EFFICACY OF MASTICIDE® FOR THE TREATMENT AND PREVENTION OF TEAT LESIONS DURING THE WINTER MONTHS

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Introduction: Teat orifice hyperkeratosis, more commonly referred to as teat end lesions, in lactating dairy cows during the winter months is quite common. Little is known about this condition. Some suggest that teat lesions can be induced by mechanical damage associated with machine milking, chemical damage to teat end tissue associated with teat disinfectants and sanitizers, frostbite, weather-related changes, and viral agents such as bovine herpes mammalitis virus. Shearn and Hillerton (1996, J. Dairy Res.) suggested that teat lesions probably result from machine milking. However, teat orifice hyperkeratosis has also been observed in beef cattle that were neither machine milked nor exposed to chemical disinfectants (Farnsworth, 1996, Proc. Natl. Mastitis Council).

Teat lesions are problematic in that they appear to be related to an increased incidence of mastitis. Biopsies from 50% of hyperkeratotic teat end tissue revealed bacterial colonization of the stratum corneum, however, no viral agents were detected (Timms et al., 1997, Proc. Natl. Mastitis Council). In addition, teat lesions can markedly influence milking characteristics, particularly milking speed. In severe cases, cows become so difficult to milk that they are culled from the herd.

The objective of this study was to determine if Masticide®, a phenolic combination, was effective in the treatment and prevention of teat orifice hyperkeratosis. This premise is based on observations in the Middle Tennessee dairy research herd. A concentrated form of Masticide® was inadvertently used on lactating dairy cows as a pre- and postmilking teat disinfectant for about a week. The herdsman and research associate noticed that teat end condition improved markedly during the short period of application of the concentrated phenolic combination. Thus, we hypothesized that the phenolic combination may be effective in controlling/preventing teat end lesion problems.

Materials & Methods: This study was conducted in two dairy research herds of The University of Tennessee; the Middle Tennessee Experiment Station dairy in Spring Hill, TN and the Knoxville Experiment Station dairy in Knoxville, TN. We have observed teat lesion problems in both of these dairy research herds.

The five-point teat end scoring system described by Timms and Faust (2000) was used. Research technicians evaluated teat ends during the afternoon milking throughout the study.

Scoring was as follows:

1) smooth bottom – no callous or ring
2) slightly raised callous or ring (smooth ring)
3) raised callous or ring (teat end as a pinpoint with smooth ring)
4) raised ring with cracking/cuts on teat end (rough ring)
5) lesions/scabs/excessive hyperkeratosis (rough ring)

Digital images of teat ends were collected throughout the study using a digital camera. This was done to visually document the teat end scoring system noted above **(Figure 1)** and to monitor changes in teat end condition associated with treatment.

Teat end score data were analyzed by analysis of variance using Statistical Analysis System software mixed models analysis (SAS Institute Inc., Cary, NC, SAS version 8.02).

EXPERIMENT 1

OBJECTIVE: to determine the most appropriate concentration of the phenolic combination that could be used without causing teat irritation.

RESULTS: A study was conducted in the Knoxville Experiment Station dairy research herd to determine the highest concentration of the phenolic combination that could be used that did not result in teat irritation. In the Fall of 2000 (September 5, 2000 through November 30, 2000), all quarters of 40 cows were dipped in varying concentrations (full strength (undiluted), three-quarter strength, one-half strength, and one-quarter strength of the phenolic combination (lot number 36391) for 3 months without observing teat irritation problems. On October 25, 2000, we ran out of the original phenolic combination and began use of materials that were shipped in 55-gallon drums (lot number 26514 manufactured by Chemical Specialty Products, Omaha, NE). We noticed that the label of the 55-gallon drums indicated 5X while the label on the 5-gallon containers indicated 4.5X. Based on several conversations with personnel at Sporicidin, a decision was made to terminate the study because of potential teat disinfectant manufacturing differences and repeat with a newly formulated consistent phenolic combination teat disinfectant. This experiment was repeated again in 2001 (August 15, 2001 and continued through November, 2002) with the properly formulated phenolic combination teat disinfectant. Forty quarters of 10 cows were dipped in the concentrated phenolic combination and evaluated daily by milkers and weekly by research personnel for indicators of teat irritation (redness, roughness, chapping, and skin breaks). No irritation was observed during this period. Based on this observation, the concentrated phenolic combination was used in Experiments 2 and 3.

EXPERIMENT 2

OBJECTIVE: to determine if a concentrated solution of a phenolic combination was effective in the treatment of teat orifice hyperkeratosis.

RESULTS: This experiment was conducted at the Middle Tennessee Experiment Station dairy from December, 2001 – April, 2002. Cows developing teat lesions were assigned alternately to two groups as follows: group 1- all teats dipped after milking in the concentrated phenolic

combination, and group 2 – control, all teats dipped after milking in the use dilution of the phenolic combination (one part concentrated phenolic combination to 5 parts water). Teats of all cows were predipped in the use dilution of the phenolic combination (one part concentrated phenolic combination to 5 parts water). Research technicians scored teat ends of cows weekly. Particular attention was placed on prolonged use of the concentrated phenolic combination on teat irritation.

Only 16 cows (8 cows per treatment group) developed teat lesions. Of the 8 cows in group 1 (teats dipped after milking in the concentrated phenolic combination), there was no change in teat end scores in 5 cows, teat end scores of one cow improved from 4 to 3 and teat end scores of 3 cows got worse **(Table 1)**. No changes in teat end scores were observed in cows in group 2 (all teats dipped after milking in the use dilution of the phenolic combination (one part concentrated phenolic combination to 5 parts water). It should be noted that the winter of 2001-2002 was very mild in Tennessee. There were many days where the temperature never went below freezing and only a few days where the ambient temperature was below freezing for the entire day **(Figure 2)**. In all likelihood, this contributed to the small number of cows that developed teat end lesions during this study.

EXPERIMENT 3

OBJECTIVE: to determine if a concentrated solution containing a phenolic combination was effective in the prevention of teat orifice hyperkeratosis.

