What a Dairy Manufacturing Undergraduate Teaching Program Should Be

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At many universities, the curricula for undergraduates continually are undergoing change. This is true in practically every subject matter area. Whether each of these changes represents progress is not certain. However, to have progress we must have change. Studies to determine the need for curriculum change, to decide the type of changes to be made, and to evaluate the changes that have been made are quite common. Therefore, it must be expected that the undergraduate teaching program for students in dairy manufacturing should be included in these curricula changes.

There are various reasons for these changes. One reason is the fact that the curriculum that might have been quite adequate and fulfilled a need, as short a time ago as ten years, is out-of-date or archaic in terms of today's students and their needs. Therefore, before we can discuss what the teaching program for a student in dairy manufacturing should be, we must consider three things: First, what type of student are we going to train? Secondly, what will the student do after he has received his training or completed his college career? Thirdly, what should be the ultimate goals of the training? Let us look at these briefly before discussing the actual training of the student.

The changing student. Our beginning students have changed considerably in recent years. The student entering the university now is in many respects quite different from the freshman of ten or twenty years ago. While beginning students always have had some variation in their backgrounds and training, this seems to be more evident now than in previous times.

There is a great variation in the quality and the level of instruction offered the student in the grade and high schools. Curricula changes are occurring there, too. Also, there is a great variation in the intellectual level and in the learning capabilities of the students entering the universities. To be sure, all of these students have met the entrance requirements. However, these requirements are minimum requirements for admittance and differentiate only between the students who can enter and those who cannot.

In general, the student entering the university today has had better training and has a better background than those of a few short years ago. I continually am amazed by some of our freshmen entering the university. Many of them have a good understanding of basic calculus and have been exposed to organic chemistry; a number have had courses in physics; and many are quite conversant in various aspects of biology. In fact, the average freshman entering the college or university has a better understanding of these subjects than many of us did when we had completed our four-year college course. Because of these variations in the students, it is evident that one teaching program or curriculum designed for all students in dairy manufacturing would be ineffectual, inefficient, and grossly inadequate.

The student's choice of careers. What does the student wish to do when he has finished his four years of college and received his Bachelor's degree? If you ask him when he first enters the university, many times he is not sure. Quite a few of the beginning students—in fact, I would say the majority—do not know what career they wish to follow upon completion of their university studies. For many of them, this holds true through various steps of their first four years of training. I sometimes think that many students use the four years of college as sort of a window-shopping trip. It is a means to find a career that will have the most appeal for them.

Students like to take a broad look and explore many opportunities before making up their minds. They are not interested in a vocational type of training, such as butter-making, cheese-making, or ice cream production. These activities do not seem to offer enough of a challenge or financial reward to them. Thus, we have very few students who know exactly what they want to do as they start their college career. Oh, we may find some of them who say, "I want to work in the area of food science," but this is such a broad area that they cannot be so specific as to say, "Well, I want to be in the dairy industry, the equipment industry," or the like.

Likewise, when employers are interviewing the current crop of college graduates, they are more interested in hiring a student whose training has been such that he can serve in various positions. Many of the traditional dairy com-
panies have diversified into different phases of the food processing industry. They prefer to hire men whom they can train in the different operations they have, and who will be adaptable to these operations. Thus, to have a teaching program that does not take these factors into consideration would be an injustice to our students.

**Ultimate goals of a teaching program.** What should be the goal or objective of any teaching program in dairy manufacturing or food science in general? It seems logical to expect that, before the student becomes a specialist in some phase of food science, he should have a good background of instruction and training in the basic sciences. Following this, he must receive a certain amount of good technical training in which he utilizes his basic sciences. But above all, there is one additional objective that we must keep in mind. This objective was described by G. Loftus Hill, in discussing the training of students in the dairy industry. He said, "Let us first, though, look at the things which all university courses should impart. One of these is a capacity to think clearly and think strongly. The mental functioning of a graduate should be as smooth and forceful as the working of a well-oiled machine. He should be a thinking person, not only in the sense that his brain is always active, but because his first reaction to any situation should be stronger mental action rather than mere emotional response."

No matter what curriculum might be designed, or teaching program devised, let us hope that our students will have the capabilities of functioning in the manner just described.

