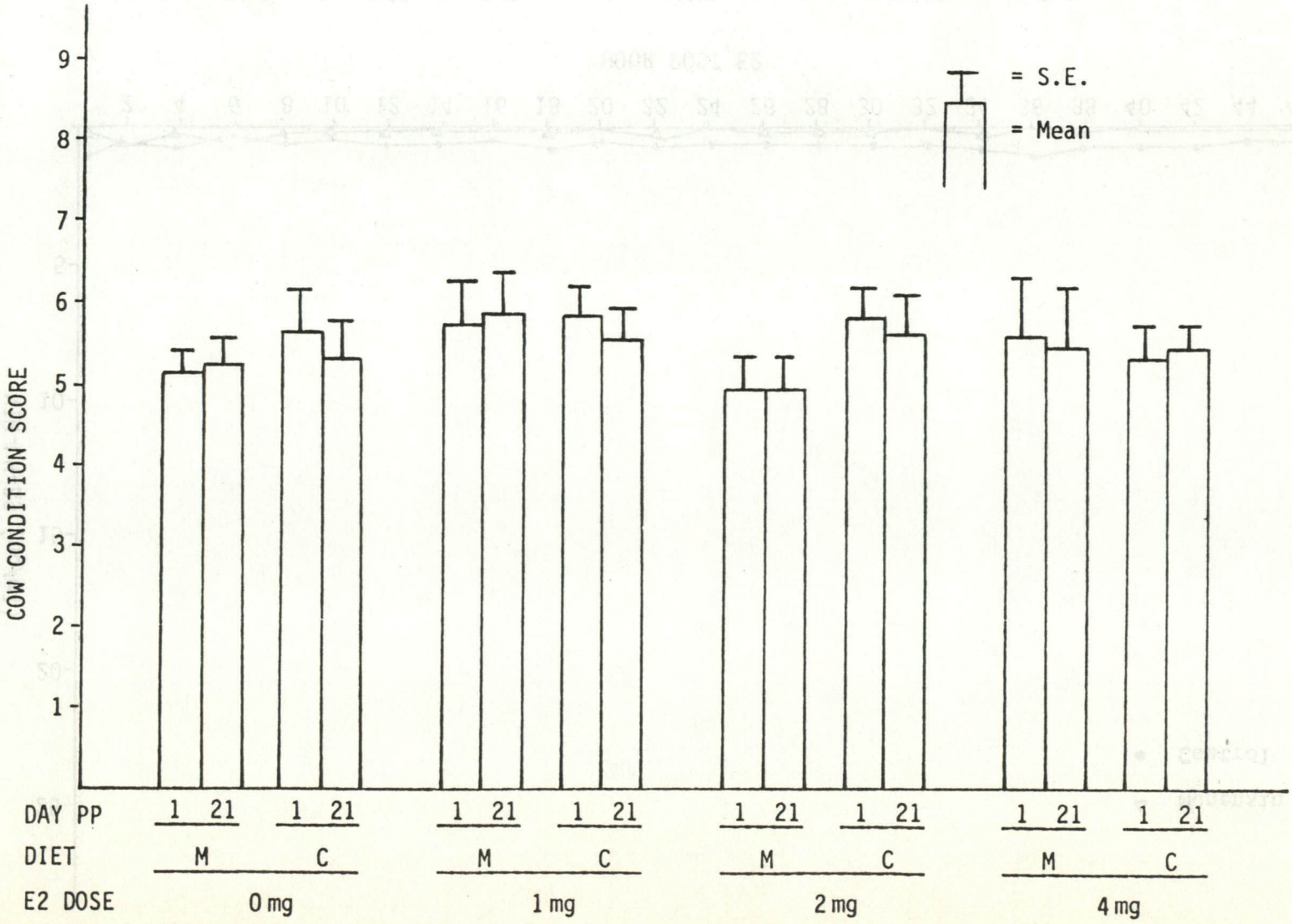

Figure 1. Effect of Diet, E2 Dose and Days Postpartum on Cow Condition Score

