Dairy products such as milk, yogurt, and cheese can interfere with certain medications, including antibiotics such as tetracycline, doxycycline, and ciprofloxacin.These antibiotics may bind to the calcium in milk, forming an insoluble substance in the stomach and upper small intestine that the body is unable to absorb.

This food category contains tyramine, which has been associated with a dangerous increase in blood pressure among patients taking monoamine oxidase inhibitors (MAIOs) and certain medications for Parkinson's disease.

Pharmacists should counsel patients taking warfarin to maintain a consistent intake of vitamin K and avoid introducing kale, spinach, and other leafy greens to their diets.Vitamin K is vital for the production of clotting factors that help prevent bleeding, but anticoagulants like warfarin exert their effect by inhibiting vitamin K. Therefore, an increased intake of the nutrient can antagonize the anticoagulant effect and prevent the drug from working.

Patients should always be wary of mixing any medication with alcohol, but some interactions are more serious than others.For instance, ingesting alcohol while taking a prescription stimulant could cause the patient to not fully realize how intoxicated they are. This is especially true when the stimulant is being abused, but it can also happen when the patient takes the drug as prescribed.

Patients should avoid eating grapefruit or drinking grapefruit juice while taking some medications, in particular statins.Compounds in grapefruit called furanocoumarin chemicals cause an increase in medication potency by interacting with enzymes in the small intestine and liver. This interaction partially inactivates a number of medications under normal circumstances.

Warfarin (Coumadin) is a blood-thinning medication that helps treat and prevent blood clots. Eating certain foods, especially those rich in vitamin K, can diminish warfarin's effectiveness. The highest concentrations of vitamin K are found in green leafy vegetables such as kale, collards, spinach, turnip greens, Brussels sprouts, broccoli, scallions, asparagus, and endive."It's not that patients should avoid foods that contain vitamin K," advises Zive. "Rather, they should keep their intake consistent from day to day."He describes a scenario that could spell trouble for an older adult: "If a doctor tells a patient that they should lose weight and they, in turn, start to eat more greens, their vitamin K intake will go up, and this will counteract the anticlotting action of warfarin."

An alcoholic drink can increase or prolong the effects of insulin or oral diabetic agents (pills) and thus lead to hypoglycemia or low blood sugar. The glucose-lowering action of alcohol can last as long as eight to 12 hours. Symptoms of hypoglycemia include nervousness, sweating, trembling, intense hunger, weakness, palpitations, confusion, drowsiness, and ultimately coma.With a doctor's approval, and in the absence of other health conditions such as pancreatitis, elevated triglycerides, and neuropathy, older adults with diabetes may be able to enjoy up to two drinks per day. A drink is defined by the American Diabetes Association as a 12-ounce beer, a 5-ounce glass of wine, or 1.5 ounces of a distilled beverage such as whiskey, vodka, or gin. Individuals can reduce the risk of low blood sugar by having alcoholic drinks at mealtime or by having a snack along with the drink.In addition, certain oral diabetic medications such as chlorpropamide (Diabinese) can cause dizziness, flushing, and nausea when taken along with alcohol.

Digoxin (Digitalis, Digitek, Lanoxin) is used to strengthen the contraction of the heart muscle, slow the heart rate, and promote the elimination of fluid from body tissues.Dietary fiber, specifically insoluble fiber

such as wheat bran, can slow down the absorption of digoxin and lessen its effectiveness. To prevent this, elders should take digoxin at least one hour before or two hours after eating a meal.Herb use can also affect digoxin. For example, ginseng can elevate blood levels of digoxin by as much as 75%, while St. John's Wort decreases blood levels of this drug by 25%."It's important for the patient to recognize signs of digoxin toxicity," says Zive. "These include a yellow tint to vision and the appearance of halos around objects, as well as weakness, confusion, dizziness, and nausea and vomiting."

Statins are highly effective cholesterol-lowering drugs. Unfortunately, says Zive, "Drinking grapefruit juice or eating fresh grapefruit can increase the amount of some statins in your blood and lead to potentially greater side effects of these drugs."Side effects of statins include muscle soreness and liver abnormalities reflected in high transaminase levels (serum glutamic-oxaloacetic transaminase and serum glutamic pyruvic transaminase) on a blood test.This interaction is especially strong with simvastatin (Zocor) and lovastatin (Altoprev), milder with atorvastatin (Lipitor), and nonexistent for pravastatin (Pravachol), so it's important for elders to check whether their prescribed statin drugs do interact before giving up vitamin C-rich grapefruit

Calcium channel blockers are prescribed for high blood pressure. A natural element found in grapefruit latches onto the intestinal enzyme called CYP3A4, which alters the breakdown of the calcium channel blockers, possibly resulting in excessively high blood levels of the drug, along with an increased risk of serious side effects.It doesn't take a jumbo serving of grapefruit to produce a deleterious effect either. For example, a single 6-ounce glass of juice can reduce levels of CYP3A4 by nearly 50%. This effect dissipates slowly. One study indicated that one third of the impact on CYP3A4 from grapefruit juice was still evident a full 24 hours later.The interaction between grapefruit and calcium channel blockers is strongest, for example, with felodipine (Plendil), nicardipine (Cardene), and nisoldipine (Sular) and weaker with amlodipine (Norvasc), diltiazem (Cardizem), and nifedipine (Adalat).Tangelos, a cross between a tangerine and grapefruitlike pomelo and Seville oranges, a bitter citrus fruit used to make marmalades, can have the same deleterious effects as grapefruit on both statins and calcium channel blockers.

Although unproven, evidence points to the likely fact that grapefruit juice gives a boost to blood levels of erectile dysfunction drugs such as sildenafil (Viagra). This may seem like a boon to some men, but it could trigger headaches symptomatic of fatal or near fatal conditions, flushing, or low blood pressure.

.The over-the-counter pain reliever acetaminophen (Tylenol) and alcohol don't mix. "Two or more alcoholic drinks per day can increase the liver toxicity of Tylenol," says Zive. "This toxicity can happen even if a patient takes less than the maximum 4 grams, or eight tablets, of Tylenol per day."This interaction can be especially problematic in older adults, says Zive, since the liver's ability to diminish drugs decreases with age. "The liver of a 65 year old doesn't function the same way it did at age 25," he says.

Dairy products such as milk, yogurt, and cheese can delay or prevent the absorption of antibiotics such as tetracyclines and ciprofloxacin (Cipro). This occurs because the calcium in such foods binds to the antibiotics in the stomach and upper small intestine to form an insoluble compound.To avoid problems, Zive recommends taking an antibiotic one hour before or two hours after a meal.However, there's no need to avoid milk and dairy with all antibiotics. For example, it's recommended that metronidazole (Flagyl) should be taken with water or milk to prevent stomach upset.

Monoamine oxidase inhibitors are an older type of antidepressant still prescribed, albeit less frequently, due to their serious side effects.“Foods containing tyramines, such as some red wines, malt beer, smoked fish, aged cheeses, and dried fruits, can cause a hypertensive crisis or severe and dangerous elevation in blood pressure when taken with this class of antidepressants,” says Zive.

Antithyroid drugs are compounds that interfere with the body’s production of thyroid hormones, thereby reducing the symptoms of hyperthyroidism. According to a broad body of research, Americans’ high-iodine diets account for the lower remission rate of hyperthyroidism in those who are prescribed antithyroid drugs.Antithyroid drugs work by preventing iodine absorption in the stomach. A high-iodine diet requires higher doses of antithyroid drugs. The higher the dose of antithyroid drugs, the greater the incidence of side effects that include rashes, hives, and liver disease.The richest dietary sources of iodine are seafood and seaweed, such as kelp and nori. Iodine is also found in iodized salt and to a lesser extent in eggs, meat, and dairy products.

Green, leafy vegetables, which are high in vitamin K, can decrease how well aspirin thins the blood. Consuming the same amount of green-leafy vegetables each day will decrease this interaction.

Grapefruit juice alters the way the body absorbs statins (cholesterol-lowering drugs) like Lipitor in the blood. It can cause these drugs to be absorbed in higher than normal amounts resulting in a greater risk of side effects.

Calcium channel blockers are prescribed for high blood pressure and are also affected by grapefruit juice. Grapefruit juice changes the way this drug breaks down in the body and may cause overly high levels of the drug in the blood, raising the risk of side effects.

Dairy products such as milk, yogurt and cheese decrease the absorption of antibiotics. Try to eat meals one to two hours before taking these to avoid this interaction.

Alcohol affects insulin or oral diabetic pills. Alcohol prolongs the effects of these drugs, which leads to low blood sugar.

Moderate pain reliever drugs with acetaminophen should not be taken with alcohol because it has a higher chance of causing severe liver damage. Antihistamines, like Benadryl, should not be taken with alcohol because it will cause increased drowsiness.

The most important interactions are those associated with a high risk of treatment failure arising from a significantly reduced bioavailability in the fed state. Such interactions are frequently caused by chelation with components in food (as occurs with alendronic acid, clodronic acid, didanosine, etidronic acid, penicillamine and tetracycline) or dairy products (ciprofloxacin and norfloxacin), or by other direct interactions between the drug and certain food components (avitriptan, indinavir, itraconazole solution, levodopa, melphalan, mercaptopurine and perindopril). In addition, the physiological response to food intake, in particular gastric acid secretion, may reduce the bioavailability of certain drugs (ampicillin, azithromycin capsules, didanosine, erythromycin stearate or enteric coated, and isoniazid). For other drugs, concomitant food intake may result in an increase in drug bioavailability either because of a food-induced increase in drug solubility (albendazole, atovaquone, griseofulvin, isotretinoin, lovastatin, mefloquine, saquinavir and tacrolimus) or because of the secretion of gastric acid (itraconazole capsules) or bile (griseofulvin and halofantrine) in response to food intake. For most drugs, such an increase results in a desired increase in drug effect, but in others it may result in serious toxicity (halofantrine).

Drug side effects and toxicity and often the drug efficacy are highly dependent on drug metabolism determining the activation and/or elimination of the respective compound. In humans, cytochromes P450 are the most important drug metabolizing enzymes of the first phase of drug biotransformation. Their activity can vary due to interindividual genetic differences, but it can be changed also by inhibition or induction of the enzymes by their substrates or other compounds that are not only drugs themselves and/or drugs taken concomitantly. Often, influence on drug metabolism by compounds that occur in the environment, most remarkably in the food, is forgotten. Some commonly used herbs, fruits as well as e.g. alcohol may cause failure of the therapy up to serious alterations of the patient's health. This review presents a brief overview of potentially dangerous nutrition factors including herbs (incl. teas, infusions) that should be considered when indicating individual drug therapy. Examples include primarily grapefruits, pomelo, star fruit, pomegranates and some other fruits, St John's Wort (Hypericum perforatum), caffeine, as well as alcohol and cigarette smoking.

In clinical trials, patients usually take many kinds of drugs at the same time. Thus, drug-drug interactions can often directly affect the therapeutic safety and efficacy of many drugs. Oral delivery is the most desirable means of drug administration. Changes in the activity of drug transporters may substantially influence the absorption of administered drugs from the intestine. However, there have been a few studies on food-drug interactions involving transporters. It is important to be aware of the potential of food-drug interactions and to act in order to prevent undesirable and harmful clinical consequences. Coenzyme Q10 (CoQ10) is very widely consumed by humans as a food supplement because of its recognition by the public as an important nutrient in supporting human health. Since intestinal efflux transporter P-glycoprotein (P-gp) is one of the major factors in drug-drug interactions, we focused on this transporter. We report here for the first time that CoQ10, which is widely used as a food supplement, affects the transport activity of P-gp.

The interaction of natural products and drugs is a common hidden problem encountered in clinical practice. The interactions between natural products and drugs are based on the same pharmacokinetic and pharmacodynamic principles as drug-drug interactions. Clinically important interactions appear to involve effects on drug metabolism via cytochrome P-450 isoenzymes, impairment of hepatic or renal function, and other possible mechanisms. To effectively counsel patients on interactions involving natural products, physicians, and pharmacists should be familiar with the most commonly used products, and have access to information on more obscure products. In this review, we describe details of drugs interaction with natural products and its impact on drug therapy management.

Diet is one of many factors that could alter the pharmacokinetics of drugs. Several fruits and berries have recently been shown to contain agents that affect drug-metabolizing enzymes. Grapefruit is the most well-known example, but also Sevillian orange, pomelo and star fruit contain agents that inhibit cytochrome P450 3A4 (CYP3A4), which is the most important enzyme in drug metabolism. The present article reviews published information on potential interactions between drugs and fruits/berries, with main focus on inhibition and induction of metabolizing enzymes.

Numerous reports have documented drug interactions with grapefruit juice (GFJ) that occur via inhibition of CYP3A enzymes. As reported by Glaeser et al. in the March 2007 issue of this journal, there is increasing recognition that GFJ may also affect the activity of influx (e.g., OATPs) and efflux (e.g., P-glycoprotein) transporters. This commentary focuses on these interactions between GFJ and drug transporters.

Clinicians perceive psycho-farmacotherapy as a real challenge mainly because of numerous adverse effects and drug interacions that may lead to potential life threatening consequences. The amount information that must be taken into account while prescribing psychotropic drugs grows day by day and it is really difficult to stay well informed. Food, like grapefruit juice (GJ), is also a significant source of interactions, which is sometimes forgotten. Grapefruit contains active bioflavonoids that may change bioavailability of many

medications and raise its concentrations above toxic levels. The mechanism of interaction is complex and connected with the influence of GJ active ingredients on prehepatic metabolism and enteric absorption pathways using p-glicoprotein (PGP) and organic anion transporting polipeptide (OATP). The main direction of GJ action is inhibition of cytochrome P450 1A2 and 3A4 isoforms. A wide range of medicines used in daily psychiatric practice undergoes phase I oxidation with CYP 3A4 and 1A2 i.e.: anxiolytics, antidepressants, mood stabilizers, antipsychotics and procognitive compounds. It raises the potential risk of dangerous interactions with grapefruit juice. GJ is generally contraindicated to patients taking psychotropics and it is advised to inform patients about described interaction.

To investigate the potential interaction between selected ingredients of grapefruit juice and, the transport of talinolol, a P-gp substrate, across Caco-2 cells monolayers was determined in the absence and presence of distinct concentrations of grapefruit juice, bergamottin, 6',7'-dihydroxybergamottin, 6',7'-epoxybergamottin, naringin, and naringenin. Talinolol permeability was selectively inhibited by grapefruit juice and its components. The furano coumarin, 6',7'-epoxybergamottin, was the most potent inhibitor (IC(50) = 0.7 microM), followed by 6',7'-dihydroxybergamottin (IC(50) = 34 microM) and bergamottin that did not show any inhibition at concentrations up to 10 microM. The flavonoid aglycone naringenin was around 10-fold more potent than its glycoside naringin with IC(50) values of 236 and 2409 microM, respectively. The flavonoids and furanocoumarins tested in this study are in the same range of concentration they are present in the juice contributing, therefore, for the overall inhibitory effect of GFJ on P-gp activity. The in vitro data suggest that compounds present in grapefruit juice are able to inhibit the P-gp activity modifying the disposition of drugs that are P-gp substrates such as talinolol.