RESULTS: This experiment was conducted at the Knoxville Experiment Station dairy from November 29, 2001 – April 18, 2002. Cows were assigned alternately to two groups as follows: group 1- all teats dipped after milking in the concentrated phenolic combination, group 2 – control, all teats dipped after milking in the use dilution of the phenolic combination (one part concentrated phenolic combination to 5 parts water). Teats of all cows were predipped in the use dilution of the phenolic combination (one part concentrated phenolic combination to 5 parts water). Research technicians scored teat ends of cows weekly for three weeks and every two weeks thereafter. Particular attention was placed on prolonged use of the concentrated phenolic combination on teat irritation.

Several different data analyses were performed. In analysis one, only cows (n=90) that were in the herd during the entire duration of the study (November 29, 2001 – April 18, 2002) were included. Mean teat end scores over time were evaluated and are presented in **Figure 3**. Teat end scores of both treatment groups followed similar patterns throughout the study. Teat end scores were lowest at the beginning of the study and increased significantly in both treatment groups over time. Teat end scores declined during the last month of the study period, but were still higher than that observed at the start of the study. There was a significant exam (time) effect ($P<0.0001$) and exam by teat disinfectant interaction ($P<0.0001$). However, no differences in the concentrated phenolic combination and the diluted phenolic combination were observed.

To standardize teat end scores at the beginning of the study, teat end score data were evaluated by subtracting the initial score and evaluating relative changes from initial scores **(Figure 4)**. Using this approach, a positive score would indicate that teat ends got worse while a negative

score would indicate that teat ends improved. Teat end scores of teats dipped in the concentrated phenolic combination had a more marked increase throughout the entire study period than teats dipped in the diluted phenolic combination and scores were >0.5 points higher at the end of the study. Particularly noteworthy is the first month of the study period. These data suggest that the concentrated phenolic teat disinfectant was likely more irritating to teat end tissue than the diluted phenolic combination.

In analysis two, only cows (n=38) that were in the herd at the start of the study but did not complete the entire study were included. This would include cows that left the herd (i.e. dried off, culled, died). Mean teat end scores over time were evaluated and are presented in **Figure 5.** Teat end scores of both treatment groups followed similar patterns throughout the study. Teat end scores were lowest at the beginning of the study and increased significantly in both treatment groups over time. There was a significant exam (time) effect ($P<0.0001$) and exam by teat disinfectant interaction ($P = 0.0164$). However, no differences in the concentrated phenolic combination and the diluted phenolic combination were observed. Teat end scores of teats dipped in the concentrated phenolic combination had a more marked increase in teat end scores throughout the study period than teats dipped in the diluted phenolic combination **(Figure 6).**

In analysis three, only cows (n=57) in the herd that entered the study late but were present at the end of the study were included. This would include all cows that calved after the study began. Mean teat end scores over time were evaluated and are presented in **Figure 7.** Teat end scores of both treatment groups followed similar patterns throughout the study. Teat end scores were lowest at the beginning of the study and increased significantly in both treatment groups over time. There was a significant exam (time) effect ($P<0.0001$) and exam by teat disinfectant interaction ($P<0.0164$). However, no differences in the concentrated phenolic combination and the diluted phenolic combination were observed. Teat end scores of teats dipped in the concentrated phenolic combination had a more marked increase in teat end scores throughout the study period than teats dipped in the diluted phenolic combination **(Figure 8).**

Images of teat ends were collected throughout the study using a digital camera. This was done to monitor changes in teat end condition associated with treatment. Composite images illustrating changes in teat end scores over time are presented in **Figures 9 - 11. Figure 9** depicts changes in the teat end of a cow over the 12 exam-scoring period. The same teat end changed from a score of 1 to a score of 2 to a score of 3 back to a score of 1 throughout the trial. Some teat ends improved over the course of the study **(Figure 10)** while some teat ends got worse **(Figure 11).** As the trial progressed, the phenolic combination teat disinfectant stained some of the teats blue **(Figure 12).**

DISCUSSION: There was no evidence in this pilot study to suggest that the concentrated phenolic combination teat disinfectant was effective in the prevention and treatment of bovine teat end hypertkeratosis. In fact, the concentrated phenolic combination teat disinfectant was probably somewhat irritating to teat ends based on the relative changes in teat end scores during the early study period and the fact that teat end scores of cows that were scored throughout the entire study period were higher at the end of the study than at the beginning of the study. Other indicators of teat irritation (redness, roughness, chapping, and skin breaks) were not evident based on application of the concentrated phenolic combination teat disinfectant in Experiment 1.

This study was conducted from November 29, 2001 – April 18, 2002. During this time period, the temperatures were unseasonably mild in Tennessee. There were many days where the temperature never went below freezing and only a few days where the ambient temperature was below freezing for the entire day. In all likelihood, this contributed to the small number of cows that developed teat end lesions during this study and thus precluded accurate evaluation of our hypothesis that the concentrated phenolic combination would be effective in the prevention of teat end hyperkeratosis.

Research on this topic is scarce and therefore work in this area is in largely unchartered waters. If this research is continued, I recommend the following changes in experimental design. Teat end scoring should be used as an indicator of teat irritation because teat end condition appears to be more reflective of teat irritation than the other measures that we evaluated. I would also recommend that a negative control (no disinfectant) and perhaps even a positive control teat disinfectant be included as treatment groups. This comment is based on the fact that we observed a significant exam (time) effect and exam (time) by treatment interaction. However, no differences in the concentrated phenolic combination and the diluted phenolic combination were observed. It would appear that teat end condition can change quite rapidly over time and is a dynamic biologic phenomenon. Including a negative control would provide information on the dynamics of teat end condition changes in the absence of application of chemical to cows teats. A positive control would be useful from a comparative perspective.

CONCLUSIONS: Results of this pilot study provided no evidence to suggest that the concentrated phenolic combination teat disinfectant was effective in the prevention and treatment of bovine teat end hypertkeratosis. Of the two teat disinfectants evaluated, it would appear that the diluted phenolic combination was preferable based on teat end scores at the conclusion of the study. Additional experiments under different environmental conditions, including more severe winter conditions, will be necessary to determine if teat disinfectants are capable of altering the course of teat end hyperkeratosis.

