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Highlights

- World Bank to provide $210m loan for food storage system in Bangladesh
- New UN food safety standards on lead levels
- Laser tool speeds up detection of *Salmonella* in food
- Patent for extended-shelf-life tomatoes
- Food ingredient to combat peanut allergies
- Affordable “generic” probiotic bacterium
- A new solution to stop bread from getting mouldy
- A fresh approach to food processing
The **Asian and Pacific Centre for Transfer of Technology (APCTT)**, a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives: to assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.

*The shaded areas of the map indicate ESCAP members and associate members*
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$210m World Bank loan for storage system in Bangladesh

The International Development Association (IDA), part of the World Bank, will provide a $210m loan, with a 40-year term and a 10-year grace period, to Bangladesh. Using the funds, the government will construct steel silos with a storage capacity of 535,500 tons of rice and wheat. It will also provide 500,000 households in disaster-prone coastal areas with smaller household silos to ensure food security during and after natural disasters. The move is part of the Bangladesh Modern Food Storage Facilities Project. The steel silos can store food grains such as rice and wheat for up to 3 years, while retaining the nutritional quality through computerised control of humidity and temperature. World Bank Bangladesh acting country head Christine Kimes said that this modern food storage system, combined with an effective distribution system, will help to ensure food security immediately after a natural disaster.

“The project will reduce the vulnerability of people living in natural disaster prone areas and help Bangladesh build a stock of food to meet emergencies,” said World Bank Bangladesh acting country head Christine Kimes. Government of Bangladesh Economic Relations Division additional secretary Arastoo Khan said, “This would protect the Government from having to replenish rice and wheat stock every 7 month with huge cost. The government would have greater maneuverability in management and distribution of cereal stock,” added Khan.

Source: http://www.foodprocessing-technology.com

Nepal government to punish hard pesticide use

Nepal’s Agriculture Secretary has announced that Nepal’s government will punish the use and sale of hard pesticides while subsidising the cost of organic plant fertiliser production by 50%. The move is part of the government’s continued policy of ‘prize and punish’ to replace both hard pesticides and herbicides with organic pesticides. Consumers International’s Member in Nepal – Socio Economic Welfare Action for Women and Children (SEWA Nepal) – helped lay the groundwork for this breakthrough for sustainable consumption in the country. SEWA Nepal spreads the message of organic farming through what it says is the first interactive programme organised on food and environment issues in Nepal.

The President of Socio Economic Welfare Action for Women and Children (SEWA Nepal) Ms Kalyanee Shah says: “Our aim is to influence policy and implementation to meet environmental and livelihood challenges emerging in the country. So we look for opportunities to carry out our agenda together with consumers, practitioners and policymakers to promote organic farming in Nepal.” SEWA Nepal’s three-phase campaign achieved outstanding success in reaching out to the media, women’s groups, government officials, and youth groups in different regions of Nepal. SEWA Nepal conducted a sensitisation programme on the importance of organic farming and held two interactive sessions with media representatives from 12 newspapers, 7 radio stations, and 8 television channels.

SEWA Nepal was a recipient of the Green Action Fund, an annual award program made available through the Swedish Society for Nature Conservation (SSNC). The 2013 awards focused on the theme of “Safer, more sustainable food for all.” Members highlighted the problems associated with irresponsible use of pesticides in farming and also raised awareness regarding demand for food that is produced by farming methods that do not employ chemical pesticides.

Applications for 2014 are now open.

Source: http://www.consumersinternational.org

Philippines’ first food-processing innovation center

The Department of Science and Technology (DOST) has launched Philippines’ first food processing innovation center in Davao, aimed to further boost the operations of the agriculture and fishery sectors in Mindanao region.

“Food processing contributes more than 40 percent of the Philippines’ major manufacturing output,” DOST Undersecretary for Regional Operations Carol M. Yorobe said during the opening of the facility. Stressing that food processing is a big contributor to manufacturing output, Yorobe said local food companies can now avail themselves of various services that the facility offers, such as vacuum packaging and immersion freezer.

Other available support services at the innovation center include food testing, information, packaging and labelling design, consultancy services, trainings, and seminars. Housed in the facility are vacuum fryer for frying vegetables, root crops, mangoes, and jack fruit without removing their color and natural flavor; spray dryer for a faster and more efficient drying method and better control...
of powder quality; and the water retort. Other equipment in the food processing innovation center are vacuum evaporator for coco honey, tomato paste, and condensed milk; freeze dryer for meats, fruits, and vegetable; vacuum packaging machines for foods stored in packed and retortable pouches like cereals, nuts, cured meat, chips, and similar products; and immersion freezer that ensures faster cooling process. Yorobe emphasized the importance of partnership between the government and the academe in achieving effective technology application and deployment. DOST has 20 attached agencies all geared towards the discovery and use of new technologies and innovations that can be used in improving the lives of Filipinos through their application in various sectors of the Philippine economy.

Source: https://ph.news.yahoo.com

Radiation technology to increase shelf life of perishables

The Indian government is contemplating large-scale use of radiation technology to increase shelf life of fruits and vegetables, especially onion, potato, and tomato, to meet supply shortage during off-season and to reduce wastage. The technology has been developed by Bhabha Atomic Research Centre (BARC) and is in use in Maharashtra. Currently, Hindustan Agro Cooperative is using radiation technology for storage of 200,000 tonnes of onions.

The topic was discussed on Wednesday at a meeting of an interministerial group called by road transport minister Nitin Gadkari in the backdrop of a sharp rise in retail prices in the three key kitchen staples in Delhi. It was attended by food minister Ram Vilas Paswan, agriculture minister Radha Mohan Singh, food processing minister Harsimrat Kaur Badal, and scientists from BARC.

Paswan said many suggestions were made in the meeting, including one that radiation centres should be set up alongside Central Warehousing Corporation (CWC) and Food Corporation of India (FCI) facilities in major metropolitan cities.

Food minister Ram Vilas Paswan said BARC’s radiation technology sounds good, but further discussions need to be held on this issue. Nuclear scientist Anil Kakodkar allayed apprehensions and said food items treated by the radioactive technology are safe. The observation of new compounds after irradiation offers the possibility of using them as markers of gamma-irradiated foods and this will be the subject of future study. The 2D-GC technique could also be used to compare the profiles of volatile organic compounds associated with various foodstuffs and its enhanced separation ability, compared with 1D-GC, of being able to cope much better with complex mixtures.