Food-drug interactions are defined as alterations of pharmacokinetics or pharmacodynamics of a drug or nutritional element or a compromise in nutritional status as a result of the addition of a drug. Elderly patients are particularly at risk because more than 30% of all the prescription drugs are taken by this population. Failure to identify and properly manage drug-nutrient interactions can lead to serious consequences. For instance, drug-nutrient interactions can result in reduced absorption of certain oral antibiotics and may lead to suboptimal antibiotic concentrations at the site of infection. This predisposes the patient to treatment failure. Induction or inhibition of enzymes in the gut by nutrients may lead to a significant change in oral bioavailability of drugs or vice versa. For example, grapefruit juice is a selective intestinal CYP3A4 inhibitor. The overall exposure of some drugs can be increased by more than fivefold when taken with grapefruit juice and increase the risk of adverse effects. The use of certain drugs may affect GI tract function and may lead to a loss of bodily electrolytes and fluid. Limiting drug prescriptions to essential medications for as short a period as possible and periodic re-evaluations of the treatment chosen are essential to minimize adverse drug-nutrient interactions.

The effect of drug on a person may be different than expected because that drug interacts with another drug the person is taking (drug-drug interaction), food, beverages, dietary supplements the person is consuming (drug-nutrient/food interaction) or another disease the person has (drug-disease interaction). A drug interaction is a situation in which a substance affects the activity of a drug, i.e. the effects are increased or decreased, or they produce a new effect that neither produces on its own. These interactions may occur out of accidental misuse or due to lack of knowledge about the active ingredients involved in the relevant substances. Regarding food-drug interactions physicians and pharmacists recognize that some foods and drugs, when taken simultaneously, can alter the body's ability to utilize a particular food or drug, or cause serious side effects. Clinically significant drug interactions, which pose potential harm to the patient, may result from changes in pharmaceutical, pharmacokinetic, or pharmacodynamic properties. Some may be taken advantage of, to the benefit of patients, but more commonly drug interactions result in adverse drug events. Therefore it is advisable for patients to follow the physician and doctors instructions to obtain maximum benefits with least food-drug interactions. The literature survey was conducted by extracting data from different review and original articles on general or specific drug interactions with food. This review

gives information about various interactions between different foods and drugs and will help physicians and pharmacists prescribe drugs cautiously with only suitable food supplement to get maximum benefit for the patient.

Our previous studies described a newly identified potential of grapefruit juice (GFJ) in mediating pharmacokinetic drug interactions due to its capability of esterase inhibition. The current study identifies the active components in GFJ responsible for its esterase-inhibitory effect. The esterase-inhibitory potential of 10 constitutive flavonoids and furanocoumarins toward p-nitrophenylacetate (PNPA) hydrolysis was investigated. The furanocoumarins bergamottin, 6',7'-dihydroxybergamottin, and bergapten, and the glycoside flavonoids naringin and hesperidin, at concentrations found in GFJ or higher, did not inhibit the hydrolysis of PNPA by purified porcine esterase and human liver microsomes. However, the flavonoid aglycones morin, galangin, kaempferol, quercetin, and naringenin showed appreciable inhibition of PNPA hydrolysis in purified porcine esterase, and human and rat liver systems. In Caco-2 cells, demonstrated to contain minimal CYP3A activity, the permeability coefficient of the prodrugs lovastatin and enalapril was increased in the presence of the active flavonoids kaempferol and naringenin, consistent with inhibition of esterase activity. In rats, oral coadministration of kaempferol and naringenin with these prodrugs led to significant increases in plasma exposure to the active acids. In addition, in portal vein-cannulated rats, coadministration of lovastatin with kaempferol (10 mg/kg) led to a 154% and a 113% increase in the portal plasma exposure to the prodrug and active acid, respectively, compared with coadministration with water. The contribution of CYP3A inhibition was demonstrated to be minimal. Overall, a series of flavonoids present in GFJ are identified as esterase inhibitors, of which kaempferol and naringenin are shown to mediate pharmacokinetic drug interaction with the prodrugs lovastatin and enalapril due to their capability of esterase inhibition.

Fruit juices and constituents are more potent inhibitors of OATPs than P-glycoprotein activities, which can reduce oral drug bioavailability. Results support a new model of intestinal drug absorption and mechanism of food-drug interaction.

The PK properties of rosuvastatin are based on first-order kinetics in the dose range tested. In this small, selected group of healthy Chinese volunteers, no clinically significant differences in PK properties between doses or sexes were found. The absorption of rosuvastatin was significantly decreased in the fed state compared with the fasting state, which suggests that rosuvastatin should be administered on an empty stomach. All rosuvastatin doses tested were well tolerated.

Concomitant administration of statins with food may alter statin pharmacokinetics or pharmacodynamics, increasing the risk of adverse reactions such as myopathy or rhabdomyolysis or reducing their pharmacological action. This paper reviews major interactions between statins and dietary compounds. Consumption of pectin or oat bran together with Lovastatin reduces absorption of the drug, while alcohol intake does not appear to affect the efficacy and safety of Fluvastatin treatment. Grapefruit juice components inhibit cytochrome P-4503A4, reducing the presystemic metabolism of drugs such as Simvastatin, Lovastatin and Atorvastatin. Follow-up studies on the therapeutic effect of statins in patients consuming a Mediterranean-style diet are necessary to assure the correct prescription because the oil-statin and minor oil compound-statin possible interactions have been only briefly studied. Preliminary study suggests that olive oil can increase the hypolipaemiant effect of Simvastatin with respect sunflower oil. The consumption of polyunsaturated rich oils, throughout the cytochrome P- 450 activation could decrease the half-life of some statins and therefore their hypolipaemic effects. The statins and n-3 fatty acids combined therapy gives rise to pharmacodinamic interaction that improves the lipid profile and leads greater cardioprotection. Although statins are more effective in high endogenous cholesterol production subjects and plant sterols are more effective in high cholesterol absorption efficacy subjects, plant esterols-statins combined therapy generates very positive complementary effects. This review ends suggesting possible

diet-stain interactions that require further investigations (e.g. types of olive oils, fruit juices other than grapefruit, fibre or consumption of alcoholic beverages rich in polyphenols or ethanol).

Warfarin is commonly used to treat or prevent thromboembolic events. Cranberry juice has been suggested to have an interaction with warfarin. However, there have been few reported cases of warfarin-cranberry juice interaction.

In the US, the use of dietary supplements, including vitamins, minerals, amino acids, and herbal products, is extensive. Nonetheless, the majority of patients report that they have little information about the risks, benefits, and adverse effects of medicines, or about their potential interactions with prescription drugs. Patients taking warfarin are at particular risk of interactions with dietary supplements, yet approximately 30% use herbal or natural product supplements on a regular basis. No current governmental regulations or voluntary programs address dietary supplement interactions with prescription drugs. Case reports represent the majority of the evidence surrounding drug interactions between warfarin and dietary supplements. Those of the highest quality include, as an assessment of causality, a modification of the recently published Drug Interaction Probability Scale. Despite positive case reports, formal drug interaction studies are often negative, suggesting that numerous patient-specific influences other than the suspected interaction alone may be responsible for a particular observation. The cranberry-juice/warfarin interaction is a recent example of such a discrepancy. Healthcare providers can play an active role in improving quantity and the quality of case reports of interactions involving warfarin and dietary supplements. A registry of anticoagulant interactions with dietary supplements has been proposed, and is currently being developed through Clotcare Online Resource (http://www.clotcare.com). The goal of this registry is to obtain high quality case-based evidence of drug interactions between anticoagulants and dietary supplements, to define these interactions based on clinical and monitoring outcomes, and to analyze likelihood of causation using a modification of the Drug Interaction Probability Scale

A 55-year-old Caucasian man was receiving warfarin therapy after undergoing aortic valve replacement. His international normalized ratio (INR) was stabilized with warfarin 95 mg/week for 5 weeks. Commencement of a low-carbohydrate, high-protein diet resulted in a series of subtherapeutic INRs that led to a 16% increase in the dosage requirement to maintain therapeutic INRs. After the patient discontinued the diet, his INR increased, and several dosage reductions were required until his INR stabilized with his original dosage of 95 mg/week. Two additional case reports have described a possible interaction between warfarin and a high-protein diet. The potential for increased dietary protein intake to raise serum albumin levels and/or cytochrome P450 activity has been postulated as mechanisms for the resulting decrease in INRs. Given the available animal and human data that demonstrate alterations in drug metabolism in the presence of altered dietary protein intake, an increase in warfarin metabolism due to cytochrome P450 activation appears to be the most likely cause. In addition to the previously reported cases, this case indicates a potential interaction between warfarin and a high-protein diet. Because of the popularity of high-protein diets and because of the risks associated with inadequate or excessive warfarin anticoagulation, patients and health care providers should be aware of this interaction to ensure appropriate monitoring when warranted.

This article reviews the published original sources of information on interactions of oral anticoagulants with dietary factors, points out deficiencies in our knowledge of these interactions, and suggests applications for this information in the clinical setting. As with many drug-nutrient interactions, the original references include a few experimental studies and many case reports. Deciding which interactions of oral anticoagulants with dietary factors are clinically relevant and determining the appropriate dietary prescription concerning each interaction involves, in most cases, an educated opinion rather than a conclusion based on extensive research. Enough information exists on the vitamin K content of foods and the quantity of vitamin K that alters coagulation status from the therapeutic range to provide the patient

with advice concerning a group of foods to avoid and a group of foods to limit to one serving per day. With respect to other dietary factors that may interact with oral anticoagulants, the patient should be cautioned concerning supplements of vitamins A, E, and C and alcohol used chronically or ingested in large quantities.

Based on anecdotal reports, the question of whether cranberry juice interacts with warfarin has been raised. This article discusses the potential mechanism, and systematically reviews case reports as well as clinical trials examining the possible interaction. We systematically searched MEDLINE via PubMed, and the Cochrane Library database. Fifteen case reports were summarized, including the initial unpublished brief reports to the Committee on Safety of Medicines and the subsequent 6 published case reports. Seven clinical trials were analyzed, including 3 studies using warfarin and 4 surrogate drugs. Only 2 cases had a validation scale suggesting a "probable" interaction, but even in these patients there were many reasons to question the validity of a relevant drug interaction. Randomized clinical trials and surrogate markers found no evidence to support the interaction between cranberry juice and warfarin. Because the moderate consumption of cranberry juice does not affect anticoagulation, we encourage the reexamination of initial warnings based on scientific evidence. We conclude that the initial precautionary warnings by administrating bodies are limited to anecdotal case reports and represent misleading conclusions.

The question of potentiation of warfarin anticoagulation by cranberry juice (CJ) is a topic of biomedical importance. Anecdotal reports of CJ-warfarin interaction are largely unconfirmed in controlled studies. Thirty patients on stable warfarin anticoagulation (international normalized ratio [INR], 1.7-3.3) were randomized to receive 240 mL of CJ or 240 mL of placebo beverage, matched for color and taste, once daily for 2 weeks. The INR values and plasma levels of R- and S-warfarin were measured during the 2-week period and a 1-week follow-up period. The CJ and placebo groups (n=14 and 16, respectively) did not differ significantly in mean plasma R- and S-warfarin concentrations. Eight patients (4 on CJ, 4 on placebo) developed minimally elevated INR (range, 3.38-4.52) during the treatment period. Mean INR differed significantly ($P<.02$) only on treatment day 12; at all other time points, the groups did not differ. Cranberry juice has no effect on plasma S- or R-warfarin plasma levels, excluding a pharmacokinetic interaction. A small though statistically significant pharmacodynamic enhancement of INR by CJ at a single time point is unlikely to be clinically important and may be a random change. Enhanced warfarin anticoagulation attributed to CJ in anecdotal reports may represent a chance temporal association.

We report a case of fatal internal haemorrhage in an elderly man who consumed only cranberry juice for two weeks while maintaining his usual dosage of warfarin. We propose that naturally occurring compounds such as flavonoids, which are present in fruit juices, may increase the potency of warfarin by competing for the enzymes that normally inactivate warfarin. While traditionally regarded as foodstuffs, consumption of fruit juices should be considered when patients develop adverse drug reactions.

Warfarin is extensively used for anticoagulation to a target international normalized ratio of 2.0-3.0 for most indications or 2.5-3.5 for high-risk indications; however, many drugs and dietary supplements induce fluctuations in the international normalized ratio. Such fluctuations may lead to therapeutic failure or bleeding complications. Cranberry juice is increasingly used for the prevention and adjunctive treatment of urinary tract infections. The United Kingdom's Committee on Safety of Medicines has alerted clinicians to a potential interaction between warfarin and cranberry juice and has advised that patients avoid their concurrent use. Review and analysis of the literature revealed that ingestion of large volumes of cranberry juice destabilize warfarin therapy. Small amounts of juice are not expected to cause such an interaction. Clinicians should be aware of this potential interaction and monitor and counsel patients accordingly.

Herein, the case is reported of a persistently elevated INR consequent to an interaction between warfarin and cranberry juice in a patient with a prosthetic mitral valve. The elevation in INR was noted two weeks after the patient began to drink cranberry juice. Subsequent symptoms included postoperative bleeding

problems. The bleeding was thought due to a biologically plausible interaction between the drug and the juice. It was concluded that patients taking warfarin should limit their cranberry juice intake.

The available data do not seem to show a clinically relevant interaction between cranberry juice and warfarin; however, patients taking warfarin with cranberry juice should be cautioned about the potential interaction and monitored closely for INR changes and signs and symptoms of bleeding.

Drug-food interactions are a significant problem in clinical practice. Foods may alter the effects of drugs by interfering with pharmacokinetic processes, such as absorption and elimination. For example, absorption of tetracyclines is decreased when taken with milk or other dairy products. Pharmacologic and pharmacodynamic mechanisms also play an important role in drug-food interactions by altering drug effects. An example is the interaction of warfarin sodium with leafy green vegetables, whereby the hypoprothrombinemic effect of warfarin may be decreased and thromboembolic complications may develop. Similarly, certain drugs may have an effect on food intake, absorption, metabolism, and utilization. Numerous drugs, such as antineoplastic agents, have been shown to suppress appetite, resulting in decreased food intake and nutritional deficiency. It is important that health care providers, such as physicians, pharmacists, and dietitians, recognize and work as a team to prevent significant drug-food interactions. Minimizing adverse drug-food interactions would improve patient care by optimizing therapeutic effects and maintaining proper nutritional status.

Traditional monoamine oxidase inhibitors (MAOIs) remain an important class of drugs for a variety of psychiatric conditions, including depressive illnesses, anxiety, and eating disorders. It was the objective of this study to refine the MAOI diet by determining the tyramine content of a variety of untested and "controversial" foods that continue to appear on MAOI diet-restricted food lists. A secondary objective of the study was to evaluate the effect of freshness on the tyramine content of some foods. Fifty-one food samples were evaluated for tyramine content by liquid chromatography. Food samples included a selection of sausages, beverages, sliced meat products, including chicken liver, and some fruits, including raspberries, bananas, and banana peels. Foods that were found to have dangerously high concentrations of tyramine (> or = 6 mg/serving) included chicken liver aged 9 days (63.84 mg/30 g), air-dried sausage (7.56 g/30 g), soy sauce (0.941 mg/ml), and sauerkraut (7.75 mg/250 g). Of the foods analyzed in this study, only those with high tyramine content per serving should continue to be absolutely restricted. All other foods are either safe for consumption or safe in moderation. The data provided should be combined with the data from other similar analytical studies to develop a list of foods that should be absolutely restricted. A more accurate list of restricted foods may enhance patient dietary compliance.