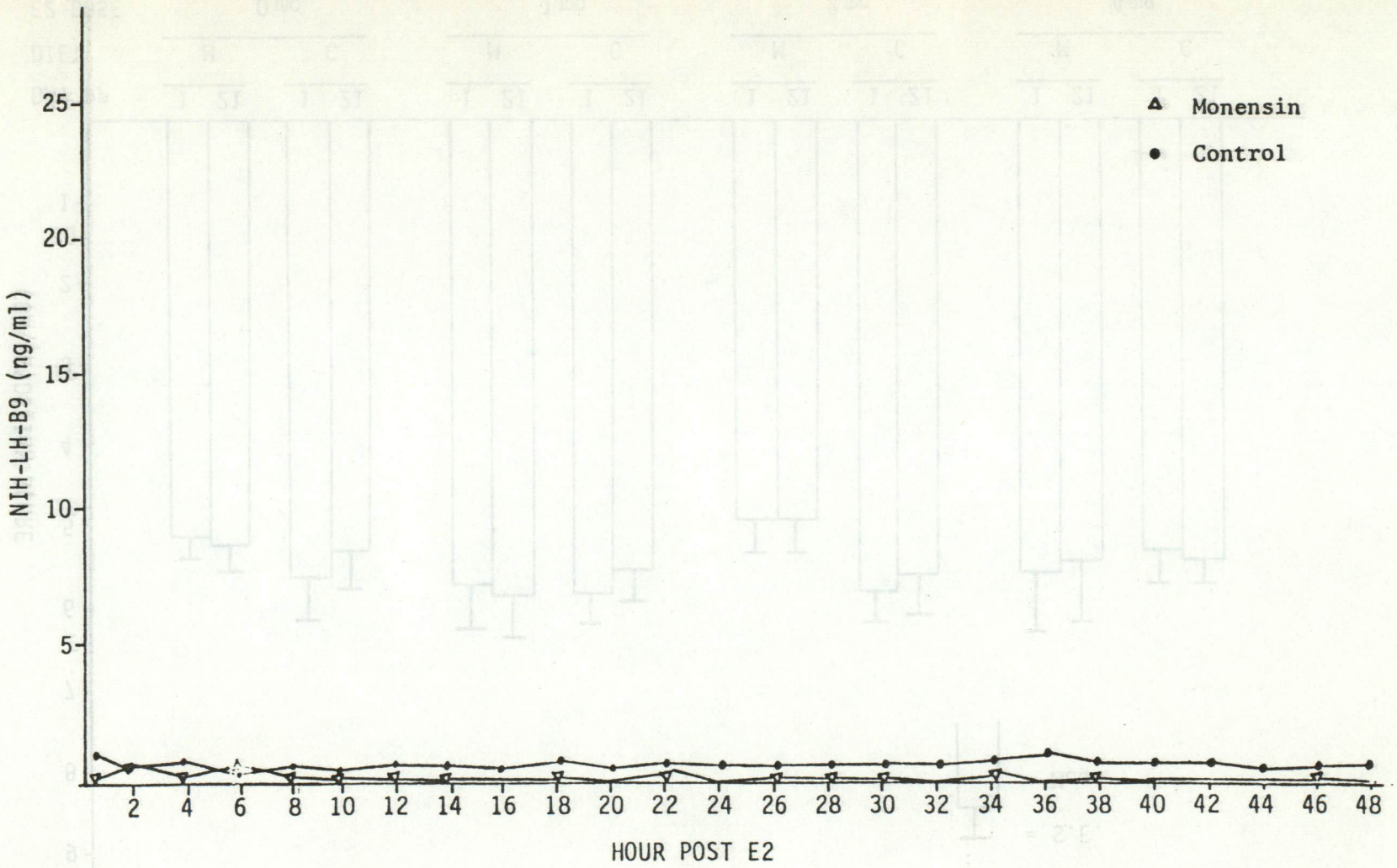

Figure 2. Effect of Monensin on LH Response to 0 MG Estradiol-17β.

