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OSIJEK

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ENGLISH IN FOOD TECHNOLOGY I
GRADUATE STUDY – 1ST YEAR

Osijek 2009

CONTENTS

Units	Page
1. The Whole World in Our Hands	3
2. Engineering Strategies	6
3. Fingerprinting Foods	9
4. Nanotechnology	12
5. New Food Product Development	15
6. Smartness in Packaging	18
7. Whole Health for Self-Care – A New Nutrition?	22
8. Minimal Processing for Healthy Food	25
9. Functional Food–Beverage Products Redefine New Age	28
10. Antioxidants	31
11.Red Winemaking	35
12.Breadmaking	40
13.Cheese	43
Additional reading	46

UNIT 1

THE WHOLE WORLD IN OUR HANDS

Activity 1

Pre-reading task

1. Why is the whole world in our hands?
2. What are the prospects of the world economy?
3. How has the world become a smaller place?

Figure 1 Globalization



www.illuminati-news.com/.../a/globalization.gif (2010-04-08)

With the new millennium we are all wondering which way the world is heading. The frantic pace of global change often blurs our view of the road ahead. But amid all uncertainties, one thing seems clear: the world is becoming a smaller place. Just look at the phenomena of the World Wide Web and global satellite communications. Suddenly the other side of the planet is not so far away anymore and as barriers fall, opportunities arise. A freer flow of both global information and trade is helping us build relationships that not too long ago would have seemed hopelessly remote and inaccessible. As world markets continue to open up, the dairy industry will benefit by forging global alliances: working relationships between a supplier in one country and an end-user in another.

Global alliances go far beyond “I have this for sale. Will you buy it?” They involve a frequent exchange of product specifications, technical know-how, market intelligence and competitive intelligence. Global alliances let U.S. companies get inside foreign markets and take advantage of the opportunities they offer. To understand the value of global alliances, consider this: about 96% of the world’s population lives outside the United States. That is a lot of mouths to feed. People in developing nations have a growing appetite and, over the long term, more and more overseas markets will be looking for U.S. dairy products. Global alliances are one way to meet that demand.

A global alliance may be a formal joint venture, with a seller and a buyer creating and jointly owning a third company. It may be a three- or four-way partnership, a chain between a U.S. manufacturer, a trading company, an importer, an overseas customer and an end-user, or

it may also be a two-way flow of products, where a U.S. seller/exporter also imports products from its overseas customer.

No matter which form they take, global alliances offer limitless possibilities. Global alliances have helped U.S. whey manufacturers spawn numerous new products and applications worldwide, particularly in Japan and Mexico. They will help U.S. manufacturers and marketers enjoy vast opportunities throughout South America when the European Union's export subsidies dry out. Despite setbacks like Mexico's financial crisis a few years ago and the current economic turmoil in Asia, over the long term more and more foreign markets will continue to emerge for a growing array of U.S. dairy products in ever-greater volumes.

Still, global alliances are not for everyone. Like any meaningful relationship, they require a big commitment of time and resources. You may need to relinquish some control to your overseas partner. They also present a risk that you will rely too much on your new partner or not enough. Nonetheless, for the sake of your future success, I urge you to consider building global alliances. Long-term growth in overseas markets is expected to outpace U.S. market growth by at least five-to-one. In the rapidly expanding markets of the millennium, global alliances will make a world of difference.

Drier, Jerry, New Products and Marketing
Insights, Dairy Foods, June 1998

Activity 2

Text organization



Scan the text to find the following information and order the information chronologically according to their appearance in the text:

- forms of alliances;
- problems of global alliances;
- globalization indicators;
- advantages of global alliances

Activity 3

Comprehension questions

1. What kind of global changes do we notice at the beginning of the new millennium?
2. Why are global alliances important?
3. Are there such alliances in Croatia?
4. What are the possible forms of partnerships?
5. What are the benefits and problems of global alliances?
6. Create small groups and talk about global alliances in food industry.

Activity 4

Vocabulary exercise

Scan the text and find synonyms for the following expressions:

- a) to form alliance _____
- b) to spread out a product _____
- c) range of products _____
- d) to give over control unwillingly _____

UNIT 2

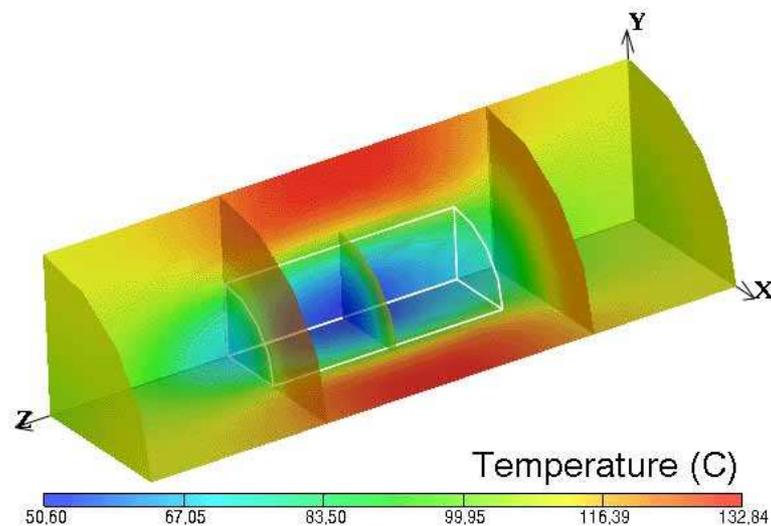
ENGINEERING STRATEGIES

Activity I Pre-reading-task

1. Do you know any of the new technologies in food industry?
2. How can new technologies be transferred to developing countries?

The last Food Engineering Symposium focused on engineering strategies for cost-effective research and developments in food. Many speakers talked about research and development becoming more expensive and they stressed the need to develop strategies and to optimize resources. Rakesh Singh of Purdu University, presented an overview of research being done to improve existing processes and to develop emerging technologies. He described unit operations involved in sterilization, pasteurization and bioseparations and discussed microwave, radiofrequency and ohmic heating research, as well as research on such separation technologies as membrane separations, precipitation electrophoresis, chromatography and supercritical fluid extraction.

Figure 2 Ohmic heating



www.hyfoma.com/.../ohmic/iftohm1b.jpg

Robert Baker of USDA's Subtropical Products Laboratory said that in the future, minimally processed or fresh-cut fruits and vegetables are expected to represent 25% of all produce sales and 50% of dollar volume. While minimal processing often dramatically increases the value of raw material, it brings with it a host of new problems associated with production, packaging and storage. Since minimally processed fruits are viable tissue, packages must allow proper gas exchange and minimize oxidative flavour or colour loss, yet prevent development of anaerobic conditions. For a minimally processed product to succeed, he said, all members of distribution chain must be made aware of the need for appropriate handling, storage and inventory control.

Gustavo Barbosa of Washington State University, discussed emerging technologies such as pulsed electric fields, pulsed light, oscillating magnetic fields, and high hydrostatic pressure, saying that they are not necessarily better than current technologies but offer new opportunities. He also pointed out the need to identify and measure engineering properties to properly implement emerging technologies such as combinations of air drying with microwaves, pulsed electric fields with thermal treatments and high pressure with ultrasound. He stressed that food engineers must not just develop unit operations and let others use them, but must take a team approach.

Larry Dawley of Greenstock Resources Inc. said that more than 1000 new prepared foods are introduced each year, but only about 10% of them may be regarded as successful. With the availability of technologies to produce a broad range of functional, cost-competitive ingredients from diverse source of feedstocks, the success rate should be much higher. To develop an appropriate food ingredient, he said, one must first inquire what the customer wants in a product, then identify whether that requires a protein, fiber, starch, or oil, then look at the kinds of technologies that are available to produce that ingredient and then choose the raw material. He illustrated this approach with process to develop value-added ingredients derived from wheat, oats and sunflowers.

Ernesto Hernandez of the Food Protein R&D Center, Texas University, described the approach that his group takes in assisting industry in developing and carrying out research and development projects, namely, conducting bench and pilot plant studies followed by scale-up studies. He then described the unit operations and chemical processes used in oilseed processing, such as drying, extrusion, pressing, solid-liquid extraction, neutralization reactions, centrifugation, adsorption and distillation. He stressed that these operations and processes need to be well understood for design and scale-up processes.

William Washburn of Food International Inc. California, said that many U.S. food processors have become involved in the handling and processing of food products in developing countries, but the results have not always been good. To develop R&D strategies and provide technology transfer to developing countries, he said consideration must be given to the entire programme from sourcing raw materials to marketing product. He reviewed specific projects showing how modern technology can contribute to the improvement of product quality and process efficiency in developing countries and challenged the audience to see opportunities to work in developing countries to broaden their perspective

IFT Annual Meeting Highlights, August 1997, Vol 51, No 8

Activity 2

Text organization

Scan the text to find the following information:

- problems with minimally processed food
- conditions for transferring new technologies to developing countries
- type of studies carried out to assist industry
- examples of emerging technologies

Activity 3

Comprehension questions

1. What current technologies are being studied for further development?
2. What conditions must be fulfilled for a minimally processed product to succeed?
3. What new opportunities do emerging technologies offer?
4. How many new products are successful at the market?
5. How can industry be helped?
6. What is a tendency in food processing today?

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

a) cost-effective research _____

b) emerging technologies _____

c) produce sale _____

d) scale-up studies _____

e) cost-competitive ingredient _____

f) to source raw material _____

UNIT 3

FINGERPRINTING FOODS

Activity 1 Anticipation

1. What is fingerprinting?
2. How can it relate to food?
3. Why is it important to identify food ingredients?
4. What is bioterrorism?

Food quality professionals must contend with a new and increasing interest in the traceability of their products, traceability being defined as “knowing what exactly a food is made of and where it comes from”. These professionals also need to address growing concerns about genetically modified (GM) crops, certification of organic ingredients and food adulteration, not to mention bioterrorism. To meet these demands every available tool needs to be marshalled. Analytical procedures, commonly known as fingerprinting, are required to positively identify products.

The unpleasant fact is that there is a criminal element in the food industry. Recognizing the need to monitor criminal activity, the FDA formed the Office of Criminal investigation (OCI). In the years since its founding, OCI has brought to trial numerous cases involving counterfeiting of food products, fraudulent misrepresentation and illegal substitution. Sadly, cases of food adulteration have been widespread over the years. Motivated by quick gains, dishonest food producers surreptitiously substitute ingredients. While such adulteration may not pose a health hazard, it cheats both consumers and law-abiding producers. Few products have attracted more attention than apple juice. Numerous scams have uncovered in which products labelled “100% apple juice” were found to contain various oligosaccharides derived from corn and other plant sources.

The vulnerability of our food supply has become more apparent since the terrorist attacks on the World Trade Center in New York and the Pentagon in Washington, DC on September 11, 2001. In subsequent investigations, Osama bin Laden, the person who was suspected of masterminding these attacks, was found to have obtained funding by infiltrating the honey trade in the Middle East. The network of stores, distributors, and suppliers of honey extends all the way from Pakistan to the United States.

Food product authenticity can be defined as the veracity of its label description, which may cover several aspects relating to product quality. Food authenticity is necessary to ensure that buyers receive what they have paid for. The issues with which authentication is concerned encompasses the following descriptors:

- a) *Species* may indicate the kind of meat or fish in a product. From an economic point of view, there may be a considerable difference between beef and venison.
- b) *Variety* is critical in specifying grain quality, e.g. pasta flour must contain the correct proportion of semolina and durum wheat.
- c) *Geographic origin* is critical for many gourmet products including wine and cheese. Certain regions, such as Bordeaux (wine) and Emmenthal (cheese), have traditionally commanded premium prices for their specialty products.
- d) *Process* can make a difference for some foods. Whereas olive oil may contain a blend of refined oil from olives, virgin olive oil is produced exclusively by mechanically or physically extracting the oil from the pomace.

- e) *Brand substitution* is a well-known type of fraud. In this regard, food processors have a vested interest in protecting their labels.
- f) *Age* often differentiates premium products, e.g. Scotch whiskey when aged in oak barrels undergoes subtle changes in its composition that improve its taste.