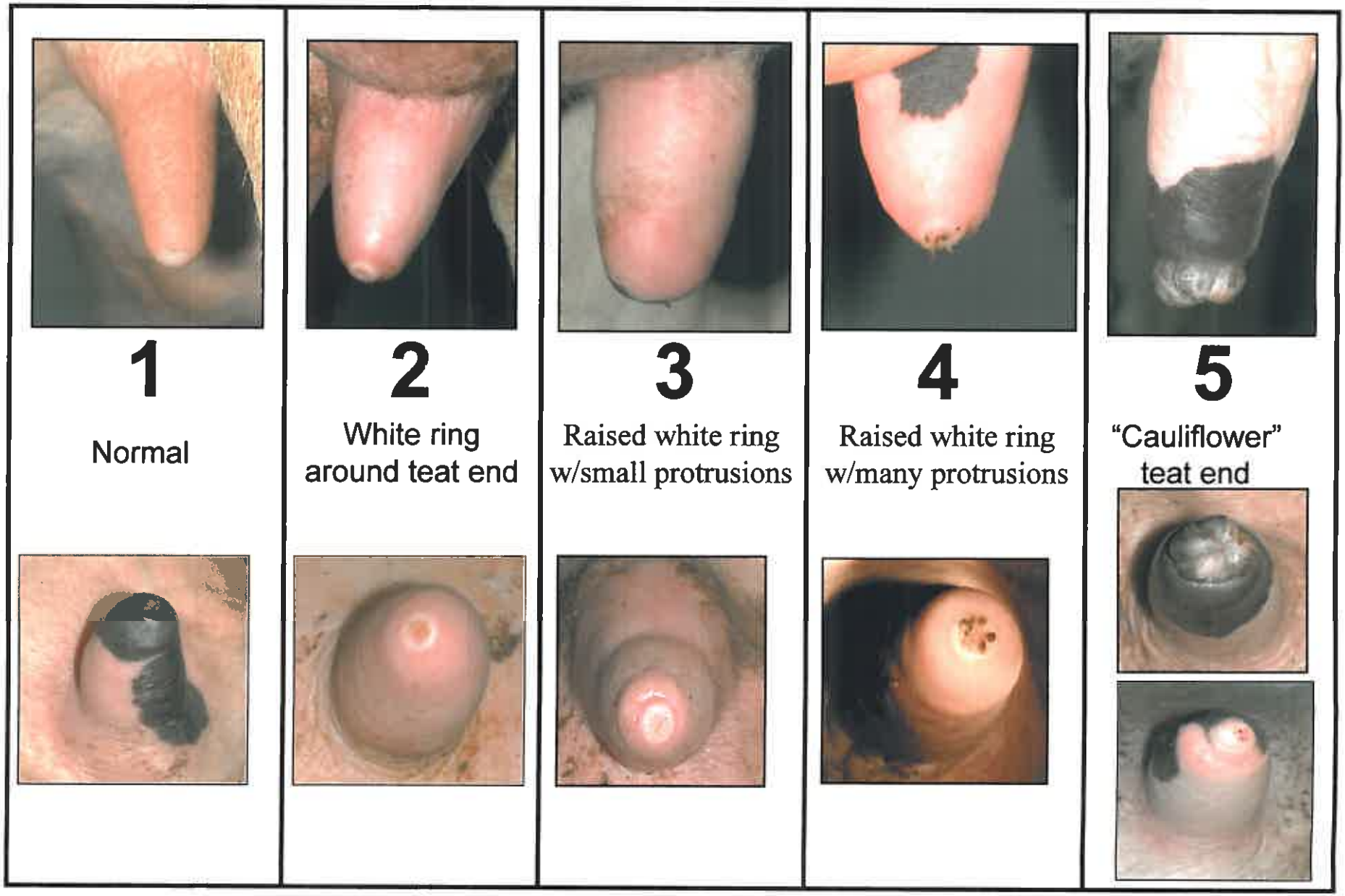


Figure 1. Teat ends were scored using a five-point teat end scoring system.

Table 1. Efficacy of Masticide for treatment of teat end lesions that occurred during lactation.

16 cows involved in trial
All teats of 8 cows dipped in the concentrated phenolic combination teat disinfectant after milkir
All teats of 8 cows dipped in the diluted phenolic combination teat disinfectant after milking

Cow	Treatment	Number of exams	Comments
43	Concentrated	15	no change
132	Concentrated	15	no change
515	Concentrated	9	after 6 weeks treatment LF improved from 4 to 3
541	Concentrated	9	after 6 weeks treatment LR changed from 3 to 4
557	Concentrated	20	after 3 weeks treatment RF,RR,LR changed from 1 to 4
561	Concentrated	15	no change
631	Concentrated	14	no change
2529	Concentrated	15	no change

Cow	Treatment	Number of exams	Comments
39	Diluted	15	no change
72	Diluted	5	no change
86	Diluted	20	no change
104	Diluted	15	no change
113	Diluted	5	no change
533	Diluted	15	no change
1000	Diluted	9	no change
2552	Diluted	15	no change

Figure 2. Daily ambient temperatures during trial.