Monoamine oxidase inhibitors (MAOIs) are mainly used in psychiatry for the treatment of depressive disorders and in neurology for the treatment of Parkinson's disease. While the classical, nonselective and nonreversible MAOIs, such as phenelzine and tranylcypromine, are characterised by the risk of inducing a hypertensive crisis when dietary tyramine is ingested, the selective monoamine oxidase-B (MAO-B) inhibitor selegiline (deprenyl) and, even more so, the selective and reversible monoamine oxidase-A (MAO-A) inhibitor moclobemide, are free from this potential interaction. Drug tolerability data for the elderly show that moclobemide is one of the most well tolerated compounds. Selegiline, especially when used in combination with levodopa, can cause anorexia, dry mouth, dyskinesia and, most problematic, orthostatic hypotension. For the traditional MAOIs, phenelzine and tranylcypromine, published data are insufficient to be able to give a conclusive tolerability statement regarding the use of these compounds in elderly people. Although orthostatic hypotension occurs in most patients treated with traditional MAOIs, the incidence in elderly patients with depression does not appear to be greater than that reported with tricyclic antidepressants.

Although the introduction of selective serotonin reuptake inhibitors ushered in an era of relative comfort among clinicians in treating major depressive disorder (MDD), no one antidepressant is appropriate for all patients with depression. In patients with atypical symptoms, efficacy of therapeutic agents may be greatest for monoamine oxidase inhibitors (MAOIs). The first-generation MAOIs such as phenelzine and isocarboxazid were largely nonselective inhibitors of both subtypes of MAO, MAO(A) and MAO(B). These medications carried with them dietary restrictions, medication restrictions, a need for titration, and a substantial side effect burden, including weight gain, cardiovascular effects (i.e., hypertension and hypotension), and sexual side effects. The second-generation MAOI selegiline is selective for MAO(B) at oral doses of up to 10 mg/day. At higher doses, selegiline loses selectivity and inhibits both MAO(A) and MAO(B). Because the antidepressant effects of selegiline occur with the higher doses that impact tyramine pressor effects, an ideal formulation would optimize dose while minimizing adverse effects of MAO(A) inhibition in the gastrointestinal mucosa. Efforts in this direction led to formulation of the selegiline transdermal system (STS). The most common side effects are irritation at the patch site and insomnia. Drugs to be avoided with the STS include some pain medications, antidepressants, muscle relaxants, and any form of sympathomimetic amines, which include amphetamines, cold products with pseudoephedrine, phenylephrine, phenylpropanolamine, ephedrine, and stimulant-containing weight-reduction agents. Although no tyramine-restricted diet is required for the 6-mg/24-hour patch, a restricted diet is recommended for the higher-dose patches to reduce the risk of hypertensive crisis.

Dietary sodium restriction has several clinical benefits, particularly that of enhancing the antihypertensive action of diuretics and other blood pressure-lowering drugs. In individuals who form hypercalciuric stones, sodium restriction along with thiazide diuretics helps to reduce urinary calcium. However, there are adverse consequences of sodium restriction, particularly in elderly patients with impaired sodium conservation mechanisms. Ischemic and nephrotoxic injuries are induced more readily in sodium-depleted animals and patients because of impaired renal hemodynamics and activation of the renin-angiotensin system. Acute renal failure can be precipitated by sodium restriction and concomitant angiotensin-converting enzyme inhibitors, nonsteroidal antiinflammatory drugs, and immunosuppressive drugs. Dietary sodium restriction in animals enhances the chronic nephrotoxicity of cyclosporine and tacrolimus, whereas similar doses of these drugs do not produce structural damage in salt-replete animals. Maneuvers that block angiotensin II protect against renal scarring and drug-induced arteriolopathy in this model. Sodium restriction can enhance the renal tubular reabsorption of drugs such as lithium, leading to toxic blood concentrations. Calcium antagonists may have better efficacy when prescribed to salt-replete hypertensive persons. Finally, there is evidence that activation of the renin-angiotensin system by sodium depletion will enhance the growth of cysts in animal models of cystic renal disease. In individual patients, the effects of sodium restriction by diet should balance anticipated benefits against any possible adverse consequences.

Literature on case reports, clinical studies and biochemical mechanisms of the sweet-tasting compound glycyrrhizic acid in liquorice was critically reviewed to provide a safety assessment of its presence in liquorice sweets. A high intake of liquorice can cause hypermineralocorticoidism with sodium retention and potassium loss, oedema, increased blood pressure and depression of the renin-angiotensin-aldosterone system. As a consequence, a number of other clinical symptoms have also been observed. Glycyrrhizic acid is hydrolysed in the intestine to the pharmacologically active compound glycyrrhetic acid, which inhibits the enzyme 11 beta-hydroxysteroid dehydrogenase (in the direction of cortisol to cortisone) as well as some other enzymes involved in the metabolism of corticosteroids. Inhibition of 11 beta-hydroxysteroid dehydrogenase leads to increased cortisol levels in the kidneys and in other mineralocorticoid-selective tissues. Since cortisol, which occurs in much larger amounts than aldosterone, binds with the same affinity as aldosterone to the mineralocorticoid receptor, the result is a hypermineralocorticoid effect of cortisol. The inhibitory effect on 11 beta-hydroxysteroid dehydrogenase is reversible; however, the compensatory physiological mechanisms following hypermineralocorticoidism (e.g. depression of the renin-angiotensin system) may last several months. It is not possible, on the basis of existing data, to determine precisely the minimum level of glycyrrhizic acid required to produce the described symptoms. There is apparently a great

individual variation in the susceptibility to glycyrrhizic acid. In the most sensitive individuals a regular daily intake of no more than about 100 mg glycyrrhizic acid, which corresponds to 50 g liquorice sweets (assuming a content of 0.2% glycyrrhizic acid), seems to be enough to produce adverse effects. Most individuals who consume 400 mg glycyrrhizic acid daily experience adverse effects. Considering that a regular intake of 100 mg glycyrrhizic acid/day is the lowest-observed-adverse-effect level and using a safety factor of 10, a daily intake of 10 mg glycyrrhizic acid would represent a safe dose for most healthy adults. A daily intake of 1-10 mg glycyrrhizic acid/person has been estimated for several countries. However, an uneven consumption pattern suggests that a considerable number of individuals who consume large amounts of liquorice sweets are exposed to the risk of developing adverse effects.

Licorice-associated hypertension is thought to be due to increased renal sodium retention. The active compound of licorice, glycyrrhetinic acid (GA), inhibits renal 11beta-hydroxysteroid dehydrogenase type 2 (11beta-HSD2) and by that mechanism increases access of cortisol to the mineralocorticoid receptor that causes renal sodium retention and potassium loss. In addition, a direct vascular effect of 11beta-HSD activity has recently been incriminated to promote hypertension, a contention based on in vitro observations. This investigation was designed to establish whether this extrarenal effect of 11beta-HSD is relevant for BP regulation and potassium concentrations in plasma. In a prospective, double-blind, cross-over study, seven patients with anuria on chronic hemodialysis were randomly assigned after a baseline period of 2 wk to placebo or GA (1 g/d) for 2 wk, separated by a washout phase of 3 wk. The ratio of plasma cortisol/cortisone, determined by gas chromatography-mass spectrometry, increased in all patients after GA intake ($F = 9.705$; $P < 0.004$), which indicates inhibition of 11beta-HSD. Twenty-four-hour BP values did not change throughout the study. The increase of the plasma cortisol/cortisone ratio was paralleled by a decline in the plasma potassium concentration in every patient. The mean SD plasma potassium concentration decreased from 5.5 +/- 0.6 mM/L at baseline to 4.9 +/- 0.7 and 4.5 +/- 0.8 mM/L after 1 and 2 wk on GA, respectively ($F = 9.934$, $P < 0.003$). Extrarenal 11beta-HSD activity influences serum potassium concentrations but does not regulate BP independently of renal sodium retention.

liquorice consumption in the Netherlands is very high; on average it is 2 kg per person annually. Also liquorice tea is growing in popularity. Both products contain glycyrrhizin. The pathophysiological mechanism of the effect ofglycyrrhizin was described earlier. In a literature study, the quantitative effect of liquorice consumption on blood pressure was evaluated. An Internet search on PubMed and Embase revealed 7 publications, all ofwhich short-term studies. These studies showed that a daily consumption of glycyrrhetinic acid of 95 mg or more caused an increase in blood pressure. --A practical guideline for an acceptable daily intake of glycyrrhetinic acid seems to be 9.5 mg a day. This means no more than 10-30 g liquorice and no more than half a cup of liquorice tea a day. --On diagnosing hypertension, the effects of liquorice and liquorice tea consumption on blood pressure should be kept in mind.

Antibiotics are widely prescribed in medical practice. Many of them induce or are subject to interactions that may diminish their anti-infectious efficiency or elicit toxic effects. Food intake can influence the effectiveness of an antibiotic. Certain antibiotics can lower the effectiveness of oral contraception. Oral anticoagulation can be influenced to a great extent by antibiotics and controls are necessary. Interactions are also possible via enzymatic induction or inhibition of cytochromes. The use of an interaction list with substrates of cytochromes enables to anticipate. Every new prescription should consider a possible drug or food interaction.

Although food-drug interactions have been studied extensively in recent years, in the light of the complex nature of these interactions general guideline for clinical practice can not be given. Drug interactions with food (containing multivalent metal ions or protein) can have an influence on drug absorption with widely variety of mechanism, resulting in changes in both the rate and extent of bioavailability. Food-drug interaction can be important in the clinical practice. Studies of the interaction between food/juice and

fluoroquinolones have produced conflicting results. A number of studies give evidence that fluoroquinolones forming slightly soluble complex with metal ions of food show reduced bioavailability. In the same time, concurrent ingestion of food/ juice with fluoroquinolones has been shown not to interfere with their absorption to a clinically significant degree.

The purpose of the present work was developing an in vitro dissolution test to highlight the possible molecular background causing ciprofloxacin (CPFX)-milk interaction. The in vitro dissolution of CPFX from film-coated tablets (Ciprinol) 500mg) was examined at different pH values, simulating certain parts of the gastrointestinal tract, in the presence of water, low-fat milk, casein- or calcium enriched water. In order to determine the amount of dissolved CPFX, solid phase extraction sample preparation followed by high performance liquid chromatography coupled with mass spectrometry was applied. Comparing the dissolution efficiency values in various media, it can be concluded, that casein has a more pronounced effect on the absorbable amount of the antibiotic at each pH value studied, than calcium. In the case of concomitant intake of CPFX film-coated tablet and milk or other dairy products not only the complexation with calcium, but also the adsorption of CPFX on the surface of proteins decreases the absorbable amount of CPFX.

To determine the effect of interaction of five Alive fruit juice on the dissolution and absorption profiles of ciprofloxacin tablets using urinary excretion

Pharmacological interaction is identified among other aspects when the effects of a drug are significantly altered clinically by the presence of food. The most important clinical significance in the history of drug-food interactions occurred in the fifties, the vitamin B6 deficiency when administering the tuberculostatic isoniazide, but there is no doubt that the interaction in the sixties between drugs that were inhibitors of the enzyme mono-amine oxidase and the biogenic amines tyramine and histamine had an important clinical significance due to the increase in hypertension and deaths due to cerebro-vascular accidents. In the seventies the types of interactions were due to the chelation between tetracyclines and the calcium of milk products, influencing the bioavailability of the antibiotic, and from this point on, studies explore in depth the interaction of foods with the different steps in the pharmacokinetics of the drugs (absorption, distribution, metabolization, and excretion), and these have helped to explain the metabolization interactions of drugs like the clinical significance between grapefruit juice whose naringenine flavonoid is a powerful inhibitor of cytochrome 450, particularly the CYP3A4 family, and terfenadine (antihistamine), with an increase in the plasma levels of the drug and patient death due to ventricular arrhythmia. In the USA the Joint Commission on Accreditation of Health Care Organization (JCAHO) has recommended monitoring of the possible drug and food interactions since 1985, and recommends that patients be informed of this. Despite the recommendations of the JCAHO, few American hospitals have protocolized these interactions and even fewer comply with these, and according to some authors, this is due to the lack of motivation caused by the lack of clinical significance. In this chapter we will study the effect of foods on drugs in two aspects: at the pharamcokinetic level with the possible alterations in absorption, distribution, metabolization, and excretion, and at the pharamcodynamic level, by alterations in the action of the drug. Also, based on a study by Delgado, which we have changed somewhat, we will report how the drugs should be taken to avoid interactions with foods. As a conclusion, it is difficult to establish which are the relevant drug-food interactions, unless they have given clinical problems. The following are important: a) drugs with a narrow therapeutic margin in which an absorption problem or a metabolization problem may disrupt the plasma levels and the patient needs (digoxin, teophylline, cyclosporin, etc). And b) the drugs like some antibiotics that, because of their action mechanisms, need to maintain adequate plasma concentrations.

The effect of milk added to coffee or black tea on the bioavailability of tetracycline was evaluated in 12 healthy volunteers according to a crossover design. Results showed that even a small volume of milk containing extremely small amounts of calcium severely impair the absorption of the drug, so that the

presence of this metal ion should be carefully controlled in order to avoid decreasing the available tetracycline.

Food-drug interactions may reduce the bioavailability of drugs taken after meals (negative food effects). We designed enteric-coated tablets that start to disintegrate when they reach the middle-to-lower region of the small intestine, and examined whether they could reduce negative food effects in dogs. Tablets containing trientine as a model drug were coated with hypromellose acetate succinate (HPMCAS) with various values of succinoyl group content. The time lag of drug dissolution from these enteric-coated tablets in simulated intestinal fluid of pH 6.8 increased as the succinoyl group content was decreased. The AUC of trientine after oral administration of its aqueous solution to fed dogs was one-eighth of that in fasted dogs. The low drug absorption in fed dogs was improved when trientine was administered as enteric-coated tablets. The average ratio of AUC in the fed state to that in the fasted state increased with decreasing succinoyl group content of HPMCAS. Negative food effects completely disappeared after oral administration of tablets coated with HPMCAS having a succinoyl group content of 6.2% or less, which probably disintegrated in the middle-to-lower small intestine. Our results indicated that food-drug interactions were avoided by separating the main absorption site of drugs from that of food components.

As part of ongoing studies to evaluate the analgesic efficacy and pharmacokinetic properties of combination oxycodone plus ibuprofen in the treatment of moderate to severe acute pain, 2 pharmacokinetic studies were conducted.

The study was aimed at determining the effect of Coca-Cola on the pharmacokinetics of ibuprofen in rabbits. In a cross-over study, ibuprofen was given orally in a dose of 56 mg/kg, prepared as 0.5% suspension in carboxymethyl cellulose (CMC) and blood samples (1 ml) were drawn at different time intervals from 0-12 hr. After a washout period of 7 days, Coca-Cola in a dose of (5 ml/kg) was administered along with ibuprofen (56 mg/kg) and blood samples were drawn from 0-12 hr. To these rabbits, 5 ml/kg Coca-Cola was administered once daily for another 7 days. On 8th day, Coca-Cola (5 ml/kg) along with ibuprofen (56 mg/kg), prepared as a suspension was administered and blood samples (1 ml each) were drawn at similar time intervals. Plasma was separated and assayed for ibuprofen by HPLC technique and various pharmacokinetic parameters were calculated. The Cmax and AUC0-alpha of ibuprofen were significantly increased after single and multiple doses of Coca-Cola, thereby indicating increased extent of absorption of ibuprofen. The results warrant the reduction of ibuprofen daily dosage, frequency when administered with Coca-Cola.