The detection of fraudulent products is a never-ending contest between criminals and food technologists. It is a technology race – as soon as a foolproof method of detection is developed, efforts are made to outwit the test. For this reason, methods of analysis tend to have a short life span. Fortunately for honest producers, the sophistication of technology is becoming more difficult to circumvent.

The use of isotope ratios in food authentication is an example of the progress which has been made. The unique ratio of isotopes, such as ^{12}C to ^{13}C or ^2H to ^1H , found in certain food products provides a fingerprint that can be used in authentication. This is the case with honey, in which the concentration of ^{13}C distinguishes it from other sweeteners. The analytical procedure, however, is somewhat involved. Because the level of ^{13}C in pure honey may vary depending on the source, ^{13}C is determined for two components of honey – protein and carbohydrate. The value for the protein provides an internal reference against which the isotope ratio for the bulk of the honey can be compared.

One method for checking the authenticity of fruits and vegetables is analysis of trace minerals. Soil- plant systems are acutely responsive to the concentration of minerals in the soil, plant species and growing conditions. The uptake of nutrients from the soil is affected by each of these variables. Thus, in potatoes, trace minerals have been used to determine geographic origin. Atomic emission spectroscopy provides the extreme sensitivity required for this analytical procedure.

Food technologists often use markers, which are valuable to determine the origin of a product and to evaluate quality changes either during processing or under storage conditions. Broadly defined, a chemical marker is a compound, whether naturally occurring in a food or intentionally added, which serves as a means for determining a product attribute. By virtue of their quantitative, predictive and mimicking features, chemical markers are ideal tracking tools. Examples of chemical markers include the chiral flavour compounds that occur in abundance in natural flavourings, essential oils and other plant extracts. Chiral compounds are frequently found among the flavour volatiles of fruits. Such markers provide analysts with a means of authenticating the products.

John.E.Stauffer, Cereal Foods World, Quality Assurance, ,
June 2002, Vol. 47. No 6

Activity 2

True-false statements

Decide whether the following statements are true or false:

- | | |
|---|-----|
| 1. Traceability of products prevents bioterrorism. | T F |
| 2. Food adulteration has been increasing over the years. | T F |
| 3. Food authentication excludes geographic origin. | T F |
| 4. Variety as a descriptor is important for gourmet products. | T F |
| 5. ^{13}C is used to define trace minerals. | T F |
| 6. Chemical markers are used to evaluate quality changes. | T F |

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

a) food adulteration  _____

b) food counterfeiting _____

c) label veracity _____

d) grain variety _____

e) nutrient uptake _____

f) flavour volatiles _____

UNIT 4

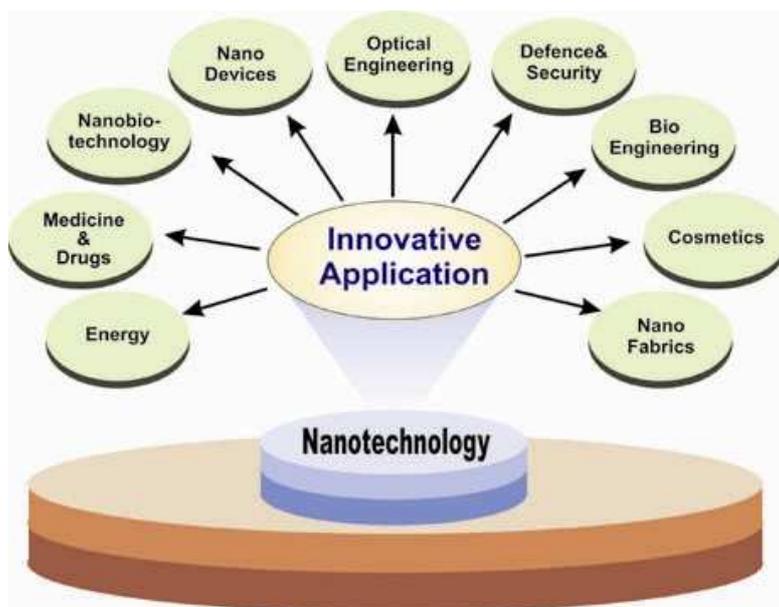
NANOTECHNOLOGY

Activity 1



Skim the first sentence of each paragraph to get the gist of the text. Try to explain the main ideas.

Figure 3 Nanotechnology application



www.nstc.in/%5CImage%5CArea%20of%20Nanotechno (2010-04-08)

In response to the growing interest in the role of nanotechnology – the study of materials measuring 100nm or less – in the food industry, an increasing number of conferences have been held around the world. At Nano-Food conference, which took place in Atlanta, executives and researchers explained current and potential applications of nanotechnology in the food industry. Attendees learned how the food and beverage industries are using or plan to use nanotechnology. “Food-related nanotechnology research is already underway and could significantly affect our food supply within the next decade”, said Peter Stroeve, Professor of Chemical Engineering at the University of California.

While the speakers concurred that incorporating nanotechnology in food systems, particularly nutraceuticals and packaging materials, shows great promise to help improve the health and taste of products, improve productivity, or protect products from contamination, they suggested that the food industry proceed with caution when developing and using nanotechnology materials. They want the food industry to test the materials and products that contain the materials to ensure that the products are safe for the consumer. They also want to make sure that the industry immediately communicates to consumers a description of nanotechnology and how it can be used in different food systems to help improve the finished products.

One interesting point made by several of the presenters is that researchers do not know all the effects on the human body that nanosized particles have. Are these particles so small that they will pass through the body without causing any effects? Or are they so small that they can pass through the membranes of organs, building up the toxic levels? These are questions

asked by George Burdock. He expressed concern that what he called food nanotechnology will need to be addressed now as new applications of nanotechnology developed for the food industry. The use of nanotechnology in foods and beverages may lead to the development of new allergens, increased rates of absorption of nanoparticles, and creation of new toxic sequelae, he argued.

One of the areas where nanotechnology shows great promise is food safety and quality. Here, new functional tools and methods that utilize nanotechnology are being developed to detect pathogens, monitor the quality of food and beverages and enhance ways to keep foods fresher longer. Nano-based sensors that detect pathogens, spoilage, chemical contaminants or product tampering or that track ingredients or finished products through the processing chain are already under development or have been commercialized.

Moreover, these sensors, based on carbon nanotubes, offer many advantages over the conventional detection methods such as high performance liquid chromatography, near-infrared spectroscopy, or specific enzymatic methods, which are time consuming and expensive, said Research Director for the Georgia Tech Packaging Research Center, Atlanta. Using nanobiosensors, in contrast, provides rapid and high-throughput detection; it is simple, fast and cost-effective; offers reduced power requirements and easier recycling and does not require exogenous molecules or labels, he added. Furthermore, the new current research includes the development of a multi-walled carbon nanotube – based biosensor that is capable of detecting 10^{-15} microorganisms, toxic proteins, and degraded products in food and beverages.

Some researchers are experimenting with integrating micro-and nano-components in ultra-thin polymer substrates, and they have presented information about how they have incorporated these substrates into electronic and wireless components for radiofrequency identification (RFID) chips. They said that the entire chip, which can fit on your fingertip, contains nanobiosensors that can detect foodborne pathogens or sense the temperature or moisture of the product and an RFID antenna can record the product's history, location and destination.

Nanorod-based biosensor enables rapid detection of the Salmonella pathogen with high sensitivity. These new biosensors include fluorescent organic dye particles attached to Salmonella antibodies; the antibodies latch onto Salmonella bacteria and the dye lights up like a beacon, making the bacteria easier to see. The researchers claim that sensor could be adapted to detect other foodborne pathogens as well.

There is also an increase in the number of nanotechnology developments in two types of packaging, active and intelligent. With active packaging, a designated compound actively changes the conditions of the packaged food or beverage to extend shelf life or improve the product's safety or sensory attributes. Intelligent packaging, on the other hand, utilizes a compound or an object that monitors the conditions of the packaged food or beverage to provide information about the quality of the product. Examples of active packaging include oxygen, carbon dioxide and off-flavour absorbers and flavouring, antioxidants and antimicrobial releasers. Temperature, gas spoilage and location indicators are examples of intelligent packaging.

Nanosized materials offer useful solutions to improve packaging, particularly the barrier. When incorporated into or on the package, blends of clay and biopolymers or aluminium or silicon oxides or metallized films act as efficient barriers to certain gases like oxygen. Some of these barriers are only 40-60nm thick. With the use of nanoparticles, bottles and packaging can be made lighter and stronger, with better thermal performance and less gas absorption. These properties can extend the shelf life of products, as well as lower the time of transportation costs involved in shipping food.

Adapted from various sources

Activity 2

Comprehension questions:

1. What is the purpose of using nanotechnology in food industry?
2. What precautions should be taken regarding nanotechnology?
3. What is the role of nano-based sensors?
4. How are nano-based sensors applied?
5. How is nanotechnology used in packaging?
6. Why are nanoparticles useful in packaging?

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

a) toxic sequelae  _____

b) product tampering _____

c) high throughput detection _____

d) off-flavour absorber _____

e) antibodies latch onto bacteria _____

UNIT 5

NEW FOOD PRODUCT DEVELOPMENT

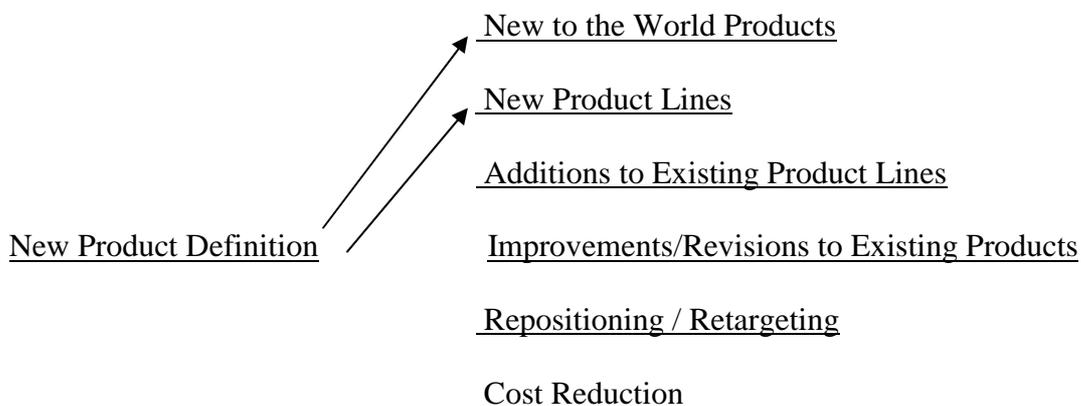
Activity 1 Anticipation

1. How many new products become successful at the market?
2. What is important to develop a new successful product?

Food manufacturers have been generating new products at an amazing pace in an effort to retain shelf space and a share of the consumer's food dollar. Several factors have been identified as driving forces behind this pace of new introductions. On the demand side, the demand for greater convenience, healthier and safer products, special dietary considerations, product variety, and other product features have been buoyed by greater disposable incomes. On the supply side, retailers have grown their capacity to handle more products, manage categories, and generally become more responsive to even slight changes in consumer preferences through innovations such as customer loyalty programmes.

Consumers have a tremendous range of alternatives in their shopping experience, almost to the point of being overwhelmed. Couponing, merchandising and advertising of new food products have kept pace with the number of new introductions. The introduction of new food products has become a strategic tool employed by manufacturers to gain or retain prime shelf space. Product life cycles for these new products are remarkably short, with industry sources estimating 96% of these new products are no longer on the shelf after one year of their release. Intensified competition between food manufacturers and shorter product life cycles, have raised the importance of focus on new product development (NPD) efficiency. Increasing or changing development costs associated with a variety of regulatory and internal research activities have similarly heightened interest in NPD.