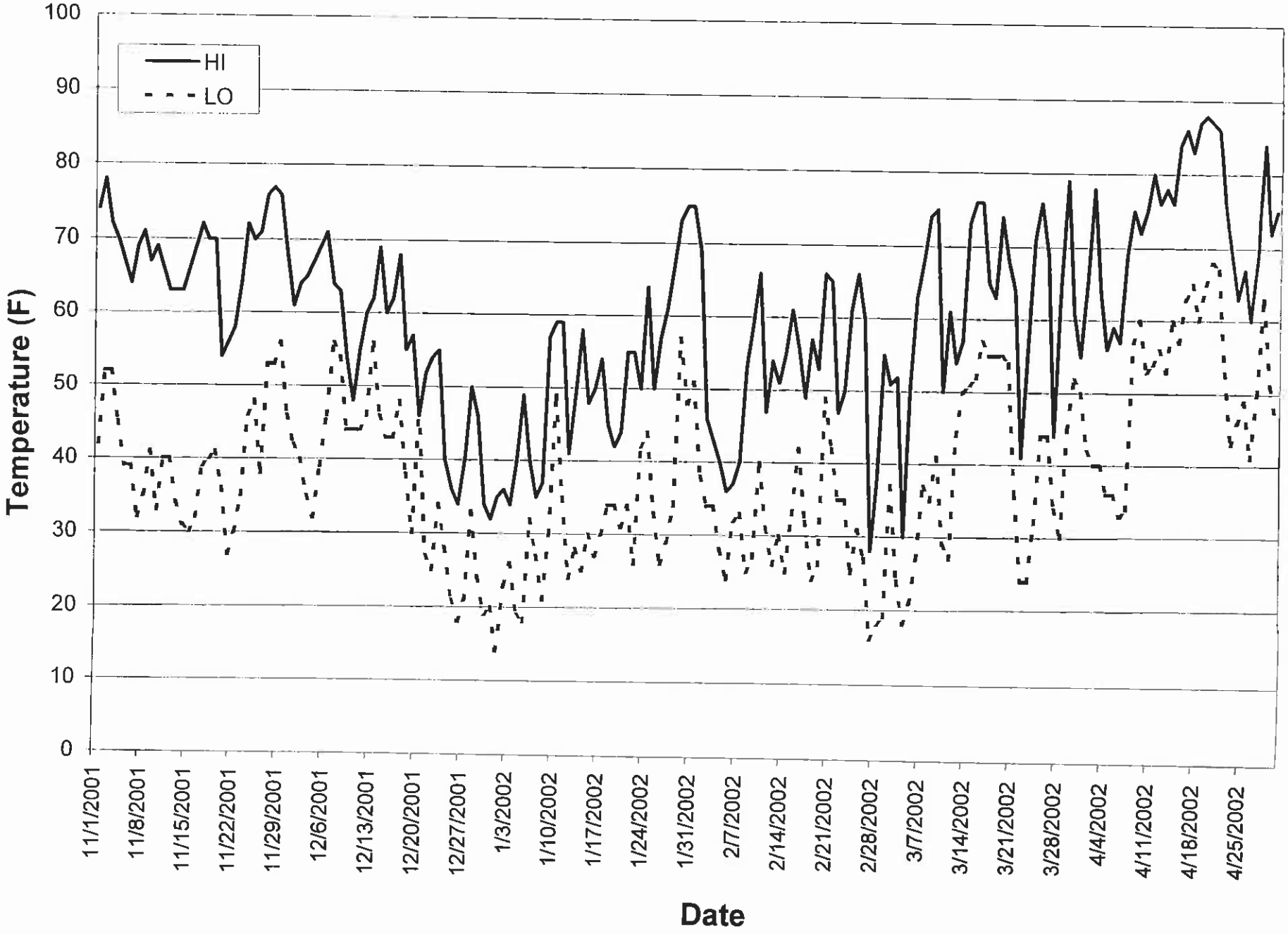


Figure 3. Mean teat end scores over all exam times.

