NEW GOALS IN UNDERGRADUATE TEACHING IN NUTRITION

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As a part of my contribution to this symposium on undergraduate teaching in animal science, the committee has suggested that I give consideration to the following questions:

(1) What are the major goals to which undergraduate teaching in nutrition should, in the long run, be directed?

(2) What are the primary means of achieving these goals? For example, should teaching on an interspecies basis be increased? Should there be greater emphasis on widely applicable principles and, if so, what are some of the major principles that should be stressed?

As I started to collect my thoughts in preparation for this paper, I was struck by the fact that the science of nutrition is plagued by a lack of definition and identification. This is rather surprising as nutrition is undoubtedly one of the most important features of our environment and, as such, is inescapable. This also applies to our animals: nutrition is the most critical factor in their economic production.

Definitions and Some Philosophy. Nutrition is an applied science rather than a basic one. It integrates biochemistry, physiology, mathematics, microbiology, statistics, pathology, physics, and others, and as such is multidisciplinary. If progress is to be made in any area, goals and objectives must be established. However, this is easier said than done, particularly in the field of nutrition, a discipline that defies simple definition. “The scope includes all matters related to foods and nutrition; namely, agricultural and food chemistry, food technology, food economics, food service, psychophysiological factors in appetite, social and cultural aspects of food practices, comparative nutrition, therapeutic dietetics, and the relation of nutrients to metabolism in health and disease” (Griffith, 1967). The American Institute of Nutrition defines nutritional science as “... the science of food, the nutrients of food, the chemistry and physiology of their utilization, and ultimately the whole series of complex relationships of food and food nutrients to the health of the body and the welfare and the happiness of mankind.”

Dr. H. H. Mitchell (1964) says that “. . . the science of nutrition deals primarily with the interactions between the animal body and its food supply with the ultimate purpose of defining quantitatively the fully adequate food supply for any combination of animal functions and for any type of internal and external stress.”

Obviously, nutrition may be defined in many ways. It can be as broad or as narrow as the interest of those involved. The term nutrition is used loosely, because it means different things to different people. If we define it in a narrow sense, goals and objectives and programs to implement its study could be drafted readily. This is not to be, because there is no escaping the breadth of nutrition. It touches animals and humans, feeds and foods, production and processing, and public health and international programs. Like animal science itself, nutrition must be an umbrella big enough to cover the wide range of interest from the practice of nutrition to the most basic fundamental aspects of the science of nutrition, which probes deeply into the mechanisms of metabolism in an effort to answer the why as well as the how. Because of the diversity involved, some think it desirable and necessary that a distinction be made between the science and the practice of nutrition.

I tend to agree with those who think that there is a real but frequently unrecognized distinction between the more basic research aspects of nutrition and the technology of the discipline. This blurred image has probably slowed down progress in the field of nutrition, but I do not view this as a serious problem in undergraduate teaching of nutrition to animal science students. On the other hand, the situation is somewhat different if a graduate degree program is involved, because the type of training needed for the science career should be different from that for a career in the practice of nutrition. This is not a new type of problem for animal husbandmen or animal scientists, if you will, as they have been wearing
several hats and straddling fences for years as they try to accommodate and adjust to the contradictions and pressures of more sophisticated research versus traditional applied efforts, and live animal (eyeball) judging versus more objective and scientific evaluation. The same thing is going on in biology, as witness the controversy involving the molecular biologists and the functional and organismic biologists. The comment of Dr. J. B. Allison is appropriate: “Nutrition is an integrating science which must not become too superficial in the study of the whole animal, nor too far removed from the whole animal in the study of reactions at the molecular level.” This is good advice for animal scientists and nutritionists—we can study the bits and pieces, the small parts, but we should not lose sight of the whole animal. We are concerned with the production of a product, and if we divorce ourselves from this, we will lose our identification with the industry. If this happens, some other group will replace us. I think it would be a serious mistake for us to go so far in our pursuit of sophistication in fundamental research that we lost sight of our primary aim in educating undergraduates, and our land-grant service orientation. This is not an argument against fundamental research—I personally feel we need much more—but rather a plea that it be done with the proper motivation and frame of mind.

If we are to be responsible in training our students of today to be the teachers of tomorrow, we must give them adequate preparation in the sciences they are to apply. The explosion of knowledge in biochemistry and the other disciplines that form the foundation on which nutrition rests has resulted in a gap between what is known in the science of nutrition and what is taught in the classroom, particularly that which is taught at the undergraduate level.

