January 1999

Defining Swine Nutrient Requirements and Allowances—What do the Numbers Mean?

Phillip S. Miller
University of Nebraska - Lincoln, pmiller1@unl.edu

Austin Lewis
University of Nebraska - Lincoln, alewis2@unl.edu

Duane Reese
University of Nebraska - Lincoln, dreese1@unl.edu

Mike Brumm
University of Nebraska, mbrumm1@unl.edu

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Phillip S. Miller
Austin J. Lewis
Duane E. Reese
Michael C. Brumm[1]

Summary and Implications

Defining nutrient requirements or allowances is the first, and conceivably most important step, in developing a nutrition program for growing-finishing pigs. Understanding the terminology and underlying principles used to define nutrient requirements and allowances for pigs will help producers better evaluate their nutrition programs. This information will also enable producers to interface production outputs (e.g., growth rate and carcass data) to published nutrient requirement and allowance programs, such as The National Research Council, Nutrient Requirements of Swine, 1998. As these and other approaches describing nutrient requirements for pigs develop, producers need a better and more complete understanding of growth biology in order to help them accurately determine the nutritional needs of their pigs. Because of the diminishing-return response of growth and biological traits to nutrient intake or concentration, the added costs associated with increasing nutrient densities at or near the requirement must be carefully considered.

Introduction

Nutrient requirements/allowances are determined based on the response of biological or growth criteria to varying intakes or concentrations. These criteria vary according to the physiological state of the pig (i.e., growth, pregnancy or lactation) and the level of production (e.g., 1.5 versus 2.2 pounds weight gain/day). The objectives of this article are to review the general processes for development of nutrient requirements and allowances, to illustrate the differences between a nutrient requirement and allowance, and to discuss how maximizing a biological response may not maximize economic returns.

Performance Criteria

Nutrient requirements are rarely based on a single research experiment but most often derived from a variety of experiments. Conditions vary among

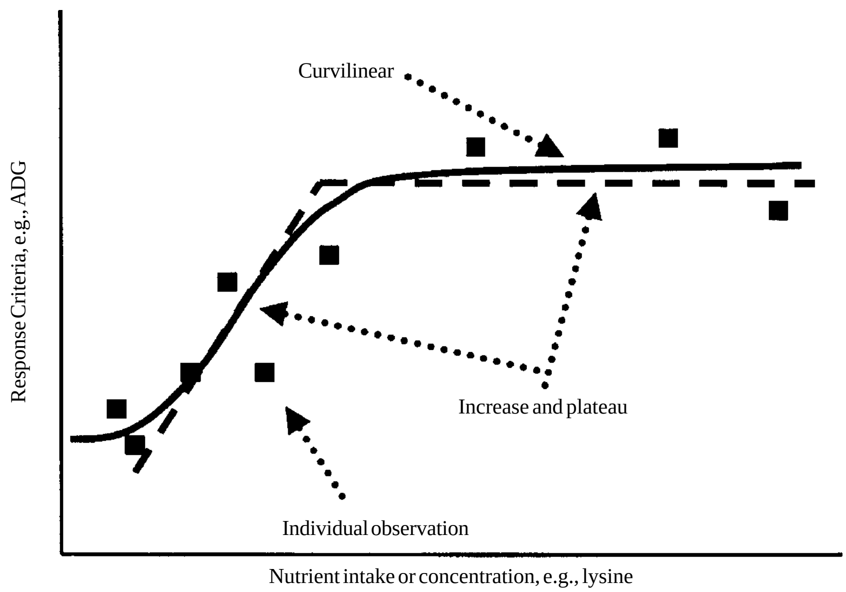

Figure 1. The response of growth to nutrient intake or concentration.

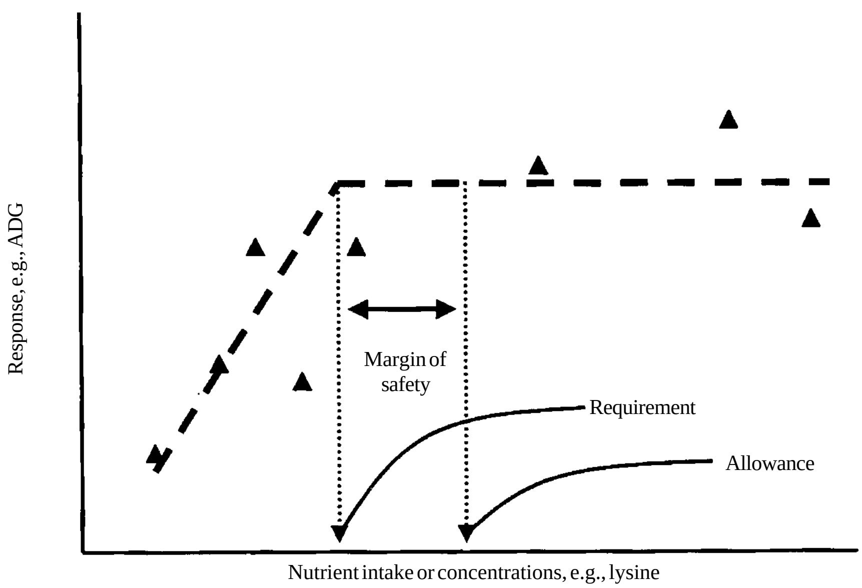

Figure 2. Representation of a nutrient requirement and allowance.

experiments or the production systems used to develop nutrient requirements and allowances. These conditions must be considered when determining a requirement or allowance's applicability. To establish a requirement or allowance, a production and/or biological criterion must be identified. Also, the criterion selected must vary (increase or decrease) according to the concentration of the nutrient of interest.