Diclofenac potassium liquid-filled soft gelatin capsule (DPSGC) is an investigational formulation that uses dispersing agents designed to facilitate rapid and consistent absorption of this NSAID.

The effect of grapefruit juice on in vivo drug metabolism was investigated in rats. The juice (4 ml or 8 ml/kg) was given orally once daily for 2 consecutive days and its effect on theophylline metabolism, pentobarbitone sleeping time and the tremorgenic action of tremorine was studied. The effect of grapefruit juice on some of these parameters was compared with that of the known drug metabolism inhibitor cimetidine given ip. Grapefruit juice at 4 ml and 8 ml/kg produced significant increases in pentobarbitone sleeping time that reached 46 and 79%, respectively, compared with 107% produced by cimetidine (50 mg/kg, ip). The juice at 4 ml/kg also significantly increased plasma theophylline concentration when measured 15, 30, 60 and 90 min after ip theophylline administration (10 mg/kg). Thereafter, no significant differences were detected in plasma drug concentrations between juice- and saline-treated animals. Administration of tremorine (25 mg/kg, ip) to saline-treated controls produced, within 2 or 3 min, tremors, piloerection, profuse salivation, defaecation, urination and chromodacryorrhesis (red tears). The onset of appearance of these signs was delayed to about 7 min in rats pretreated 1 hr earlier with either grapefruit

juice (4 ml/kg, orally) or cimetidine (50 mg/kg, ip). The severity of the above signs was markedly reduced to a similar extent in both the juice- and cimetidine-treated rats. These results suggest that grapefruit juice may act as an inhibitor of drug metabolism in rats, and that its consumption may alter the disposition of certain concomitantly administered drugs.

The effect of grapefruit juice (GFJ) on the pharmacokinetics of a single dose of theophylline was examined in an open crossover study. Healthy male volunteers were given sustained release theophylline (300 mg) along with 300 ml of either water or GFJ. Blood samples (2 ml) were collected at different time points from 0 to 48 h. Plasma was assayed for theophylline by HPLC and various pharmacokinetic parameters were calculated. Theophylline levels were lower at all time points with GFJ coadministration as compared to water but were significantly lower only during the absorption phase from 1 to 4 h. Although the pharmacokinetic parameters were not significantly different between the two groups, all values were reduced except Tmax which was slightly increased. The results indicate that patients may be advised not to consume GFJ when taking slow-release theophylline and monitoring of plasma theophylline levels in patients consuming GFJ might be helpful in better management of patient care.

Rupatadine is an oral active antihistamine for the management of diseases with allergic inflammatory conditions, such as perennial and seasonal rhinitis and chronic idiopathic urticaria. Oral rupatadine has been approved for the treatment of allergic rhinitis and chronic urticaria in adults and adolescents in several European countries.

To investigate the pharmacokinetics of esomeprazole before a high-fat meal and fasting

Many monoamine oxidase inhibitor (MAOI) diets are considered to be excessively restrictive and founded on poor scientific evidence. We present a safe and practical MAOI diet based on the related clinical and analytic data.

Isoniazid inhibits the metabolism of several drugs, resulting in clinically significant interactions in some patients. Clinical trials and case reports have documented that isoniazid can cause increased phenytoin and carbamazepine serum concentrations and toxicity. In relatively high doses, isoniazid can also cause increased effect of theophylline and warfarin. Isoniazid inhibits metabolism of selected benzodiazepines and vitamin D. Inhibition of monoamine oxidase and histaminase by isoniazid can cause significant drug-food interactions. Food greatly decreases isoniazid bioavailability. Although probably best recognized as an inhibitor of drug metabolism, isoniazid has a biphasic effect of inhibition-induction on one cytochrome P450 isozyme, CYP2E1, which partially explains the interaction with acetaminophen and increased risk of hepatotoxicity. Continued investigations will likely result in discovery of new isoniazid interactions.

Reports have shown that oleanolic acid (OA), a triterpenoid, exists widely in food, medicinal herbs and other plants, and that it has antimycobacterial activity against the Mycobacterium tuberculosis strain H37Rv (ATCC 27294). In this study it was found that OA had antimycobacterial properties against eight clinical isolates of M. tuberculosis and that the MICs of OA against drug-sensitive and drug-resistant isolates were 50-100 and 100-200 microg ml(-1), respectively. The combination of OA with isoniazid (INH), rifampicin (RMP) or ethambutol (EMB) showed favourable synergistic antimycobacterial effects against six drug-resistant strains, with fractional inhibitory concentration indices of 0.121-0.347, 0.113-0.168 and 0.093-0.266, respectively. The combination treatments of OA/INH, OA/RMP and OA/EMB displayed either a synergistic interaction or did not show any interaction against two drug-sensitive strains. No antagonism resulting from the OA/INH, OA/RMP or OA/EMB combination was observed for any of the strains tested. OA exhibited a relatively low cytotoxicity in Vero cells. These results indicate that OA may serve as a promising lead compound for future antimycobacterial drug development.

To determine the effect of a high-fat meal, orange juice, and antacids on absorption of a single oral dose of cycloserine and to estimate its population pharmacokinetic parameters.

Glimepiride is a new generation sulphonylurea being prudently characterized in more than 2000 NIDDM patients. It has a short onset of action and a long duration of action. The same pharmacodynamic effect as with traditional sulphonylureas is achieved with secretion of less insulin, suggesting a possible extrapancreatic action. Glimepiride is given once daily in doses from 1-8 mg/day. 100% absolute bioavailability and the absence of a food interaction guarantee highly reproducible pharmacokinetics. Glimepiride is a remarkably safe drug especially in NIDDM patients at high risk e.g. the renally impaired, elderly or physically very active person. Hypoglycemia is less frequent in the first weeks of treatment than with glibenclamide. Ongoing studies are investigating the possible beneficial clinical effect of its different binding behavior to the potassium channel, especially in the heart.

Sodium levothyroxine is one of the most prescribed drugs all over the world. Oral thyroxine treatment is often used lifelong and the search for optimal daily dose may be a challenge for the physician. Patient age and compliance to prescribed regimen are in fact relevant features to achieve therapeutic goal. Also, the absorption of thyroxine is not a linear function of the ingested dose being sensitive to several interferences. Inaccurate administration modality, thyroxine interaction with different drugs, pregnancy, and malabsorption are all possible causes of increased need for thyroxine. Important and simple evidences are now available to improve the accuracy of drug administration and optimize the treatment. In fact, recent evidence pointed out the role of gastric acid secretion on the subsequent intestinal absorption of thyroxine in relation with the timing of food ingestion as well as with pH impairment associated to frequent gastric disorders like Helicobacter pylori infection and gastric atrophy.

Grapefruit juice may slightly delay the absorption of levothyroxine, but it seems to have only a minor effect on its bioavailability. Accordingly, the clinical relevance of the grapefruit juice-levothyroxine interaction is likely to be small.

Food can impact the pharmacokinetics of a drug product through several mechanisms, including but not limited to, enhancement in drug solubility, changes in GI physiology, or direct interaction with the drug. Significant food effects complicate development of new drugs, especially when clinical plans require control and/or monitoring of food intake in relation to dosing. The prediction of whether a drug or drug product will show a human food effect is challenging. *In vitro* models which consider physical–chemical properties can classify the potential for a compound to demonstrate a positive, negative or no food effect, and may be appropriate for screening compounds at early stages of drug discovery. When comparing various formulations, dissolution tests in biorelevant media can serve as a predictor of human drug performance under fasted and fed conditions. Few *in vivo* models exist which predict the magnitude of change in pharmacokinetic parameters in humans when dosing in the presence of food, with the dog appearing to be the most studied species for this purpose. Control of gastric pH, as well as the amount and composition of the fed state in dogs are critical parameters to improving the predictability of the dog overall as a food effect model. No single universal model is applicable for all drugs at all stages of drug development. One or more models may be required depending whether the goal is to assess potential for a food effect, determine the magnitude of change in pharmacokinetic parameters in the fed/fasted state, or whether formulation efforts have the ability to mitigate an observed food effect.

Mercaptopurine is a purine analog used for acute lymphoblatic leukemia and chronic myelogenous leukemias. Since it is inactivated by xanthine oxidase (XO), concurrent intake of substances containing XO may potentially reduce bioavailability of mercaptopurine. Cow's milk is known to contain a high level of XO. In vitro and in vivo data suggest that concurrent intake of cow's milk may reduce the bioavailability of

mercaptopurine. This interaction may be clinically significant. Therefore most patients should try to separate the timing of taking mercaptopurine and drinking milk.

Flaxseed, the richest source of mammalian lignan precursors, enhances the tumor growth-inhibitory effect of tamoxifen while exerting no adverse effects on other estrogen-responsive tissues such as bone. Ingestion of sesame seed produces mammalian lignans comparable with flaxseed, but its anticancer potential is unknown. This study determined the interactive effects of sesame seed and tamoxifen on established MCF-7 tumor growth and bone health in ovariectomized athymic mice simulating a postmenopausal condition.

Scientists employing methods of genetic engineering have developed a new group of living organisms, termed 'modified organisms', which found application in, among others, medicine, the pharmaceutical industry and food distribution. The introduction of transgenic products to the food market resulted in them becoming a controversial topic, with their proponents and contestants. The presented study aims to systematize objective data on the potential benefits and risks resulting from the consumption of transgenic food. Genetic modifications of plants and animals are justified by the potential for improvement of the food situation worldwide, an increase in yield crops, an increase in the nutritional value of food, and the development of pharmaceutical preparations of proven clinical significance. In the opinions of critics, however, transgenic food may unfavourably affect the health of consumers. Therefore, particular attention was devoted to the short- and long-lasting undesirable effects, such as alimentary allergies, synthesis of toxic agents or resistance to antibiotics. Examples arguing for the justified character of genetic modifications and cases proving that their use can be dangerous are innumerable. In view of the presented facts, however, complex studies are indispensable which, in a reliable way, evaluate effects linked to the consumption of food produced with the application of genetic engineering techniques. Whether one backs up or negates transgenic products, the choice between traditional and non-conventional food remains to be decided exclusively by the consumers.

The newborn digestive tract is rapidly colonized right after birth. The type of feeding could significantly influence this colonization process. Infant formulas like inulin try to mimic the bifidogenic effects of human milk by addition of prebiotics. Moreover, studies in the recent past have evidenced important effects of inulin during early infant life. The present review article will highlight recent updates about the use of inulin in the pediatric clinical setting.

Taking responsibility for your life, among other factors, means also considering what to eat and which nutrition pattern to follow. Everyone needs to think about what they put on the plate and which ingredients should be avoided. Food, as such, will never be a drug or medication, like a painkilling tablet relieving pain in a short amount of time, for example. However, proper nutrition is our ally in the prevention of diseases, maintaining balance in our body and our mind. By following the main principles of a healthy diet, the physiological homeostasis can be managed, as well as faster recovery from disease achieved. This review is aimed at summarizing basic principles of nutrition recommendations and at empowering stakeholders (pharmacists, medical biochemists, physicians) to be able to communicate to their patients and customers healthy and sustainable nutrition choices through the personalized advice.

Many of the scientific and regulatory challenges that exist in research on the safety, quality and efficacy of dietary supplements are common to all countries as the marketplace for them becomes increasingly global. This article summarizes some of the challenges in supplement science and provides a case study of research at the Office of Dietary Supplements at the National Institutes of Health, USA, along with some resources it has developed that are available to all scientists. It includes examples of some of the regulatory challenges faced and some resources for those who wish to learn more about them.

General views on three aspects were discussed. The first aspect is regulatory categories, which can range from "soft to hard", an expression using the English and Japanese translation of the French term, "drogue douce" (soft drug). This categorization starts with "so-called health foods" and extends to Foods with Health Claims [Foods with Nutrient Functional Claims (FNFC); Foods with Functional Claims (FFC); Foods for Specified Health Uses (FOSHU)], OTC drugs, and ethical drugs. "The Basic Policy for New Drug Approval" (1967) made a distinction between OTC and prescription drugs. FOSHU (1991) originally included foods for "patients", such as low allergen rice with preventive "health claims". Foods for Medical Uses (FMU) later became an independent subcategory under Foods for Special Dietary Uses. On the other hand, manufacturers of FFC can make various "health claims" on the basis of randomized controlled trial or systematic review (2015). Products in the intermediate zone between food and drug have an annual market of over 2 trillion yen (US$ 20 billion). The second aspect is the five elements, i.e., quality, safety, efficacy, information, and cost, which are derived from WHO's "The rational use of drugs" (1985). The adoption of Sustainable Development Goals (SDGs) by the UN General Assembly (2015) led to the addition of "ecology" as the sixth element, which is applicable for herbal and animal raw materials. The third aspect is quality control and quality assurance. This initially began with manufactured products and was expanded to the service fields handled by various health workers including pharmacists.

The use of food supplements or functional food has significantly increased in the past decades, especially to compensate both the modern lifestyle and the food shortages of the industrialized countries. Despite food supplements are habitually intended to correct nutritional deficiencies or to support specific physiological functions, they are often combined with common drug therapies to improve the patient's health and/or mitigate the symptoms of many chronic diseases such as cardiovascular diseases, cystic fibrosis, cancer, liver and gastrointestinal diseases. In recent years, increased attentions are given to the patient's diet, and the use of food supplements and functional food rich in vitamins and antioxidants plays a very important role in the treatment and prevention of neurodegenerative diseases such as Parkinson's disease (PD). Natural compounds, phytochemicals, vitamins, and minerals can prevent, delay, or alleviate the clinical symptoms of PD in contrast to some of the main physiopathological mechanisms involved in the development of the disease, like oxidative stress, free radical formation, and neuroinflammation. The purpose of this review is to collect scientific evidences which support the use of specific biomolecules and biogenic elements commonly found in food supplements or functional food to improve the clinical framework of patients with PD.

Hemp (*Cannabis sativa* L.) is a herbaceous anemophilous plant that belongs to the Cannabinaceae family. The cannabis seed (hemp) has long been utilized as a food source and is commercially important as an edible oil source. In this review, the positive and negative health effects of cannabis, the relationship between cannabis and various diseases, and the use of cannabis in various food products have been discussed. In addition, the scientific literature on the potential use of cannabis and its derivatives as a dietary supplement for the prevention and treatment of inflammatory and chronic degenerative diseases in animals and humans has been reviewed. Cannabis is being developed as a key ingredient in a variety of food items, including bakery, confectionery, beverages, dairy, fruits, vegetables, and meat. Hemp seeds are high in readily digestible proteins, lipids, polyunsaturated fatty acids (PUFA), insoluble fiber, carbs, and favorable omega-6 PUFA acid to omega-3 PUFA ratio and have high nutritional value. The antioxidants of cannabis, such as polyphenols, help with anxiety, oxidative stress, and the risk of chronic illnesses, including cancer, neurological disorders, digestive problems, and skin diseases. Cannabis has been shown to have negative health impacts on the respiratory system, driving, and psychomotor functions, and the reproductive system. Overall, the purpose of this research is to stimulate more in-depth research on cannabis's adaptation in various foods and for the treatment of chronic illnesses.