Source: http://timesofindia.indiatimes.com

National Edible Oil Fortification Project launched in India

The Confederation of Indian Industry (CII) and the Global Alliance for Improved Nutrition’s (GAIN) National Edible Oil Fortification Project was launched in New Delhi recently.

Sudha Pillai, former member secretary, Planning Commission of India, stated that as the nation’s health was paramount, addressing the management of these deficiencies warranted public health interventions. “The government has taken many initiatives, but the interventions have not gone to the root cause,” she added.

“By using the public-private partnership (PPP) model, we can bring many diverse actors from the public and private sectors into a coalition, to work on improving nutrition together in a way that reflects local culture and conditions, fosters innovation and entrepreneurship, and works to create self-sustaining cycles of growth,” Pillai said.

The project aims to build consensus around fortification as an industry-led initiative and to generate evidence on the merits of business-led expansion of a fortified edible oil portfolio. It would entail engagement with various stakeholders (business leaders, technical experts, nutritionists and policy-makers) to build consensus on taking forward the agenda of large-scale fortification of edible oils.

India has made impressive strides in leading the developing world. It has one of the youngest populations in the world and is raring to capture the world stage in growth and development. India’s growth story is marked with exceptionally high levels of hunger and malnutrition (particularly micronutrient malnutrition), which often goes unnoticed, even by those affected. Multiple micronutrient deficiencies continue to be significant public health problems in India with serious consequences and a devastating impact on the health and productivity of the population.

Fat-soluble vitamins, such as vitamins A and D, have multiple functions. Recent research suggests that vitamin D could play a role in decreasing the risk of many chronic illnesses, including osteomalacia and muscle weakness, common cancers, autoimmune diseases, infectious diseases, diabetes, and cardiovascular disease.
The fortification of edible oil with vitamins A and D offers one of the most feasible and cost-effective interventions. The merit in pursuing edible oil fortification in India lies in the mass penetration of edible oil across the population groups and geographies, as also in its effectiveness in addressing some of the challenges related to nutrition security.

J P Meena, additional secretary, Ministry of Food Processing Industries (MoFPI), said, “Besides maintaining the shelf life of food, food processing preserves food nutrients in transit, creates new products with enriched nutrients, fortifies products with essential micronutrients, and also provides assistance creating forward and backward linkages to maintain the nutritive value of the food product.” Meena added that the ministry was working towards developing a national food map/grid that would showcase agricultural and livestock produce and states, zones and clusters with food-processing potential (so as to tap the strengths and weaknesses and to tackle them by suitable interventions, ensuring access and affordability of the produce all across the country).

Source: http://www.fnbnews.com

A new Viet Nam action plan for agriculture

Action plans for developing the agricultural and fishery product processing industry to implement Vietnam’s industrialization strategy within the Vietnam–Japan cooperation framework by 2020 with a vision for 2030 has been signed by Prime Minister Nguyen Tan Dzung. Five typical items—namely, rubber, coffee, tea, shrimp, and fruit—were selected. According to this plan, agricultural and fishery product processing industry accounts for 20% of Vietnam’s industrial output value and has maintained this rate over the last 10 years. Meanwhile, Euromonitor International has forecast that the global Packaged Food Market, which was valued at US$860 billion in 2010 will boost to US$1,000 billion USD in 2015. This reveals the development potential of the agricultural and fishery product processing industry in Vietnam. Most of Vietnam’s products are semi-processed. Deep processing technology is still limited.

Processing industry has the most significant number of companies. Up to 2012, there have been 6,000 agricultural-fishery product processors, which is a noteworthy number. According to the plan, Vietnam is oriented to be a high-quality agricultural fishery producer by 2020.

The country will define three to five agricultural and fishery products that can promote the image of Vietnamese trademark. Four strategies are aimed: constant and high-quality supplies, developing deep process, enhancing goods circulation, and improving marketing activities and promoting trademarks. Regarding agricultural and fishery process development, the plan includes competence enhancement for R&D centers; improving circulation of goods and distribution efficiency for small companies, forming goods movement and distribution facilities (auction, semi-process at wholesale markets, distribution channels to end-users), supporting marketing activities and brand making; building demo park for high technological agricultural process, signing mutual agreements on recognizing agricultural and fishery quality test results between Vietnam and importing markets.

Source: http://www.seafood.vasep.com.vn

Food Safety on the Agenda in Viet Nam

Food safety is getting extra attention in Viet Nam, thanks in part to a Japan International Cooperation Agency (JICA) project. On July 2, the Vietnamese Ministry of Agriculture and Rural Development decided to promote the Basic GAP Guidance for Vegetable Production in Viet Nam. GAP stands for “good agricultural practices.” The guidance was based on recommendations from the JICA’s “Project for Strengthening the Capacities for the field of Management of Vietnam’s Crop Production Sector for Improving the Productivity and Quality of Crop’s Products in Vietnam.”

Source: http://www.jica.go.jp

“Irradiated food safe for consumption”

The food irradiation process, which uses nuclear technology, is the best alternative method to increase food quality and safety, according to the Malaysian Nuclear Agency (MNA) Director-General Datuk Dr Muhamad Lebai Juri. Dr Muhamad said irradiated food was safe for consumption as the process did not leave any trace of radioactive materials in food products. He also said research to determine the suitability of the irradiation method to be done on local food products had been carried out by MNA researchers, with cooperation from other agencies, since 1980.

The fourth edition of the 2-day Food Safety Seminar organized by MNA and Malaysian Radiation Protection Association concluded recently. It was aimed at discussing irradiation-related issues to provide greater understanding and change the public perception on the irradiation method.

Source: http://www.therakyatpost.com
New UN safety standards on lead levels

The UN Food and Agriculture Organization (FAO) and the World Health Organization (WHO) said that no more than 0.01 mg per kg of lead should be permitted in infant formula and no more than 0.2 mg per kg of arsenic should be permitted in rice.

The decision comes from the Codex Alimentarius Commission, the UN food safety standards body jointly run by FAO and WHO, which sets standards to promote safer and more nutritious food for customers worldwide. The Commission’s recent annual meeting was attended by representatives from 170 countries and the European Union, as well as 30 international governmental and nongovernmental organizations. The countries agreed that infants and young children are particularly vulnerable to the toxic effects of lead, suffering profound and permanent adverse health effects, particularly to the brain and nervous system. Often found in the environment, lead can end up in ingredients that are used in the production of infant formula. Levels can be controlled and monitored by sourcing raw materials from areas where lead is present in less amounts.