A common growth trait used to establish requirements or allowances for growing-finishing pigs is average daily gain (ADG). The response of ADG to nutrient (e.g., lysine) intake is curvilinear (increases linearly and reaches a plateau after the requirement has been observed, see Figure 1). Often, the response of the performance trait is represented by two linear lines (increase and plateau).

Nutrient Requirements Versus Allowances

Depending on the source or publication, either nutrient requirements or allowances will be presented. **A requirement is defined as the nutrient intake or concentration that maximizes the response criteria. An allowance is equivalent to the requirement plus an additional amount often called a margin of safety** (see Figure 2). The new National Research Council publication documenting swine nutrient needs is requirement-based (NRC, 1998, Tenth Revision, National Academy Press, Washington, D.C.), whereas the Nebraska and South Dakota Swine Nutrition Guide (Nebraska Cooperative Extension Publication 95-210) presents nutrient allowances. Generally, using nutrient allowances to formulate diets eliminates the possibility of under feeding a nutrient, a scenario more likely using nutrient requirements. The downside of using allowances is the potential for overfeeding a nutrient, which in the case of expensive ingredients, increases costs and decreases profit. In addition, dietary nutrient excesses will increase nutrient excretion, contributing to environmental problems.

Underlying Biological Processes

While performance criteria are useful in defining nutrient specifications, describing and measuring the underlying biological process(es) utilizing the nutrient are helpful in establishing the nutrient requirement. An example of this is in the NRC, 1998 *Nutrient Requirements of Swine.* In this publication, the driving force defining the lysine (and other dietary essential amino acids) requirements for growing-finishing pigs is the rate of muscle protein deposition, or simply, the rate of lean deposition (see Figure 3). The shape of the curve is assumed constant (unless indicated differently by the user) and is adjusted according to the average daily lean gain estimated by the user. If the

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Figure 3. The lean growth curve of a growing-finishing pig.

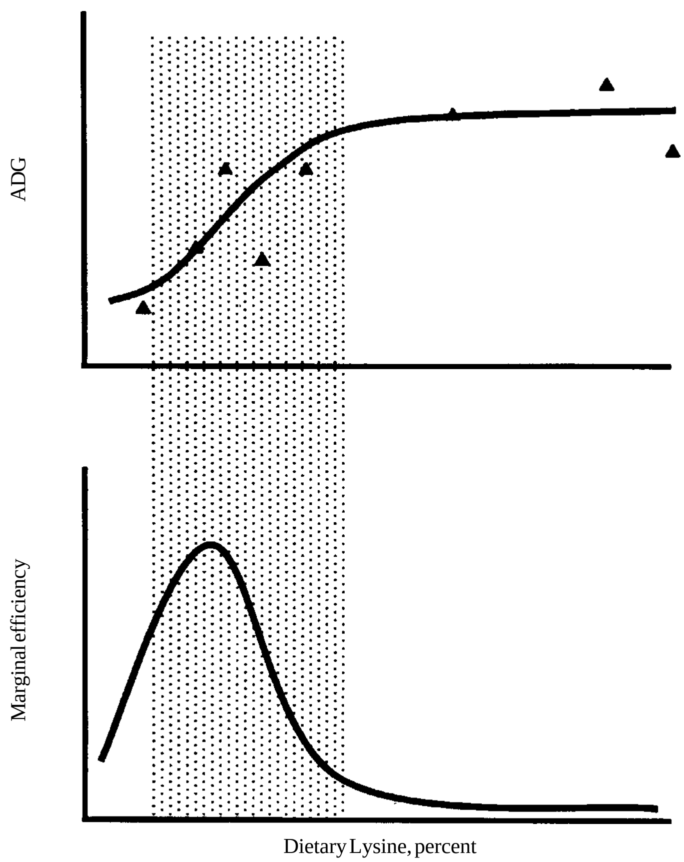

Figure 4. The relationship between average daily gain and the efficiency with which lysine is used for growth.

concentration of lysine in muscle protein is known and the proportion of dietary lysine absorbed and metabolized (not degraded or used for non-muscle functions) is estimated, the amount of dietary lysine required can be determined. Therefore, producers can utilize kill-sheet information listing the lean (muscle) percentage in their pigs, along with an estimate of initial lean percentage (estimated from the initial weight of pigs entering the growing-finishing facility), to apply to the model of lysine utilization developed by the NRC and estimate the lysine requirement.

Maximizing Growth versus Maximizing Profit

Because the response of growth traits follows a pattern of diminishing returns (see Figure 1), maximizing the response does not always define a nutrient concentration or intake that will maximize profit. As the requirement is approached, the efficiency (marginal efficiency) of utilizing the nutrient for a specific function (e.g., lean growth) decreases dramatically (Figure 4). Depending on the nutrient in question, the additional cost of increasing the concentration of a nutrient in the diet to increase growth or performance from 95 to 100 percent of maximum may be greater than the potential return. Studies at the University of Wisconsin demonstrated that formulating diets to maximize growth by adding supplemental dietary lysine can add as much as $2.76/pig to the cost of producing a 240-pound pig with no or little benefit in growth rate and/or carcass quality.

Because producers must consider the diminishing return response, dietary nutrient intakes or concentrations should be scrutinized to ensure the nutrient is not being overfed relative to the potential economic return.

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[1]Phillip S. Miller is an associate professor, Austin J. Lewis is a professor, Duane E. Reese is associate professor and Extension swine specialist, Department of Animal Science and Mike C. Brumm is professor and Extension swine specialist at the Northeast Research and Extension Center, Concord, Nebr.