It is important at this point to clarify some of the terms and concepts inherent to most discussions relating to new products since they range from truly innovative and different products to only slight reformulations. There are degrees of newness. New products can fall in any one of three general categories: a product not previously produced by the company but exists in the market, a product presented to a new market, or a totally new product to the marketplace. These basic definitions have been modified or expanded by several authors in an attempt to bring some conceptual clarity to the research and practice of new product development. Robert Cooper, for example, categorizes new products as follows:



New to the world - types of products are produced by the company for the first time with no existing satisfactory substitutes produced by competitors. With *new product lines*, a company enters an established market with a product that is new to the company but not to the marketplace. By making *additions to existing product lines*, a firm can produce a product which is fairly new to the marketplace. *Revisions of existing products* are aimed at improving the existing product. *Repositioning or retargeting* occurs when firms enter a new market segment with the old product. *Cost reduction products* allow a firm to reduce the cost of the product but still provide the same benefits that the old, existing product has provided to the customer.

Food product innovations can come in two forms:

a) Food Packaging Innovations include:

- new packaging materials that improve shelf- life, freshness and quality;
- new packaging that presents the food in new and different ways (new shape or new design);
- new packaging that increases product versatility (i.e. packaging that can be used in the microwave and oven);
- new packaging that increases ease of use (milk carton designs that are easily opened).

b) Food Product Innovations include: organic foods and health foods, prepared meals, fortification (addition of vitamins, minerals), new manufacturing techniques that improve sensory qualities such as minimal processing, heat treatments etc.

A good example of product innovation is exhibited in yoghurt product innovation. The food packaging has been segmented, namely the fruit puree has been taken out. In other words, the manufacturer has presented the product to the consumer in a way that offers a choice regarding the way how the product can be consumed – either mix at the start, mix at each spoonful or eat separately. This type of innovation could be quickly developed to further product differentiation. For example, the degree of segmentation could be increased or a third type of product could be added (topping).

Woods, Timothy, & Demiralay, Aslihan, 1998, An Examination of New Food Product Development Process
Http:// www.uky.edu/Ag/AgEcon (2009-10- 10)

Activity 2

Comprehension questions

1. Why do manufacturers produce new products?
2. What is the usual life cycle of a new product?
3. What defines a new product?
4. When is food packaging defined as innovative?
5. What type of food is included in food innovation?
6. Give examples of product innovations.

Activity 3

Text organization

Order the following subtitles chronologically as they appear in the text:

- a) NPD efficiency focus
- b) Categories of food product innovations
- c) Definition of a new product
- d) Driving forces of a new product generation

1 _____ 2 _____ 3 _____ 4 _____

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

- a) product versatility _____

- b) food fortification _____

- c) retargeting _____

- d) disposable income _____

UNIT 6

SMARTNESS IN PACKAGING

Activity 1

Pre-reading exercise

1. What is the role of packaging in food industry?
2. How can packaging be smart?
3. Write a list of things that a customer might like a food package could do.

Imagine the three scenarios. The tin of baked beans that urges you to buy it as you pass along the supermarket aisles (assuming you still shop for goods and they are not delivered to you via internet), the smart microwave that has your steaming plate of lasagne ready the moment you arrive, following a mobile call to your smart home on the way home (assuming you still go out to work), and the pill bottle that alerts the health centre if an elderly relative forgets the medication. They are all visions of a future in which the package does more than just contain and protect its contents – it plays an active and sometimes intelligent role in adding functionality to the product itself, or to aspects of product consumption, convenience or security.

Figure 4 Smart packaging



www.unipack.ru/user_files/file2249.jpg (2010-04-08)

Smartness in packaging is a broad term that covers a number of functionalities, depending on the product being packaged, including food, beverages, pharmaceutical, household products etc. Examples of smartness would be in packages that:

- retain integrity and actively prevent food spoilage (shelf-life);
- enhance product attributes (e.g. look, taste, flavour, aroma etc);
- respond actively to changes in product or package environment;
- communicate product information, product history or condition to user;
- assist with opening and indicate seal integrity;
- confirm product authenticity and act to counter theft.

There is an important distinction between package functions that are smart/intelligent, and those that become active in response to a triggering event, for example, filling, exposure to UV, release of pressure etc and then continue until the process is exhausted. Some smart packaging already exists commercially and many other active and intelligent concepts are under development. A good example of active packaging is the highly successful foam-producing “widget” in a metal can of beer. Another is the oxygen scavenging MAR technology. Other examples of smart packaging include:

Active

- oxygen scavenging;
- anti-microbial;
- ethylene scavenging;
- heating/cooling;
- odour and flavour absorbing/releasing;
- moisture absorbing.

Intelligent

- * time-temperature history;
- * microbial growth indicators;
- * light protection;
- * physical shock indicators,
- * leakage, microbial spoilage Indicators.

Active food packaging systems using oxygen scavenging and anti-microbial technologies have the potential to extend the shelf-life of perishable foods while at the same time improving their quality by reducing the need for additives and preservatives. In intelligent packaging, the package function switches on and off in response to changing external/internal conditions, and can include a communication to the customer or end user as to the status of the product. A simple definition of intelligent packaging is “ a packaging which senses and informs”. Intelligent labelling and printing, for example, will be capable of communicating directly to the customer via thin film devices providing sound and visual information, either in response to touch, motion or some other means of scanning or activation. Voice-activated safety and disposal instructions contained on products will be used to tell the consumer how they should be disposed of after consumption – information that can be also used in recycling industry to help sort packaging materials.

Improved convenience is a value-added function that customers are likely to pay extra. Self-heating packages, for soup or coffee, and self –cooling containers for beer and soft drinks have been under active development. The new technology uses the latent heat of evaporating water to produce the cooling effect. The water is bound in a gel layer coating a separate container within the beverage can and is in close thermal contact with the beverage. The consumer twists the base of the can to open a valve, exposing the water to the desiccant held in a separate, evacuated external chamber. This initiates evaporation of the water at room temperature. The unit has been designed to meet a target specification set by major beverage customers cooling 300ml of beverage in a 355ml can by 16.7 °C in three minutes. On the other hand, thermo-chromic labelling is used for self-heating or self-cooling containers. The most common use is a thermo-chromic ink dot, which indicates the product is at the correct serving temperature following refrigeration or microwave heating. Plastic containers of pouring syrup for pancakes can be purchased in the USA that are labelled with a thermo-chromic ink dot to indicate that the syrup is at the right temperature following microwave heating. Rising food industry interest in time-temperature indicators, due to ever stringent requirements to monitor the environments products are subjected to throughout the supply chain, will drive the intelligent packaging market.

Adapted from various sources

Activity 2

Comprehension questions

1. What is a vision of packaging in food industry?
2. What is the purpose of smart packaging?
3. How do active and intelligent packaging systems differ?
4. How does voice-activated safety system function?
5. How are the time-temperature indicators used?
6. Where do you see the advantages or disadvantages of smart packaging?

Activity 3

Text organization

Order the following subtitles chronologically as they appear in the text:

- a) Smartness in packaging
- b) Improved convenience
- c) Future role of packaging
- d) Classification of smart packaging

1. _____ 2. _____ 3. _____ 4. _____

Activity 4

Group work

Here are some comments that people have made about active packaging. Discuss these comments in groups.

“I don’ want any chemicals
anywhere near my food.”

“I think it is a good thing. If oxygen
is removed from food packs, the food
will have more vitamins”.

“I am a bit concerned
about disposal of all this
plastic. Will you be able to
recycle it?”

Activity 5

Vocabulary

Translate the following expressions and use them in your own sentences:

a) oxygen scavenging _____

b) enhancement of product attribute _____

c) foam- producing widget _____

d) perishable food _____

e) stringent requirement _____

Activity 6
Vocabulary -Word family
Complete the following table.

Noun	Verb	Adjective
_____	to retain	_____
_____	_____	commercial
_____	_____	perishable
_____	to exhaust	_____

UNIT 7

WHOLE HEALTH FOR SELF- CARE – A NEW NUTRITION?

Activity 1

1. Are people interested in self-care? Why?
2. What are the potential sources of learning about food and health?

I remember when mothers used to say, “Clean your plate, many children are starving today”. Today too many people apparently clean their plates, too many times. The rise in obesity in the United States is a growing concern. Simultaneously, there has been a widespread movement toward purchasing food and nutrition products that contribute to whole health, a self-care approach to preventative self-care. More and more people today actively seek to learn about nutrition and how the food they eat will influence their health. Nearly 90% of consumers in the survey say that their food purchases are influenced by health concerns and their belief that eating a better diet can reduce serious health risks.

The FMI study asked about general health concerns relating to motivation for self-care. The top four concerns were:

- 1) managing or treating a specific health condition on your own;
- 2) reducing the risk of a specific health conditions;
- 3) following advice of a doctor;
- 4) avoiding artificial preservatives or additives.

The primary health concerns included problems with cholesterol, diabetes, heart diseases, high blood pressure, weight loss. The quest for self-care is apparently being driven by deteriorating confidence in the medical care system in the United States and by its active promotion of self-care and health information. Consumers are more actively seeking information about the relationship between the foods and they eat and their health. The Nutrition Fact Label on foods is also being used by more consumers than ever, and foods are being dropped or added to the shopping cart based on what is being learned from reading labels. This proactive control of foods in the diet increases with income and education and is greatest for those who are college educated and earn more than \$50,000 a year. Types of information sought by many consumers relate to the importance of fibre intake and benefits of herbal products, protein, soy and reducing salt intake. The primary sources of information being used are magazines, books and Internet.

Even though consumers say they seek more information and sometimes act on it in adding or dropping foods from their diets, when asked what they buy to maintain their health 79% reported vitamins and minerals and other over-the-counter medications, 72% reported prescription medications and 73% reported fortified foods. About 50% of consumers buy foods without artificial additives or preservatives and about 38% buy herbal remedies and organic food. Perhaps this accounts for the double-digit annual growth in the sale of organic products and functional foods over the past five years. They have carved out considerable niches in the food market with organic sales reaching about \$8 billion and functional food sales reaching about \$1.3 billion.

With a plethora of health and nutrition information available in the media and on food labels, its use being promoted by the health care system, why do we find so much evidence of poor diets? Three reasons predominate: it costs more to eat healthy; healthy foods do not taste

so good and it is less convenient to eat healthy. One part is the convenience in preparing food at home and the other is the lack of more healthy foods available for take-out from dine-in restaurants and fast-food establishments. In spite of the rhetoric about health and appearance, time pressure imposed by modern lifestyles often overcomes the best intentions and long-term concerns. The take-out market for food has reached \$176 billion or about 22% of total food and beverage sales. It was recently reported that there was a fall-off in the number of meals purchased at a restaurant to be eaten at home in favour of new ready-to-eat and ready-to-cook products offered at the grocery store. Frozen entrees have gained in popularity with 22% of consumers using them for evening meals. Consumers are cutting the time it takes to cook (assemble) meals at home by serving fewer dishes and using ready-to-cook or-eat entrees. With the number of shopping trips to a supermarket down to an average of 1.8 trips per week, less frequent shopping demands that convenient foods must be more shelf stable than are ready-to-eat take-out foods. Even though almost 50% consumers report making something from scratch more than three times a week, 41% use short-cuts like bagged salads and 45% use boxed or frozen meals and 38% use heat-and-eat foods.

The overall picture is a cause for concern about using food to enhance health, the intention to do so, and the tendency to buy and eat foods that are convenient and fit lifestyles that do not include time in the kitchen. American consumers continue to delegate the preparation of their food to others- food manufacturers, restaurants, deli counters etc. This is not unique to any demographic, although it is more prevalent among younger consumers. The food industry must respond to this phenomenon. Good taste sells, and fat is the macro-nutrient that carries the flavours we love. In making low-fat foods palatable, high sugar content is needed, which increases calories and decreases satiation. Niche markets are developing to address consumers seeking organic foods, functional foods and foods that promise health, such as herbal products. These niches are relatively small and some are raising concerns about efficacy and the distinct possibility of overdosing on vitamins and minerals, especially supplements that are combined with numerous fortified foods. A healthy diet is a delicate balancing act for each consumer and for the food industry as well.

Kinsey, D., Jean , Cereal Foods World, May 2002 Vol. 47 No 5

Activity 2

Comprehension questions

1. What are the main concerns related to self-care motivation?
2. What determines the type of food that will be dropped or added to the shopping cart?
3. What do people buy to maintain health?
4. Why do people still eat unhealthy?
5. How does modern lifestyle determine the type of food we eat?
6. How is the low-fat food made palatable?

