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NEW DEVELOPMENTS IN FOOD SCIENCE AT THE
U.P. COLLEGE OF AGRICULTURE

BY

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Ladies and Gentlemen! It is a great pleasure for me to speak to you today. The subject of my talk is "New Developments in Food Science at the U. P. College of Agriculture (Los Baños)". However, I think the topic is just as appropriate for the whole of the Philippines today as it is for Los Baños. The time is ripe for big developments in Food Science. In certain respects, these developments are long overdue. If Food Science research had begun in earnest 10 years ago, those projects would be paying rich dividends already today.

It is an interesting fact that it has been the advanced countries with the most food that have done the most research developing new foods and new sources of protein. Let's take a look at recent developments in the United States. Many of you may be aware of the switch in the United States from a principally butter-consuming country to one in which 75% of the market is now vegetable fat-based margarines. At the present time, the large food companies such as General Mills and General Foods as well as many others are engaged in a very active program of research developing lines of synthetic meats manufactured from vegetable, primarily soy, protein. There is already a synthetic lean bacon on the market. This fall, General Mills is test marketing another meat substitute. Let's analyze it. The meat market in the United States is \$30 billion/year. If a company can corner even 1% of this market with synthetic meats, it has a \$300,000,000 business. At the time I left the United States six months ago, the major milk companies were vigorously exploring the field of synthetic milks based on soy and other vegetable proteins. The surplus skim milk has disappeared from the American scene. Ahead, with rising populations, the United States is going to need synthetic milks to extend its milk supply and to supply adequate nutritional beverages to its infants and children. Thus, it is a conservative estimate that within 5 to 10 years, all Americans will be eating a percentage of their diet in vegetable margarines, synthetic meats, and synthetic milks.

What has all this to do with the Philippines and particularly with the College of Agriculture at Los Baños?

When I came to Los Baños six months ago, the general assignment was to expand graduate research in Food Science. One of our prime objectives was to develop protein-rich foods, particularly for infants and children, from plant sources such as soybean and coconut. In our initial thinking, these foods were to supply principally the needs of the developing countries. However, in recent months, it has become clear that large food companies in the United States will be watching developments in the field of plant

protein based milks and other products as there may be a market for them in the United States in the very near future.

How can we approach these important problems in food science at Los Baños? Research costs money. The costs must be paid by the government, by foundations, or by industrial grants. From experience, we know that research does pay off. In the long run, instead of costing money, research yields money to the government in the form of increased exports and taxes on expanded industrial payrolls and production. It pays off in the form of better and cheaper products for the consumers. Particularly here in the Philippines and the Southeast Asia where coconut is such a tremendous products, the time is ripe for rapid advances in coconut technology and development of a wide range of new coconut products.

At Los Baños, we have received Food Science research support from the U. S. Agency for International Development. Food Science research is not new at Los Baños. Over the past years, about 150 scientific publications dealing with various Food Science problems have originated at Los Baños. However, Food Science as a discipline is relatively new. Equipment for food processing research has been lacking. AID has provided 200,000 pesos to purchase equipment for Food Science pilot plant over the next three years. In addition, Food Science research requires supplies and materials. AID has granted us about 24,000 pesos over the next three years to cover supplies and materials. Machines and supplies mean little if we do not have trained people to design and run the experiments. The AID has granted us about 100,000 pesos over the next three years to employ two Assistant Professors - one in Food Science and one in Nutrition plus three technical assistants, secretarial and other help.

What will we accomplish with this research support? First, we will develop soy and/or coconut based milks and other soy-coconut based food products which have flavors acceptable to the Philippine consumers. These studies have already begun in cooperation with the Department of Home Technology. Taste panel studies related to methods of processing and flavoring soy milks are underway. Economic and sociological studies are to be made at the barrio level to determine the factors influencing the mother's choice of foods for their infants following weaning and the amount of money, if any, available for purchase of infant foods. If insufficient money is available, barter may be used to supply the needs of such families.

It is almost a certainty that these soy-based beverages will be distributed as soft drinks sterilized in the bottle. The reason is that this is the form in which they have proven to be most acceptable for distribution in Hongkong, Bangkok, and Taiwan. The Philippines has the largest per capita consumption of soft drinks in the world. It is only natural to cater to this habit in the Philippines. You may say but how can soy milk compete with the usual soft drinks? In

Hongkong, it is the Pepsi Cola dealer who bottles soymilk and soymilk outsells Pepsi Cola. Soymilk is a real profit maker sold in the tune of 60,000,000 bottles per year in Hongkong alone. But the flavor has to be adapted to the Philippine taste. If it is to be fed to infants, the nutritional quality must be excellent. Finally, it has to be produced at a price as least competitive with other soft drinks.

In the barrios, in order to give the poorer people the benefits of this research, it may be necessary to modify production perhaps distributing it with the same flavors but in a pasteurized form produced each day. Soymilk can be produced using very simple processing methods. Ingredients cost at the present time is about 15 centavos/quart or about 4 centavos per 8 ounces soft drink bottle.

You may say, this all looks good on paper, but we don't grow many soybean in the Philippines. However, recent research has been directed toward developing varieties that grow well in the Philippines. The agronomists at Los Baños and industrial producers in Mindanao have demonstrated that soybeans can be grown successfully in the Philippines. If soymilk is produced commercially, there will be an excellent market for soybeans as a cash crop and experience has shown that if farmers know that they can sell a product at a profit, they will grow it. At the present time, a large Philippine company is willing to guarantee the farmers a cash price for all the soybeans they produce.