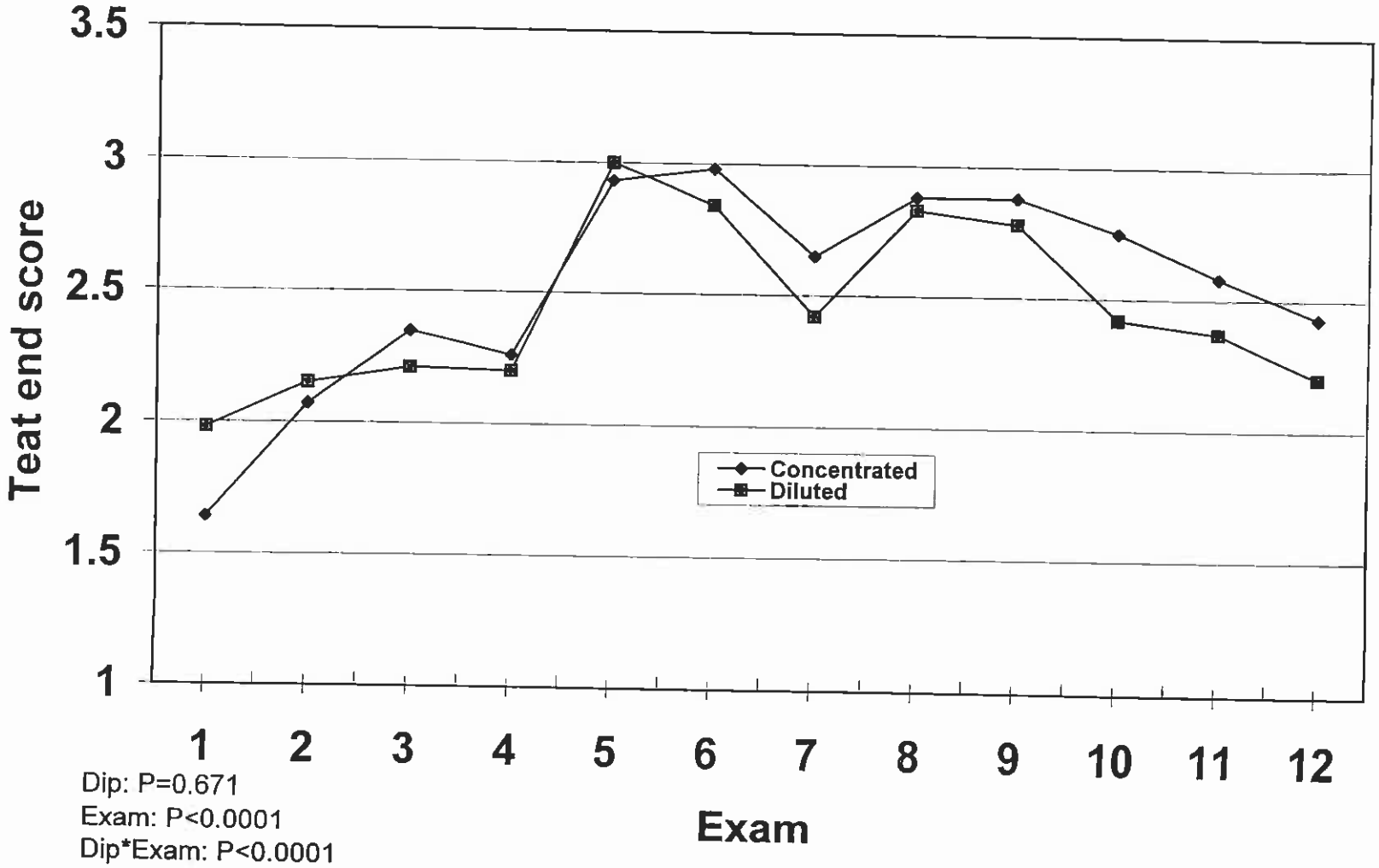


Figure 4. Relative changes in teat end scores from the initial score over all exam times.

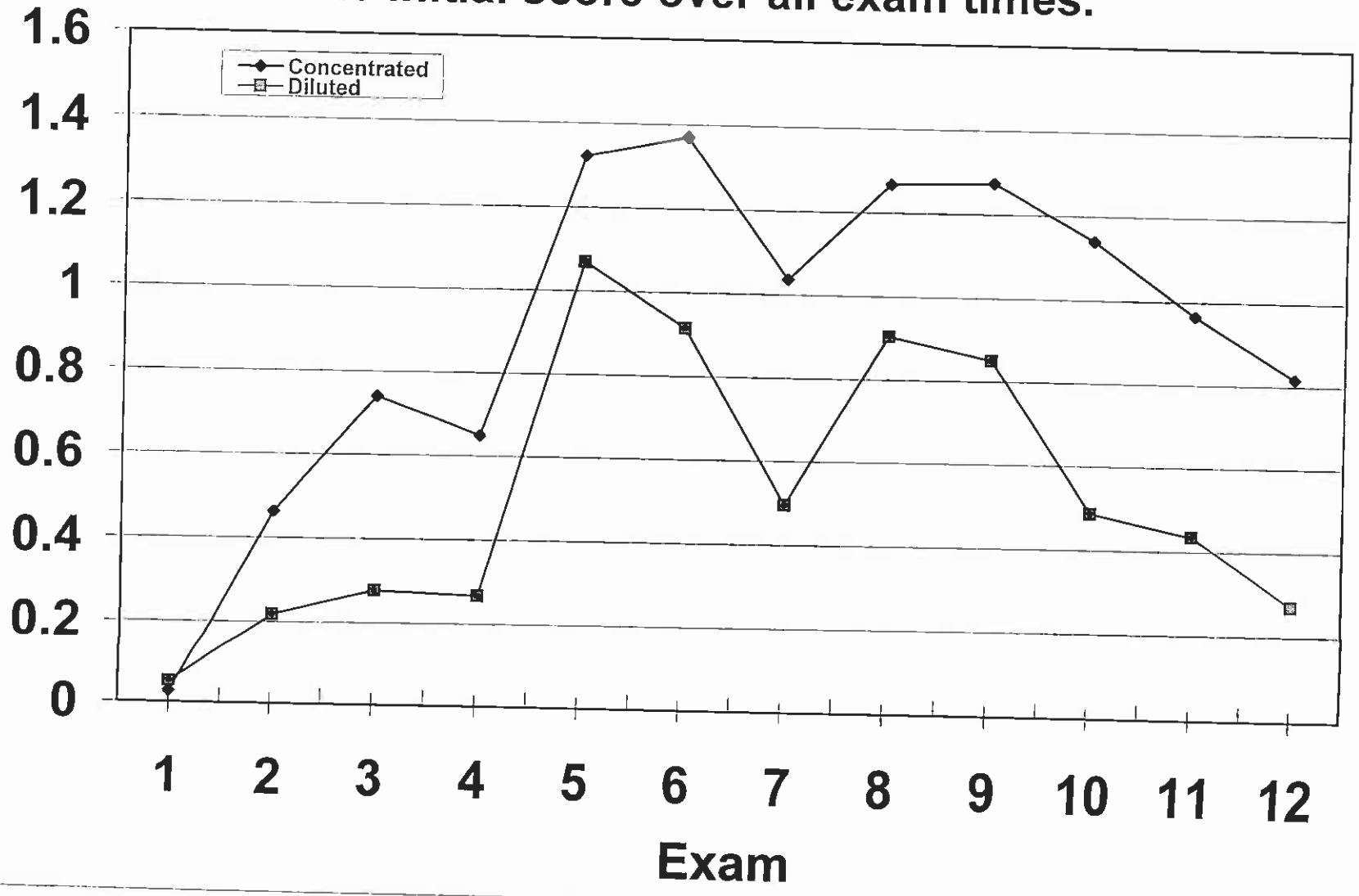


Figure 5. Mean teat end scores of cows that started but did not complete the entire study.