**Flexible curricula with multiple options.** How can all of these above requirements be met in an era of rapidly growing college enrollments, where closer and closer scrutiny is being paid to the costs per student of training and instruction, and in an era where there are many more job opportunities in the food industry than there are trained students available?

Utilizing a flexible curriculum with multiple options can fulfill these needs. To do this, we no longer attempt to train a student in just dairy manufacturing. We are now designing our teaching programs to train the student as a food scientist. If he wishes to emphasize the dairy manufacturing aspects of food science, this is possible under the flexible curriculum—multiple option programs.

Under this program, the student should obtain the best training possible in the basic sciences—chemistry, physics, biology, mathematics, etc. If possible, these subjects should be taught in the subject matter department of the university and not in the food science department. In addition to the training in the basic sciences, the student should have training in the basic communications, such as speaking, writing, etc. Along with these subjects, the student should have the opportunity to take additional courses that will stimulate his thinking and broaden his education. These may be in the social sciences, history, psychology, or the arts. Depending on the background of the student when he enters the university, his capabilities, the methods of instruction used at the university, and the types of special requirements each university normally has, it probably will require at least the first two years of the student's college career to get this basic foundation needed to be a major in any phase of food science. After he has received this basic training, he is then ready to select an option and choose a course of study to fit his needs.

The number of options offered at any one college or university will depend on the resources of the university. It is not expected that every university will offer every possible option. They should specialize in the options in which they have strength and capabilities. The following options are given as examples. This is not a complete list nor does it exhaust all of the possibilities.

**Science option.** The first might be called the science option. This is for the student who has intentions of going on to graduate school to do research, or he may be interested in doing laboratory work, or possibly to become engaged in some type of product development work. He is the student who, as we sometimes say, is scientifically inclined. Under this option, in addition to the basic science courses mentioned above, he would take more advanced courses in the various sciences—courses in bacteriology, biochemistry, statistics, and the like. He would be required to take some technical courses in food science. It is not possible to state the exact number of credit hours of technical courses that should be required. This will vary with different institutions. Certainly, it must be at least the minimum number of hours required for classification as a major in the department. The type and scope of these technical courses will be discussed later.

**Engineering option.** Another option might be the engineering option. This would be for students interested in food engineering, equipment design, plant layout, etc. These students should be given the opportunity to take as
many engineering courses as possible, and this, of course, within the engineering school where available. They, too, would be required to take technical courses in the food science department, but with the minimum credit hours it is the university's policy to require for a major.

Production and technology option. This option would be for students interested in food processing, the plant supervision and production operations. These are the men who will be operating the production lines and supervising the processing procedures in dairy plants or other types of food plants. These students should be required to take a maximum number of technical courses in the food science department. The number of credits would depend upon university policy. If a fifteen-credit minimum is required for a major, it is suggested that these students probably would be taking approximately 25 credit hours in the department. They also should have some training in personnel management and labor relations.

Business and industry option. The business and industry option is for the student who may wish to go into management, into sales, or into businesses allied to the food industry. He would be required to take the minimum number of credit hours of technical subjects in the food science department. However, he would take a maximum permissible number of courses given in commerce, economics, or business administration.

These four options mentioned are just examples. There may be many other options or combinations of options. The actual number of courses taken under any option should be quite flexible; the requirements should be designed for the needs of the student and on the basis of the availability of the courses at the university.

Technical courses in food science. The technical courses taught in any food science department should include courses in three general categories. Beyond this, a department may offer specialized courses in any related subject in which it might have the capability. The three basic categories are as follows:

a. Food chemistry. This is the adaptation of chemical techniques of food analysis—the composition of foods and the chemical properties of basic food constituents. The chemistry of food fats, proteins, carbohydrates, minerals, emulsifiers, stabilizers, food additives, etc., would be covered in the food chemistry courses. Usually, it is necessary to present this material at two levels. The beginning food chemistry course covers the analytical and control procedures, the advanced courses go into more details on the chemistry of the food constituents.

b. Sanitation and quality control. The organization of these courses will differ, depending on the institution. The subject matter should stress the sanitation involved in food processing and food plant operation, as well as the various regulations and standards that apply to food products. The statistical approach to quality control should be included in the subject matter presented in these courses.

c. Principles of food processing. These courses should be designed on a principle basis, rather than on a product-oriented basis. By principle basis is meant that the approach to the technical subjects would be under such headings as food preservation, dehydration, homogenization, fermentation, etc., rather than by individual products. As you know, these principles are applicable to many types of food products. A student with training in the principles can adapt them to the processing of whatever product he may eventually be concerned with.