Activity 3

Comprehension check

Use the information from the text to complete the following sentences:

1. People want to learn more about food so that _____

_____.

2. Since people are reducing time for cooking at home, they usually serve _____

_____.

3. People do not like healthy food because _____

_____.

4. Convenient foods must be more shelf stable because _____

_____.

Activity 4

Vocabulary

Translate the following expressions:

a) objed napravljen od ostataka hrane _____

b) lijekovi bez recepta _____

c) smanjeno povjerenje u medicinsku zaštitu _____

d) hrana koja ima vitaminima _____

e) hrana za ponijeti _____

f) ukusna hrana _____

UNIT 8

MINIMAL PROCESSING FOR HEALTHY FOOD

Activity 1

Anticipation

1. Why do consumers like minimally processed food?
2. What is a danger related to such food?

The fresh-cut fruit and vegetable industry is constantly growing due to the consumers' tendency of health consciousness and their increasing interest in the role of food for maintaining and improving human well-being. In fact fruits and vegetables are basic ingredients of the highly demanded Mediterranean diet, associated with a beneficial and healthy function against numerous diseases. This beneficial effect has been attributed to non-essential food constituents, phytonutrients that possess a relevant bioactivity when frequently consumed as a part of regular diet. However, it is well-known that modern ways of life usually tend to reduce a suitable intake of rich sources of antioxidant compounds, such as fruit and vegetables, being more emphasized in some parts of the population, especially children. It is known that a food which meets nutritional requirements is unlikely to be accepted if consumers do not like the flavour or other quality attributes. Additionally, it has been shown that consumers' needs for convenience are correlated with food choice. Therefore, the fresh-cut fruit and vegetable industry is still working to increase the assortment of minimally processed vegetable products.

These products have emerged to fulfil consumers' demands for healthy, palatable and easy to prepare plant foods. "Minimal processing" describes non-thermal technologies to process food in a manner to guarantee the food safety and preservation as well as to maintain as much as possible fresh-like characteristics of fruits and vegetables. Among others, visual properties of fresh-cut fruit and vegetable commodities are one of the most important parameters to evaluate the total quality of the product by consumers. Looking at the package, it will be possible to evaluate the absence or presence of discoloration (enzymatic browning of cut surfaces), mechanical damage (foiled lettuce leaves), as well as decay.

During minimal processing (including peeling, cutting and grating operations) many cells are broken and intracellular products, such as oxidizing enzymes, are released accelerating the decay of the product. Each step in the processing affects quality and microflora of fresh-cut fruit and vegetables. For these reasons, the cutting and shredding must be performed with knives or blades as sharp as possible made from stainless steel. However, many different solutions have been tested to avoid the acceleration of decay due to peeling, cutting or slicing. The newest tendency is called the immersion therapy. Cutting a fruit while it is submerged in water will control turgor pressure, due to the formation of a water barrier that prevents movement of fruit fluids while the product is being cut. Additionally, the watery environment also helps to flush potentially damaging enzymes away from plant tissue. Another alternative could be the use of water-jet cutting, a non-contact cutting method which utilizes a concentrated stream of high pressure water to cut through a wide range of foodstuffs.

New techniques for maintaining quality, shelf life and inhibiting undesired microbial growth of fresh-cut fruits and vegetables are demanded in all the steps of production, storage and distribution chain. Each food has unique requirements to ensure the slowest possible aging and to extend the shelf life. The primary means of accomplishing life extension is refrigeration, sometimes combined with modifying the storage atmosphere or removing the ripening hormone, ethylene, for instance by continually passing air over the produce. By

extending the time during which food is fresh and safe to eat, packaging enables products such as fresh vegetables to be shipped greater distances and reach distant markets. The use of UV-C light, modified atmosphere packaging (MAP), heat shocks and ozone treatments, have proved useful in controlling microbial growth and maintaining quality during storage of fresh-cut produce. It is also important to mention the use of acidic or alkaline electrolyzed water, chlorine dioxide, bacteriocins, and power ultrasound.

The new technology, relating to aging prevention, tackles the area of packaging. Thus, a low-cost food film wrap that can precisely match the respiration rate of packed fresh produce has been developed by researchers. The film has been successfully tested on fresh-cut lettuce and stir-fry mixtures. The film is aimed at solving a dilemma caused by the fact that fresh produce continues to respire after harvest, taking in oxygen and giving off carbon dioxide. Respiration depletes the food's store of starches and sugars and results in aging. Modified atmosphere packaging (MAP) has been developed to create a beneficial atmosphere for storage within a polymer packaging film. Its goal is to modify the respiration rate of a particular food using the permeability of a film to control the atmosphere. When the food is initially packaged in the film, the atmosphere within is a standard air mix, but the flow of oxygen and carbon dioxide across the film barrier soon equalizes into the atmosphere that is optimal for the food inside. Most traditional plastic is not permeable enough for high-respiratory foods like broccoli. So it is important that the oxygen level in the package never falls to anaerobic conditions. Over the past years, a unique MAP technology has been developed that uses activated diffusion and capillary gas flow principles to improve and control gas flow across the film. The packager can, therefore, tailor the film to maximize the life span of a particular product.

Allende, Anna, Tomas-Barberan, Francisco, Gill, Maria, Minimal processing for healthy traditional foods, 2006
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VHY-4K5HWD3-1..
(2008-03-11)

Activity 2

Comprehension questions

1. Why has minimally processed food become popular?
2. What can happen during minimal processing?
3. What are possible solutions that prevent decay during cutting?
4. How can shelf life of fresh-cut fruits and vegetables be extended?
5. Why has MAP been developed?
6. How does MAP function?

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

a) product decay _____

b) water-jet cutting _____

c) immersion therapy _____

d) fruit shredding _____

e) film permeability _____

Activity 4

Vocabulary

Complete the following table

Noun

immersion

Verb

submerge

respire

Adjective

acidic

alkaline

UNIT 9

FUNCTIONAL FOOD - BEVERAGE PRODUCTS

REDEFINE NEW AGE

Activity 1 Anticipation

1. How is functional food defined?
2. Can you think of some examples of functional drinks?
3. Why are such drinks so popular?

The concept of functional food was born in Japan. In the 1980s, health authorities in Japan recognized the concept of food that should promote health and reduce the risk of diseases. Functional foods have not as yet been defined by legislation in Europe. Generally, they are considered as those foods which are intended to be consumed as part of the normal diet and that contain biologically active components which offer the potential of enhanced health or reduced risk of disease. Examples of functional foods include foods that contain specific minerals, vitamins, fatty acids or dietary fibre, foods with added biologically active substances such as phytochemicals or other antioxidants and probiotics.

Figure 5 Smart drinks



www.4.bp.blogspot.com/.../s400/smartdrinks.jpg (2010-04-08)

Functional is the new frontier for food and beverage companies looking to grab the attention and dollars of many consumers. Beverages are on cutting edge of functional foods. Many of the New Age beverages, called energy drinks, include “natural” vitamins and minerals, amino acids, herb extracts, and other ingredients that allegedly stimulate energy, alertness or psychoactive effects. Most energy drinks fall into the functional foods – or nutraceuticals – classification. They got their start in the U.S. through health food stores but

they are rapidly moving into the mainstream as a result of growing consumer interest in natural remedies.

In fact, the beverage market is on the cutting edge in functional food development. Energy drinks, isotonic (sport) beverages, herbal and green teas, fortified waters, caffeinated drinks, fringe, “recreational” soft drinks are fast rewriting the definition of New Age beverages – a term coined just a few years ago for beverages that did not fit the traditional definition. The new beverage market is a marketing glitz because beverages are relatively cheap to blend, bottle and distribute. Niche marketers can gain a foothold by distributing through specialty foodservice and retail stores. On the other hand Internet provides a means to gain wide exposure globally for minimal cost.

Energy and smart drinks, once the preserve of techno clubs, rave parties and other post-midnights, pre-adult activities, are going mainstream. Smart drinks, known in the trade as smart- nutrient cocktails, emerged as part of rave culture to keep the dancers going for an entire night. Now, people are finding that they are just as good as at keeping you through a day’s work as through a night’s jol. The active ingredients in smart drinks do not impair your motor-control functions, do not leave you feeling tired after an initial energy boost (as coffee does), and do not destroy your lungs. What’s more smart drinks are not chemically addictive.

That is the perspective of a self-confessed proponent. Since most of the ingredients in these beverages have not been fully tested, such a rosy assessment of the side effects may just be wishful thinking. Controversy continues to surround the short- and-long term effects of ingredients new to the U.S. market, some untested. “Brain Wash” , for example, contains ginseng, ginger, buchu, skullcap (a herbal sedative), ma huang (ephedrine), mad dog weed (*Alisma plantago aquatica*), a plant used by the American Indians for heart and gastrointestinal ailments, colours, natural and artificial – heady ingredients for a soft drink.

New ingredient technology plays an important role. It is aimed at adding proteins in solution, with high bioavailability. In addition, technology has enhanced the integration of juices, as well as colours, vitamins and flavours in beverage formulations. “Activating water”, for example, provides energy to consumers in two phases. This drink delivers a quick energy kick from natural caffeine, green coffee beans and dextrose and the combination of fructose and fiber maintains energy over the long haul. Activating water is enriched with six vitamins and contains only natural flavours. This refreshing energy booster is available in a variety of innovative taste directions. “Tasteful water” contains 3% fruit juice and it is as clear as water in spite of the juice content. Tasteful water appeals to young, modern consumers who value healthy nutrition but do not want to give up great taste.

[http://www.eufic.org/article/en/page/BARCHIVE/expid/basics-functional-foods/\(2009-0402\)](http://www.eufic.org/article/en/page/BARCHIVE/expid/basics-functional-foods/(2009-0402))

Activity 2

Comprehension questions

1. What makes food functional?
2. What are characteristics of New age beverages?
3. How did energy drinks emerge?
4. Why are new beverages so successful at the market?
5. What is the effect of active ingredients in smart drinks?
6. What is activating water?

Activity 3

Vocabulary

Translate the following expressions and use them in your own sentences:

a) to be on the cutting edge _____

b) fortified water _____

c) to gain a foothold _____

d) niche market _____

e) heady ingredient _____

UNIT 10

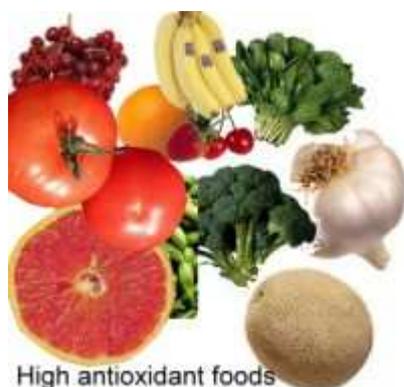
ANTIOXIDANTS IN FOOD

Activity 1 Anticipation

1. What is the role of antioxidants?
2. What are the main sources of antioxidants?

Free radicals created by oxidation are known to cause many diseases and can wreak havoc on your body. You would have noticed oxidation when a slice of apple turns brown. But you cannot see the damage that is happening within your body. Antioxidants work at scouring away these free radicals and thereby leading to improved health. The cells of our body need oxygen for metabolism. But when there are excessive oxygen molecules and other free radicals that are formed due to other cellular reactions, they cause infinite damage to the body. These unstable oxygen molecules are referred to as free radicals and they are cited as an important cause for most chronic diseases. These free radicals are highly reactive chemical substances that travel throughout the body and wreak havoc on the cells. We are also exposed to free radicals in the atmosphere. Free radicals are known to cause cells to mutate and die. They have a role in the development of cancerous cells. The process of aging is said to be a result of free radical damage.

Figure 6 High antioxidant foods



www.anti-diabetes-diet-supplements.com/image-... (2010-04-08)

Antioxidants work as scavengers of free radicals. When your body has insufficient antioxidants, it can lead to significant damage and disease. Boosting your body's defence mechanism with adequate amounts of natural antioxidants and antioxidant supplements can boost body resilience and reduce chances of disease. Antioxidants can aid in controlling high blood pressure. Vitamin E is a powerful antioxidant that can stop the oxidation of LDL or bad cholesterol. Antioxidants are known to reduce the chances of stomach or bladder cancer. Minerals such as selenium, copper, manganese and zinc provide antioxidant properties when they are combined with certain enzymes.