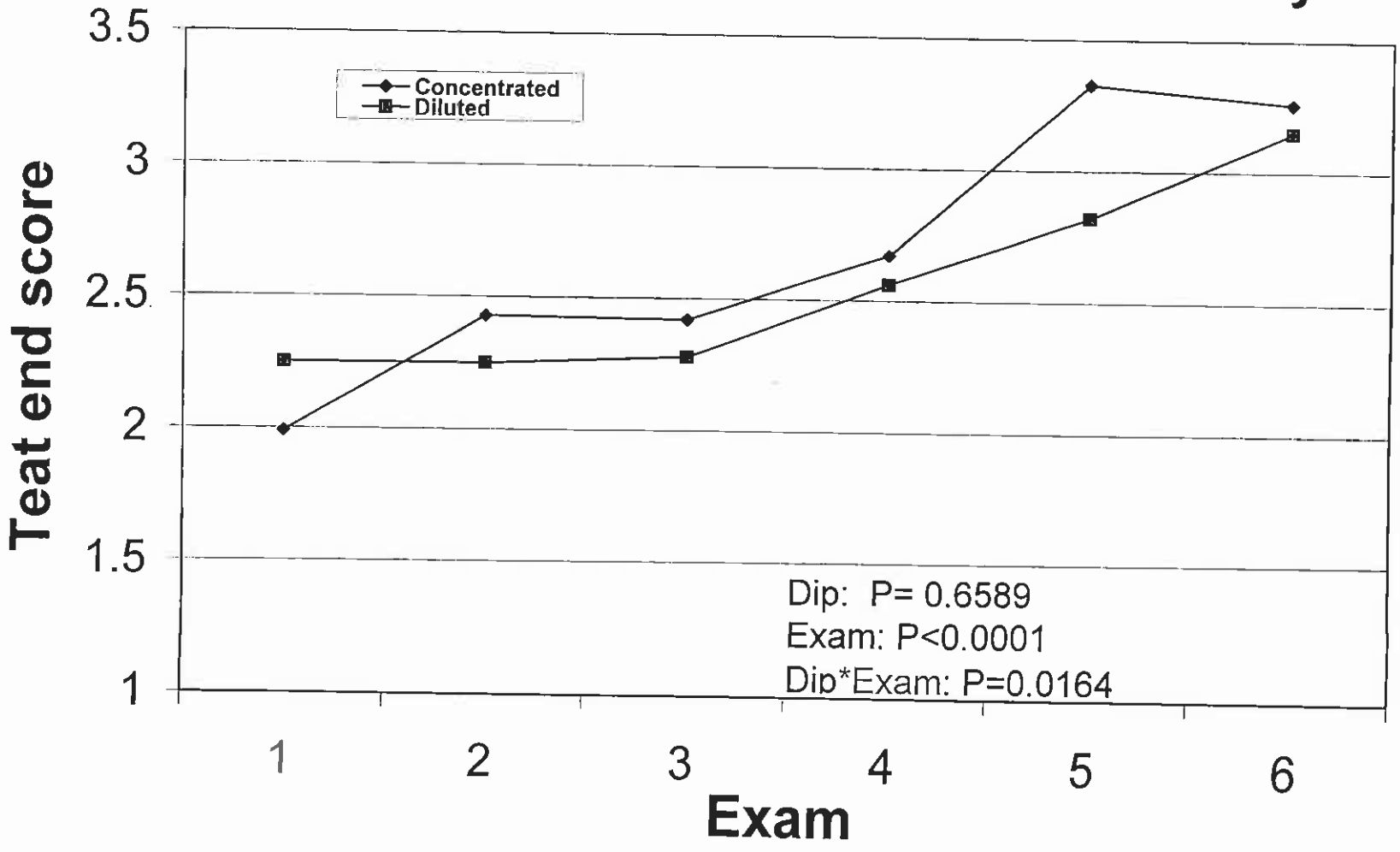


Figure 6. Relative changes in teat end scores from the initial score in cows that started but did not complete the entire study.

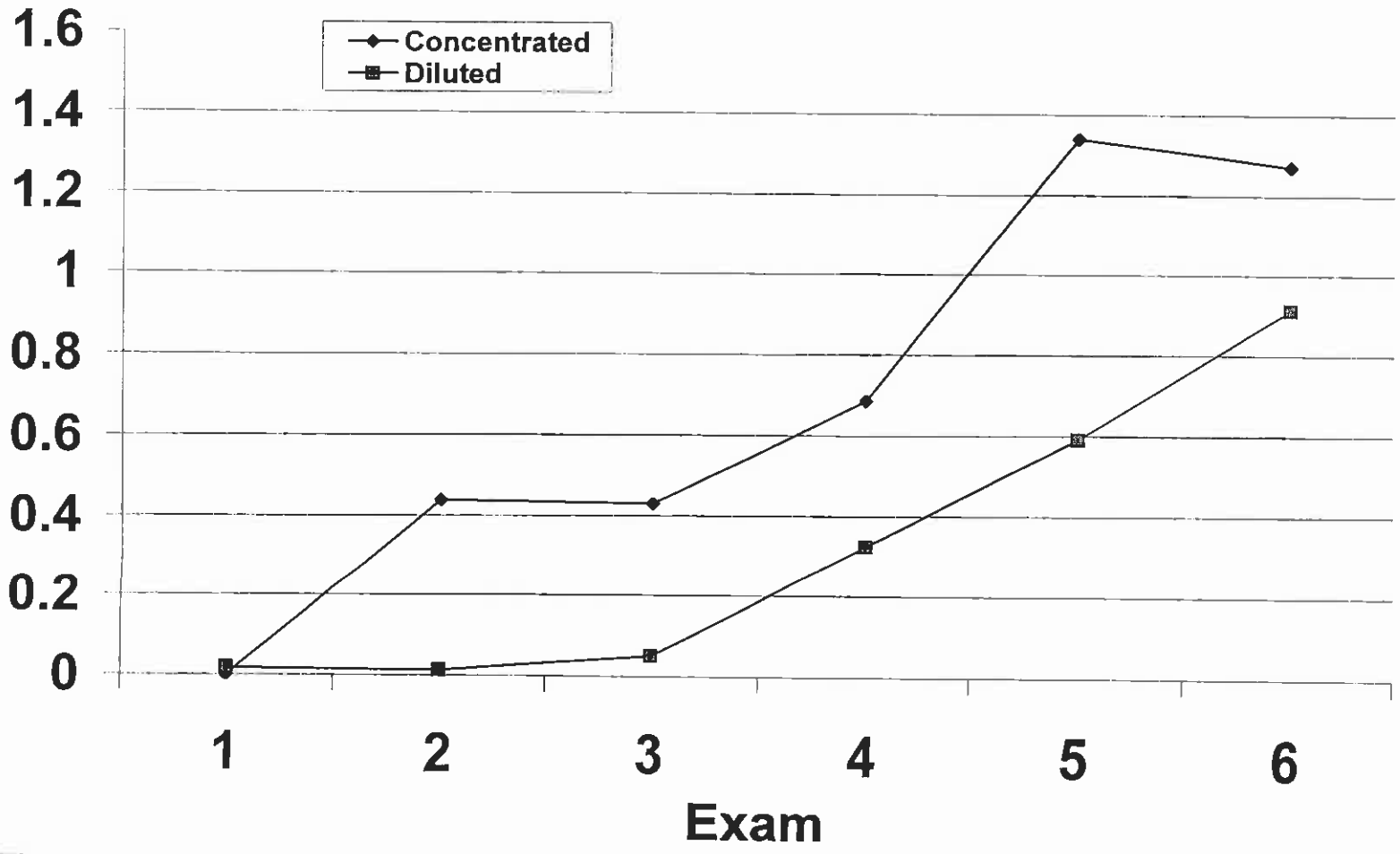


Figure 7. Mean teat end scores of cows that started the study late.