Moreover, long-term exposure to arsenic can cause cancer and skin lesions and has been associated with developmental effects, heart disease, and diabetes. Ingested arsenic can also severely damage the nervous system and brain. Like lead, arsenic is found in the environment and is naturally present at high levels in the groundwater and soil in parts of the world. The danger is that it can enter the food chain by being absorbed into crops from water and soil. Even more alarming is that rice, a major staple food for millions of people, absorbs arsenic more than other crops. This is particularly concerning in Asian countries, where paddy fields are irrigated with groundwater containing arsenic-rich sediments pumped from shallow tube wells. Improved irrigation and agricultural practices can help reduce contamination. Another method is to grow crops in raised beds instead of in flooded fields. On veterinary drugs, the Commission recommended that their use should be restricted in food-producing animals in order to prevent residual amounts of the drugs remaining in meat, milk, eggs, or honey.

Countries also agreed on maximum levels of pesticide residues and additives in foods as well as maximum levels of contaminants, including toxins called fumonisins that are produced by mold growing on maize.

Source: http://www.un.org

Food licensing and registration deadline extended in India

The Food Safety and Standards Authority of India (FSSAI), the country’s apex food regulator, has extended the deadline for obtaining licences and securing registration for food business operators (FBOs) in the country under the Food Safety and Standards Regulations (FSSR), 2011, by 6 months. The new deadline is February 4, 2015. The current deadline lapsed on August 4, 2014, following which it was decided to accord extension. With the nod of the competent authority, the regulator issued a notice in this regard, which stated that the timeline mentioned in Sub-regulation 2.1.2 of Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011, has been extended by 6 months.

When contacted, health ministry officials informed that FSSAI has been allowed to extend the deadline. As far as the conversion of licences was concerned, Maharashtra was the leader, with more than 1.51 lakh licences converted. FBOs, meanwhile, were relieved upon receiving the news regarding the extension. They previously feared a crackdown by FSSAI in the event of their failure to obtain licences or ensure registration, as per FSSR 2011.

Source: http://www.fnbnews.com

China’s legislature releases draft Food Safety Law

China’s legislature, the National People’s Congress (NPC), has released a draft of the revised Food Safety Law (2014 Draft FSL) for public comment. The comments were due on July 31, 2014. The Food Safety Law was last revised in 2009, when the government changed the law’s name from the Food Hygiene Law and altered most of its content. Since then, the Law has been one of the focal points of increasingly intense discussion both inside China and abroad in the context of numerous incidents of misbranded, or at times dangerously adulterated, human food produced by some farmers and food manufacturers in China. The NPC has not adopted a timeline for its final enactment of the Law. Once the revisions to the FSL are adopted, the China Food and Drug Administration and other agencies will probably revise and draft new implementing regulations. These agencies will also probably seek stakeholder comment in that process.

Source: http://www.natlawreview.com
Distribution of bacterial biofilm contamination

The process of attacking bacterial biofilms adhering to food packaging has been patented by the Hebrew University of Jerusalem’s technology transfer company, Yissum.

Michael Brandwein, a graduate student at the Hebrew University of Jerusalem, was one of two graduate students presented with a Kaye Innovation Award during the 77th annual meeting of the Hebrew University Board of Governors on June 11.

Brandwein’s research has focused specifically on corrugated cardboard boxes. The Hebrew University has signed an agreement with B.G. Tech of Kibbutz Beil Guvrin for further development and commercialization. Bacterial biofilms are an ever-increasing problem in the food industry, especially for fresh produce. The US Centers for Disease Control and Prevention recently reported that foodborne diseases cause an estimated 48 million illnesses each year in the United States alone, of which 45% are caused by bacteria.

Industrialized countries have seen increased demand for fresh produce as awareness of the health benefits of eating fruits and vegetables has grown. But public health concerns about fresh produce are especially acute because many of these products are consumed without cooking. Countless microorganisms, including illness-causing bacteria, attach to food and packaging surfaces and form biofilms in a complex and multifaceted process.

It was recently discovered that bacteria actually talk to one another, in a process called quorum sensing. This cross-talk is one of the factors that regulate biofilm formation. When certain molecules detect a sufficiently high cell density, they activate a cascade of genetic processes that leads to the bacteria’s adhesion. Controlling the production or integration of these molecules can prevent the bacteria from coordinating to create a biofilm.

“While millions of dollars have been spent globally to develop antimicrobial polymers, no one has succeeded in developing and marketing anti-quorum sensing/anti-biofilm polymers. We therefore predict that our product will enjoy exclusivity for many years to come,” said Brandwein. “We envision our technology being applied to frozen food packaging, poultry and meat packaging and other areas within the food packaging industry.”

The researchers predict revenue potential in the many millions of dollars. In addition to addressing health concerns, preventing food contamination has significant economic implications for increasing the shelf life of products.

Test to confirm A2 content of milk

One of Australia’s largest milk brands, PURA, has developed a test to verify the A2 protein content of its milk. From July 1, all of PURA’s milk in Victoria, Australia, will have been tested to confirm that it naturally contains both A2 and A1 proteins.

PURA’s research found that 75% of consumers surveyed are actively looking at labels to check what ingredients are in the food that they are consuming.

Initially launched in May in South Australia as a test market, July 1 marks the launch of the milk in Victoria, with the rest of Australia following in July.

Source: http://www.foodmag.com.au

New sensor to detect harmful bacteria on food industry surfaces

A new device designed to sample and detect foodborne bacteria is being tested by scientists at the University of Southampton, the United Kingdom, the results of which are used in the Biolisme Project.

Listeria monocytogenes has the highest hospitalization (92%) and death (18%) rates among all foodborne pathogens. Listeriosis mainly affects pregnant women, newborn children, the elderly, and people with weakened immune systems.

The new device aims to collect and detect the pathogen on location within 3–4 hours. This early and rapid detection can avoid the cross-contamination of ready-to-eat food products. The prototype sensor has been finalized in France and field trials are now under way to test the device before it is demonstrated in food factories.

The Biolisme Project was started in 2009 by a consortium of six partners from four different countries and is funded by the European Union’s Seventh Framework Programme for Research (FP7).