Foods rich in natural antioxidants are: tomatoes, broccoli, cauliflower. Vegetables and fruits that have a rich colour are high in phytonutrients and they are the best antioxidants such as blueberries, spinach, carrots, raspberries, cranberries, blackberries, apricots, plums, grapes, mangoes. Vegetable oils such as olive oil, soybean oil, safflower oil and whole grains (brown

rice and soybean) also provide natural antioxidants, including garlic, onion, salmon, tuna and wheat germ as well.

Antioxidant activity of flavonoids has been studied since the 1940s and it is undisputed. With the immense volume of research being released every year regarding the effects of radical oxygen species on human health, the role of flavonoid antioxidants cannot be ignored. The two leading causes of mortality in the U.S. cancer and cardiovascular diseases, can be significantly impacted by the ingestion of antioxidants including flavonoid –rich foods. Green tea, onion, apples, grapes, Ginkgo are just a few of the many thousands of plants that contain flavonoid antioxidants. There is enough research today to make some conclusions about the clinical use of flavonoids and to warrant their use in the prevention and treatment of cancer, cardiovascular diseases, inflammatory conditions, periodontal disease or macular degeneration.

Among the fruits, vegetables and nuts analyzed, cranberries, blueberries and blackberries ranked highest among the fruits studied regarding their antioxidant concentration and capacity. The health benefits of blueberries stem from the anthocyanins and other natural phytochemical compounds they contain. Berries are a rich source of ellagic and folic acid.

Consumers, especially children, like foods in red, blue and purple, which makes berries not only perfect antioxidants but also great colorants for dairy foods. Therefore, when formulating with berries, it is important that the berries retain their colour after processing. Also, shape and texture retention is very important. Berries work well in ice cream, soft-serve, frozen yogurt, flavoured milk, cottage cheese and smoothies. Raspberries are often combined with either dark chocolate or white chocolate. White chocolate raspberry is reported to be one the most popular yogurt flavours today.

<http://www.targetwoman.com/articles/antioxidant-food.html> (2009-11-29)

Activity 2

Comprehension questions

1. What is the effect of free radicals on human body?
2. How do they function?
3. How do antioxidants function?
4. What are excellent sources of antioxidants?
5. Why are flavonoids important?
6. What type of fruit is the best antioxidant source?
7. Why are berries important in food industry?

Activity 3

Vocabulary

Translate the following expressions:

- a) scavengers of free radicals

- b) to wreak havoc

- c) to boost defence mechanism

- d) to scour away radicals

- e) periodontal disease

- f) texture retention

- g) smoothies

- h) soft-serve

Activity 3

Analyze the content of total phenols in food.

FRUIT / SERVING SIZE (g)	TOTAL PHENOLS PER SERVING (mg)
 CRANBERRIES 1/2 cup (55)	373
 PEAR 1 medium (166)	317
 RED GRAPES 1/2 cup (80)	296
 APPLE 1 medium (138)	256
 CHERRIES 1/2 cup (73)	231
 STRAWBERRIES 8 medium (147)	195
 WATERMELON 1 large wedge, 2 cups diced (286)	183
 BLUEBERRIES 1/2 cup (70)	181
 BANANA 1 medium (126)	174
 GREEN GRAPES 1/2 cup (80)	155

www.cranberryinstitute.org/.../prnov.jpg (2010-04-08)

UNIT 11

RED WINEMAKING

Activity 1

Pre-reading task

1. Is white wine obtained from red or white grapes?
2. Is high wine acidity typical for warm regions?

Figure 7 Red wine



www.blog.americanfeast.com/images/Red%20Wine%202.jpg (2010-04-08)

Red wine is a macerated wine. The extraction of solids from grape clusters (specifically from skins, seeds and possibly stems) accompanies the alcoholic fermentation of the juice. In conventional red winemaking, extraction of grape solids is by means of maceration, which occurs during must fermentation. Other methods exist that dissociate fermentation and maceration, such as thermovinification.

The localization of red pigment exclusively in skins, at least in the principal varieties, permits a slightly tinted or white wine to be made from the colourless juice obtained from a delicate pressing of red grapes. Wines for the elaboration of champagne are a good example. The designation *blanc de blanc* was created to distinguish white wines derived from white varieties and those from red. Finally, varietal nature is not sufficient for characterizing the origin of a red wine. Maceration intensity is of prime importance.

The length and intensity of maceration are adjusted according to grape variety and the type of wine desired. In fact, maceration is a means by which the winemaker can personalize the wine. Primeur wines are made to be drunk young: their aromas and fruitiness greatly outweigh phenolic compound concentrations, but premium wines require a sufficient tannin concentration to develop properly during ageing.

Grape quality directly influences grape skin maceration quality in red winemaking and is thus of the greatest importance. In fact, the grape skin is more affected than the juice by the cultivation techniques, maturation conditions and sanitary state. Vintage and growth rankings are therefore much more clearly defined with red wines than whites. In the Bordeaux region, anthocyanin and tannin concentrations in the same parcel can vary by as much as a factor of two, from one year to another, according to maturation conditions. Must acidity and sugar

concentrations can fluctuate by 50% and 15%, respectively. These numbers are not surprising, since the plant requires a lot of energy to synthesize anthocyanins. For this reason, the northernmost vineyards produce only white wines. In any case, when phenolic compound concentrations are examined in relation to environmental conditions, their nature, properties and localization in the tissues must also be considered. Enologists readily define “good” tannins as those that give wines a dense structure without aggressiveness, and “bad” tannins as those characterized by vegetal and astringent herbaceous flavors.

Grape composition and quality variability result in heterogeneous grape crops. Grape selection can compensate for this heterogeneity and tanks should be filled with a homogeneous single-variety grape crop that has the same sanitary state and level of maturity. *Terroir* quality, wine age, rootstock and fruit load should also be considered. This batch selection, effected at filling time, must be maintained during the entire winemaking process, until the definitive stabilization after malolactic fermentation. The best batches are then blended together to make a wine of superior quality. The complementary characteristics of the various batches often produce a blended wine that is superior in quality to each of the batches before blending.

The grape crop should also be carefully sorted to eliminate damaged or unripe grapes. This operation can be effected in the vineyard during picking or in the winery at harvest reception. At the winery, the grapes are spread out on the sorting tables. A conveyor belt advances the crop, while workers eliminate bad grapes. A concern for perfection in modern winemaking has led to the generalization of such practices. Their effectiveness is even more pronounced when they are applied to grape crops of superior quality.

Red grape crop heterogeneity requires specific winemaking techniques to be adapted according to the crop. Much remains to be learned in optimizing the various grape specifications.

The generalization of malolactic fermentation is another characteristic of red winemaking. This phenomenon has been recognized since the end of the last century but, until the last few decades, it was not a consistent component of red winemaking. For a long time, a slightly elevated acidity was considered to be an essential factor in microbial stability and thus contributed to wine quality. Moreover, red wine acidification was a widespread practice. It has currently disappeared for the most part, since it is only justified in particular situations. Today, on the contrary, malolactic fermentation is known to produce a more stable wine by eliminating malic acid, a molecule easily biodegraded.

It was in temperate regions that malolactic fermentation (MLF) first became widespread. These wines, which are rich in malic acid, are distinctly improved, becoming more round and supple. MLF was then progressively applied to all red wines, even those produced in warm regions already having a low acidity. This type of fermentation may not be advisable in all regions and another method of stabilizing red wines containing malic acid should be sought.

The classic steps in red winemaking are:

- i) mechanical harvest treatments (crushing, destemming and tank filling);
- j) vatting (primary alcoholic fermentation and maceration);
- k) draining (separation of wine and pomace by dejuicing and pressing);
- l) final fermentations (exhaustion of the last grams of sugar by alcoholic fermentation and malolactic fermentation).

Activity 2

True/false statements

Decide whether the following statements are true or false:

- | | |
|---|-----|
| 1. White wine can be obtained from red grapes. | T F |
| 2. Varietal nature is essential to characterize the origin of red wine. | T F |
| 3. Concentrations of anthocyanins in soil is always the same. | T F |
| 4. The northernmost vineyards produce only red wines. | T F |
| 5. Good tannins have vegetal savour. | T F |
| 6. Malolactic fermentation is typical for white winemaking. | T F |
| 7. Wines in warm regions have low acidity. | T F |
| 8. Malolactic fermentation produces more stable wines. | T F |

Activity 3

Vocabulary

Find English equivalents for the following expressions:

- a) obojeno vino _____
- b) meko vino _____
- c) patvoreno vino _____
- d) vo na aroma vina _____
- e) povišena kiselost vina _____
- f) jabu na kiselina _____
- g) biljni okus vina _____
- h) koli ina vo ne arome _____
- i) muljanje grož a _____

Activity 4

Read these extracts and answer the following questions :

1. Why is the new scanner practical?
2. How does the wine scanner function?
3. What can be controlled by wine scanners?

Hand-held wine scanner ups quality control

Two French entrepreneurs have developed a novel hand-held wine tester that will better help wine firms meet specific consumer tastes by taking scientific samples like a diabetic measures blood sugar. The new wine scanner was awarded a prize for one of the most innovative products unveiled at the wine production expo in Montpellier.

Wine is dropped onto a small metal electrode and inserted into the machine, which then tells the user the content of certain molecules and also micro-bubbles that affect the quality, body and aroma of the wine during fermentation. The results appear in between 30 seconds and two minutes. The scanner controls the critical phases of winemaking and more precisely malolactic fermentation, which is critical and indispensable in obtaining good quality. The ability to check wine regularly so as to create a product as close to consumer needs as possible has

become more important than ever amid the fierce competition now prevalent in the world wine sector.

Champagne makers turn to finger-print technology

1. Why is finger-print technology good for wine makers?
2. What gives wines the specific character?
3. Are bigger or smaller bubbles responsible for aroma and flavour of champagne? Why?

Scientists have developed a method of finger-printing champagne, cava and other wines to prevent cheaper products being passed off as the more expensive varieties.

Atomic absorption spectrometry was used to measure the concentration of 16 trace minerals in the champagne and cava. The results showed that nine of these could be used to give the wines a unique fingerprint that was different in the case of cava and champagne. Champagne, for example, contained 0.6 mg/l of zinc, roughly twice the amount found in cava. The trace minerals are taken up from the soil where the grapes are grown and soils from different regions have differing complex of trace minerals. It is the difference in the soils that is thought to give wines their character. The same method could be used to fingerprint many other wines to prevent fraud.

Furthermore, scientists are still working on ways to perfect the bubbles, which according to experts are the key to the drink's flavour and aroma. The smaller the bubbles, the better, say the experts. The reason smaller bubbles make better champagne is essentially because there are more bubbles available to release the flavour and aroma. The little bubbles pick up flavour and aroma molecule during their ascent, pulling them along until the bubbles literally explode onto the surface of the liquid, creating the sensory fireworks that are generally associated with a good tasting, refreshing champagne.

Grape "x-ray" technology unlocks wine analysis

1. What is "x-ray" technology used for?
2. How will this technology help winemakers?

The new machine, which looks like some sort of teleporting device, uses a process similar to that used by x-ray machines to probe the content and make-up of grapes. It then takes seconds to send detailed information on colour, acidity, sugar content and maturity to an adjacent computer screen, where the user can see the results on a range of handy graphs. This will help winemakers to give consumers what they want. For example, consumers want certain aromas and the best ways to get this is by following the colour.

New technology keeps wine fresh

1. How can wine be preserved in open bottles?
2. What technology was applied in the past?
3. What are the advantages of the new technology?

