U.S. NATIONAL AND INTERNATIONAL EDUCATION FOR THE SAFETY AND QUALITY OF OUR GLOBAL FOOD SUPPLY

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U.S. Food Science Education: Need for Specialists in Microbial Food Safety and Quality

While U.S. colleges and universities produce a substantial number of graduates with a degree in food science, there is a critical shortage of specialists trained in microbial safety and quality of food products. There are even fewer graduates with an understanding of the specifics of and hands-on experience in dealing with food products that arrive in the U.S. from overseas.

For the first time, with this proposal, we are offering the unique opportunity of training a U.S. student in ways to handle and control foodborne pathogens and spoilage microorganisms, both issues of major concern when it comes to the internationally-produced food. This training will be provided as a part of an educational package for the selected graduate (M.S.) student and will consist of hands-on experience in dealing with real food products, the spoilage and pathogenic microorganisms challenging these products, and the means of efficient control of these microorganisms in food products by formulation of commercially-available natural preservatives.

Ethnically-Unique Armenian Food for the U.S. market

Armenia is a country with a rich history and traditions in agriculture and a variety of ethnically-unique food products that it offers on both the local and international markets. Armenian food can be loosely characterized as “Mediterranean/Middle Eastern” cuisine, with many products similar to those in the Georgian, Greek, Turkish, and Lebanese cultures. These products, while carrying the same/similar (e.g., processed meat product “Basterma”) or completely different (e.g., Turkish dairy drink “Airan” and Armenian “Tan”) names, are often similar in taste and the utilized manufacturing technology.

According to Ghanalyan (2009), there are at least 1,270,000 native Armenians currently living in the U.S. – this is equivalent to 1/3 of the population of Armenia. The biggest U.S. Armenian community resides in Los Angeles, CA (64,997), followed by other large settlements in Glendale, CA (53,840), Greater New York (31,867), Greater Boston (21,709), and Metro Detroit (11,986).

Being favored by millions of people in the U.S., Armenian food is produced by local industries and imported from Armenia. Some of the imported Armenian food products are cheeses, wine, processed meat, fish, and juices. The USDA is actively assisting Armenian dairy manufacturers through several programs targeted at improving the manufacturing technology, quality, and safety of these products. Figure 1 exemplifies a unique Armenian...
smoked cheese manufactured at the local Armenian family-owned factory which is equipped by the USDA.

**Food Science Education in Armenia: Past and Present**

Before the collapse of the Soviet Union, most of the specialists for the country’s food industry and related governmental offices received their education at several specialized food technology educational institutions located in Russia and Ukraine. Now an independent nation, Armenia does not have a single university within its borders that can provide a continuous, in-depth education in the areas of food science. The presented challenge is much larger than a current lack of educated specialists and the absence of appropriate educational institutions. Clearly, there is a need for future generations of Armenian specialists who will not only advance their country’s food industry, but will assist governmental offices in the proper design and implementation of food laws and regulations at the level of international standards. Based on educationally promoted developments in the food industry and the establishment of internationally-accepted food laws, the Armenian food industry will provide the country’s population with safe and healthy food by implementing advanced technologies and methods for controlling food safety. In turn, this will assist in the creation of new jobs in the food industry (private sector), governmental institutions and academia. In total, these developments will boost the country’s economy and will help its products reach international markets.

To boost the food science education of Armenian students, we initiated a research project with Danisco USA that involved Yerevan State University’s (Armenia) microbiology students. Drs. Petersen (Danisco) and Chikindas (Rutgers University) travelled to Armenia to commence this project. The students were trained in collecting dairy samples from households in the country’s rural areas where fermented milk products are made at home using indigenous starters that are passed from generation to generation. Several hundred samples of fermented cow, sheep and goat milk were collected and analyzed for acid production and other parameters important in dairy fermentation (Danisco report is attached). In addition to training the Armenian students and guiding the project, Drs. Petersen and Chikindas were acting consultants to several Armenian food companies. Figure 2 depicts their visit to the Armenian dairy company Ashtarak Kat.

While numerous educational initiatives were previously brought to Armenia, none of them resulted in the establishment and solidification of continuous food science education at the undergraduate and graduate levels. Instead of organizing short-term courses and programs, we are working on building continuous food science education at the Armenian State Agrarian University. Our initiative received support from U.S. and Armenian governmental bodies and private organizations in both

![Fig. 2. Drs. Petersen (Danisco) and Chikindas (Rutgers) visiting Ashtarak Kat dairy factory in Armenia (2nd and 3rd to the right). Photo courtesy of Danisco USA.](image)
countries, including Congressman Pallone (NJ), Deputy Minister of Foreign Affairs of Armenia, Dr. Kocharyan, and the Armenian State Agrarian University (letters attached).

**Foodborne Pathogens and Spoilage Bacteria: Major Microbial Challenges**

The complexity of the Armenian food system and the growing availability of imported food ingredients and consumable items have created conditions vulnerable to food contamination. As a result, periodic outbreaks of foodborne illnesses are quite common in Armenia. According to the Armenian Ministry of Health, an average of 200 cases of salmonellosis, 150 cases of enteritis, and 350 cases of intestinal infection caused by unknown pathogens are registered annually in Yerevan, the country's capital.

Armenia's food and agricultural products are finding their way to the international market, which may create challenges due to the lack of government-approved international-quality standards and because of variability in an assortment of product formulations. For instance, products of Armenian companies such as SIS NATURAL LLC (fruit and vegetable juices) and Arkadzuk LLC (smoked fish) are available in the U.S., Canada, Australia, Russia and EC countries. Major microbial challenges reported by these two industries are juice spoilage by *Alicyclobacillus acidoterrestris* and contamination of smoked fish by *Listeria monocytogenes*.

*A. acidoterrestris* is a Gram-positive, spore-forming spoilage organism causing significant losses to the fruit juice industry (Goto et al. 2007). While growing in fruit juices, this microorganism produces guaiacol and other taint compounds, causing formation of a very distinctive and offensive smell. Unlike other common spore-forming spoilage organisms, *A. acidoterrestris* spores demonstrate considerable resistance to thermal processing and are highly acid tolerant (Silva et al. 1997). These characteristics confer the ability to survive traditional pasteurization temperatures and prevent the use of formula acidification to control spoilage in shelf-stable juice-based beverages.

*L. monocytogenes* is a notorious Gram-positive foodborne pathogen with high mortality rate and especially high health and life-threatening for pregnant, elderly and immune-compromised individuals. It can multiple at refrigeration temperature and capable of adapting to the acidic environment (Bonnet et al. 2006), which makes it a serious challenge for food products’ microbial safety. Soft cheeses, hot dogs, processed meat and turkey, and seafood have been implicated in several outbreaks of listeriosis (for review see: Gandhi and Chikindas 2007). Smoked fish has been also reported as a product whose consumption may cause listeriosis (Ericsson et al. 1997; Miettinen et al. 1999).

Recognizing the challenges presented by these microorganisms, SIS NATURAL LLC and Arkadzuk LLC are interested in keeping their image as businesses that use no harsh chemicals in their products’ formulations and are considering the use of natural antimicrobials as demanded by educated consumers. This was discussed with the companies’ management during Dr. Chikindas’ visit to Armenia in 2010 (Fig. 3).