Source: http://www.wun.ac.uk
**VATIS UPDATE: Food Processing**

**Safety/Quality Control**

### New device will find carcinogenic food fungus faster

Dr Stephen Euston at Heriot–Watt University, the United Kingdom, is leading a project to test the feasibility of a new device, designed by Edinburgh Biosciences, which will detect aflatoxins much more quickly and accurately than current methods. The focus is on making the device easy to use, with simple and instant results that do not require a chemistry degree to be able to understand them. This will remove the need for expensive laboratory technicians to spend days analyzing samples, potentially hundreds of miles away. Aflatoxins fluoresce strongly, which we’re using to our advantage. We’re using the latest Light Emitting Diodes (LEDs) with a new generation of interference filters to develop a highly sensitive instrument that will detect the fluorescence and identify aflatoxins rapidly.

“The EU has the most stringent requirements of any regulatory body when it comes to the level of aflatoxins permitted in foodstuffs. Anything above four micrograms per kilogram, which is equivalent to four billionths of a kilogram, is not permitted. Our device will detect aflatoxins at an even lower level. This device will have huge benefits to farmers, transportation agents, port inspectors, buyers, importers, exporters, and producers of foodstuffs for human and animal consumption. Ultimately, though, the consumer will benefit. Food will be safer and as production costs go down, so too should retail costs.”

In addition to developing a prototype instrument that will be of low cost and easy to use, Dr Euston and his team are working to establish test procedures that will allow the instrument to be used to test bulk material in situ, whether nuts, corn, or cereals.

The team expects to have a prototype instrument by June 2014.

Source: http://phys.org

### Laser tool speeds up detection of Salmonella in food

In the United States, Purdue University researchers have developed a laser sensor that can identify *Salmonella* bacteria grown from food samples about three times faster than conventional detection methods.

Known as BARDOT (pronounced bar-DOH’; short for “bacterial rapid detection using optical scatter technology”), the machine scans bacterial colonies and generates a distinct black-and-white “fingerprint” by which they can be identified. BARDOT takes less than 24 hours to pinpoint *Salmonella*.

“BARDOT allows us to detect *Salmonella* much earlier and more easily than current methods,” said Arun Bhunia, a professor of food science, who collaborated with then-Purdue engineer Daniel Hirleman to create the machine. “This could ultimately help provide safer food to consumers.”

*BARDOT identified *Salmonella* bacteria with an accuracy of 95.9%. It also individually distinguished eight of the most prevalent *Salmonella* serovars. “While many tools can only detect a single kind of bacterium, BARDOT picks out multiple types of disease-causing bacteria on a plate with a single scan,” Bhunia said. In addition to *Salmonella*, BARDOT can identify *Escherichia coli*, *Vibrio*, *Listeria*, *Bacillus*, and many more food-borne pathogens.

The paper was published in *mBio* and is available at http://mbio.asm.org/content/5/1/e01019-13

BARDOT is commercially available through Advanced BioImaging Systems of West Lafayette, Ind. The company can be contacted at 765-807-0772.

Source: http://www.purdue.edu
INGREDIENTS

Food ingredient to combat peanut allergies

In a step toward reducing the risk associated with peanut products, the leading cause of severe food allergic reactions in the United States, a team of scientists from North Carolina State University’s Plants for Human Health Institute has developed a food ingredient from peanut flour and cranberry extracts, among other plants, which has the potential to lessen the life-threatening allergic reactions brought on by peanut consumption.

The scientists developed flours in which peanut proteins were bound with polyphenols from plants like blackcurrant, cinnamon, cranberry, and green tea; the cranberry compounds–peanut flour combination is the only one to go to animal trials thus far, where it triggered the beneficial desensitization reactions without provoking harmful allergic responses in laboratory tests with mice. The scientists plan to expand their work and create hypoallergenic food ingredients for other food allergies like eggs, soy, and milk as soon as funding can be secured.

Researchers from the University of North Carolina at Chapel Hill and the U.S. Department of Agriculture co-authored the study, “Novel Strategy to Create Hypoallergenic Peanut Protein-Polyphenol Edible Matrices for Oral Immunotherapy,” which was published recently in the Journal of Agricultural and Food Chemistry.

Funding support was provided by the Everett W. Byrd Endowment and NC State University’s Plants for Human Health Institute at the NC Research Campus in Kannapolis.

For more information, access: www.plantsforhumanhealth.ncsu.edu.

Acidified whey protein method gets rid of “off” notes

Acidified whey protein can often taste too tart or astringent when made by conventional methods. But Glanbia Nutritional Ireland (Brussels, Belgium) says its method, patented in late January, improves flavor, odor, tartness, and sweetness.

Conventional methods include dry blending an acid with whey proteins. But the pH levels of these dry-blended acidified whey proteins can only be lowered so far before significant astringency and tartness problems develop, the authors state.

Instead, Glanbia uses wet blending to first combine whey protein and an acidulant, prior to spray drying. The company uses a precise amount of acidulant to effectively lower the pH level to a desirable range (most likely between 2.8 and 5.6), subsequently improving flavor.

The new patent, #8,637,102, is called “Acidified whey protein compositions and methods for making them.”

Source: http://www.nutritionaloutlook.com

Extrusion cooking can improve nutritional content

Extrusion technology has the potential to provide increased food security to Africa, while creating job opportunities and saving energy, according to a report by food scientists published by the Institute for Food Technology.

“Extrusion technology, as a cooking process, is particularly suitable for the beneficiation of by-products as it is energy efficient, environmentally friendly and compared to other cooking processes, it has no waste streams that need to be treated,” said LJ Grobler, professor of mechanical engineering at North-West University in Potchefstroom, South Africa, and head of ExtruAfrica.

Source: http://foodtank.com

Technology to develop dry powder formulations

SCeapro Inc. (CZO–V) (“Ceapro” or “the Company”) announced the signing of a Licensing and Development Agreement with the University of Alberta, Canada, for the rights related to a technology entitled “Formation of Micro/Nanoparticles and Encapsulation of Bioactives Using Supercritical Fluid Technology.”

“This partnership between Ceapro and the University of Alberta is a great example of translational research from lab to market,” said Gilles Gagnon, President and CEO of Ceapro.

This technology was invented by Dr Temelli from the Department of Agricultural, Food & Nutritional Science of the University of Alberta
Ingredients

along with Dr Bernhard Seifried, now Senior Researcher at Ceapro.