A hi-tech way of preserving open bottles of wine from oxygen contact could prevent consumers and restaurants from being afraid to open better bottles of wine. The new device

developed, uses replaceable cartridges of argon gas to displace oxygen from partially empty bottles of wine. Argon is an inert element that does not react with wine. Low-end solutions currently on the market are ineffective. Vacuum-creating pump systems only produce a 70% vacuum and the valves they use are susceptible to air leakage. These systems are only likely to keep wine for 12 hours. The new device, on the other hand, preserves wine for up to one week.

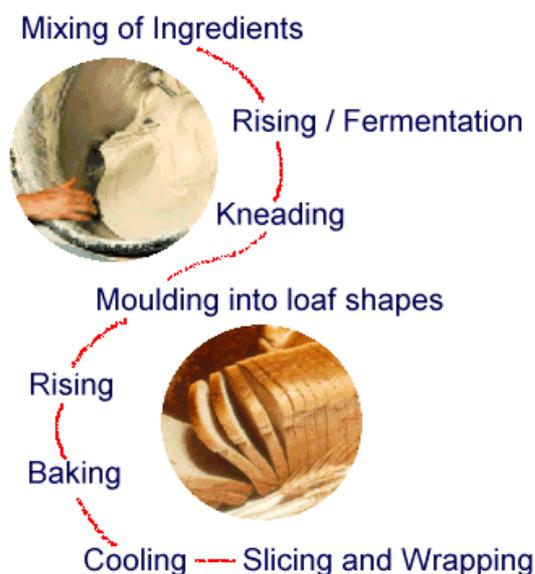
UNIT 12

BREADMAKING

Activity 1

Skim the first sentence of each paragraph to get the main ideas of the text.

Figure 8 Bread making



www.homebakingco.com/brsteps.gif (2010-04-08)

The process for producing a certain bread type depends primarily on the required characteristics of the product. The country and the size of the business also play a role. In craft bakeries, rather complex methods of making and processing dough are in use, whereas the processes used in industrial bakeries are, in general, more straightforward. However, in both types of business, one can distinguish four processing steps in the total breadmaking process and they have the same specific aims.

Mixing. The aim of the mixing process is more than to obtain a homogeneous mass; after the homogeneous mass is obtained, the mixing is continued until the dough becomes extensible. This part of the mixing process is called “gluten development”. In fact, mixing bread dough up to the necessary stage of development is so difficult that, in former days, the mixing was done in more than one step. This method is called “sponge and dough”. Part of the ingredients are mixed into a sponge, and the sponge is given a rest for some time before the rest of the ingredients are mixed in. With the better mixing equipment presently used in the bakery, straight-dough methods have become more convenient.

Most bread dough is still made in batch mixers, although continuous mixers, which produce a continuous flow of dough, have been on the market for more than 50 years. Their use is not common in the production of daily bread; in the industrial production of other products, like croissants and pizzas, the use of continuous mixers is somewhat higher.

Fermentation. Formerly, fermentation was the backbone of the total breadmaking process. The whole dough usually was given a resting or “floor” time of considerable length, lasting one or more hours, often interrupted by a mechanical treatment, so-called “punching” or “knock-back”. After scaling and rounding, the individual dough pieces may be given a fermentation time of about 1 hour. This second fermentation period is also named “intermediate proof”.

At present, fermentation is very often restricted to one process step, with the scaling and rounding done directly after mixing and the total time ranging from less than 10 min to 45 min. This has been made possible through the use of intensive mixers and the application of modern bread improvers.

The aim of fermentation is to continue the process of dough development that was started during mixing. The leavening of the dough during fermentation, followed by a mechanical treatment, results in better texture (in fact, better eating characteristics) and better flavour compared with those of a product made without fermentation or with a short fermentation process.

Proof. At the end of the fermentation, the dough pieces are moulded and given a final proof. Its aim is to increase the specific volume of the dough pieces from 1.0-1.5 L/kg at the start of the final proof to 2.5-5.0 L/kg, depending on the type of product, at the beginning of baking. This increase in volume is a result of gas production by the yeast and the gas retention properties of wheat flour dough. Treatments during or at the end of the final proof are cutting, dusting, brushing with glazing agents, and turning dough pieces upside down.

Baking. The four technological aspects of baking are crumb formation, crust formation, oven spring and heat transport. The transformation of dough to crumb is a consequence of the gelatinization of the starch and the heat-induced setting of the gluten. At the same time, the physical structure turns from a foam to a sponge. The formation of the crust starts with the dehydration of the outer layer of the dough piece. This is followed by the Maillard reaction, a condensation reaction between proteins and sugars, which results in browning of the crust. The third aspect is the oven spring, a consequence of the excellent gas-retention properties of wheat flour dough. The dough's increase in volume during fermentation is continued during the first part of the baking process. This results in a of 4-10 L/kg, depending on the product type. Only a small part of the heat transport in the dough is due to conduction. The greater part of the heat required to bake the product originates from condensation of steam in the product.

Activity 2
Comprehension questions

1. What is gluten development?
2. What happens during fermentation?
3. When are dough pieces moulded?
4. Why is there an increase in the dough volume?
5. Why does formation of the crust occur?
6. What is the role of steam condensation?

Activity 3
Vocabulary

Translate the following expressions and use them in your own sentences:

- a) extensible dough _____

- b) batch mixer _____

- c) scaling and rounding _____

- d) dough resting _____

- e) final proof _____

- f) glazing agents _____

- g) crumb and crust formation _____

UNIT 13

CHEESE

Activity 1

Skim the first sentence of each paragraph to get the main ideas of the text.

History Origins

Cheese is an ancient food whose origins predate recorded history. There is no conclusive evidence indicating where cheese making originated, either in Europe, Central Asia or the Middle East, but the practice has spread within Europe prior to Roman times and has become a sophisticated enterprise by the time the Roman Empire came into being.

Proposed dates for the origin of cheese making range from around 8000 BC (when sheep were first domesticated) to around 3000 BC. The first cheese may have been made by people in the Middle East or by Nomadic Turkic tribes in Central Asia. Since animal skins and inflated internal organs have, since the ancient times, provided storage vessels for a range of foodstuffs, it is probable that the process of cheese making was discovered accidentally by storing milk in a container made from the stomach of an animal, resulting in the milk being turned to curd and whey by the rennet from the stomach. There is a widely-told legend about the discovery of cheese by an Arab trader who used this method of storing milk. The legend has many individual variations.

Cheese making may also have begun independent of this by the pressing and salting of curdled milk in order to preserve it. Observation that the effect of making milk in an animal stomach gave more solid and better-textured curds, may have led to the deliberate addition of rennet.

The earliest archaeological evidence of cheese making has been found in Egyptian tomb murals, dating to about 2000 BC. The earliest cheeses were likely to have been quite sour and salty, similar in texture to rustic cottage cheese or feta, a crumbly, flavoured Greek cheese.

Cheese produced in Europe, where climates are cooler than in the Middle East, required less salt for preservation. With less salt and acidity, the cheese became a suitable environment for beneficial microbes and moulds, giving aged cheeses their pronounced and interesting flavours. Cheese has become the most popular milk invention.

Making cheese Curdling

The only strictly required step in making any sort of cheese is separating the milk into solid curds and liquid whey. Usually this is done by acidifying (souring) the milk and adding rennet. The acidification is accomplished directly by the addition of an acid like vinegar in a few cases, but usually starter bacteria are employed instead. These starter bacteria convert milk sugars into lactic acid. The same bacteria (and the enzymes they produce) also play a large role in the eventual flavour of aged cheeses. Most cheeses are made with starter bacteria from the Lactococci, Lactobacilli or Streptococci families. Swiss starter cultures also include *Propionibacter shermani*, which produces carbon dioxide gas bubbles during aging, giving Swiss cheese or Emmental its holes.

Some fresh cheeses are curdled only by acidity, but most cheeses also use rennet. Rennet set the cheese into a strong and rubbery gel compared to the fragile curds produced by acidic coagulation alone. It also allows curdling at a lower acidity – important because flavour- making bacteria are inhibited in high-acidity environment. In general, softer, smaller, fresher cheeses are curdled with a greater proportion of acid to rennet than harder, larger, longer-aged varieties.

Curd processing

At this point the cheese has set into a very moist gel. Some soft cheeses are now essentially complete: they are drained, salted and packaged. For most of the rest, the curd is cut into small cubes. This allows water to drain from the individual pieces of curd.

Some hard cheeses are then heated to temperatures in the range of 35 C – 35 C. This forces more whey from the cut curd. It also changes the taste of the finishes cheese, affecting both the bacterial culture and the milk chemistry. Cheeses that are heated to the higher temperatures are usually made with thermophilic starter bacteria which survive this step – either lactobacilli or streptococci.

Salt has a number of roles in cheese besides adding a salty flavour. It preserves cheese from spoiling, draws moisture from the curd, and firms up a cheese texture in an interaction with its proteins. Some cheeses are salted from the outside with dry salt or brine washes. Most cheeses have the salt mixed directly into the curds.

A number of other techniques can be employed to influence the final texture and flavour of cheese. Some examples:

- * Stretching: (Mozzarella, Provolone). The curd is stretched and kneaded in hot water, developing a stringy, fibrous body.

- * Cheddaring: (Cheddar , other English cheeses). The cut curd is repeatedly piled up, pushing more moisture away. The curd is also mixed (or milled) for a long period of time, taking the sharp edges off the cut curd pieces and influencing the final product's texture.

- * Washing: (Edam, Gouda, Colby). The curd is washed in warm water, lowering its acidity and making a milder-tasting cheese.

Adapted from various sources

Activity 2

Comprehension questions:

1. When and where did cheese production start?
2. How did it start?
3. Why is salt important for cheese production?
4. How is acidification done?
5. What techniques are used to make an impact on the final texture and flavour of cheese?

Activity 3

Text comprehension

Use the information from the text to complete the following sentences:

1. Cheese making was very likely discovered accidentally when
_____.
2. Cheese produced in Europe required less salt for preservation because
_____.
3. Most cheeses are made with
_____.
4. Salt has various roles in cheese, for example
_____.
5. Hard cheeses are heated because
_____.

Activity 4

Vocabulary

Find the English equivalents for the following expressions:

- h) seoski doma i sir
- i) odležavanje sira
- j) drobljiv sir
- k) rastezanje sira
- l) usireno mlijeko

ADDITIONAL READING

UNIT 1

IS NANOTECHNOLOGY GOING TO CHANGE THE FUTURE OF FOOD TECHNOLOGY?

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Nanotechnology is seen by many as a growth area that will transform tomorrow's world. Most countries in the world see nanoscience and nanotechnology as important. In Japan expenditure was \$400M in 2001 and is expected to be \$960M in 2004. The USA's 21st Century Nanotechnology Research and Development Act, passed in 2003, has allocated approximately \$3.7B from 2005-2008, compared to an expenditure of \$750M in 2003. In Europe current funding for R&D in nanotechnology is around €1B, much of which is funded through national and regional programmes. In the United Kingdom the DTI initiative on Micro- and NanoTechnology Manufacturing offers £45M in support of commercial applications between 2003-2009.

To consider the potential, and to address concerns, the UK government commissioned the Royal Society and the Royal Academy of Engineering to carry out an independent study into current and future developments in nanosciences and nanotechnology. Their report was published in July 2004¹. Although the report does not specifically address the impact on the food industry, it does discuss bionanotechnology, and potential developments in computing, materials and sensors. It also addresses concerns about the safety and systems by controlling the shape and size at the nanometre scale.

Some of the nanostructures in food are familiar compounds. Many food proteins are globular structures between 10s to 100s nm in size - true nanoparticles. The majority of polysaccharides and lipids are linear polymers less than one nm in thickness, and are examples of 1 dimensional nanostructures. When foams are prepared and stabilised and emulsions formed, 2 dimensional nanostructures are created, one molecule thick, at the air-water or oil-water interface. Setting a gel, or adding polymers to delay the sedimentation of dispersions or the creaming of emulsions, generally involves creating 3 dimensional nanostructures, by causing food biopolymers to assemble into fibrous networks. When starch is boiled to make custard, small 3 dimensional crystalline lamellae 10s nm in thickness are melted. The texture of the paste or gel formed on cooling depends on the re-crystallisation of starch polysaccharides, as does the long-term staling of bakery products.