Anti-microbial drugs are widely employed for the treatment and cure of diseases in animals, promotion of animal growth, and feed efficiency. However, the scientific literature has indicated the possible presence

of antimicrobial drug residues in animal-derived food, making it one of the key public concerns for food safety. Therefore, it is highly desirable to design fast and accurate methodologies to monitor antimicrobial drug residues in animal-derived food. Legislation is in place in many countries to ensure antimicrobial drug residue quantities are less than the maximum residue limits (MRL) defined on the basis of food safety. In this context, the recent years have witnessed a special interest in the field of electrochemical biosensors for food safety, based on their unique analytical features. This review article is focused on the recent progress in the domain of electrochemical biosensors to monitor antimicrobial drug residues in animal-derived food.

In December 2016, a panel of experts in microbiology, nutrition and clinical research was convened by the International Scientific Association for Probiotics and Prebiotics to review the definition and scope of prebiotics. Consistent with the original embodiment of prebiotics, but aware of the latest scientific and clinical developments, the panel updated the definition of a prebiotic: a substrate that is selectively utilized by host microorganisms conferring a health benefit. This definition expands the concept of prebiotics to possibly include non-carbohydrate substances, applications to body sites other than the gastrointestinal tract, and diverse categories other than food. The requirement for selective microbiota-mediated mechanisms was retained. Beneficial health effects must be documented for a substance to be considered a prebiotic. The consensus definition applies also to prebiotics for use by animals, in which microbiota-focused strategies to maintain health and prevent disease is as relevant as for humans. Ultimately, the goal of this Consensus Statement is to engender appropriate use of the term 'prebiotic' by relevant stakeholders so that consistency and clarity can be achieved in research reports, product marketing and regulatory oversight of the category. To this end, we have reviewed several aspects of prebiotic science including its development, health benefits and legislation.

Industrial hemp (*Cannabis sativa* L., Cannabaceae) is an ancient cultivated plant originating from Central Asia and historically has been a multi-use crop valued for its fiber, food, and medicinal uses. Various oriental and Asian cultures kept records of its production and numerous uses. Due to the similarities between industrial hemp (fiber and grain) and the narcotic/medical type of Cannabis, the production of industrial hemp was prohibited in most countries, wiping out centuries of learning and genetic resources. In the past two decades, most countries have legalized industrial hemp production, prompting a significant amount of research on the health benefits of hemp and hemp products. Current research is yet to verify the various health claims of the numerous commercially available hemp products. Hence, this review aims to compile recent advances in the science of industrial hemp, with respect to its use as value-added functional food ingredients/nutraceuticals and health benefits, while also highlighting gaps in our current knowledge and avenues of future research on this high-value multi-use plant for the global food chain.

Nowadays, much attention is paid to issues such as ecology and sustainability. Many consumers choose "green cosmetics", which are environmentally friendly creams, makeup, and beauty products, hoping that they are not harmful to health and reduce pollution. Moreover, the repeated mini-lock downs during the COVID-19 pandemic have fueled the awareness that body beauty is linked to well-being, both external and internal. As a result, consumer preferences for makeup have declined, while those for skincare products have increased. Nutricosmetics, which combines the benefits derived from food supplementation with the advantages of cosmetic treatments to improve the beauty of our body, respond to the new market demands. Food chemistry and cosmetic chemistry come together to promote both inside and outside well-being. A nutricosmetic optimizes the intake of nutritional microelements to meet the needs of the skin and skin appendages, improving their conditions and delaying aging, thus helping to protect the skin from the aging action of environmental factors. Numerous studies in the literature show a significant correlation between the adequate intake of these supplements, improved skin quality (both aesthetic and histological), and the acceleration of wound-healing. This review revised the main foods and bioactive molecules used in nutricosmetic formulations, their cosmetic effects, and the analytical techniques that allow the dosage of the active ingredients in the food.

Understanding how dietary nutrients modulate the gut microbiome is of great interest for the development of food products and eating patterns for combatting the global burden of non-communicable diseases. In this narrative review we assess scientific studies published from 2005 to 2019 that evaluated the effect of micro- and macro-nutrients on the composition of the gut microbiome using in vitro and in vivo models, and human clinical trials. The clinical evidence for micronutrients is less clear and generally lacking. However, preclinical evidence suggests that red wine- and tea-derived polyphenols and vitamin D can modulate potentially beneficial bacteria. Current research shows consistent clinical evidence that dietary fibers, including arabinoxylans, galactooligosaccharides, inulin, and oligofructose, promote a range of beneficial bacteria and suppress potentially detrimental species. The preclinical evidence suggests that both the quantity and type of fat modulate both beneficial and potentially detrimental microbes, as well as the Firmicutes/Bacteroides ratio in the gut. Clinical and preclinical studies suggest that the type and amount of proteins in the diet has substantial and differential effects on the gut microbiota. Further clinical investigation of the effect of micronutrients and macronutrients on the microbiome and metabolome is warranted, along with understanding how this influences host health.

Results suggest consumer's perceptions of "healthy," which is primarily based on fat content, partially aligns with the FDA definition but also suggest consumers perceive the word as a broader and more nuanced concept that defies easy, uniform definition. Results highlight areas where nutrition education may be needed and suggest disclosures may need to accompany health claims so that consumers know what, precisely, is being communicated.

Hempseeds, the edible fruits of the *Cannabis sativa* L. plant, were initially considered a by-product of the hemp technical fibre industry. Nowadays, following the restorationing of the cultivation of *C. sativa* L. plants containing an amount of delta-9-tetrahydrocannabinol (THC) <0.3% or 0.2% (industrial hemp) there is a growing interest for the hempseeds production due to their high nutritional value and functional features. The goal of this review is to examine the scientific literature concerning the nutritional and functional properties of hempseeds. Furthermore, we revised the scientific literature regarding the potential use of hempseeds and their derivatives as a dietary supplement for the prevention and treatment of inflammatory and chronic-degenerative diseases on animal models and humans too. In the first part of the work, we provide information regarding the genetic, biochemical, and legislative aspects of this plant that are, in our opinion essential to understand the difference between "industrial" and "drug-type" hemp. In the final part of the review, the employment of hempseeds by the food industry as livestock feed supplement and as ingredient to enrich or fortify daily foods has also revised. Overall, this review intends to encourage further and comprehensive investigations about the adoption of hempseeds in the functional foods field.

Dr Stephen DeFelice coined the term "Nutraceutical" from "Nutrition" and "Pharmaceutical" in 1989. The term nutraceutical is being commonly used in marketing but has no regulatory definition. An attempt to redefine nutraceuticals and functional foods is made in this article. The proposed definitions can help distinguish between functional foods, nutraceuticals, and dietary supplements. The advantages and disadvantages of nutraceuticals are also briefly discussed.

Current dietary guidelines for breast cancer patients (BCPs) fail to address adequate dietary intakes of macro- and micronutrients that may improve patients' nutritional status. This review includes information from the PubMed and Biomed Central databases over the last 15 y concerning dietary guidelines for BCPs and the potential impact of a personalized, nutrient-specific diet on patients' nutritional status during and after antineoplastic treatment. Results indicated that BCPs should receive a nutritional assessment immediately after diagnosis. In addition, they should be encouraged to pursue and maintain a healthy body weight [body mass index (BMI; in kg/m^2) 20-24.9], preserving their lean mass and avoiding an increase in fat mass. Therefore, after nutritional status diagnosis, a conservative energy restriction of 500-1000 kcal/d could be considered in the dietary intervention when appropriate. Based on the reviewed information, we

propose a personalized nutrition intervention for BCPs during and after antineoplastic treatment. Specifications in the nutritional therapy should be based on the patients' nutritional status, dietary habits, schedule, activities, and cultural preferences. BCPs' daily energy intake should be distributed as follows: <30% fat/d (mainly monounsaturated and polyunsaturated fatty acids), ∼55% carbohydrates (primarily whole foods such as oats, brown rice, and fruits), and 1.2-1.5 g protein · kg^{-1} · d^{-1} to avoid sarcopenic obesity. Findings suggest that 5-9 servings/d of fruits (∼150 g/serving) and vegetables (∼75 g/serving) should be encouraged. Garlic and cruciferous vegetables must also be part of the nutrition therapy. Adequate dietary intakes of food-based macro- and micronutrients rich in β-carotene and vitamins A, E, and C can both prevent deterioration in BCPs' nutritional status and improve their overall health and prognosis.

Public unrest about the use of antimicrobial agents in farming practice is the leading cause of increasing and the emergences of Multi-drug Resistant Bacteria that have placed pressure on the agri-food industry to act. The usage of antimicrobials in food and agriculture have direct or indirect effects on the development of Antimicrobial resistance (AMR) by bacteria associated with animals and plants which may enter the food chain through consumption of meat, fish, vegetables or some other food sources. In addition to antimicrobials, recent reports have shown that AMR is associated with tolerance to heavy metals existing naturally or used in agri-food production. Besides, biocides including disinfectants, antiseptics and preservatives which are widely used in farms and slaughter houses may also contribute in the development of AMR. Though the direct transmission of AMR from food-animals and related environment to human is still vague and debatable, the risk should not be neglected. Therefore, combined global efforts are necessary for the proper use of antimicrobials, heavy metals and biocides in agri-food production to control the development of AMR. These collective measures will preserve the effectiveness of existing antimicrobials for future generations.

Milk and dairy products containing milk fat are major food sources of saturated fatty acids, which have been linked to increased risk of cardiovascular-related clinical outcomes such as cardiovascular disease (CVD), coronary heart disease (CHD), and stroke. Therefore, current recommendations by health authorities advise consumption of low-fat or fat-free milk. Today, these recommendations are seriously questioned by meta-analyses of both prospective cohort studies and randomized controlled trials (RCTs) reporting inconsistent results. The present study includes an overview of systematic reviews and meta-analyses of follow-up studies, an overview of meta-analyses involving RCTs, and an update on meta-analyses of RCTs (2013-2018) aiming to synthesize the evidence regarding the influence of dairy product consumption on the risk of major cardiovascular-related outcomes and how various doses of different dairy products affect the responses, as well as on selected biomarkers of cardiovascular disease risk, i.e., blood pressure and blood lipids. The search strategies for both designs were conducted in the MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Web of Science databases from their inception to April 2018. From the 31 full-text articles retrieved for cohort studies, 17 met the eligibility criteria. The pooled risk ratio estimated for the association between the consumption of different dairy products at different dose-responses and cardiovascular outcomes (CVD, CHD, and stroke) showed a statistically significant negative association with RR values <1, or did not find evidence of significant association. The overview of 12 meta-analyses involving RCTs as well as the updated meta-analyses of RCTs did not result in significant changes on risk biomarkers such as systolic and diastolic blood pressure and total cholesterol and LDL cholesterol. Therefore, the present study states that the consumption of total dairy products, with either regular or low fat content, does not adversely affect the risk of CVD.

Food-drug interactions (FDIs) arise when nutritional dietary consumption regulates biochemical mechanisms involved in drug metabolism. This study proposes FDMine, a novel systematic framework that models the FDI problem as a homogenous graph. Our dataset consists of 788 unique approved small

molecule drugs with metabolism-related drug-drug interactions and 320 unique food items, composed of 563 unique compounds. The potential number of interactions is 87,192 and 92,143 for disjoint and joint versions of the graph. We defined several similarity subnetworks comprising food-drug similarity, drug-drug similarity, and food-food similarity networks. A unique part of the graph involves encoding the food composition as a set of nodes and calculating a content contribution score. To predict new FDIs, we considered several link prediction algorithms and various performance metrics, including the precision@top (top 1%, 2%, and 5%) of the newly predicted links. The shortest path-based method has achieved a precision of 84%, 60% and 40% for the top 1%, 2% and 5% of FDIs identified, respectively. We validated the top FDIs predicted using FDMine to demonstrate its applicability, and we relate therapeutic anti-inflammatory effects of food items informed by FDIs. FDMine is publicly available to support clinicians and researchers.

Metabolic diseases are serious threats to public health and related to gut microbiota. Probiotics, prebiotics, synbiotics, and postbiotics (PPSP) are powerful regulators of gut microbiota, thus possessing prospects for preventing metabolic diseases. Therefore, the effects and mechanisms of PPSP on metabolic diseases targeting gut microbiota are worth discussing and clarifying. Generally, PPSP benefit metabolic diseases management, especially obesity and type 2 diabetes mellitus. The underlying gut microbial-related mechanisms are mainly the modulation of gut microbiota composition, regulation of gut microbial metabolites, and improvement of intestinal barrier function. Moreover, clinical trials showed the benefits of PPSP on patients with metabolic diseases, while the clinical strategies for gestational diabetes mellitus, optimal formula of synbiotics and health benefits of postbiotics need further study. This review fully summarizes the relationship between probiotics, prebiotics, synbiotics, postbiotics, and metabolic diseases, presents promising results and the one in dispute, and especially attention is paid to illustrates potential mechanisms and clinical effects, which could contribute to the next research and development of PPSP.

There is no evidence that Hippocrates, although being credited for it, ever literally stated 'let thy food be thy medicine and thy medicine be thy food'. However, yet in line with Hippocrates' philosophy, we are currently witnessing a reappraisal of the complementarity of nutrition and pharmacology. Recent studies not only underline the therapeutic potential of lifestyle interventions, but are also generating valuable insights in the complex and dynamic transition from health to disease. Next to this, nutritional biology can significantly contribute to the discovery of new molecular targets. It is clear that most of the current top-selling drugs used in chronic cardio-metabolic diseases modulate relatively late-stage complications, which generally indicate already longer existing homeostatic imbalances. Pharmacologists are increasingly aware that typical multifactorial disorders require subtle, multiple target pharmacological approaches, instead of the still often dominating 'one disease - one target - one drug' paradigm. This review discusses the recent developments in the pharma-nutrition interface and shows some relevant mechanisms, including receptors and other targets, and examples from clinical practice. The latter includes inflammatory diseases and progressive loss of muscle function. The examples also illustrate the potential of targeted combinations of medicines with nutrition and (or) other life-style interventions, to increase treatment efficacy and (or) reduce adverse effects. More attention to a potentially negative outcome of drug-food combinations is also required, as shown by the example of food-drug interactions. Together, the developments at the food-pharma interface underline the demand for intensified collaboration between the disciplines, in the clinic and in science.

Bio-based industries rely extensively on the use of enzymatic biocatalysts. The global market for industrial enzymes, of which approximately half is used for food applications, is estimated at $5.5 billion. Most enzymes used in food production worldwide are produced by recombinant DNA techniques. Production and use of food enzymes are regulated by three main bodies: the Joint Food and Agriculture Organization of the United Nations/World Health Organization Expert Committee on Food Additives; the European Food Safety Authority; and the U.S. Food and Drug Administration. Regulation in the U.S. follows a largely

product-oriented approach while the EU emphasizes production processes. Both systems have, or are developing, lists of approved enzymes to facilitate trade while protecting consumer health and welfare. This paper compares regulatory policies, and presents the growing food industry in Turkey as a case study of a national system responding to the food enzyme production and regulatory landscape.