The “PGX Technology” is a platform that can produce numerous morphologies of biopolymers ranging from fine fibres to granular powder, which are highly water soluble and could find commercial success in a wide range of industries including functional foods, nutraceuticals, cosmeceuticals, and pharmaceutical products.

For more information, contact: Megan Lee
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Are essential oils tomorrow’s solutions for diabetes?

Researchers at the U.S. Department of Agriculture and the University of Illinois Urbana–Champaign think some of these plant extracts may actually help control diabetes, which has been published in the Journal of Agricultural and Food Chemistry.

Researchers discovered that oregano, rosemary, and marjoram extracts all have the ability to inhibit enzymes DPP-IV and/or PTP1B. These enzymes control insulin production in humans and, thus, the production of blood glucose — a major factor in diabetes management.

For the purpose of this study, the researchers sourced each extract from both greenhouse harvests and commercially grown herbs. While there was no clear indication that growing methods influenced each plant’s ability to provide enzyme-inhibiting solutions, greenhouse herbs did contain more polyphenols (gallic acid) and flavonoids (rutin).

Sesame seed oil extract may improve soy oil for frying

U.S. Department of Agriculture (USDA) scientists are determining how to better protect soy oil’s good-for-you polyunsaturated fats from the oxidation that can occur at the high temperatures typically used for frying food.

In preliminary experiments at the Agricultural Research Service, National Center for Agricultural Utilization Research in Peoria, IL, the scientists found that sesamol, extracted from sesame seed oil, provided better antioxidant protection for soy oil than nine other natural antioxidants that the team tested.

Peer-reviewed articles published this year and in 2012 in the Journal of the American Oil Chemists’ Society document this ARS research.

Apple pomace as a potential ingredient

Researchers from Dublin Institute of Technology, and Teagase Food Research Centre, Ireland, formulated extruded snacks and baked scones with increasing levels (0–30%) of apple pomace (AP). The incorporation of up to 20% of AP in extruded snacks and baked scones does not change significantly (P < 0.05) the proximate composition of the final products, except for the content of starch of baked scones. At this level of incorporation, the fiber content, phenolic content, and antioxidant capacity increased when compared to the products to which no AP was added.

Encapsulated food ingredients

Innovative Food Processors, Inc. (IFP), the United States, introduces a new line of Encapsulated Food Ingredients to replace ingredients formerly coated with partially hydrogenated vegetable oils (PHOs). IFP’s non-PHO-encapsulated ingredients include, but are not limited to, Encapsulated Salt, Encapsulated Citric Acid, other Encapsulated Acidulants, Encapsulated Sodium Bicarbonate, Encapsulated Caffeine, and Encapsulated Ascorbic Acid. The newly developed non-PHO coating systems can be applied to almost any dry, free-flowing food ingredient. In November 2013, the US Food and Drug Administration proposed the removal of PHOs from the GRAS (generally recognized as safe) list. IFP is confident in the duplicate or improved performance properties of their new encapsulated ingredient-coating system. The coating system is enhanced by IFP’s PrimeCAP® encapsulation technology that applies microscopic coating layers—thinner and more elongated, to provide further enhanced performance properties into IFP’s ingredients. For samples or for more information on IFP, please visit the website http://www.ifpinc.biz, or e-mail us at SALES@IFPINC.BIZ.

Source: http://www.nutriceuticalsworld.com
A new solution to stop bread from getting mouldy

Scientists have finally found a way to make bread last longer—and the new method replaces chemical preservatives with ingredients sourced from plants.

From the moment that delicious loaf of crispy, hot bread leaves the oven, it interacts with microbes, fungi, and yeast in the air—and a few days later, lumps of bluish-green mould appear on its surface. That is why packaged bread contains preservatives to extend the shelf life of the product. But Brazilian researchers have found a way to reduce the amount of chemicals put into bread while making it last longer.

Called ‘active packaging’, this alternative adds natural preservatives to the packing material instead of chemicals to the fresh bread. The compounds used in active packaging come from plants such as oregano and clove, which have natural antimicrobial properties.

The team of scientists from the University of Viscosa in Brazil have mixed plants’ essential oils with water, and a thickener derived from plant material and used them to make ‘edible films’, which are placed inside the plastic bags used to store bread, and the researchers have found that bread remains mould-free for 15 days at room temperature.

Absorption base ensures longer shelf life for strawberries

Depron, has succeeded in developing an absorption base that demonstrably lengthens shelf life of strawberries. The HAS University of Applied Sciences in Den Bosch has determined that strawberries cultivated in open field have a longer shelf life if the traditional bubble wrap is replaced by an absorption base. The latter offers a tremendous advantage to the entire chain (from grower to consumer) and adds value in terms of sustainability and food safety.

Depron is active in the development of polystyrene foam products and has developed the “open cell structure” for polystyrene packaging in the past. This invention led to the development of special absorption bases for the fish-packaging industry. Through development of a new polystyrene formula, Depron has now developed an absorption base that is suitable for soft fruit and meat packaging.

In February and July, the University tested large amounts of strawberries in various packages, under different conditions, such as temperature and humidity. The result was significant:

- Shelf life is extended by 2 days on average.
- The strawberries look better.
- The base absorbs all the moisture, preventing leakages.

This new product offers benefits for both the Dutch market and export. And the market in which this innovative absorption base will be able to play a part is very big. Experience has shown that many packaged meat and soft fruit products (which release moisture), such as blackberries, raspberries, strawberries, and mushrooms, are still thrown away. Depron’s new absorption base will certainly contribute to the reduction of this waste.

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Ozone treatment extends fruit shelf life

A new technology, developed by Anacail from the University of Glasgow, the United Kingdom, which relies on the antimicrobial
properties of ozone, has been developed to extend the shelf life of packaged fruit by up to 20 days.

The system can be used once food is packaged. A retractable device is applied to the outside of the pack, which generates plasma within it. The plasma then breaks the atomic bonds of standard atmospheric oxygen (O\textsubscript{2}), then forming ozone (O\textsubscript{3}), which is a natural germicide and kills fungi, bacteria, and mould within the pack. Over time, it breaks down to re-form standard oxygen. There is no impact on the taste of the food from the ozone and the procedure does not require any additional substance to be introduced into it.

Trials on packages of tomatoes and grapes have shown the ozone treatment to be effective, cutting the number of fruits that went mouldy and extending shelf life by 5–20 days.