Where there is a detailed understanding of the nanostructures present in food, rational approaches to the selection of new materials can be used, or quality through food processing can be enhanced. Protein crystallography provides atomic resolution information on protein structure. Site-directed mutagenesis allows the protein structure to be modified systematically,

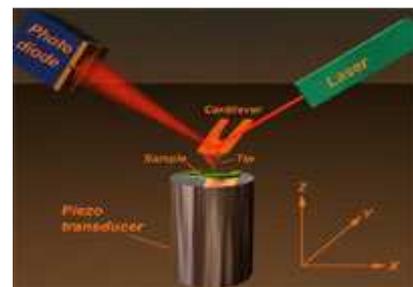


Figure 1. Schematic diagram of an atomic force microscope. Like an old-fashioned gramophone a sharp probe attached to a flexible cantilever tracks the undulations of the sample surface. The resulting motion of the cantilever is monitored and used to generate a 3D image of the surface.

and structure-function relationships determined. Genetic engineering provides a route to the design of new structures and, if this is unacceptable to consumers, the scientific understanding allows targets to be defined for accelerated plant breeding or screening of natural varieties. Similarly knowledge of the crystal structures of fats allows the selection and tempering of particular crystal forms in order to optimise structure and texture.

WHAT IS NANOSCIENCE?

What exactly are nanoscience and nanotechnology? Nanoscience is defined as the study of phenomena and the manipulation of materials at the atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale. The term 'nano' is derived from the Greek word for dwarf. To put things in perspective a nanometre (nm) is one-billionth of a metre, or approximately one hundred thousandth of the width of a human hair.

IMPLICATION FOR THE FOOD INDUSTRY

One way the food industry can benefit from nanoscience is to use new physical tools developed to study nanostructures. Major microscopic methods developed to probe the nanoworld include the scanning tunnelling microscope invented in 1982, and its more versatile offspring, the atomic force microscope (AFM), reported in 1986. AFM has proved particularly useful for probing molecular structures in food². As a microscopic technique it allows heterogeneous systems to be seen and this heterogeneity has proved to be important in understanding their behaviour. It has led to new molecular understanding of the behaviour of polysaccharide gelling and thickening agents, new molecular descriptions of the structure and functionality of starch, and a new mechanism of action for certain starch-degrading enzymes.



[Click to enlarge](#)

Figure 2. AFM images showing the displacement of a milk protein (green) surfactant increases the protein network is compressed and increases in height until it breaks. Images sizes are (a) 1.0 x 1.0 μm , (b) 1.6 x 1.6 μm , (c) 3.2 x 3.2 μm and (d) 10 x 10 μm . The cartoon illustrates the changes in the protein network.

A good example of the power of nanoscience is how it has changed the understanding of the role of interfacial structures in controlling the stability of foams and emulsions.

When a foam or emulsion is created an air-water or oil-water interface is generated, and the molecules present at the interface determine its stability. A source of instability is the presence of both proteins and small molecules, like surfactants or lipids. Proteins or surfactants alone will stabilise interfaces, but by mechanisms that are mutually incompatible. When both are present they battle for control of the interface and the surfactants normally win. Although surfactants or lipids are more surface-active than proteins they actually find it difficult to displace the proteins.

Nanoscience in the form of AFM explains how this happens. It shows that the proteins form networks and thus, to displace the proteins, the surfactants have to break the network. They do this by finding weaknesses in the network where proteins are only weakly attached. These proteins can be removed, allowing the surfactant to gain a foothold at the interface. More surfactant pours into these breaches, expanding the area they occupy and compressing the protein network until it eventually breaks, and proteins can be displaced.

As all proteins used to stabilise foams and emulsions form networks this newly identified displacement mechanism is generic. Strategies for improving the stability of the protein networks can thus be suggested and these can be applied widely in the baking, brewing and dairy industries. Components can be added that bind or mop up small molecules such as lipids, or the cross-linking of the protein network can be enhanced, making it harder to break. In the future more complex multilayer structures can be designed using nanofabrication. Adding an extra layer can be used to consolidate the weaknesses in the protein network and to stabilise it against surfactant or lipid attack. By carefully choosing the molecular components the properties of the interfacial layers can be designed. Coalescence of droplets can be enhanced or inhibited, or the porosity of the interface regulated to optimise encapsulation and release. Similar approaches can be used to design new surface coatings or barriers. Nanoscience provides understanding that allows conventional technologies to be used rationally to improve food structure.

Nanotechnology is generally regarded as new approaches to manipulation of materials and structures. This new type of material science will impact on the food industry. The electronics industry already uses nanotechnology and there are likely to be continued advances in the miniaturisation of computer chips and enhanced data storage. In the long-term, the advent of quantum computing and cryptography would offer new applications, currently difficult, or impossible using conventional computing. Apart from IT applications advances in computing will allow the improved analysis of large sets of data, in areas such as genomics and proteomics, which will undoubtedly lead to improvements in food safety and authentication.

Improved nanofabrication is likely to lead to new higher density and more efficient and reproducible arrays, and the development of more comprehensive and sophisticated sensors. The idea of assembling interfacial structures, coatings or barriers layer by layer has already been discussed. Molecular fabrication will lead to new materials and new surface structures. The question here is whether the food industry will sit back and hope that they will be able to exploit developments in material science, or whether they will grasp current funding opportunities to work with nanotechnologists to design the types of structures they need. It might be possible to design surfaces that repel bacteria and inhibit biofilm formation, or create novel layered structures that can be peeled to remove contamination. Will it be possible to develop new and improved packaging materials, and can they be used to monitor and record the quality of the material during storage?

The applications described above involve the production of large-scale assemblies by molecular fabrication. They would not introduce nanoparticles, as such, into food. Should nanoparticles be added to food? One area where there might be a future drive to the use of nanoparticles lies in the blurring of the distinction between functional foods and pharmaceuticals. Nanoparticles may seem attractive as delivery vehicles. Small particles can go where other particles cannot reach and surfaces could be designed to target release of drugs or nutrients. The health implications of the use of nanoparticles is thoroughly discussed in the Royal Society and Royal Academy of Engineering report¹, and they also address the implications for future research in this area, the assessment of risk, and the potential needs for approval and labelling. The general public has already begun to voice concerns about possible long-term side effects associated with the use of nanoparticles. Future proponents of such approaches will need to weigh potential benefits against the need to ensure the safety of such products and, more importantly, the possibility of convincing consumers that such an approach is needed.

CONCLUSION

At present there are clear opportunities for nanoscience and nanotechnology in food technology. Some applications can be anticipated and can result in targeted advances in technology. However, new scientific advances usually lead to new technological innovations that might not have been predicted at the outset. At present the food industry is at a crossroads. It can pass by and hope to exploit developments in nanotechnology as they emerge serendipitously or otherwise in the future, or it can embrace these new skills and set targets to drive scientific advances in pursuit of specific goals.

<http://www.foodtech-international.com/papers/nanotechnology.htm> (2010-04-21)

UNIT 2

WORSE THAN WE THOUGHT THE LOWDOWN ON HIGH FRUCTOSE CORN SYRUP AND AGAVE “NECTAR”

By Sally Fallon Morell and Rami Nagel

High fructose corn syrup (HFCS) entered the market place in the early 1970s and within twenty years, accounted for over half the refined sweeteners used in the U.S. food supply. Produced mainly by the two food processing giants, Archer Daniels Midland and Cargill, it is the main sweetener in soft drinks and is increasingly replacing sugar in baked goods, bread, cereals, canned fruits, jams and jellies, dairy desserts and flavored yoghurts. Sweeter and less expensive than sugar, HFCS represents the major change in the American diet over the last forty years. Although the food industry made this change very quietly, consumers are beginning to ask a lot of loud questions about the new sweetener as research accumulates to indicate that it is much worse for us than we thought.

Research indicates that free refined fructose interferes with the heart's use of key minerals, like magnesium, copper and chromium. In humans, fructose feeding leads to mineral losses, especially higher fecal excretions of iron and magnesium, than do subjects fed sucrose. Iron, magnesium, calcium, and zinc balances tended to be more negative during the fructose-feeding period as compared to balances during the sucrose-feeding period. Because fructose competes with glucose and galactose for absorption, excess fructose can be carried to the lower intestine where it provides nutrients for the existing gut flora, which produce gas. It may also cause water retention in the intestine. These effects may lead to bloating, excessive flatulence, loose stools, and even diarrhea depending on the amounts eaten and other factors.

All fructose must be metabolized in the liver. The livers of test animals fed large amounts of fructose develop fatty deposits and cirrhosis, similar to problems that develop in the livers of alcoholics. Excessive fructose consumption is also believed to contribute to the development of non-alcoholic fatty liver disease. Fructose is a reducing sugar, as are all monosaccharides. The spontaneous chemical reaction of simple sugar molecules to proteins, known as glycation, is thought to be a significant cause of damage in diabetics and an important contribution to many age-related chronic diseases.

In one study, glycated products were significantly higher in fructose-fed rats compared with the other sugar-fed and control rats. Although the body does not require insulin to assimilate fructose, some studies indicate impaired insulin action in the liver and peripheral tissues after long-term feeding. Fructose reduces the affinity of insulin for its receptor, which is the hallmark of type-2 diabetes. This is the first step for glucose to enter a cell. As a result, the body needs to pump out more insulin to handle the same amount of glucose.

Fructose ingestion acutely elevates blood pressure in healthy young humans. Fructose consumption leads to more lactic acid formation compared to glucose. Extreme elevations cause metabolic acidosis, even leading to death. A number of studies report elevations in plasma uric acid after dietary consumption of fructose, especially in patients with high blood pressure. Elevated uric acid may be a risk factor in coronary disease. This may explain the findings of a recent study published in British Medical Journal linking fructose to gout. Cases of gout have risen in recent years, despite the fact that gout is commonly considered a Victorian disease. The suspect is fructose found in soft drinks and other sweetened drinks.

Studies on the Maillard reaction indicate that fructose may contribute to diabetic complications more readily than glucose. The Maillard reaction is a browning reaction that occurs when compounds are exposed to various sugars. Fructose browns food seven times faster than glucose, resulting in a decrease in protein quality and a toxicity of protein in the body. This is due to the loss of amino acid residues and decreased protein digestibility. Maillard products can inhibit the uptake and metabolism of free amino acids and other nutrients such as zinc, and some advanced Maillard products have mutagenic and/or carcinogenic properties. The Maillard reactions between proteins and fructose, glucose, and other sugars may play a role in aging and in some clinical complications of diabetes.

In studies with rats, fructose consistently produces higher kidney calcium concentrations than glucose. Fructose generally induces greater urinary concentrations of phosphorus and magnesium and lowered urinary pH compared with glucose. There is significant evidence that high-sucrose diets may alter intracellular metabolism, which in turn facilitates accelerated aging through oxidative damage. Scientists found that the rats given fructose had more undesirable cross-linking changes in the collagen of their skin than in the other groups. These changes are also thought to be markers for aging. The scientists say that it is the fructose molecule in the sucrose, not the glucose, that plays the larger part.

Researchers found that rats fed a high-calorie diet supplemented with high-fructose corn syrup for eight months exhibited impaired spatial learning ability and reduced function of the hippocampus, thus impairing cognitive function. Fructose intake is associated with small LDL particle size in overweight schoolchildren. Small LDL is associated with higher rates of heart disease.

<http://www.trit.us/modernfood/HFCSAgave.pdf> (2010-04-21)

UNIT 3

CORN SWEETENERS

Called “one of the greatest achievements in the sugar industry,” the development of the various types of corn syrups, maltodextrins and high-fructose corn syrup from corn starch sources, represents the pinnacle of food processing. Corn starch can be hydrolyzed into glucose relatively easily, but it was not until the 1970s that it became a major commercial product, bringing about major changes in the food industry.