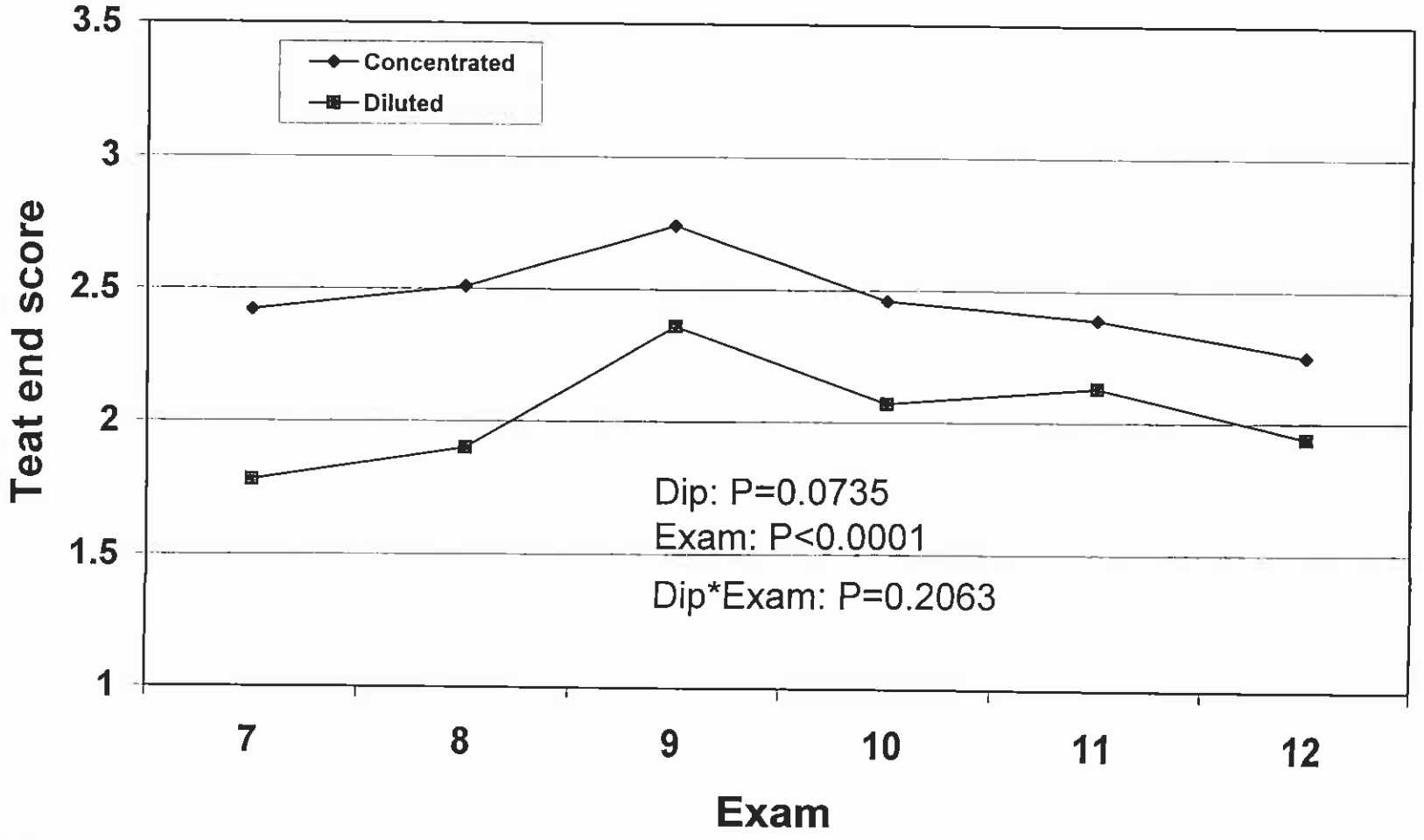


Figure 8. Relative changes in teat end scores in cows that started the study late.