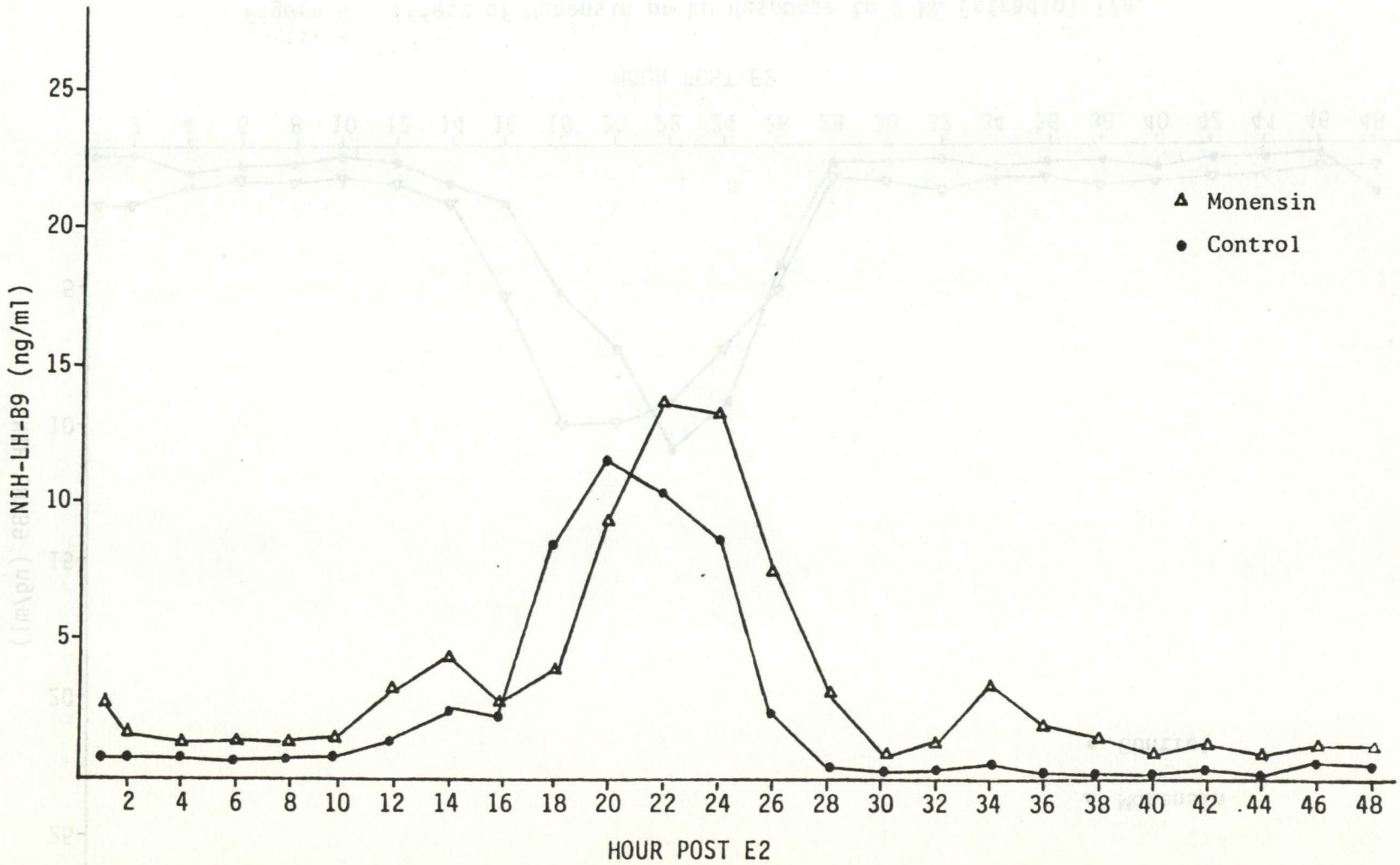

Figure 3. Effect of Monensin on LH Response to 1 MG Estradiol-17β.