Corn starch is processed and refined from the kernels of corn by using a series of steeping (swelling the kernel), separation and grinding processes to separate the starch from the other parts of the kernel (which are used for animal feed.).The starch is hydrolyzed using acid, acid-enzyme, or enzyme-enzyme catalyzed processes. The first enzyme is generally a thermally stable alpha amylase which produces about 10-20 percent glucose. Further treatment with the enzyme glucoamylase yields 93-96 percent glucose. The final corn syrup (glucose syrup) products include dried corn syrup, maltodextrin and dextrose (glucose). With the development of glucoamylase in the 1940s and 1950s, it became a straightforward matter to produce high percent glucose syrups (corn syrup). However, these have shortcomings in the sweetener industry. D-glucose has only about 70 percent of the sweetness of sucrose, on a weight basis, and is comparatively insoluble. Fructose is 30 percent sweeter than sucrose, on a weight basis, and twice as soluble as glucose at low temperatures, so a 50 percent conversion of glucose to fructose overcomes both problems, giving a stable syrup that is as sweet as a sucrose solution of the same concentration.

According to food industry literature, one of the “triumphs” of enzyme technology so far has been the development of glucose isomerase, which in turn led to the commercialization of high fructose corn syrups. Several types of bacteria can produce such glucose isomerases. The enzymes are resistant to thermal denaturation and will act at very high substrate concentrations, which means that they are stable at higher operational temperatures and can be used over and over during processing. This is a key to the production of an inexpensive substitute for sugar. Glucose isomerases convert the glucose in corn syrup into fructose, resulting in high fructose corn syrup (HFCS). HFCS comes in three different formulations. Forty-two percent fructose corn syrup is used mostly in processed foods like pastries, cookies and ketchup. However, soft drink manufacturers requested a high-fructose blend, one containing 55 percent fructose. This is produced by using vast chromatographic columns of zeolites or the calcium salts of cation exchange resins to absorb and separate the fructose from the other components. A very sweet 90 percent high fructose corn syrup is used as a sweetener in low-calorie “diet” products.

Growing consumer resistance to HFCS is the likely explanation for a recent industry campaign to put the new sweetener in a favorable light. Ads run on television and in popular magazines portray HFCS as benign and its critics as bossy, overbearing, unqualified and misinformed. For example, a full-page ad in *Better Homes and Gardens* portrays two attractive women engaged in the following conversation: “My dry cleaner says high fructose corn syrup is loaded with calories.” The reply: “A registered dietitian presses your shirts?” Then comes the official statement: “There’s a lot of misinformation out there about sugars made from corn. Truth is, high fructose corn syrup is nutritionally the same as table sugar. The same number of calories too.

As registered dietitians recommend, keep enjoying the foods you love, just do it in moderation. On the surface, the official statement is true. Both HFCS and sugar have approximately the same number of calories, both are pure carbohydrate and both are virtually devoid of vitamins and minerals. For this reason alone, HFCS should be strictly avoided.

http://www.en.wikipedia.org/wiki/High_fructose_corn_syrup (2010-04-14)

UNIT 4

UTILIZATION OF FOOD WASTES FOR SUSTAINABLE DEVELOPMENT

EJE AFC- Electronic Journal of Environmental, Agricultural and Food Chemistry ISSN: 1579-4377

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ABSTRACT

This review article deals with the alternative means of handling food wastes including the conversion of wastes from gari industry, cassava peels, shaft from processed cassava, yam, banana agro-waste, corncobs, citrus, pastures and sugar cane, forage, organic wastes etc. into useful products for human and animal consumption in Nigeria.

The bioconversion of waste to useable energy is also a part of utilization of waste, as by burning solid fuel for heat, by fermenting plant matter to produce fuel, as ethanol, or by bacterial decomposition of organic waste to produce methanol. Alternative means of handling food wastes focus more on utilization rather than disposal. Thus, the possibility of producing a useful product from wastes will greatly enhance and ensure sustainable economic development in Nigeria and the world at large.

SOURCES AND NATURE OF FOOD WASTE FOR BIOPRODUCT DEVELOPMENTS

Waste contains three primary constituents: cellulose, hemicellulose and lignin, and can contain other compounds (e.g. extractives). Cellulose and hemicellulose are carbohydrates that can be broken down by enzymes, acids, or other compounds to simple sugars, and then fermented to produce ethanol renewable electricity, fuels, and biomass-based products (Puri, 1984; Wyman and Goodman, 1993; van Wyk, 2001). When the amount of organic agricultural waste, such as corn stalks, leaves and wheat straw from wheat-processing facilities, sawdust and other residues from wood mills, is also considered, this component of solid waste could be a principal resource for bio-development (Louwrier, 1998; van Wyk, 2001). Materials of organic origin are known as biomass (a term that describes energy materials that emanate from biological sources) and are of major importance to sustainable development because they are renewable as opposed to non-organic materials and fossil carbohydrates (van Wyk, 2001).

A surveys on the potential for biomass waste to alleviate energy problems in Tanzania through utilization of agro-industrial residues for anaerobic conversion into biogas and bio-diesel, sisal industry, the largest producer of agro-industrial residues, has a potential to produce energy that could greatly supplement the current shortfall of hydropower generation (Kivaisi and Rubindamayugi, 1996).

In 2004, Kareem and Akpan reported that the use of agricultural by-products as substrate for enzyme production was cheap and could facilitate large scale production of industrial enzymes in the tropics. Eight isolates of *Rhizopus* sp. was obtained from the environment and were grown on solid media for the production of pectinase enzymes.

Three media formulated from agricultural materials were the following: medium A (Ricebran + Cassava Starch, 10:2w/w); Medium B (Cassava Starch + Soyabean, 1:2 w/w); Medium C (Ricebran + Soyabean + Casein hydrolysate, 10:20.5 w/w). The result obtained by Kareem and Akpan (2004) showed that medium A gave the highest pectinase activity of 1533.33u/ml followed by medium A and C with 1,366.66 and 1066.00u/ml respectively after 72hrs fermentation. The three solid media supported profuse mycelial growth of *Rhizopus* species and enhanced its pectinase producing potential (Kareem and Akpan, 2004).

A comparative study of the performance of cow dung and poultry manure as alternative nutrient sources in a bioremediation process was described by Obire and Akinde (2005) and Chukwura et al. (2005). Obire and Akinde (2005) also reported that amelioration of oil polluted soil with cow dung and poultry manure facilitates the disappearance of crude oil in the soil thereby increasing the rate of soil recovery. Poultry manure performed better than cow dung which will greatly enhance food productivity at such a time like this when the world at large is facing food crisis.

Coffee-husk and Pulp

Coffee husk and coffee pulp are coffee processing by-products. Some of the husk is used as organic fertilizer (Cabezas et al. 1987) while coffee pulp has its application and utilization in swine feeding (Jarquín, 1987). The presence of tannins and caffeine diminishes acceptability and palatability of husk by animals.

Caffeine

Caffeine is also a component of several cola drinks. The addition of caffeine in cola drinks is responsible for almost 70% of the world's pure caffeine trading (Mazzafera, 2002; Mazzafera et al., 2002). Asano et al (1993) reported a successful microbial production of theobromine from caffeine while Braham and Bressani (1987) and Bressani and Braham (1987a,b) have reported the potential uses of coffee berry byproducts and the composition, technology, and utilization of coffee pulp in other species as well as its anti-physiological factors. The popularity of coffee beverage is also based on the stimulant effect of caffeine, because of this pharmacological effect; caffeine has long been added to medical formulations to compensate the depressive effects of other drugs (James, 1991) Okonko et al. *EJEAFChe*, 8 (4), 2009. [263-286] 268.

Citrus Pulp

According to Wing (1975) and Wing et al (2003), the Florida Citrus Exchange established a fellowship for research into uses of citrus waste in 1911 and thus launched an area of investigation which remains strongly productive. Involved primarily is citrus pulp, consisting mainly of the rag, peel, and seeds of oranges with minor amounts from other fruits (Hendrickson and Kesterson, 1965). This waste collects on concrete slabs or in open pits at canneries. Cattle eat citrus pulp in the fresh state, but it accumulates too fast for current consumption, and it ferments and spoils too rapidly to save as it is produced. The feeding value and nutritive properties of citrus by-products proved that the digestible nutrients of dried grapefruit refuse were good for growing heifers (Neal et al., 1935).

Citrus Molasses

Citrus molasses also serve as a substrate for fermentation in the beverage-alcohol industry (Becker et al., 1946). The remaining distillery waste can be condensed to a very acceptable feedstuff high in pentose sugars and, because of yeast used for fermentation, high in good quality protein. Large and increasing amounts of citrus molasses are used for production of beverage alcohol. The remaining sugars, which are pentoses, cannot be used by the beverage industry, but they are an excellent source of energy for cattle.

EJEAFc- Electronic Journal of Environmental, Agricultural and Food Chemistry
ISSN: 1579-4377

http://ejeafche.uvigo.es/index.php?option=com_docman&task=doc_view&gid=476&Itemid=33. (2010-04-14)

UNIT 4

SAFETY FIRST

The optimism for 2008 must be tempered by the concern for food safety, once again the No. 1 concern among our processors. And for good reason: Last year was one of the worst for food recalls. It was a year in which the industry was overwhelmed by food scares and in which “Let’s go for some Chinese” went from a common lunch suggestion to a guaranteed laugh in a Letterman monologue.

"There’s a change of consumer perception regarding the environmental impact of consumer products. Consumers will start to challenge the logistics of certain products and their distribution based on the environment," said Hubertus Schubert, engineering consultant/process engineering for Coca-Cola Co., Atlanta.

But the inundation of Chinese ingredient scandals was only half of last year’s food safety debacle. The domestic fiascos came hot and heavy. One meat processor, Topps Meat Co., folded rather than face the music of the second largest beef recall in U.S. history. E. coli O157:H7 in its hamburgers sickened dozens – but killed no one. And Augusta, Ga.-based Castleberry Foods Inc. was almost taken down by a recall of nearly 100 of its meat-based products for botulism.

We specifically asked about E. coli concerns, although certainly other bugs wreaked havoc last year. Four in 10 answers they are “extremely concerned.” Add in another fourth who are “very concerned” and nearly a fifth “somewhat concerned” and you’ll see this tiny bug is making enough commotion to keep more than 80 percent of processors up at night.

It wasn’t just meat and meat-based pet food that put the fear into processors last year. Bagged spinach and salad recalls nearly devastated those markets. ConAgra early in the year took a \$66 million hit for contaminated peanut butter, then near the end of the year recalled Banquet pot pies. Cheese, tortillas, smoked salmon dip, puffed veggie snacks ... a veritable supermarket of recalled consumer food products proved processors are having considerable trouble keeping the bugs out of the food.

This epidemic of food-safety failures pushed the issue to one of its highest showings as a top processor concern – more than 52 percent compared to 47 percent last year and 30 percent the year before. "Food safety has captured the attention of both the American public and lawmakers," says Dexter Manning, national food and beverage industry leader for Grant Thornton LLP. “Unfortunately, the FDA’s budget has been slashed in recent years resulting in a reduced number of inspections at a time when we probably need them the most.

“With elections coming this year, many fear food safety will take a back seat,” Manning adds. “On the bright side, the agreement with China is a first step toward improving the quality and safety of imported food and drug products. Under the terms of the agreement, the U.S. will have inspection access to certain Chinese manufacturing facilities for a limited number of products specified in the accord.”

Get clean, stay clean

For the experts, how to ensure safer food still boils down to the no-brainer of clean hands and a clean workplace. "To keep the U.S. food supply safe, all individuals in the food chain, from the farmer to the consumer, must properly handle and process food," states John Surak of the Milwaukee-based American Society for Quality (www.asq.org). His colleague, Janet Raddatz, tenders a note of optimism: "Our food supply is as safe as it has ever been. Emerging pathogens, mass transportation and a global supply chain will continue to challenge us, yet the food industry remains vigilant in providing consumers with a wide variety of safe, high-quality food products."

So, have our respondents made progress in this regard? Numbers are up only a couple percentage points above the already high numbers implementing employee training programs (89 percent for 2007; 87 percent in 2006) and HACCP plans (57 percent and 55 percent). Improved pest control, more/improved sanitary equipment and rapid microbial detection all stayed within the same percentages in 2007 as 2006.

<http://www.foodprocessing.com/articles/2008/015.html> (2010-04-22)