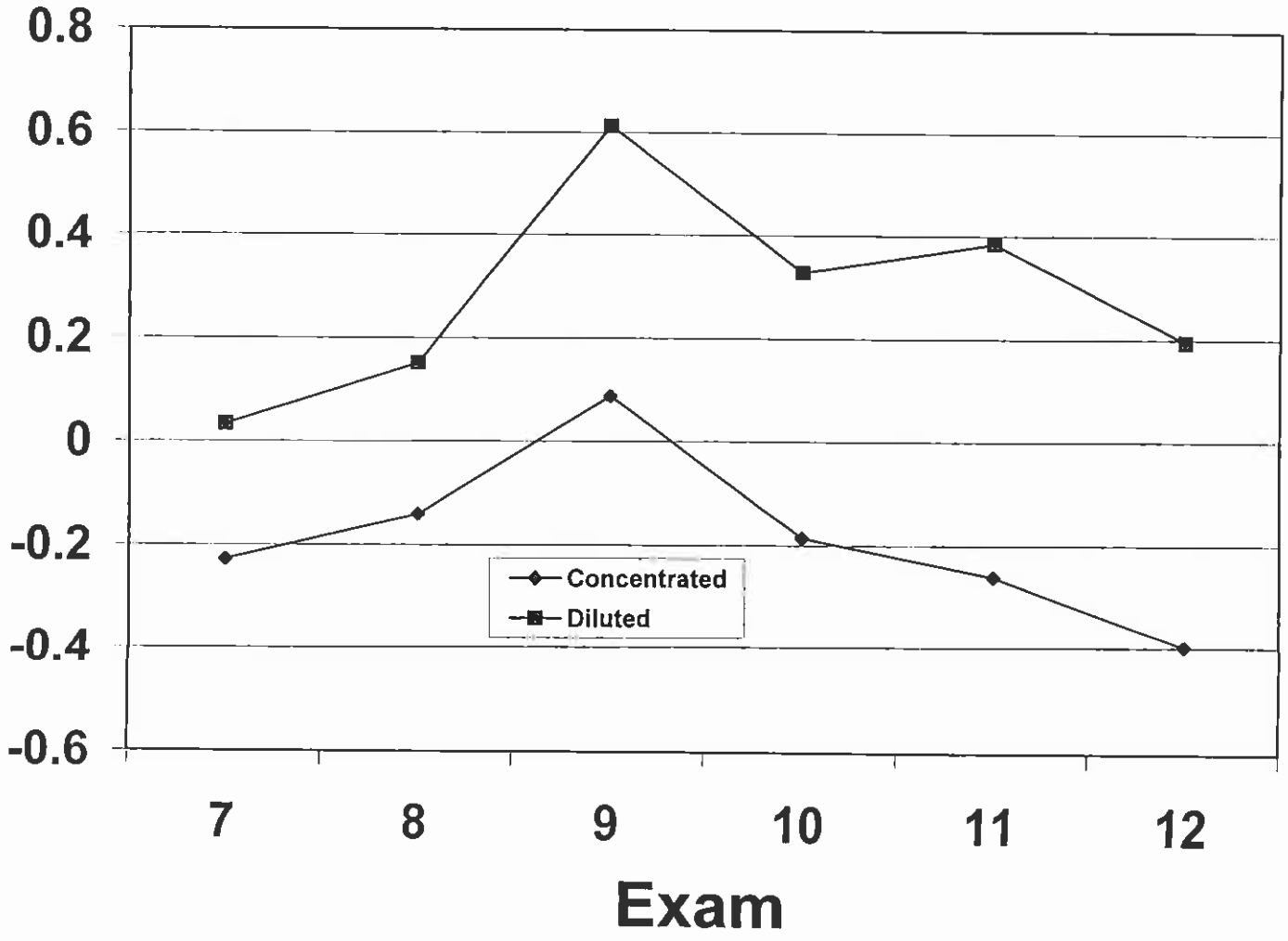


Figure 9. Jersey 9896 was predipped and postdipped with a diluted phenol-based post milking teat disinfectant. Teat end scores changed during the study.

Exam 1 score 1

Exam 2 score 1

Exam 3 score 1

Exam 4 score 2

Exam 5 score 3

Exam 6 score 1

Exam 7 score 1

Exam 8 score 2

Exam 9 score 1

Exam 10 score 1

Exam 11 score 1

Exam 12 score 2

Figure 10. Some teat ends improved over the course of the study.

Holstein cow 3715 was scored until she left the milking herd after the 10th exam She was predipped using the diluted phenolic combination and postdipped with the concentrated phenolic combination.

The right rear teat depicted here shows an improvement in teat end score by the end of the trial. The initial teat end score was 4 and the last exam score was 2.

Exam 1 Score 4

Exam 2 Score 4

Exam 3 Score 3

Exam 4 Score 3

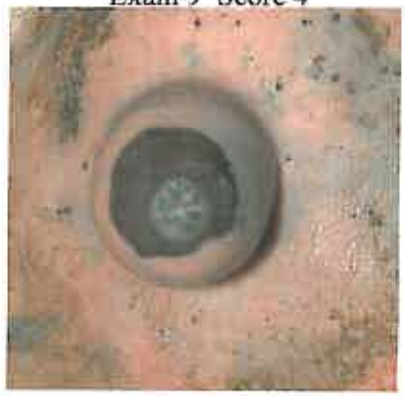
Exam 5 Score 5

Exam 6 Score 5

Exam 7 Score 3

Exam 8 Score 4

Exam 9 Score 4



Exam 10 Score 2

Figure 11. Some teat ends got worse over the course of the study.

Holstein 3641 was scored until she left the milking herd after the 5th exam.She we predipped using a diluted phenolic combination and postdipped using a concentrated phenolic combination teat disinfectant. The right rear teat depicted here shows a teat end that got progressively worse. The initial teat end score was 1 (obscured by a droplet of milk in the image) and the 3rd, 4th and 5th exam scores were 4.

Exam 1 Scored 1

Exam 2 Scored 2

Exam 3 Score 4

Exam 4 Scored 4

Exam 5 Scored 4

Figure 12. As the trial progressed the phenolic combination teat disinfectant stained some of the teats blue.

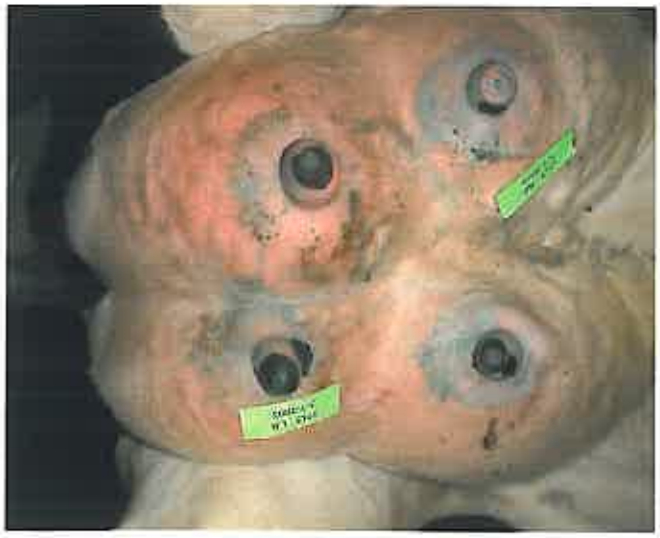
Exam 1

Exam 4

Exam 6

Exam 8

Exam 9



Exam 10