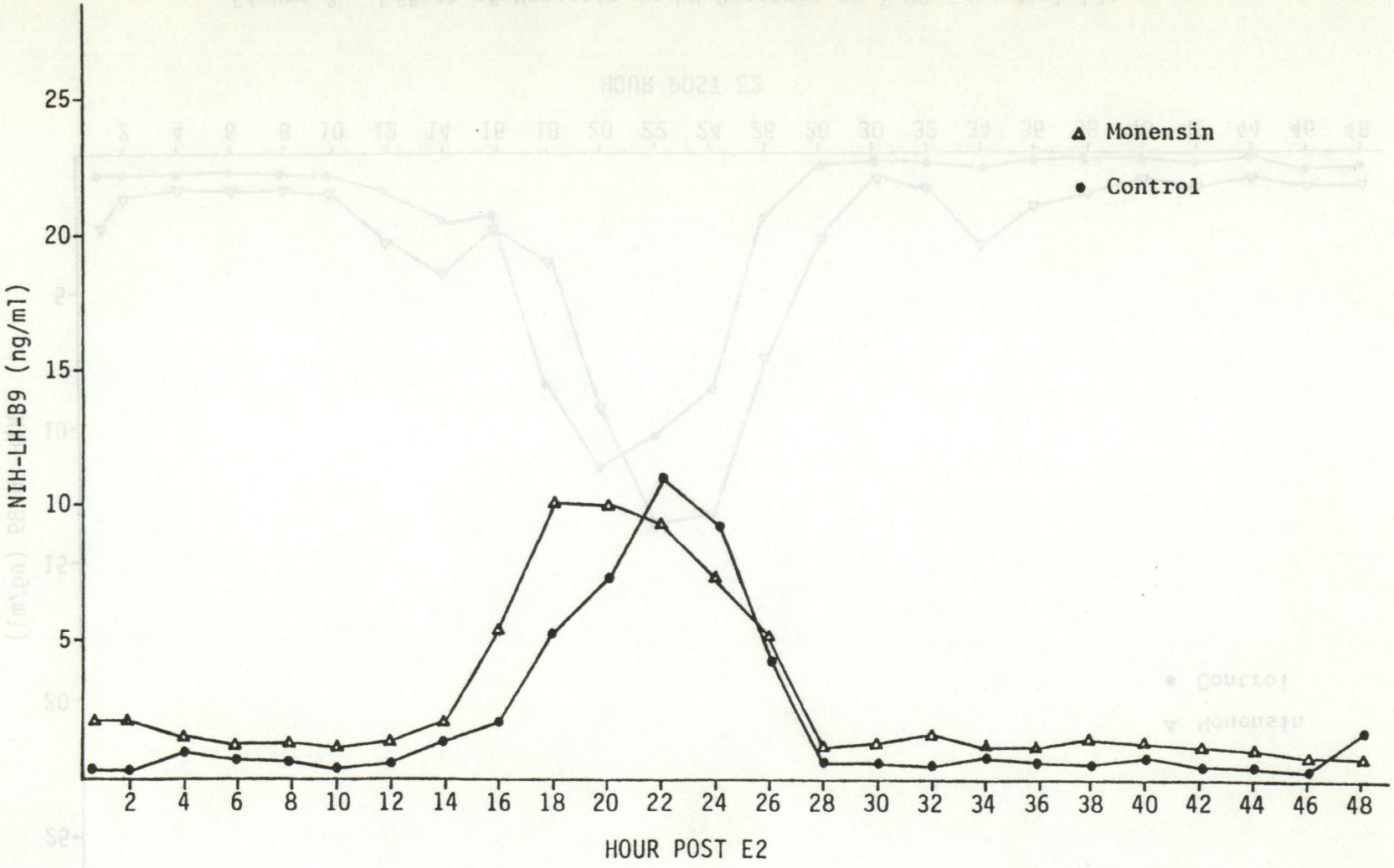

Figure 4. Effect of Monensin on LH Response to 2 MG Estradiol-17β.