Anacail’s chief executive, Ian Muirhead, says: ‘We believe our ozone packaging solution can have a significant impact for producers, retailers and consumers by improving the quality of the fruit by stopping it decaying so quickly, and as a consequence reducing waste. The extended shelf life will also offer the opportunity for tomato and table grape exporters to expand their overseas market penetration by maintaining product quality longer than currently achieved.’

Source: http://www.food-contact.com

**Technique to increase fruits’ shelf life**

Ashraf Dar, a postgraduate in food technology from the Islamic University Of Science And Technology, Kashmir, India, and his professor have developed a unique ‘low-pressure system,’ which can increase the shelf life of fruits.

Ashraf Dar says his innovation can be helpful to fruit growers of the Kashmir valley to keep their fruits fresh for a long duration.

According to Ashraf, the main aim of his innovation is to help farmers who cannot afford to send their fruits to the cold stores, as a result of which their fruit is rotten. He has developed the low-pressure system using a container and few other things.

Changes in climatic conditions like prolonged winters, rains etc badly affect fruits. Therefore, Ashraf’s invention can certainly provide a helping hand to the fruit growers of the Kashmir valley.

Ashraf presented his low-pressure system at the 9th JK Science Congress held at Kashmir University in October 2013. His invention has been much appreciated by experts of food technology at Kashmir University and other states.

“I need help from government so that I can establish a large project at farmer level. I have already submitted my project to innovation cell of Kashmir University. My aim is to give the respiring time to a fruit grower so that he is able to hold his produce for 10 to 15 days without loss of quality and thereby maintaining the harvest freshness. By doing so the fruit grower of the valley will not fall as easy prey to the middle men involved in the marketing of his produce,” Ashraf revealed.

Source: http://www.agronfoodprocessing.com

**Essential oil may be future of food preservation**

The processed food and beverage market is still saturated with synthetic preservatives, but many plant-based essential oils are proving useful for their antimicrobial and antioxidative traits. Some essential oils, such as rosemary oil, are already in use, but the category is still immature. Researchers at the Prince of Songkla University in Thailand have compiled a review of essential oils for food preservation for those interested.

Rosemary extract is arguably the most common essential oil used for extending product shelf life, due to its ability to combat gram-positive and gram-negative bacteria. Oregano oil, thyme oil—with high levels of a compound called cavacrol—and a variety of bottlebrush, *Callistemon comoybensis* have a “broad spectrum of antimicrobial activity” against many types of bacteria.

Many oils have shown some sort of antimicrobial activity in published research, and they can be extracted from a variety of plant parts—such as leaves, seeds, flowers, and roots—and through a variety of extraction techniques, including steam processes and supercritical CO\textsubscript{2} extraction. For the bitter oils, modern technology makes available encapsulation techniques and other ways of getting an ingredient’s preservative power without its odor.

To learn more about essential oils for shelf-life extension, read the *Thailand Review*. It is currently free for public viewing.

Source: http://www.nutritionaloutlook.com
UV-C irradiation of grape juice

Scientists from Izmir Institute of Technology, Turkey, have investigated UV inactivation kinetics of freshly squeezed grape juice. UV inactivation kinetics of freshly squeezed turbid white grape juice (FSTGJ) treated with an annular flow UV reactor by applying UV dosages ranging from 0 to 116.7 J/mL, at three different flow rates (0.90, 1.75, and 3.70 mL/s), were modeled by using log-linear, Weibull, Hom, and modified Chick–Watson models. The populations of Escherichia coli K-12, lactic acid bacteria (LAB), and foodborne yeasts were reduced by 3.759, 4.133, and 1.604 log cfu/mL, respectively, after exposure to UV dosage of 116.7 J/mL at the lowest flow rate. The inactivation kinetics of foodborne yeasts were best described by the modified Chick–Watson model, with the least root mean squared error (RMSE = 0.001, $R^2 = 0.999$). Besides, the inactivation kinetics of E. coli K-12 and LAB were best fitted by the Weibull model ($R^2 = 0.999$). Additionally, when the UV exposure time was increased up to 32.5 min (i.e., eight cycles), UV-C treatment of FSTGJ resulted in 5.341 log cfu/mL reduction in E. coli/K-12, which meets the Food and Drug Administration requirement of a 5log reduction of microorganisms in fruit juices.

UV-C irradiation is a nonthermal method and allows the processing of fruit juices with minimal or no changes in flavor, essential nutrients, and vitamins. Although thermal pasteurization is the most convenient way of increasing the shelf life of fruit juices, it causes a “cook taste” in grape juice. So, the application of UV-C irradiation to process grape juice was investigated. The shape of the microbial inactivation curve is sigmoidal in UV treatment. Kinetic parameters (e.g., k and D) and models can be used for the development of UV-C irradiation process to ensure microbial safety in juice products.

Source: http://onlinelibrary.wiley.com

Development of nondairy probiotic drink

Researchers from Central Institute of Post Harvest Engineering and Technology, India, have developed nondairy probiotic drink (PD) utilizing sprouted wheat, barley, pearl millet, and green gram separately with oat, stabilizer, and sugar using L. acidophilus-NCDC14, with soymilk and distilled water as liquid portion. Acidity (in terms of lactic acid) and pH in different PD samples ranged from 0.45 to 1.02% and 4.11–4.49, respectively, with values being higher in green gram–based PD. Probiotic count ranged from 9.10 to 11.06, 10.36 to 11.17, 10.36 to 11.51, and 10.36 to 11.32 log cfu/mL in wheat-, barley-, pearl millet-, and green gram–based PD samples, respectively. Sensory acceptability of all four PDs with soymilk was higher up to 6 g of wheat, barley, and green gram and 4 g pearl millet flour per 100 mL liquid portion. Sensory acceptability score was $>7$ and the probiotic count was good.

Source: http://www.sciencedirect.com/

Affordable “generic” probiotic bacterium

All kinds of probiotic beverages – are available and popular in the Western world, even though the supposed health benefits of these products have been questioned. While studies do confirm the positive effects of probiotics on people with a weakened immune system or an unbalanced diet, for example, by preventing diarrhea, these products were not earlier available in Africa

Inspired by the idea of generic drugs, Dutch microbiologists Remco Kort and Wilbert Sybesma decided to introduce probiotic yogurt in Uganda and started developing the first “generic” probiotic bacterium in the world. They bought several probiotic products in the supermarket, isolated a bacterium for which the patent had expired in 2006, cloned it, checked whether the DNA matched, and named it Lactobacillus Yoba (‘yo’ referring to yogurt, ‘ba’ to bacteria).