Three-dimensional food printing (3DFP) uses additive manufacturing concepts to fabricate customized designed products with food ingredients in powder, liquid, dough, or paste presentations. In some cases, it uses additives, such as hydrocolloids, starch, enzymes, and antibrowning agents. Chocolate, cheese, sugar, and starch-based materials are among the most used ingredients for 3DFP, and there is a broad and growing interest in meat-, fruit-, vegetable-, insect-, and seaweed-based alternative raw materials. Here, we reviewed the most recent published information related to 3DFP for novel uses, including personalized nutrition and health-oriented applications, such as the use of 3D-printed food as a drug vehicle, and four-dimensional food printing (4DFP). We also reviewed the use of this technology in aesthetic food improvement, which is the most popular use of 3DFP recently. Finally, we provided a prospective and perspective view of this technology. We also reflected on its multidisciplinary character and identified aspects in which social and regulatory affairs must be addressed to fulfill the promises of 3DFP in human health improvement.

the training intervention has significantly improved the knowledge of the food handlers. We recommend that the National Food and Drug Agency, in collaboration with restaurant owners, ensure regular on-the-job training of food handlers.

Increased health risk associated with the sedentary life style is forcing the food manufacturers to look for food products with specific or general health benefits e.g. beverages enriched with nutraceuticals like catechin, curcumin rutin. Compounds like polyphenols, flavonoids, vitamins are the good choice of bioactive compounds that can be used to fortify the food products to enhance their functionality. However due to low stability and bioavailability of these bioactives (both hydrophobic and hydrophilic) within the heterogeneous food microstructure and in the Gastro Intestinal Tract (GIT), it becomes extremely difficult to pass on the real health benefits to the consumers. Recent developments in the application of nano-delivery systems for food product development is proving to be a game changer which has raised the expectations of the researchers, food manufacturers and consumers regarding possibility of enhancing the functionality of bioactives within the fortified food products. In this direction, nano/micro delivery systems using lipids, surfactants and other materials (carbohydrates, polymers, complexes, protein) have been fabricated to stabilize and enhance the biological activity of the bioactive compounds. In the present review, current status of the various delivery systems that are used for the delivery of hydrophilic bioactives and future prospects for using other delivery systems that have been not completely explored for the delivery of hydrophilic bioactives e.g. niosomes; bilosomes, cubosomes are discussed.

Recombinant *Epinephelus lanceolatus* piscidin (RELP) was previously shown to improve growth performance and immune response when used as a feed additive for *Gallus gallus domesticus*. However, the long-term toxicity of RELP has not be thoroughly investigated. In the present study, we evaluated the subacute and subchronic oral toxicities of RELP in SD rats by hematological, biochemical, and histopathological analyses. To determine subacute and subchronic toxicities, male and female rats were fed with RELP 1000 mg/kg bodyweight/day for 28 and 90 days, respectively. Bodyweight and food intake were unchanged by RELP treatment over the course of the studies. After exposure, samples of blood, heart, lung, liver, and kidney were collected and analyzed. Results demonstrated that RELP exposure did not cause any observable hematological, biochemical, or histological abnormalities in SD rats. Thus, RELP may be a safe feed additive for use in agriculture and aquaculture.

Food allergies are increasing at an alarming rate, with 6.5% of the general population affected. It has been hypothesized that the increase in allergies stems from the "hygiene hypothesis". The gut microbiome, a

collection of microbiota and their genetic contents from the gastrointestinal tract, has been shown to play a part in the development of food allergies. The Food and Drug Administration requires all regulated food companies to clearly state an inclusion of the major, or "big eight" food allergens on packaging. This review is to provide information on the significant advancements related to the gut microbiome and each of the eight major food allergies individually. Establishment of causal connection between the microbiome and food allergies has uncovered novel mechanisms. New strategies are discussed to prevent future sensitization and reaction through novel treatments involving functional additives and dietary changes that target the microbiome.

Oral bioavailability is the key to the bioefficiency of food bioactive ingredients; it evaluates the relationship between foods and their health benefits. The analysis of the main factors limiting the oral bioavailability (bioaccessibility, absorption, and transformation) has led to the proposal of classification systems for pharmaceuticals and nutraceuticals (Biopharmaceuticals Classification System and Nutraceutical Bioavailability Classification Scheme). Based on the relevant studies published in the last decade, this review presents the essential aspects regarding the factors limiting the oral bioavailability of the biocomponents and different in vitro methods used to investigate the mechanisms involved in the digestion, absorption, and metabolism of biocomponents, particularly encapsulated bioactive compounds. Oral bioavailability investigated by in vitro studies provides the food and drug manufacturers with information to formulate delivery systems more efficiently and to determine the dosage of biocomponents for increase the health benefits and avoid or reduce the risk of toxicity.

The excessive consumption of sugar, salt, and fat is associated with an increased risk of non-communicable diseases. Therefore, a study on estimating the added sugar, salt, and fat intake in certain populations is important for establishing specific recommendations aiming at improving diet quality, and thus public health. This study aimed to determine the food consumption pattern and the intakes of added sugar, salt, and fat from different food groups and food sources among the residents of South Jakarta, Indonesia. The study was conducted with a cross-sectional design, involving 323 respondents. Data on socio-economic conditions, health and nutritional status, and food consumption were collected. Food consumption data were acquired through the 2-day weighed food record. Results showed that the daily food consumption in the observed population reached 1868-2334 g/capita/day. The total added sugar intake in different groups of respondents ranged between 34.9 and 45.9 g/capita/day, with the highest values observed in school-age boys. Beverages and snacks were identified as the main added sugar sources in the respondents' diet. The total salt intake ranged from 5.46 to 7.43 g/capita/day, while the observed fat intake reached 49.0-65.1 g/capita/day. The major food source contributing to the salt and fat intake included street/restaurant/fast food. Male subjects tended to consume a higher amount of salt and fat than female subjects. These findings can be used as baseline information for providing a strategy for reducing sugar, salt, and fat intakes, with strong implications for improving public health.

Chronic diseases such as atherosclerosis and cancer are now the leading causes of morbidity and mortality worldwide. Inflammatory processes and oxidative stress underlie the pathogenesis of these pathological conditions. Bioactive peptides derived from food proteins have been evaluated for various beneficial effects, including anti-inflammatory and antioxidant properties. In this review, we summarize the roles of various food-derived bioactive peptides in inflammation and oxidative stress and discuss the potential benefits and limitations of using these compounds against the burden of chronic diseases.

The encapsulation process has been utilized in the field of food technology to enhance the technofunctional properties of food products and the delivery of nutraceutical ingredients via food into the human body. The latter application is very similar to drug delivery systems. The inherent sophisticated nature of release mechanisms requires the utilization of mathematical equations and statistics to predict the release behavior during the time. The science of mathematical modeling of controlled release has gained a tremendous

advancement in drug delivery in recent years. Many of these modeling methods could be transferred to food. In order to develop and design enhanced food controlled/targeted bioactive release systems, understanding of the underlying physiological and chemical processes, mechanisms, and principles of release and applying the knowledge gained in the pharmaceutical field to food products is a big challenge. Ideally, by using an appropriate mathematical model, the formulation parameters could be predicted to achieve a specific release behavior. So, designing new products could be optimized. Many papers are dealing with encapsulation approaches and evaluation of the impact of process and the utilized system on release characteristics of encapsulated food bioactives, but still, there is no deep insight into the mathematical release modeling of encapsulated food materials. In this study, information gained from the pharmaceutical field is collected and discussed to investigate the probable application in the food industry.

In the growing market of health food, certain disturbances occur, such as uneven quality of products, imitation of health food, prohibited drug content in health food, functional efficacy, and actual disagreement. The safety of health food has attracted wide attention from all walks of life. In this study, we constructed a three-party game model of health food safety risk evolution, which includes health food enterprises, health food consumers, and government regulators, based on prospect theory and evolutionary game method. We also consider the attributes of "trust products" of health food, the ability to identify the safety information of health food, the subjective perception of the efficacy of health food, and the certification effect of the regulatory information of the government supervision department. The influence mechanism of these factors, including the cost of searching for health food information, consumers' subjective perception of health food efficiency, and the certification effect of supervision departments, on health food safety risk evolution is described using theoretical deduction and simulation analysis. On this basis, the corresponding conclusions are established, which provide a theoretical basis for further exploration of the strategy of health food market governance.

Food-grade phosphates are used in the production of foods to function as buffers, sequestrants, acidulants, bases, flavors, cryoprotectants, gel accelerants, dispersants, nutrients, precipitants, and as free-flow (anticaking) or ion-exchange agents. The actions of phosphates affect the chemical leavening of cakes, cookies, pancakes, muffins, and doughnuts; the even melt of processed cheese; the structure of a frankfurter; the bind and hydration of delicatessen meats; the fluidity of evaporated milk; the distinctive flavor of cola beverages; the free flow of spice blends; the mineral content of isotonic beverages; and the light color of par-fried potato strips. In the United States, food-grade phosphates are generally recognized as safe, but use levels have been defined for some foods by the Code of Federal Regulations, specifically Titles 9 and 21 for foods regulated by the U.S. Department of Agriculture (USDA) and the U.S. Food and Drug Administration (FDA), respectively. Standards for food purity are defined nationally and internationally in sources such as the Food Chemicals Codex and the Joint Food and Agriculture Organization and World Health Organization (FAO/WHO) Expert Committee on Food Additives.

Ongoing efforts to develop microbiota-directed foods (MDF) provide potentially new ways for improving health status. A MDF could alter the structural and functional configuration of a consumer’s gut microbial community, provide substrates for microbial transformation to biomolecules necessary for a healthy state, or act through a combination of these mechanisms. The development of MDFs promises to expand our view of ‘essential nutrients’ and prompt questions about how they should be classified and regulated.

EU legislation established the factors that should be applied for the setting of maximum levels of vitamins and minerals in food supplements and other foods enriched with these nutrients, considering the different sensitivity of the population groups, in order to minimize the risks of an excessive intake. A decade and a half later, these maximum levels have not yet been set. Because of this delay, in many European countries maximum daily amounts have been established for food supplements, with great differences from one country to another. In France, these maximum levels have just been updated taking into account the age,

the physiological situation and the state of health of the population groups: children of 1-3 years, children of 3-10 years, adolescents of 11-17 years, adults, women with probability of pregnancy, pregnant women, lactating women, menopause, old people, smokers, patients receiving anticoagulant treatment, renal patients, etc.

The established use of wheat bran (WB) as a food ingredient is related to the nutritional components locked in its dietary fibre. Concurrently, the technological impairment it poses has impeded its use in product formulations. For over two decades, several modifications have been investigated to combat this problem. Ninety-three (93) studies (review and original research) published in English between January 1997 and April 2021 reporting WB modifications for improved nutritional, structural, and functional properties and prospective utilisation in food formulations were included in this paper. The modification methods include mechanical (milling), bioprocessing (enzymatic hydrolysis and fermentation with yeasts and bacteria), and thermal (dry heat, extrusion, autoclaving), treatments. This review condenses the current knowledge on the single and combined impact of various WB pre-treatments on its antioxidant profile, fibre solubilisation, hydration properties, microstructure, chemical properties, and technological properties. The use of modified WB in gluten-free, baked, and other food products was reviewed and possible gaps for future research are proposed. The application of modified WB will have broader application prospects in food formulations.

To the best of our knowledge, this is the first analysis of the chemical diversity and complexity of FooDB. This study represents a step further to the emerging field of "Food Informatics". Future study should compare directly the chemical structures of the molecules in FooDB with other compound databases, for instance, drug-like databases and natural products collections. An additional future direction of this work is to use the list of 3,228 polyphenolic compounds identified in this work to enhance the on-going polyphenol-protein interactome studies.

Food, Drug, & Cosmetic (FD&C) dyes are synthetic color additives used in food, prescription drugs and over-the-counter medicines (OTCs). Consumption of FD&C dyes has been associated with neurobehavioral behavior in some children. The amount of dye used in commercial products is proprietary, making it difficult to assess dietary intake and determine exposure in children. To date, no studies have examined FD&C dyes in OTCs or vitamins in the United States. To address this, FD&C Red No. 40, Yellow No. 5, Yellow No. 6, Blue No. 1, and Blue No. 2 levels were measured in prenatal vitamin tablets, children's chewable and gummy vitamins, pain reliever tablets and syrups, and cough/cold/allergy tablets and syrups. Dyes were isolated using solid phase extraction (SPE) and quantified by high performance liquid chromatography (HPLC). Dye levels varied between products with highest levels in pain reliever and cough/cold/allergy syrups. Significant variability was observed within some brands. Degradation of Red No. 40, Blue No. 1, and Yellow No. 6 was observed in the vitamin gummies. Intake of FD&C Red No. 40 is two times the US FDA ADI (accepted daily intake) for some children's pain reliever syrups and almost three times the US FDA ADI for some cough/cold/allergy syrups.

As part of its effort to assure a safe food supply, the Food and Drug Administration maintains a passive surveillance system for the reporting and followup of complaints related to food items. This surveillance system, called the Complaint Reporting System, records and investigates consumer complaints about the quality of a specific food item, its packaging, or unexpected effects following consumption of the food. This study, relying on data gathered from the 2,726 reports of discovery of a foreign object in a food item during fiscal year 1989, develops a profile of consumer complaints, focusing on those associated with resultant injury or illness. Fourteen percent of all reported cases of foreign object exposure cited resultant illness or injury. The most common foreign object reported in food is glass, and the most common injury is a laceration or abrasion of soft tissues of the perioral area, including the throat. There was a disproportionate representation of children younger than age 3 years with documented illness or injury. Only 3 percent of the complaints came from attending health professionals; 82 percent were self-reported.

Practitioner awareness of the system is limited primarily because literature in this area is scant. The collection and investigation of reports of foreign objects in food are important because such reports provide early warnings of potential problems with manufacturers' food items. Although data suggest that severe injury from foreign object ingestion is rare, continued monitoring is warranted. Health professionals are encouraged to report such injuries through the existing system.

Liposomes play a significant role in encapsulation of various bioactive compounds (BACs), including functional food ingredients to improve the stability of core. This technology can be used for promoting an effective application in functional food and nutraceuticals. Incorporation of traditional and emerging methods for the developments of liposome for loading BACs resulted in viable and stable liposome formulations for industrial applications. Thus, the advance technologies such as supercritical fluidic methods, microfluidization, ultrasonication with traditional methods are revisited. Liposomes loaded with plant and animal BACs have been introduced for functional food and nutraceutical applications. In general, application of liposome systems improves stability, delivery, and bioavailability of BACs in functional food systems and nutraceuticals. This review covers the current techniques and methodologies developed and practiced in liposomal preparation and application in functional foods.