Introductory nutrition courses are very important because it is here that the student’s curiosity is aroused, his interest stimulated, and the area evaluated. It is in the beginning nutrition courses that the student begins to develop an appreciation for the interaction between biochemistry and physiology and the growth and performance and well-being of the organism. He begins to see what nutrition really is and, if the course is well done, a research career may be started or a competent technologist turned out for a successful career. Poorly done, the beginning course becomes a dull requirement for the student, something to be gotten out of the way and forgotten as quickly as possible.

Animal science is confronted with a real dilemma and a major challenge as it attempts to improve the quality of its undergraduate program in nutrition. Major changes are taking place in agricultural colleges and experiment stations throughout the country. Forces and pressures are involved that create more than one master. Research is becoming more sophisticated and expensive, and more of it is being supported by federal agencies. As a result, graduate programs are increased and undergraduate programs tend to be neglected. One solution is to develop programs aimed at preparing the undergraduate for graduate study. This may work in some states and in some institutions, but it obviously will not work in others. It should be pointed out that a very high percentage of our undergraduate students do not go on to graduate school. Therefore, most schools will probably attempt to serve both the undergraduate who plans to go on to advanced studies and the student who plans a terminal program with a B.S. degree. There may be, and probably should be, an increase in 2-yr. programs to train agricultural technologists.

Some Assumptions. In arriving at the goals which I will list a little later, I am making the following assumptions:

1. That our students coming out of high school will be far better trained in mathematics, chemistry, physics, biology, and communications than the present students.
2. That there will be no significant increase in the number of students enrolled in 4-yr. programs in the animal sciences.
3. That more and more of our students will come from nonfarm homes. Fewer of our students will have the indoctrination of 4-H clubs and vocational agriculture than in the past and, if we are to get the bright students from the large high schools, we are going to have to challenge them with imaginative ideas and convince them that feeds and feeding can be scientific nutrition. On the other hand, it won’t become that by simply changing the course title. To paraphrase Dr. George Gries, “A swine production unit doesn’t become scientific by simply changing the title to the Division of Porcine Pediatrics.”
(4) That we are training the teachers, researchers, leaders, and livestock producers for many years ahead and that we do them a disservice if we don't give them the very best training available.

(5) That the training given to the student must give him flexibility to adjust to tomorrow's rapidly changing problems and conditions. He must be trained as a broad specialist. This means training in disciplines that give him an adequate understanding of nutritional concepts. I don't mean to minimize the importance of application, but I think it is very important that we equip our students to grow and to develop if they are to stay abreast of and contribute to the advanced technology we will have in the future.

Courses. Hill (1967) makes a point of the fact that it is not always easy to distinguish nutrition as a science from nutrition as a process and that most students get their first exposure to formal nutrition as a part of another field, usually in a species- or industry-oriented course. Under these conditions, a student develops a rather narrow view of the field of nutrition and has little understanding of the general knowledge of nutrition which applies across species and fields. Ideally, to prepare a student for training in nutrition, he should first acquire a background in the fundamental sciences of chemistry, physics, and mathematics, followed by biochemistry, biology, and physiology. With this kind of a background, he would then be ready for his first nutrition course, which should deal largely in principles. The outline for the comparative nutrition course recommended by the Animal Science Action Committee is, I believe, an excellent starting place. Briefly, this outline includes: some history of the science of nutrition with appropriate identification of major contributions in nutrition research; energy supply and energy metabolism; the quantitative and qualitative aspects of growth and development and associative nutrient interrelationships; regulation of metabolic processes and the involvement of enzymes, minerals, vitamins and hormones; reproduction and the production of products; and, finally, the methodology of animal nutrition, chemical, physical, and biological assays and procedures, plus the necessary mathematical and statistical tools needed for analysis and interpretation. A course of this kind would be an excellent introduction to the beginning student of nutrition. It should be followed by a course in nutrition technology. Such a course would include feed ingredients as sources of nutrients, physical and chemical characteristics of feeds, processing methods, quality control, feed additives, ration formulation, interspecies feeding problems, and information on regulatory agencies. There should be a laboratory with this course. These laboratories should be well thought through and planned, and coordinated with species specialists. Every student should be exposed to some animal experience.

Even though a technology course is recommended in the undergraduate program, a major share of the emphasis should be on principles. If we train students without a thorough understanding of the nutritional principles underlying practice, we have trained him for a very short and, I am afraid, not too productive career.

In addition to the above, I would add to one of the courses, probably the first one, a section dealing with nutrition in its international aspects. We need to broaden the vistas of our students and, with nutrition being a part of our ecology, the most important element in our environment, what better stage do we have from which to project nutritional concepts? With respect to the world picture we need to be concerned with malnutrition and inadequate food supplies, with food production, processing, and spoilage, with specific nutrient deficiencies and special-area problems and, in general, with how nutrition is involved in all these things as they affect man's economy, his welfare and his happiness.