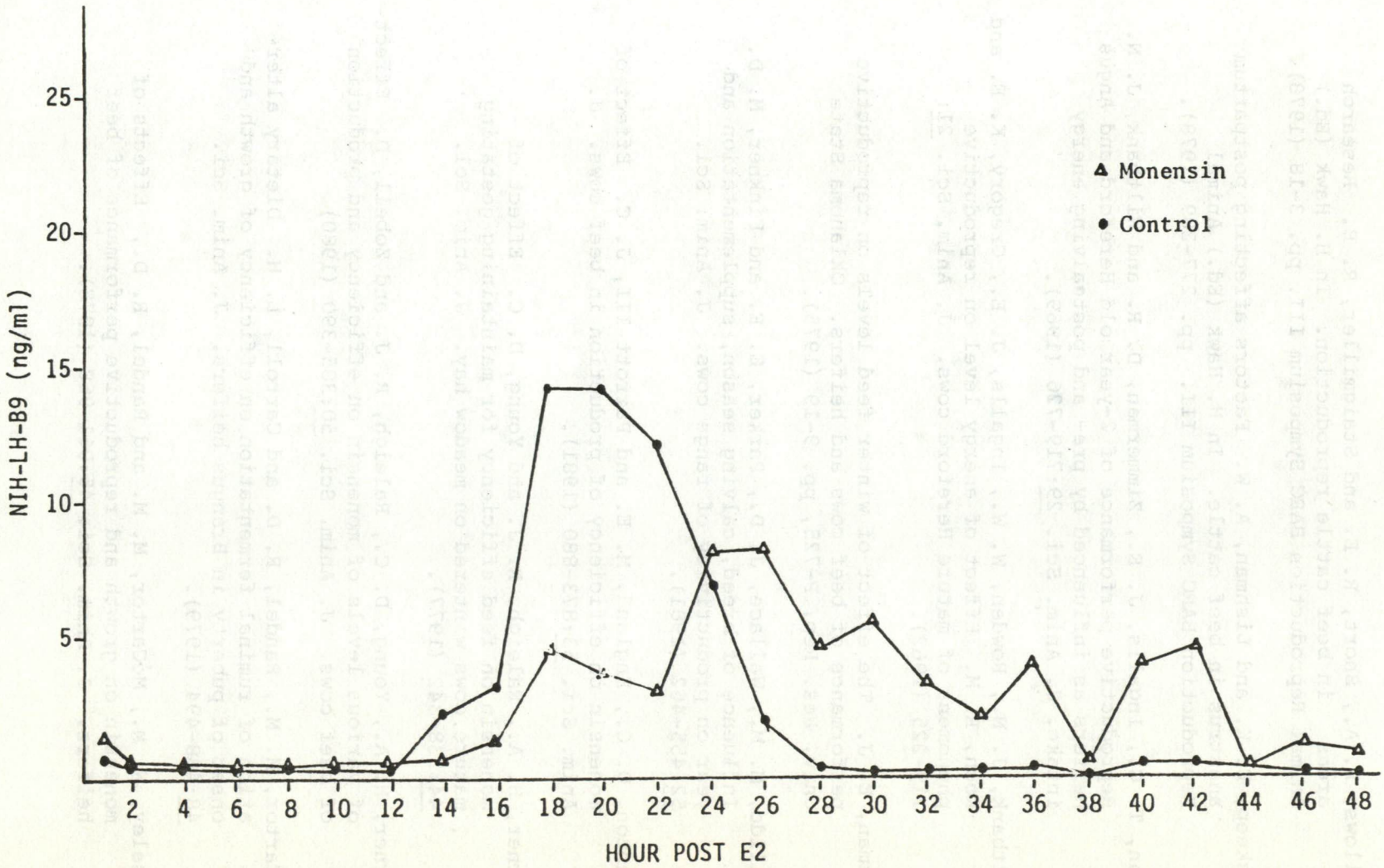

Figure 5. Effect of Monensin on LH Response to 4 MG Estradiol-17β.

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