The priority-based assessment of food additives (PAFA) is a database maintained by the U.S. Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition. PAFA contains extensive administrative, chemical, and toxicological information on 1685 regulated direct food additives. The database also has limited administrative and chemical information on an additional 1236 direct additives. The total 2921 substances represent everything added to food in the United States. PAFA contains up to 150 different kinds of information about each chemical. Administrative and chemical information includes Chemical Abstracts Service Registry numbers, Code of Federal Regulations citations, the annual usage and estimated daily U.S. human consumption, the Joint Committee on Food Additives Allowable Daily Intakes, the FDA Redbook structure categories of the chemicals, and their technical effects. Toxicology information shows the type of studies done for each chemical, the species of animals tested, the toxicological effects observed and the sites where they were seen, the lowest doses that cause a toxicological effect in each study, a source citation, and other types of related information.

The food sector includes several large industries such as canned food, pasta, flour, frozen products, and beverages. Those industries transform agricultural raw materials into added-value products. The fruit and vegetable industry is the largest and fastest-growing segment of the world agricultural production market, which commercialize various products such as juices, jams, and dehydrated products, followed by the cereal industry products such as chocolate, beer, and vegetable oils are produced. Similarly, the root and tuber industry produces flours and starches essential for the daily diet due to their high carbohydrate content. However, the processing of these foods generates a large amount of waste several times improperly disposed of in landfills. Due to the increase in the world's population, the indiscriminate use of natural resources generates waste and food supply limitations due to the scarcity of resources, increasing hunger worldwide. The circular economy offers various tools for raising awareness for the recovery of waste, one of the best alternatives to mitigate the excessive consumption of raw materials and reduce waste. The loss and waste of food as a raw material offers bioactive compounds, enzymes, and nutrients that add value to the food cosmetic and pharmaceutical industries. This paper systematically reviewed literature with different food loss and waste by-products as animal feed, cosmetic, and pharmaceutical products that strongly contribute to the paradigm shift to a circular economy. Additionally, this review compiles studies related to the integral recovery of by-products from the processing of fruits, vegetables, tubers, cereals, and legumes from the food industry, with the potential in SARS-CoV-2 disease and bacterial diseases treatment.

Probiotics have been defined as "Live microorganisms that when administered in adequate amounts confer a health benefit on the host". This definition covers a wide range of applications, target populations and

(combinations of) microorganisms. Improved knowledge on the importance of the microbiota in terms of health and disease has further diversified the potential scope of a probiotic intervention, whether intended to reach the market as a food, a food supplement or a drug, depending on the intended use. However, the increased interest in the clinical application of probiotics may require specific attention given their administration in a diseased population. In addition to safety, the impact of the type of product, in terms of quality, production method and, e.g., the acceptance of side effects, is now part of the current regulatory constraints for developers. In the European Union, foods are regulated by the European Food Safety Authority and drugs by the European Medicines Agency; in the United States, the Food and Drug Administration (FDA) deals with both categories. More recently, the FDA has defined a new "live biotherapeutic products" (LBP) category, clarifying pharmaceutical expectations. Since 2019, the quality requirements for this category of drug products have also been clarified by the European Pharmacopoeia (Ph. Eur.). Similar to all products intended to prevent or treat diseases, LBPs will have to be registered as medicinal products to reach the market in the US and in Europe. In this area, regulatory authorities and the pharmaceutical industry will routinely use guidelines of the "International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use" (ICH). Although ICH guidelines are not legally binding, they provide very important recommendations, recognized by almost all drug authorities in the world. In this review, we discuss some aspects of this regulatory framework, especially focusing on products with an intended use in a diseased or vulnerable target population.

Commercial pet food in USA is generally safe, but adulteration does occur. Adulterated food has to be recalled to protect pets and public health. All stakeholders, including food firms, distributors, and government agencies such as the Food and Drug Administration (FDA) participate in food recall. The objective of this review is to describe the pet food recall procedure from start to finish, and to review class I and II pet food recalls from 1996 to 2008, with a specific focus on those due to chemical contaminants/adulterants. Information was requested from the FDA by Freedom of Information Act. Only those recalls backed by the FDA scientific review were considered. The legal framework for food recalls in the Code of Federal Regulations, Title 21, Chapter 1, Part 7 and in the Food and Drug Administration Amendments Act of 2007, Title X was reviewed. From 1996 to 2008, there were a total of 22 class I and II pet food recalls. Of these, only six (27%) were due to chemical adulterants. The adulterants were aflatoxins, cholecalciferol, methionine, and melamine, and cyanuric acid. The causes of adulteration included inadequate testing of raw materials for toxins, use of wrong or faulty mixing equipment, and misformulation of raw materials. Overall, pet food manufactured in the USA is safe. Even with shortcomings in the recall process, the incidence of illness associated with pet food adulteration is low. Added changes can only make the system better in the future to safeguard pet and public safety.

With any in vivo model, diet plays an important role, even in an organism as simple as the fruit fly - Drosophila melanogaster. Flies serve as good surrogates to study human diseases as approximately 77% of human disease genes are orthologous in the fly. Though breeding and caring for fruit flies is simple, the use of this organism in drug discovery is wide-ranging, especially in the administration of drugs to flies, via their food. We present a standard method for preparing fly food containing drugs for administration to Drosophila melanogaster, from a chemist's perspective.

Antibiotics have been widely used in the treatment of livestock diseases. However, the emergence of issues related to drug resistance prompted governments to enact a series of laws regulating the use of antibiotics in livestock. Following control of the problem of drug resistant bacteria, public attention has shifted to the recurring incidence of human health and safety issues caused by residual veterinary drugs in livestock products. To guarantee the safety and hygiene of meat, milk, and eggs from food-producing animals, governments and relevant agencies established laws and regulations for the use of veterinary drugs. It is, therefore, necessary to monitor the content of residual drugs in livestock products at regular intervals to assess whether the regulations have resulted in the effective management of food product safety, and to

prevent and manage sudden problems related to this issue. A 2011-2015 livestock product post-marketing monitoring program launched by the Taiwan Food and Drug Administration (TFDA) inspected 1487 livestock products. Over the past 5 years, there were 34 samples identified that did not conform to the regulations; these samples included residue drugs such as β-agonists, chloramphenicols, β-lactam antibiotics, sulfa drugs, enrofloxacin, and lincomycin. Inspections of commercial livestock products with the consistent cooperation of agricultural authorities did not detect the drugs that were banned by the government, whereas the detection of other drugs decreased annually with an increase in the post-market monitoring sample size. In the future, the TFDA will continue to monitor the status of residual veterinary drugs in commercial livestock products, adjust the sampling of food products annually according to monitoring results, and closely cooperate with agricultural authorities on source management.

Postbiotics are health-promoting microbial metabolites delivered as a functional food or a food supplement. They either directly influence signaling pathways of the body or indirectly manipulate metabolism and the composition of intestinal microflora. Cancer is the second leading cause of death worldwide and even though the prognosis of patients is improving, it is still poor in the substantial part of the cases. The preventable nature of cancer and the importance of a complex multi-level approach in anticancer therapy motivate the search for novel avenues of establishing the anticancer environment in the human body. This review summarizes the principal findings demonstrating the usefulness of both natural and synthetic sources of postbotics in the prevention and therapy of cancer. Specifically, the effects of crude cell-free supernatants, the short-chain fatty acid butyrate, lactic acid, hydrogen sulfide, and β-glucans are described. Contradictory roles of postbiotics in healthy and tumor tissues are highlighted. In conclusion, the application of postbiotics is an efficient complementary strategy to combat cancer.

In this study, we observed that calorie labeling was associated with small decreases in mean calorie and nutrient content of fast food meals 2 years after franchise labeling and nearly 1 year after implementation of labeling nationwide. These changes imply that calorie labeling was associated with small improvements in purchased meal quality in US chain restaurants.

Consumer interest in foods with enhanced nutritional quality has increased in recent years. The nutritional and bioactive characterization of fruits and their byproducts, as well as their use in the formulation of new food products, is advisable, contributing to decrease the global concerns related to food waste and food security. Moreover, the compounds present in these raw materials and the study of their biological properties can promote health and help to prevent some chronic diseases. *Opuntia ficus-indica* (L.) Mill. (prickly pear) is a plant that grows wild in the arid and semi-arid regions of the world, being a food source for ones and a potential for others, but not properly valued. This paper carries out an exhaustive review of the scientific literature on the nutritional composition and bioactive compounds of prickly pear and its constituents, as well as its main biological activities and applications. It is a good source of dietary fiber, vitamins and bioactive compounds. Many of its natural compounds have interesting biological activities such as anti-inflammatory, hypoglycemic and antimicrobial. The antioxidant power of prickly pear makes it a good candidate as an ingredient of new food products with fascinating properties for health promotion and/or to be used as natural extracts for food, pharmaceutic or cosmetic applications. In addition, it could be a key player in food security in many arid and semi-arid regions of the world, where there are often no more plants.

Nowadays, there is a growing concern about contamination of toxic metals (TM) in pet food due to the great potential for health risks of these elements. TM concentrations in commercial pet foods (n = 100) as well as in ingredients used in their composition (n = 100) were analyzed and compared to the Food and Drug Administration (FDA) maximum tolerable level (MTL), and the TM concentrations found in the different sources of carbohydrate, protein, and fat were compared. The TM concentrations were determined by inductively coupled plasma with optical emission spectrometry (ICP-OES). Concentrations above the

MTL for aluminum, mercury, lead, uranium, and vanadium were observed in both dog and cat foods, and the percentage of dog foods that exceeded the MTL of these TM were: 31.9%; 100%; 80.55%; 95.83%; and 75%, respectively, and in cat foods: 10.71%; 100%; 32.14%; 85.71%; 28.57%, respectively. The MTL values of these TMs and the mean values in dog foods (mg/kg dry matter basis) (MTL [mean ± standard deviation]) were: aluminum: 200 (269.17 ± 393.74); mercury: 0.27 (2.51 ± 1.31); lead: 10 (12.55 ± 4.30); uranium: 10 (76.82 ± 28.09); vanadium: 1 (1.35 ± 0.69), while in cat foods were: aluminum: 200 (135.51 ± 143.95); mercury: 0.27 (3.47 ± 4.31); lead: 10 (9.13 ± 5.42); uranium: 10 (49.83 ± 29.18); vanadium: 1 (0.81 ± 0.77). Dry foods presented higher concentrations of most TM ($P < 0.05$) than wet foods ($P < 0.05$). Among the carbohydrate sources, there were the highest levels of all TM except cobalt, mercury, and nickel in wheat bran ($P < 0.05$), while among the protein sources, in general, animal by-products had higher TM concentrations than plant-based ingredients. Pork fat had higher concentrations of arsenic, mercury, and antimony than fish oil and poultry fat. It was concluded that the pet foods evaluated in this study presented high concentrations of the following TM: aluminum, mercury, lead, uranium, and vanadium.

The Western dietary pattern of intake common to many Americans is high in fat, refined carbohydrates, sodium, and phosphorus, all of which are associated with processed food consumption and higher risk of life-threatening chronic diseases. In this review, we focus on the available information on current phosphorus intake with this Western dietary pattern, and new knowledge of how the disruption of phosphorus homeostasis can occur when intake of phosphorus far exceeds nutrient needs and calcium intake is limited. Elevation of extracellular phosphorus, even when phosphorus intake is seemingly modest, but excessive relative to need and calcium intake, may disrupt the endocrine regulation of phosphorus balance in healthy individuals, as it is known to do in renal disease. This elevation in serum phosphate, whether episodic or chronically sustained, may trigger the secretion of regulatory hormones, whose actions can damage tissue, leading to the development of cardiovascular disease, renal impairment, and bone loss. Therefore, we assessed the health impact of excess phosphorus intake in the context of specific issues that reflect changes over time in the U.S. food supply and patterns of intake. Important issues include food processing and food preferences, the need to evaluate phosphorus intake in relation to calcium intake and phosphorus bioavailability, the accuracy of various approaches used to assess phosphorus intake, and the difficulties encountered in evaluating the relations of phosphorus intake to chronic disease markers or incident disease.

Harmonization of national consumption data for international comparison is an important but challenging work, yet to date there is a lack of comparable food classification system that incorporates food description in Taiwan. In 2015, European Food Safety Authority (EFSA) released a new standardized food classification and description system called FoodEx2, which provides a flexible combination of classifications and descriptions. Based on FoodEx2 and a unique data set of daily food consumption offered by Taiwan Food Consumption Database, this study aims to provide a harmonized, food description incorporated, food classification system (HFDFC system) that captures all the useful details of food groups in exposure assessments. The HFDFC system was built according to six risk-assessment-related facets including food sources, processed products, cooking methods, manufacturers (brand), food additives and specialty foods. The HFDFC system includes 199 foods in the core list and 131 foods in the extended list. This study also compared the Acrylamide hazard index estimated under the HFDFC system with that under the National Food Consumption Database in Taiwan (NFCDT). The findings indicated that the HFDFC system provides useful and detailed information that helps the users to quickly identify food information in a harmonized manner and to reduce estimation bias. The HFDFC system is expected to facilitate global comparisons in the food risk assessment because it is built based upon EU Foodex2.

The food chain, from production to the consumer's kitchen, can be an important contributor to the development, persistence and dissemination of antibiotic-resistant (ART) microbes, including both ART foodborne pathogens and commensal bacteria. Many factors in the food chain, such as the antimicrobial

compounds used and how they were used, microbial co-selection, fitness and persistence mechanisms, host lifestyle, and food treatment conditions, influence the antibiotic resistance (AR) cycle. Targeted mitigation strategies, such as those used in the dairy processing industry, can be effective in reducing the AR gene pool.

The US Food and Drug Administration (FDA) has premarket review authority over food additives, but a food manufacturer may, according to the legislation, intentionally add a substance to human food or animal food without their premarket review or approval if the substance is generally recognized, among qualified experts, to be safe under the conditions of its intended use. Generally recognized as safe (GRAS) implies that the current scientific community agrees on the adequacy of how data is generated. This system has come under public pressure because of doubts as to its efficiency and the FDA's recent GRAS rule is part of the response. The FDA guidance for testing food additives, known as the "Redbook", is about two decades old. Work toward a new "Redbook" is on the way, but the US Grocery Manufacturer Association (GMA) also has initiated the development of an independent standard on how to perform GRAS determinations. This review of the current guidance shows a very rigorous system for higher concern levels, but also many waiving options. Opportunities and challenges for safety evaluations of food additives are discussed. Where scientific progress has allowed improving existing and adapting new methods, these should be adopted to improve product safety and animal welfare. The continuous adaptation of such improved methods is therefore needed. Especially, there are opportunities to embrace developments within the toxicity testing for the 21st century movement and evidence-based toxicology approaches. Also, the growing understanding of the limitations of traditional tests needs to be considered.

Exposures to lead have emanated from various sources, including food, throughout human history. Occupational and environmental exposures (especially pica) appear to account for much of the identified human disease, however, food-borne exposures deserve further investigation. Lead residues in food can result from: biological uptake from soils into plants consumed by food animals or man, usage of lead arsenate pesticides, inadvertent addition during food processing, and by leaching them improperly glazed pottery used as food storage or dining utensils. Estimates of total dietary exposure should reflect frequency

distribution data on lead levels in specific food commodities in relation to the quantities actually ingested by various sample populations to distinguish degrees of risk associated with particular dietary habits. Earlier estimates of average total dietary intake of lead by adults have been reported to range from above 500 mug/day downward with more recent estimates suggesting averages of 200 mug/day or lower. The strengths and weaknesses of these data are discussed along with analytical and sampling considerations. FDA programs related to food surveillance, epidemiology, and toxicological investigation are briefly described.

