

A Survey of Trends and Rationales for Dietary Phosphorus Recommendations Among Mid-South Dairy Nutritionists

M. Sansinena¹, L. D. Bunting¹, S. R. Stokes², and E. R. Jordan²

¹Louisiana Agricultural Experiment Station
LSU Agricultural Center, Baton Rouge
and

²Texas Agricultural Extension Service
The Texas A&M University System

BACKGROUND

Ration formulation in the context of nutrient balance and environmental management is now a permanent part of our discourse as professional nutritionists. In this context, perhaps no nutrient feeding standard will be debated more contentiously than that of phosphorus. Phosphorus is an expensive nutrient with unquestionable environmental implications. However, the derivations of current phosphorus feeding standards, while perhaps accurate, are frequently questioned. In addition, many practical formulation, feeding, and merchandising considerations influence the phosphorus level targeted by the nutrition consultant. All that is known with certainty is that formulated dietary phosphorus levels for most dairy rations are in excess of NRC recommendations (Satter and Wu, 1999).

In 1997, we conducted an anonymous survey of phosphorus formulation practices among members of the Texas Animal Nutrition Council and attendees of this conference. Presumably, all those responding to the survey either formulated dairy rations on a regular basis or were involved in academic or corporate decision-making in this regard. The primary objective of the survey was to identify those aspects of phosphorus nutrition in which available research data or other resources were perceived as being weak or absent. In this regard, we hoped to identify researchable aspects of P utilization. What follows is a summary of that survey.

METHODS AND FINDINGS

Seventy individual surveys (Figure 1) were mailed out between the months of May and June, 1997. The 31 returned surveys (44% of total) were received within two months. Each question and its options were coded and statistically analyzed using the Frequency Procedure of SAS. Because the survey was

anonymous, no attempt was made to relate responses to specific geographic areas.

Who Responded to the Survey?

Of the 31 individuals who responded, 14 identified themselves with a feed company, ten with independent consulting, four with the extension service; and three with university teaching and research. No respondents identified themselves as producers; therefore, all were presumed to be professional nutritionists.

Source of Phosphorus Values for Formulation

For ingredient phosphorus values for use in formulation, three respondents used laboratory analysis exclusively, four used published book values exclusively, and the remaining 24 (77%) used some combination of the two. Twenty-four respondents (77%) used the NRC as a primary reference for published phosphorus values.

Phosphorus Analysis

Among those respondents who obtained ingredient phosphorus values via laboratory analysis, 17 (63%) of these used wet chemistry exclusively. Interestingly, eight respondents (30%) used laboratory values based on both NIRS and wet chemistry. Two used NIRS values exclusively. Inorganic molecules do not absorb light energy in the near infrared region; hence, NIRS mineral calibrations are based on indirect associations of minerals with organic molecules in the feedstuff. For forages and other individual feedstuffs, error rates are much higher for **all** minerals, than for organic components (Dyer and Feng, 1997; National Forage Testing Association, 1999). NIRS should not be used for mixed feeds with added inorganic minerals. Approximately 95% of those who analyzed their ingredients felt the values they obtained were both acceptably accurate and repeatable.

Figure 1: A survey of phosphorus formulation trends in large dairy herds

1) **Your main activity?** (Check the one category that best describes your nutrition activity)

- Producer
 Consultant
 Feed company
 Extension
 Teaching/Research

2) **For phosphorus values for individual feed ingredients or mixed rations, which of these do you use?** (Check all that apply)

- Book values (please specify):
 NRC
 Others _____
 Laboratory analysis? (If you do not analyze for phosphorus, skip question 3)

3) **Phosphorus analysis:**

a) **What type of phosphorus analysis is used by your lab(s)?**

- Wet chemistry
 NIRS
 Not sure

b) **How much confidence do you have in the phosphorus results reported by your lab(s)?**

- Accuracy:
 Very accurate
 Acceptable
 Marginal
 Not sure
 Repeatability:
 Very repeatable
 Acceptable
 Marginal
 Not sure

c) **Why do you have ingredients analyzed for phosphorus?** (Check all that apply)

- Non-specific: company policy, expected by client, part of routine analyses, etc.
 You believe feeds vary considerably in phosphorus content.
 You don't think NRC (*book*) values are correct.

4) **What is your typical formulated level (%) of phosphorus in the following lactation rations?** (You may mark as a range)

	<.3	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85	.9	>.9
High producers	<input type="radio"/>												
Low producers	<input type="radio"/>												