It is desirable to have at least one product-oriented course. By this is not necessarily meant a course dealing with one product, but a course that might include several products. This should give the production and technology student particularly an opportunity to do some processing work. However, we must keep in mind that the university is not in as favorable a position to train a student in the processing of a specific product as will be the company for which he will be working. Each company has its own method of processing its product. The student while still in college seldom knows what product he will be concerned with in his future employment. Also, he eventually may be concerned with a number of products. He will gain this experience in his first job, or subsequent jobs. If he has a good training in the principles, he can work with most any type of product.

Conclusion

There are several advantages to the flexible curriculum–multiple option approach in our teaching program. Under this procedure, the student gets better training. He is given instruction by specialists. One department does not try to teach all courses. He receives his chemistry work from the chemistry department, his bacteriology in a bacteriology department, his engineering in an engineering department, his
mathematics in a mathematics department. This may not be possible in all schools, but should be a goal for which we are striving.

Another advantage is that the curriculum can be designed to fit the capabilities of the student. We must get away from having a set number of courses, and this is what the student must take, or else. As advisers of students, we must assume a greater responsibility. Provisions must be made to help the student select the courses that will meet his needs and be within the realm of his capability. A flexible curriculum—multiple option type of instructional program will help attract more students. It will attract students with broader interests. A student who may not have considered food science as a career may now do so, because he can take courses more to suit his talents and interests.

Last but not least, a flexible curriculum—multiple option type of program will provide the food industry with the trained man-power required to fit its diverse needs. It will provide a student with enough flexibility so that he can fill a number of positions. You will note from the discussions presented here today, the food industry wants men of this type. They want men who have this ability—the ability to think and to understand the principles that can be applied over a broad range of products.

What Industry Wants for Training in Dairy Manufacturing from the Production and Management Standpoint

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Educational Changes

Industry leaders are concerned about the changes taking place in dairy industry education. We have noted the drop in dairy technology graduates. This comes at a time when, because of many changes taking place in our industry, there is greater need than ever for well-educated manpower. Many of us in industry have the feeling our universities should be upgrading and strengthening the dairy technology curriculum. A real concern is that the aims for dairy education are not clear. I would like to point out how many of these young men are brought into our commercial companies, and what we are seeking in these men.

Present Leadership

Many dairy companies are now headed by executives who have moved from jobs as production specialists into high level management. Career usually follows a pattern. A university graduate begins in the laboratory or some supervisory position in the plant, advancing in production and sales operations to the level of production manager or sales manager. While working in the above areas, more and more questions of business find their way to the young man and, finally, a gradual training in administrative planning, financial, and legal aspects come his way. Then because of proper background and broad training experience, coupled with personal qualities, he is ready to join the top management team. Our question is, What kind of university education will best prepare these men for their duties and responsibilities in industry?

I would first like to emphasize to our educators that they should enlarge their thinking about the skills required of a leader in the dairy business. We are so prone to think that the all-important phase is the technical, which deals with the product itself. I recall for you that business deals with materials, machines, methods, men, and money. So far as materials go, we think in terms of milk and handling of milk in all its ramifications. Let us not forget that a big area of business is the cost dimension, or the money aspect. We need men prepared to handle all the "M" areas. Our men work over the entire field, bringing all of them together. My emphasis in this paper is that our university educators should put greater balance into the dairy technology curriculum, so men will be trained in a broader way. The processing industry has need for scientists and engineers capable of advancing our technology, but in a more pressing way we need young men to develop into positions of leadership capable of handling the complex affairs of the modern dairy enterprise.

Type of Men Needed

The type of man we need in industry can perhaps be more clearly understood if I cite the basic skills we desire and look for in the university graduate. First, we are in need of men who have mastered the art of thinking and