The healthy dairy product has been handed out weekly to a local primary school and will also be sold in small shops soon. The duo is working on a solution that has better preservability by freeze-drying the bacteria into a powder. The powder lasts for 1 year and will be packaged in easy-to-handle sachets, as used for sugar. The freeze-dried bacteria will not only be distributed to factories but also to women running small shops. The Yoba for Life Foundation not only aims to provide healthy yoghurt, it also offers new business opportunities for local communities.

A fellow professor of the Dutch Wageningen University is testing the possibility to add the Yoba bacteria to mutandabota in Zimbabwe to see if it can be fermented with the Yoba bacteria to increase the nutritional value. ‘The Yoba bacteria can be used in any fermented dairy product’, Sybesma explains. ‘That’s how we are planning to spread Yoba all over the continent.’

Source: http://www.compassmedia.nl
'Whey' better plastic for food packaging

A recent European Union-funded project developed a more cost-effective and recyclable oxygen barrier layer for use in plastic packaging.

Food must be suitably packaged to prevent exposure to oxygen, which can decrease flavour, colour, and nutrient content, as well as shelf life. Current packaging materials consist of synthetic polyolefin films coated with additional synthetic polymers to create an oxygen barrier. Unfortunately, these packaging materials are difficult to recycle and they can be expensive.

Whey, a biopolymer by-product of cheese production, represents an alternative material with which to coat plastic films. The ‘Whey protein-coated plastic films to replace expensive polymers and increase recyclability (WHEYLAYER) project looked into developing this biopolymer.

Researchers were able to successfully design a whey coating with a barrier layer and an active layer. The barrier layer is created by converting sweet and sour whey into whey protein isolates (WPIs), which can then be supplemented with plasticisers. The active layer contains antimicrobials or antioxidants to extend the shelf life of the packaged food.

The newly developed coating also improves recyclability and can easily be removed using enzymes. Project partners ensured that the recycling process is easily integrable into recycling plants and that recyclers are educated about how to handle the new material.

WHEYLAYER has also created an efficient way to use discarded whey. It is also expected to benefit the plastics industry. Overall, project results promise positive economic effects, in terms of food preservation and environmental advantages.

Source: http://cordis.europa.eu

Extended-shelf-life films

These printed extended-shelf-life films are laser microperforated with anti-mist properties. These films have been developed by TCL Packaging, the United Kingdom, to display products at their best and maintain maximum freshness.

TCL carries out extensive testing of foodstuffs for customers to determine exact respiration rates and match microperforation processes to the end product. TCL works with leading industry testing bodies using highly scientific methods and real-time test data to establish gas transmission rates. The company then recommends the appropriate printed film for the application, including the size, amount, and patterning of microperforations, to ensure optimum packaging performance.

TCL recently led a technical team that developed a new packaging film for chopped lettuce packers supplying McDonald's; this film — a new clear, recyclable, monolayer PE-based material with easy peel properties — is a move away from traditional PET/PE laminate films but keeps iceberg lettuce fresh, ensures that packs are easy to open, and improves packing speeds.

Part of the development work involved a number of subtle chemical changes and many trials of the extended-shelf-life film properties through the extrusion process to create a film that meets the technical requirements. The outcome is a new clear, recyclable, monolayer PE-based material with easy peel properties. The film runs successfully at high speeds without any temperature issues.

The resulting film meets all the requirements of the McDonald’s supply chain and the brand’s commitment to renewable and recyclable packaging. Interest is already being expressed for this new product from lettuce and salad packers in a number of European countries.

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Source: http://www.tcl-packaging.com

Flexible packaging innovation

The Schur Star® Squeeze 'n' Mix packaging instrument has two compartments with a frangible seal in the middle. Simply mix marinades and meat inside the packaging. The easy opening guarantees convenient access afterward.

By separating the meat from the marinade, shelf life of the product is extended compared to marinated meat products. The visibility of the raw meat leads to more consumer trust in quality and freshness, resulting in increased sales and customer loyalty.

The innovative Squeeze 'n' Mix method offers simple, clean, easy, and convenient in-pack meat marinating.
Packing

- Squeeze the compartment that is filled with marinade with your hands.
- The middle seal splits allowing the marinade and the meat to mix.
- Allows the meat to marinate inside the packaging without any mess.

The Schur Star Concept consists of the Schur Star packaging machine and the premade Schur Star bags supplied to customers linked together on one string. The bags can be made to meet all possible functionalities required, including all types of barrier properties.

The Schur® Star bagging system allows companies to package a wide variety of products using Schur’s premade bags and SchurStar packaging machine. The two are designed to work in combination to deliver up to 80 filled and sealed bags per minute with fast changeovers and simple machine operation.

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New fully biodegradable packaging developed

PBIO4MAP is a Research for SMEs project funded under the Seventh Framework Programme that started on 1 November 2014. The Laboratory of Polymer Technology at Åbo Akademi University, Finland, is a partner in the project.

At least two different biodegradable thermoplastic materials, mainly polylactic acid (PLA) and polyvinyl alcohol, will be combined. A biodegradable coating based on natural waxes will cover the outer layer of the multilayer structure.

BIO4MAP offers low environmental impact solutions:
- The new packages allow the easy recyclability of PLA,
- The new packages are fully compostable in conditions according to the standard EN13432:2000, and
- Use of agricultural waste (leaves, greenery) as a raw material source for wax-based coating production.

As a result of this combination of material advances, shelf-life studies, and processing technology improvements, a high-performance transparent barrier and a biodegradable package for customized MAP food packaging beyond current state of the art will be obtained.

BIO4MAP has a planned duration of 30 months and a budget of 1.5M€ and is composed of ten participants from five different countries.

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Coolant packaging

Wageningen UR Food & Biobased Research, the Netherlands, has helped the Dutch post company PostNL to develop coolant packaging that will enable supermarkets to make cost- and energy-efficient deliveries to their customers. Fresh produce can be delivered to customers at the right temperature, safeguarding shelf life and quality. PostNL and the Dutch online supermarket Vershuys.com will be using the packaging in the home delivery service they introduced in the province of Limburg earlier this year.

