Effects of Dietary Phosphorus Levels on Reproductive Efficiency in Dairy Heifers

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Story in Brief

Seventy-six heifers, 38 Holstein, 30 Ayrshire, 6 Guernsey, and two Jersey were used to study the effects of dietary phosphorus level on reproductive capacity. Length and regularity of estrous cycles, number of services required for conception, and percent pregnant were the factors considered. Marker bulls were used to aid in visual detection of estrus. All heifers were bred by artificial insemination. No differences were found between heifers fed minimum daily requirements for phosphorus, and those heifers fed supplemental phosphorus as far as estrus exhibition, services per conception, and pregnancies were concerned. Younger heifers required more services per conception and exhibited more erratic estrus cycles than did older heifers.

Introduction

There have been conflicting reports concerning the effect of phosphorus on reproductive efficiency. Phosphorus levels in the diet ranging from 0.16 to 0.4 percent have been suggested as the cause of problems varying from anestrous cows to increased number of services per conception. However, regular cycling and fertility has been found in cows who have shown other phosphorus deficiency symptoms.

Recommended phosphorus levels for growing heifers are 0.21 - 0.23 percent in the diet. Levels below 0.14 percent are generally considered to be low and conducive to reproductive problems.

The objective of this study was to investigate the relationship between dietary phosphorus levels and reproductive problems in dairy cattle. Specifically, the effects of a low level (0.13 - 0.22 percent) were compared to the effects of supplementation to 0.40 percent phosphorus in the ration.

Experimental Procedure

Seventy-six dairy heifers were divided into two age groups with Group I averaging 10.2 months and Group II, 19.2 months at the start of the experiment. The trial period lasted from June 30, 1976, to December 16, 1976. Each group was then subdivided into a treated or control group. Group I controls were fed free choice alfalfa hay, corn, and pasture resulting in 0.25 - 0.27 percent P in the diet. Group II controls were fed prairie hay *ad libitum*, corn with urea, and pasture resulting in 0.10 - 0.13 percent P in the diet. Treated heifers in both groups were supplemented with monoammonium phosphate to achieve 0.4 percent phosphorus in the diet. Calcium and energy levels were kept constant to meet requirements.

Blood samples were taken every two weeks to determine phosphorus and calcium levels. Weights were measured once a month to monitor growth rate. The heifers were checked for estrus twice daily with the help of deviated bulls wearing chin-ball markers. The breeding season started on October 7 and pregnancy checks were made by a veterinarian 45 - 55 days after the last insemination.

Results and Discussion

Blood phosphorus levels in Group I averaged 7.18 mg percent in the treated group, and 7.01 percent in the control group for a difference of 0.2 mg percent. In Group II the average was 7.61 mg percent for the treated and 6.28 mg percent for the control group, making a difference of 1.3 mg percent. As expected, there was a larger difference among the older heifers than among the younger heifers since the intake differences were larger for the older heifers. Calcium levels were similar for all groups, averaging 9.5 mg percent.

Table 1 summarizes reproductive data for the study. There was no real effect of phosphorus level on the percentage of heifers in each group exhibiting heat in the first 21 days of the breeding season. The percentage ranged from 91 percent to 96 percent, indicating that cycling was not affected. These percentages also indicate that heat detection efforts were quite adequate. All heifers had been bred at least once by day 40 of the breeding season.

A comparison of the percent of the animals conceiving to first service raises some questions. In the older groups, there was no difference, with 65.0 percent of the treated heifers and 66.6 percent of the control heifers conceiving to first service. However, the younger group averaged significantly lower with the supplemental heifers having no apparent advantage over the control heifers. Through the third service, control and treated heifers were similar in conception patterns. The decreased conception percentage to first service in the younger heifers can likely be attributed to their age. They averaged 9 months younger and were just starting their cycles. They also exhibited more erratic cycles (Table 1) with the common problem being short cycles. This

Table 1. Comparison of effects of phosphorus level on dairy heifers

Item measured	Group I (young) Treated		Control		Group II (old) Treated		Control	
Blood phosphorus (mg %)		7.18		7.01		7.61		6.28
No & % in heat 1st 21 days	15/16	93.8	15/16	93.8	20/22	90.9	21/22	25.5
Conc. to 1st Service (%)		46.6		33.3		65.0		66.6
No & percent settled in:								
1st 21 days	7/16	43.8	5/16	31.3	13/22	59.1	14/22	63.6
2nd 21 days	3/16	18.8	3/16	18.8	5/22	22.7	3/22	13.6
3rd 21 days	1/16	6.3	4/16	25.0	1/22	4.5	0	0.0
4th 21 days	3/16	18.8	3/16	12.6	1/22	4.5	1/22	4.5
Total settled (no & %)	14/16	87.5	14/16	87.5	20/22	90.9	18/22	81.8
Avg. services/conc.		2.20		2.45		1.57		1.68
Total irregular cycles (No & %)	16/71	22.5	15/72	20.8	4/84	4.8	9/10	10.0
Total heifers with irregular cycles (No & %)	6/16	37.5	10/16	62.5	3/22	13.6	5/22	22.7

causes difficulty in knowing when to inseminate the animal, and this likely contributed to the lowered conception efficiency reflected in conception to first service as well as average number of services per conception. Table 1 also presents the breeding efficiency by 21-day segments of the breeding season. Older heifers tended to conceive earlier in the breeding season than did younger heifers. However, there was very little difference in the percentages of heifers settled after 84 days of the breeding season.

It has been widely suggested that marginal phosphorus levels cause irregular cycling. Table 1 summarizes the degree of irregular cycling by age and phosphorus level. The greater incidence of irregular cycles was observed in the younger group with about 20 percent of the cycles for the entire study in both treated and controls being an irregular length. The older group had fewer irregular cycles, about five percent and 10 percent, respectively, for treated and control animals. The number of heifers showing irregular heats showed similar patterns with a very strong implication that younger heifers will show a greater incidence of irregular heat periods. The percentages and numbers would suggest that a greater percentage of the heifers on the lower phosphorus level (both young and old groups) exhibited irregular cycles. However, it is doubtful that this is fact.

In the younger animals, there was no difference in blood phosphorus levels in treated and control animals. In the older group, the treated heifers had somewhat higher phosphorus levels than did control heifers. The differences between groups in the number of heifers showing irregular heats was small and could not be uniquely attributed to phosphorus level. It should be pointed out that there were irregular cycles in both age groups and phosphorus levels. Irregularities will be greater in young heifers in the first few cycles following puberty. However, the majority of the heifers quickly settle into a routine cycling pattern. Some small percentage of a heifer population will be difficult or repeat breeders, as is typical with cow populations.

It can be concluded that feeding phosphorus to dairy heifers at the lower end of recommended levels will have little effect on reproductive performance. Supplying additional phosphorus had no discernible effect on reproductive performance. It would be unusual that phosphorus deficiencies could exist in routine heifer raising programs.