Interactions. I cannot overemphasize the importance of encouraging interaction among the disciplines that nutrition draws upon. As we look to the years ahead and attempt to anticipate the problems that need to be solved, one cannot but be impressed with the vast amount of knowledge that will be required to sort out the intricacies and the complexities of interacting situations. No one person has the specialized competence in the several sciences involved to be effective in solving the nutritional problems of the future. Rapid progress in one area cannot be made without a related response in another. Coordinated team attack on several fronts is essential if man is to make progress in eliminating human suffering related to nutritional needs. Since nutrition is an integrative science based largely upon biochemistry and physiology, it follows that the teacher of nutrition must be not only as well trained in the fundamental sciences as his
counterparts but also he must also maintain a continual dialogue with the teachers and researchers in the supportive sciences. This dialogue and interaction between the disciplines is essential if we are to close the gap between what is known and what is taught. It is also important that nutritionists teaching in animal science departments be animal scientists first, with an appreciation and an understanding of livestock, and biochemists-physiologists second. As Dr. Caside (1966) has said, "It is rare that an investigator uninitiated with livestock will choose to work with these animals as experimental subjects. If the scientific basis for tomorrow's animal husbandry is to expand, we must have a group of biologists who will work with these animals through choice and who will not be content with the assumption that all is known from a study of one or two convenient laboratory species."

Obsolescence and Opportunity. A very important by-product of interaction among the disciplines is the prevention of obsolescence on the part of the teacher. Nutrition is a science that is so dynamic and fast moving that it is all too easy for the instructor to become obsolete. Good teaching depends upon the ability of the instructor to take developing knowledge from biochemistry, etc., and apply it to animals and humans. In this connection the nutritionist has a major advantage over many other scientists because he has so many situations where he can relate science to technology. We should exploit this opportunity to the utmost—this chance to show that good research can pay off in better meat animals, faster and more efficient gains, a higher quality product, more efficient utilization of our feed supplies, etc. The responsibility of education in this area is more and more in the hands of nutritionists as biochemists have lost much of their early interest in nutrition now that most of the nutrients have been discovered and much of the quantitation has been done. To stay on top of developments in related areas teachers should audit courses, participate in seminars, and find out what is being taught in supporting courses. In the past there has been too much isolation to the detriment of undergraduate programs in nutrition.

Goals and Implementation. I suggest that the major goals of undergraduate teaching in nutrition should be:

1. To educate the student with a body of knowledge (nutrition) based largely on principles and fundamentals which equip him to apply reason in a problem-solving situation. He should be prepared to grow and adapt as nutritional technology changes.
2. To prepare students to do a more effective job of improving the nutrition of various animal species. The application of the technology to increase efficiency of food production (meat, milk, eggs, etc.).
3. To identify nutrition as a scientific discipline in our total educational structure.
4. To attract and encourage qualified students to consider nutrition as a qualified field for graduate study.
5. To expose the student to the international aspects of nutrition. The tremendous problems of malnutrition and inadequate food supplies are so serious that all students should have some knowledge, even though limited, of what is involved.

What are the primary means of achieving these goals?

1. Rewrite the course outlines—but first find out what is being taught in other areas. The outline should be developed without preconceived notions based on traditional practice and should take into account the previous educational background of the student which, in many cases, is either different or better than we had anticipated.
2. Assign competent enthusiastic teachers to these undergraduate nutrition courses and, most important, have a definite plan for preventing obsolescence in these teachers.
3. Promote the interdisciplinary interaction referred to earlier. Perhaps an "Institute of Nutrition" should be considered as a vehicle for bringing together the nutrition faculty and the scientists in related disciplines that are now scattered in the many departments.
4. Teach at the undergraduate level two nutrition courses: Comparative Nutrition and Nutrition Technology. The first should be on principles. The second on application, involving interspecies feeding, and should include a laboratory.
I make the above recommendation of goals and means of implementation with the full awareness that there is nothing very new, unique, or original in what is suggested. Good education, whether it be in nutrition or something else, is not something which lends itself to readily prescribed formulas.

Competent, enthusiastic, alert, informed, interested teachers working in a climate free of vested interests and petty jealousy (that we sometimes excuse or justify on the basis of competitiveness and ambition) would go a long way toward solving any problems we have in teaching nutrition at the undergraduate level.

Man is a product of his inheritance and his environment. The one he can do a little about—the other is subject to constant change and is within man’s power to modify extensively. The impact of nutrition will always be great, but the quantitative and qualitative change for improvement will be related to the amount of interaction that takes place between nutrition and the related disciplines, the objectivity with which we can view our problems, and the degree to which we can set aside some archaic notions.

Literature Cited