The coolant packaging is made from a high-insulation material and contains exactly the right number of cooling elements to ensure that a pack of meat, fish, dairy, vegetables, and/or fruit is delivered to a customer at a maximum temperature of 7°C. This guarantees the shelf life and quality of the goods, regardless of whether the customer lives 2 or 20 km from the supermarket. The supermarket no longer needs to use refrigerated transport, making the deliveries cost and energy efficient.

Researchers at Food & Biobased Research also devised an advanced model for predicting the course of the temperature in product packages. “The model allows us to calculate how quickly the temperature in the package will rise for certain combinations of products, and how the temperature is distributed inside the package”, explains Matthijs Montsma, researcher on the project.

Being able to predict the course of the temperature inside the package enables supermarkets to decide how many cooling elements to include, where they should be placed, and how long the delivery can take. This will allow them to optimise their logistics and guarantee food safety at the same time.

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Source:
http://www.packagingeurope.com
http://www.wageningenur.nl
Prototype single-pass mobile decorticating machine

Philippine Coconut Authority (PCA) engineers have developed a single-pass decorticating machine that will lessen power bills relative to the traditional decorticating machine.

This prototype machine developed by PCA is an axial flow/drum type driven by a 12-hp four-stroke engine and weighs approximately 360 kilograms. This will serve the need of small coconut farms in remote villages for low-cost but efficient coir-processing equipment.

The model costs P250,000, whereas the commercial decorticating machine would cost around P 350,000 and is run by an 18-hp diesel engine.

For more information, contact: 
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Source: 
http://www.pca.da.gov.ph

A fresh approach to food processing

TOMRA Sorting, Norway, has developed a unique sensor-based sorting solution, the Halo, which combines intelligence with advanced control and is a robust, compact machine providing high capacity, low maintenance, flexibility, and gentle handling.

TOMRA Sorting’s produce material handling machine Genius is equipped with high-resolution cameras and lasers to reject any predetermined unwanted items within milliseconds.

An add-on, the Advanced Foreign Material Detector, identifies defects and objects previously difficult to distinguish because of their similar structure or colour characteristics.

In addition, TOMRA Sorting has unveiled the Primus Gemini for sorting multiple fruit applications with defects such as discolorations, overripening, hail marks, and insect damage, plus foreign material. The Primus Gemini sorter with the Advanced Shrivelled Detector allows removal of shrivelled berries for fresh packing. It offers one sorting solution for detecting soft and discolored berries and provides a three-way sort.

Source: 
http://www.foodmag.com.au

Leaf splitting unit for Aloe vera gel expulsion machine

A leaf-splitting unit was designed and fabricated for Aloe vera gel expulsion machine by researchers from Junagarh Agricultural University, India. The splitting unit consisted of grip roller, reciprocating blade, rotary disc, and eccentric drive. The rotary motion was converted into the reciprocating drive with slanted rotary disc mounted on shaft. The grip roller was covered with spongy material to hold the A. vera leaf without breaking rind. The design parameters included were grip roller dimensions and speed, stroke of reciprocating blade, and size of rotary disc.

Gel extraction from A. vera leaves is important as it is used as a preservative coating, in food drinks, and in cosmetics. The developed leaf-splitting unit would reduce manual contact and minimize the processing time to get good quality gel from A. vera leaves without contamination.

Source: 
http://onlinelibrary.wiley.com/

Robotic pick-and-pack process for shelf-ready packaging

CKF Systems Ltd, the United Kingdom, has developed a fully automated low-cost robot case packing system. The integrated system eliminates the need for manual packing and improves reliability, operates within a confined space, thereby increasing flexibility and future proofing.

The system places packs into cases in a ‘penny stack’ configuration for optimum in-store presentation, with the ability to handle a range of weights and pack sizes with minimal changeover, along with the integration of case handling and labeling within the robot cell.

For more information, contact:
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Source: 
http://grocerytrader.co.uk

Automatic tea-brewing machine

D’lecta Café, India, unveiled the world’s first automatic tea-brewing machine and has already filed the technology for patent.

The machine has been designed, developed, and patented by D’lecta Foods.

The tea-vending units are targeted at the out-of-home segment and would be offered to offices and hotels on lease with a comprehensive annual maintenance contract (AMC) by the company.

Source: 
http://www.foodmag.com.au

Source: 
http://www.fnbnews.com
Food Safety Management: A Practical Guide for the Food Industry

Food Safety Management: A Practical Guide for the Food Industry is the first book to present an integrated, practical approach to the management of food safety throughout the production chain. While many books address specific aspects of food safety, no other book guides you through the various risks associated with each sector of the production process or alerts you to the measures needed to mitigate those risks.

Using practical examples of incidents and their root causes, this book highlights pitfalls in food safety management and provides key insight into the means of avoiding them. Each section addresses its subject in terms of relevance and application to food safety and, where applicable, spoilage. It covers all types of risks (e.g., microbial, chemical, and physical) associated with each step of the food chain. The book is a reference for food safety managers in different sectors, from primary producers to processing, transport, retail, and distribution, as well as those in the food services sector.

It is useful for food safety managers, including those involved with primary production, processing, transport, retail and distribution, and food service; food inspectors and auditors responsible for the evaluation and assessment of food production processes and facilities; and upper level undergraduate/graduate students in food safety, food microbiology, and food engineering courses.

Contact: Elsevier Singapore Pte Ltd, 3 Killiney Road #08-01 Winsland House 1, 239519, Singapore. Tel: +65 6 349 0200; Fax: +65 6 733 1510

Methods in Food Analysis

This book reviews methods of analysis and detection in the area of food science and technology. Each chapter deals with determination/quantification analyses of quality parameters such as lipids, color, texture, and rheological properties in different food products. It provides a reference for food engineers, researchers, as well as undergraduate and postgraduate students.

Contact: CRC Press, Tel: +44 (0) 1235 400524; Fax: +44 (0) 1235 400525; E-mail: book.orders@tandf.co.uk
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- Amount less than Rs 500 should be sent through a demand draft only. Otherwise, payment should be made by cheque/demand draft/UNESCO coupon in favour of the Asian & Pacific Centre for Transfer of Technology, payable at New Delhi.
- *Six issues per year. A print version for distribution to a select target group is supported by the Ozone Cell, Ministry of Environment & Forests, Government of India.
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