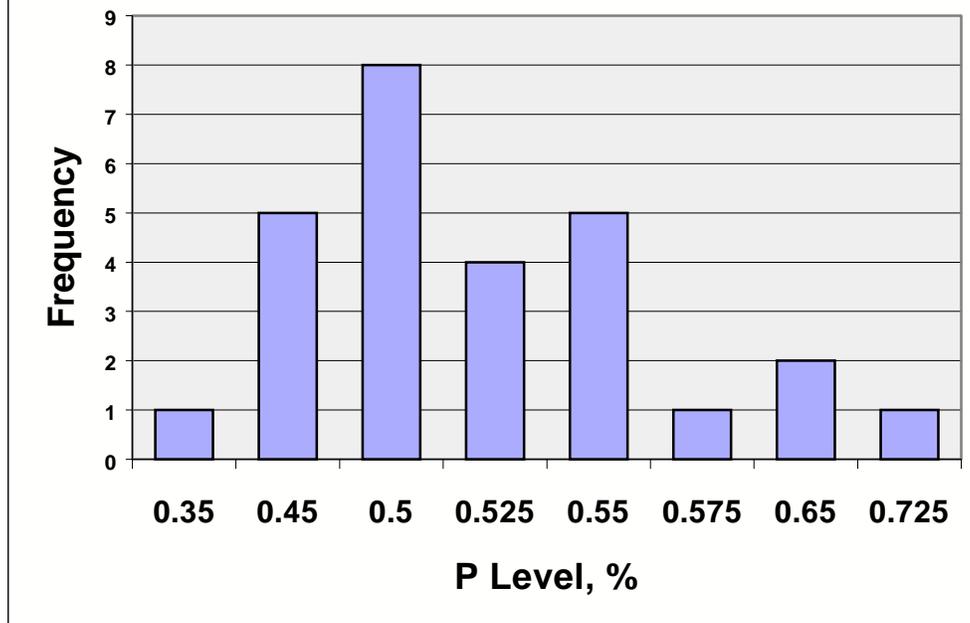
5) **If you feed more phosphorus than recommended by the NRC, what is the basis for this increase?** (Check all that apply)

- I do not actually balance for phosphorus. The phosphorus level is the default result of the ingredients I use.
 I believe lactating cows require more phosphorus than the NRC recommends.
 I am not confident in NRC or laboratory phosphorus values for ingredients and protect myself accordingly.
 I allow a safety margin for herds fed partial TMRs or grazing.
 I allow a safety margin for variable phosphorus bioavailability in some ingredients.

What do you believe to be the percent availability of phosphorus in the following ingredients?

	<input type="radio"/> <30%	<input type="radio"/> 30 to 50%	<input type="radio"/> 50 to 70%	<input type="radio"/> 70 to 90%	<input type="radio"/> >90%
Non-legume forages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Alfalfa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oilseed products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grains & grain byproducts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 2: Recommended P Levels for High Producers



Nineteen of the 27 respondents (70%) who had ingredients analyzed did so because they believed that ingredients vary considerably in phosphorus content. Eleven of these individuals indicated that they did so because they also felt that available book values were unreliable. Eight of those who had ingredients analyzed indicated that they did so for reasons ostensibly unrelated to phosphorus formulation (non-specific). These would have included *matter of course* reasons such as corporate policy or client expectations.

Recommended Phosphorus Levels For High Producing Dairy Herds

Twenty-seven of the 31 respondents provided information on formulated phosphorus levels for lactation rations. Although respondents were allowed to show the range of phosphorus levels used in their formulations, only about 40% of respondents chose to do so. The range of phosphorus levels employed by a given nutritionist was typically less than .1%. The mean formulated level of phosphorus for high-producing cows was .52% with a coefficient of variation of 14% and an overall range of .35 to .72%. The mean formulated level of phosphorus for low-producing cows was .45% with a coefficient of variation of 18% and an overall range of .30 to .68%. As observed in other surveys (Satter

and Wu, 1999), the levels of phosphorus formulated for lactation rations were generally in excess of those suggested by the NRC. The margin of excess over NRC recommendations seemed to be essentially the same for both high- and low-producing herds.

Reasons For Ration Phosphorus in Excess of NRC Standards

All survey respondents answered this question and most suggested that there were several factors or formulation considerations that would lead to a final ration phosphorus level that was in excess of NRC standards. Four individuals indicated that they did not always balance for phosphorus; presumably, supplemental phosphorus was not required in those rations. Almost half of the respondents (15 of 31) expressed a belief that lactating cows require more phosphorus than suggested by the NRC. However, the belief that a safety margin was required appeared to be the most prevalent reason for exceeding NRC recommendations. As justification for this, respondents cited a lack of confidence in published ingredient phosphorus values (nine responses), safety margins for grazing and partial TMR usage (15 responses), and concern for variable phosphorus bioavailability in feed ingredients.

Perceptions of Phosphorus Bioavailability in Feed Ingredients

Eight respondents did not speculate on phosphorus bioavailability for the given classes of ingredients. Among the 23 who did, there was a general opinion that phosphorus bioavailabilities in these classes of ingredients were less than 100%. The bioavailability range selections shown in Figure 1 were numerically weighted and an average bioavailability estimate was determined for each ingredient class. Respondents believed that phosphorus bioavailability averaged about 60% for non-legume forages, 65% for alfalfa, 65% for oilseed products and 60% for grains and grain byproducts.

SUMMARY

The findings of this limited survey suggest that dairy producers in the Mid-South region of the U.S. are likely feeding about 30% more phosphorus than recommended by the NRC. The desire to

maintain an adequate safety margin seemed to be the primary rationale of the nutrition consultants for upward deviations from the NRC feeding standard. However, many consultants clearly do not feel that the NRC recommendations for dietary phosphorus for lactating cattle are adequate.

LITERATURE CITED

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