Some people may object to growing soybeans when there is already such a supply of potential coconut protein available. However, let's examine the potentialities of producing protein in the form of soybeans or coconut. About 156 coconut palms can grow on a hectare of land. If each of these produces 50 nuts/year and each coconut contains 350 grams of coconut meat containing roughly 7% protein, the total production of protein will be 190 kilos of protein/hectare. Average yield of soybeans in the Philippines is 2,000 kilos/hectare which, calculated at a protein content of 45%, yields 900 kilos protein/hectare in a single crop/year. Thus, soybeans offer yields of protein that are too attractive to be overlooked in a world in which there is generally insufficient protein to supply the needs of all the people.

In addition, the protein is already concentrated, approximately 45% of the dry weight in soybean. Coconut meat must first be dried and then fat extracted to yield a product with 20% protein. Infants and children which suffer most from the lack of this essential nutrient. Insufficient protein in the diet of infants leads to stunted mental and physical development, insufficient resistance against disease and premature death. So we are going to investigate new soy-based milks and other products as a primary objective in our research at Los Baños. However, soybeans are very versatile. You are all familiar with soy sauce which is produced by growing the mold Aspergillus on the beans and then allowing the enzymes to digest the beans in salt brine. Over a period of months, the proteins and lipids are split yielding the typical flavors of soy sauce. It was soy sauce that lead to the

development of mono-sodium-glutamate as a popular flavoring ingredient. In other parts of Asia, Indonesia and Malaya particularly, another soybean product called tempeh is popular. In this case, the soybeans are overgrown with mold of the species Rhizopus. The mold produces proteolytic and lipolytic enzymes as well as enzymes which breakdown the intracellular matrix of the soybeans. The result is new flavors that are highly satisfactory to millions of people including most people unacquainted with the product. With tempeh, the entire fermentation is over in from 24 to 72 hours and the product is deep fat fried or cooked in soups as a source of protein in place of meat. While whole soybeans are not thoroughly cooked after boiling for 6 hours, the mold fermented beans are ready to eat after deep fat frying for 3 to 5 minutes or following boiling for 10 minutes in soups. Where fuels are scarce or expensive, this is a very important consideration. The fermented soybeans are also more easily chewed aiding digestion.

The proteins in soymilk can be precipitated readily by heating the milk to boiling and adding small quantities of calcium or magnesium salts. The soybean curd (tokua) is sold on many markets in the Philippines and is quite popular. However, most Filipinos do not realize how simple it is to prepare the curd. Tahu is made by similar procedures. Other popular products from soybeans are miso - a soy sauce flavored soybean-cereal paste and yuba a protein-rich film that forms on the surface of soymilk when it is simmered just below boiling.

Although soymilk has been consumed for centuries in China, it is only recently that research has shown the way to produce soymilk with flavors acceptable to most consumers. Recent research has paved the way for making soymilk similar in flavor and consistency to Cow's milk. And, even in the United States, we will all be drinking a portion of our milk in this form in the future.

But what about coconut which is already a tremendous agricultural product in the Philippines? Even though it does not contain as much protein as soybeans, it is produced in such huge quantities that it offers a considerable potential supply of protein to supply the needs of protein deficient areas. Unfortunately, traditional methods of drying copra do not yield a high quality base for the production of protein for human consumption. Yet, with some diligent imaginative research, which we intend to do at Los Baños, it is our belief that the traditional methods of drying copra can be improved so that molds do not overgrow the coconut meat. We must insure that the copra does not contain aflatoxin which would be injurious to health of consumers. A research project is underway on this important subject. Methods have to be developed for extracting coconut proteins in wholesome, undenatured, soluble condition so that they can be utilized in a variety of forms in human foods.

At the present time, coconut water is discarded in relatively

huge quantities - reported to be 50,000 gallons per day in a single factory producing desiccated coconut. Yet, research at Cornell University and other institutions has shown that coconut water contains materials with remarkable growth-promoting properties particularly for plant tissue cultures. We still know far too little of these growth factors and how they may be extracted and concentrated. Research will show the way to making new food products and fermentation stimulators from this waste product from the coconut industry.

Coconut protein is rather unique because of its functional properties and the fact that it is relatively high in methionine, an amino acid often deficient in plant proteins. In fact, to make soybean protein equivalent to milk protein, it is necessary to add methionine. This suggests that a milk prepared from a mixture of soybean and coconut may be better nutritionally than either one alone. It is conceivable that plant protein milks can be produced with a nutritional value better than cow's milk. There has never been enough cow's milk to supply the total needs of the world's population. With increasing populations, with the supply of land/person decreasing, it is going to be necessary to feed more and more of the world's population on plant proteins which can be produced far more economically per unit of land than by feeding the plants to animals and using the meat and milk from the animals. This does not mean that all animal proteins will disappear as fish and marine animals will be harvested from the oceans for the foreseeable future. On land areas where only grasses can be grown efficiently, it is still more economical to let ruminant animals transform the grass into edible meats and milk. As human population increases the amount of garbage also increases. It is still economical to feed this to pigs and convert the garbage to additional edible meat. There will always be food materials that do not meet human standards which can be more economically fed to poultry and animals thus supplying us with a variety of animal and plant foods to make our diets interesting.

But what we do eat in the future is going to be the result of Food Science research today. That is why we are expanding Food Science research at Los Baños.