Escherichia coli O157 : H7 (*E. coli* O157 : H7) has been found to be the major cause of food-borne diseases and a serious public health problem in the world, with an increasing concern for the emergence and spread of antimicrobial-resistant strains. Hitherto, little is known about the carriage of *E. coli* O157 : H7 and its antimicrobial susceptibility profile in the food of animal origin in Ethiopia. This study aimed to determine the occurrence and multidrug resistance profile of *E. coli* O157 : H7 from food of animal origin at different catering establishments in the selected study settings of Arsi Zone. One hundred ninety-two animal origin food items, namely, raw/minced meat (locally known as "Kitfo," "Kurt," and "Dulet"), raw milk, egg sandwich, and cream cake samples were collected and processed for microbiological detection of *E. coli* O157 : H7. Out of 192 samples, 2.1% (4/192) were positive for *E. coli* O157 : H7. Two *E. coli* O157 : H7 isolates were obtained from "Dulet" (6.3%) followed by "Kurt" (3.1%, 1/32) and raw milk (3.1%, 1/32), whereas no isolate was obtained from "Kitfo," egg sandwich, and cream cake samples. Of the 4 *E. coli* O157 : H7 isolates subjected to 10 panels of antimicrobial discs, 3 (75%) were highly resistant to kanamycin, streptomycin, and nitrofurantoin. Besides, all the isolates displayed multidrug resistance phenotypes, 3 to 5 antimicrobial resistance, amid kanamycin, streptomycin, nitrofurantoin, tetracycline, and

chloramphenicol. The occurrence of multidrug-resistant *E. coli* O157 : H7 isolates from foods of animal origin sampled from different catering establishments reveals that the general sanitary condition of the catering establishments, utensils used, and personnel hygienic practices did not comply with the recommended standards. Thus, this finding calls for urgent attention toward appropriate controls and good hygienic practices in different catering establishments dealing with consuming raw/undercooked foods of animal origin.

Appropriate control measures, at both national and international levels, are thereby indicated to halt the adulteration of foodstuff products that constitute a health hazard or pose a life-threat to consumers as well as constituting a financial fraud.

Many specialists note that the food offered today - as a result of very complex technological processing - is devoid of many components that are important for the organism and the shortages have to be supplemented. The simplest for it is to consume diet supplements that provide the missing element in a concentrated form. In accordance with the applicable law, medicinal products include all substances or mixtures of substances that are attributed with properties of preventing or treating diseases with humans or animals. Permits to admit supplements to the market are issued by the Chief Sanitary Inspector and the related authorities; permits for medicines are issued by the Chief Pharmaceutical Inspector and the Office for Registration of Medicinal Products, Medical Devices and Biocidal Products. Therefore, admittance of a supplement to the market is less costly and time consuming_than admittance of a medicine. Supplements and medicines may contain the same component but medicines will have a larger concentration than supplements. Sale of supplements at drug stores and in the form of tablets, capsules, liquids or powders makes consumer often confusing supplements with medicines. Now there are no normative documents specifying limits of microbiological impurities in diet supplements. In Polish legislation, diet supplements are subject to legal acts concerning food. Medicines have to comply with microbiological purity requirements specified in the Polish Pharmacopeia. As evidenced with the completed tests, the proportion of diet supplement samples with microbiological impurities is 6.5%. Sales of diet supplements have been growing each year, they are consumed by healthy people but also people with immunology deficiencies and by children and therefore consumers must be certain that they buy safe products.

Selenium is one of the elements classified within the group of micronutrients which are necessary in trace amounts for the proper functioning of organisms. Selenium participates in the protection of cells against excess H_2O_2, in heavy metal detoxification, and regulation of the immune and reproductive systems as well. It also ensures the proper functioning of the thyroid gland. Selenium induces the occurrence of the selenoprotein synthesis process involved in the antioxidant defense mechanism of the organism. Recent years have brought much success in the studies on selenium. Anticarcinogenic properties of selenium against some cancers have been reported. Supplementation is increasingly becoming a solution to this problem. A large number of different supplementation methods are promoting studies in this area. Slight differences in the selenium content can result in excess or deficiency, therefore supplementation has to be done carefully and cautiously.

This review considers potential approaches to solve an important problem concerning the impact of applied pesticides of various classes on living organisms, mainly agricultural crops used as food. We used the method of multi-residual determination of several pesticides in agricultural food products with its practical application for estimating pesticides in real products and in model experiments. The distribution of the pesticide between the components of the soil-plant system was studied with a pesticide of the sulfonylureas class, i.e., rimsulfuron. Autoradiography showed that rimsulfuron inhibits the development of plants considered as weeds. Cereals are less susceptible to the effects of pesticides such as acetamiprid, flumetsulam and florasulam, while the development of legume shoots was inhibited with subsequent plant death.

The ability of dairy farmers to market cull cows and veal calves may be affected by the final rule on Pathogen Reduction and HACCP (Hazard Analysis Critical Control Points) Systems, a sweeping reform of USDA food safety regulations that was published on July 25, 1996. Although the regulations apply only to slaughter and processing plants handling meat and poultry, the rule will have an impact on food animal producers, including dairy farmers. Under this regulation, plant operators are required to evaluate potential hazards and to devise and implement controls that are appropriate for each product and plant to prevent or reduce those hazards. Processing plants may need to consider the potential hazards associated with incoming animals, such as illegal drug residues, which may result in marked changes in the relationships among some producers, livestock markets, and slaughter plants. Such information may actually improve the marketability of some animal classes because documentation will help the packer ensure the safety of products for sale to domestic and foreign markets. Dairy scientists are in an excellent position to explain the food safety issues to dairy farmers and to help develop the appropriate strategies that are necessary to guide the changes needed. These scientists can be conduits for information, the research leaders for practical solutions to reduce public health risks, and valuable resources to help farmers adjust to the impact of these new in-plant regulatory systems.

Mycotoxins are low-molecular weight compounds produced by diverse genera of molds that may contaminate food and feed threatening the health of humans and animals. Recent findings underline the importance of studying the combined occurrence of multiple mycotoxins and the relevance of assessing the toxicity their simultaneous exposure may cause in living organisms. In this context, for the first time, this work has critically reviewed the most relevant data concerning the occurrence and toxicity of mycotoxins produced by *Alternaria* spp., which are among the most important emerging risks to be assessed in food safety, alone or in combination with other mycotoxins and bioactive food constituents. According to the literature covered, multiple *Alternaria* mycotoxins may often occur simultaneously in contaminated food, along with several other mycotoxins and food bioactives inherently present in the studied matrices. Although the toxicity of combinations naturally found in food has been rarely assessed experimentally, the data collected so far, clearly point out that chemical mixtures may differ in their toxicity compared to the effect of toxins tested individually. The data presented here may provide a solid foothold to better support the risk assessment of *Alternaria* mycotoxins highlighting the actual role of chemical mixtures on influencing their toxicity.

The Food and Drug Administration (FDA or we) is amending the food additive regulations to provide for the safe use of folic acid in corn masa flour. We are taking this action in response to a food additive petition filed jointly by Gruma Corporation, Spina Bifida Association, March of Dimes Foundation, American Academy of Pediatrics, Royal DSM N.V., and National Council of La Raza.

Food is the primary source of nutrients to keep us nourished and healthy. Poor and unhealthy diets implicated with the increase of several non-communicable diseases (NCDs) require a food-based approach to reduce the ongoing rise. Traditional knowledge and science behind food-related health benefits became evident in the last three decades. Active ingredients, bioactive molecules and conventionally used herbs were clinically researched and proven to have beneficial outcomes. In the Indian scenario, the multiplicity of food products, including medicinal type formats, such as health supplements, containing plant, herbs or novel ingredients, brings in a new complexity to regulations. Several of these ingredients are pharmacologically active substances and could overlap with drug regulations. The data generated on the nutritional and health benefit of a supplement should be reproducible, outcomes measurable and disease risk reduction shown by well-designed research studies. Regulatory challenges occur at several levels, namely, harmonization of law, fair trade practice, population exposures to chemicals and contaminants, food borne illness, rise in NCD's, novel ingredients, new technologies and a legacy of regulatory practice. While regulatory and legal challenges will always exist, reliance on the role of scientific research in the regulatory context becomes significant

Magnesium is a vital mineral that takes part in hundreds of enzymatic reactions in the human body. In the past several years, new information emerged in regard to the antibacterial effect of magnesium. Here we elaborate on the recent knowledge of its antibacterial effect with emphasis on its ability to impair bacterial adherence and formation complex community of bacterial cells called biofilm. We further talk about its ability to impair biofilm formation in milk that provides opportunity for developing safer and qualitative dairy products. Finally, we describe the pronounced advantages of enrichment of food with magnesium ions, which result in healthier and more efficient food products.

We have recently adapted a reinstatement model, commonly used to study relapse to drugs of abuse, to study the role of stress and anxiety in relapse to palatable food seeking [Ghitza UE, Gray SM, Epstein DH, Rice KC, Shaham Y. The anxiogenic drug yohimbine reinstates palatable food seeking in a rat relapse model: a role of CRF(1) receptors. Neuropsychopharmacology [in press]]. We found that the anxiogenic drug yohimbine, as well as pellet-priming, reinstate food seeking in food restricted rats previously trained to lever press for palatable food pellets (25% fat, 48% carbohydrate). Here, we studied the generality of the effect of yohimbine and pellet priming on reinstatement of food seeking by using three distinct pellet types: non-sucrose carbohydrate (NSC) (5.5% fat, 60% carbohydrate, 4.5% fiber), fiber (0% fat, 0% carbohydrate, 91% fiber) and sucrose (0% fat, 91% carbohydrate, 4% fiber). Rats were placed on a restricted diet (75-80% of daily standard food) and for 9-12 intermittent training days (9 h/day, every other day) lever-pressed for the food pellets under a fixed ratio-1 (20-s timeout) reinforcement schedule. Subsequently, the rats were given 9-10 daily extinction sessions during which lever-presses were not reinforced, and were then injected with yohimbine (0, 0.5, 1.0, 2.0 mg/kg, i.p.) or given a single food pellet to induce reinstatement of food seeking. Yohimbine reinstated food seeking previously reinforced by NSC and sucrose pellets, but had a minimal effect on food seeking in rats previously trained to lever press for fiber pellets. Pellet priming produced a greater degree of reinstatement of lever pressing in rats previously trained on NSC pellets than in rats trained on fiber or sucrose pellets. Results suggest that the magnitude of the effect of yohimbine and pellet priming on reinstatement of food seeking depends in part on the composition of the food pellets used during training.

We report the microencapsulation of oil soluble vitamins (A, D and E) using a one pot ultrasonic process and raw egg white proteins as a shell material. Green tea catechin/iron complex coating method was further developed to impart UV filtering property to the microcapsules in order to protect the encapsulated nutrients from photodegradation. The microcapsules showed antibacterial properties and long shelf-life. The encapsulated vitamins were protected from degradation upon heating, UV irradiation, simulated storage/transit and cooking processes. The in-vitro digestion study showed that functional vitamin D can be potentially released in the gastrointestinal tract improving vitamin D availability by more than 2-fold compared to the free vitamin. The vitamin D microcapsules were highly stable and maintained their microstructures once incorporated into staple food products. The low-cost egg white shell encapsulated vitamins can improve the nutritional value of staple food products to combat maternal and child malnutrition.

Antibiotics have been used for many years as growth promoters. They contribute to build the immunocompetence (i.e. ability of the body to produce a normal immune response following exposure to an antigen) of birds against infectious diseases and as growth promoters. Antibiotics have been widely used as growth promoters in the field of animal production since 1940s. There is a hypothesis that is effect is brought about by dynamic biological interaction with the micro-flora in the intestine. In 1951, the United States Food and Drug Administration approved the use of antibiotics as animal additives to prevent disease in general and, in some cases, to improve efficiency without veterinary prescription. In the 1950s and 1960s, each European state approved its own national regulations about the use of antibiotics in animal feeds. However, using antibiotics may develop bacteria resistant to these drugs. Accordingly, the use of antibiotics has been minimized and replaced by effective dietary supplements such as probiotics and/or prebiotics that

are claimed to enhance growth and positively modulate the immune response. The current review paper sheds light on the benefits of using probiotics and/or prebiotics in poultry feed versus the risk of using antibiotics and the mechanisms by which they exert their effects, as well as the economic analysis of using these beneficial additives in poultry feed.

Linseed, commonly known as flaxseed, is a fibre-rich food product. According to the recent study prepared by the American Institute for Cancer Research (AICR), an adequate intake of dietary fiber contributes to reducing the risk of colorectal cancer. In addition, the flaxseed and the oil extracted from it are considered to be food products with a high content of anti-inflammatory, unsaturated α-linolenic acid (ALA). However, the authors of the most recent scientific research have assigned the anticancer significance of flax seeds to plant lignan - secoisolariciresinol diglycoside (SDG), of which flaxseed is the main food source. This article provides a review of the world scientific literature together with an assessment of the validity of dietary supplementation with SDG from flaxseeds in cancer and during chemotherapeutic treatment. The paper also presents the European Food Safety Authority (EFSA) and the US Food and Drug Administration (FDA) view on dietary supplementation with flax seeds and its lignans. Additionally, selected dietary supplements available on the Polish market containing SDGs, linseed oil or linseed were analysed, together with a description of their intended use suggested by the manufacturers.

New eating habits, actual trends in production and consumption have a health, environmental and social impact. The European Union is fighting diseases characteristic of a modern age, such as obesity, osteoporosis, cancer, diabetes, allergies and dental problems. Developed countries are also faced with problems relating to aging populations, high energy foods, and unbalanced diets. The potential of nutraceuticals/functional foods/food supplements in mitigating health problems, especially in the gastrointestinal (GI) tract, is discussed. Certain members of gut microflora (e.g., probiotic/protective strains) play a role in the host health due to its involvement in nutritional, immunologic and physiological functions. The potential mechanisms by which nutraceuticals/functional foods/food supplements may alter a host's health are also highlighted in this paper. The establishment of novel functional cell models of the GI and analytical tools that allow tests in controlled experiments are highly desired for gut research.

Traditional probiotics are increasingly being used in a medical context. The use of these products as drugs is considerably different from the traditional use as food or food supplements, as, obviously, the target population is different (diseased versus healthy or at risk population). Besides the target population, also the regulatory context is different, mainly with respect to production, administration regime and type of clinical studies required. In this paper we will, besides the regulatory differences, focus on aspects that may impact the efficacy of a live biotherapeutic product (drug), especially in a clinical setting. The impact of the dosage seems to depend on the strain and the application and may follow some rationale. In contrast, information on the impact of the time of administration or diet, is often still lacking. The matrix and the use of protective measures may clearly have an impact on the survival and efficacy of the strain.

Macro- and microalgae-based foods are becoming popular due to their high nutritious value. The algal biomass is enriched with polysaccharides, protein, polyunsaturated fatty acids, carotenoids, vitamins and minerals. However, the most promising fraction is polysaccharides (PS) or their derivatives (as dietary fibers) which are not entirely fermented by colonic bacteria hence act as potential prebiotic. Primarily, algae become famous as prominent protein sources. Recently, these are widely adopted as functional food (e.g., desserts, dairy products, oil-derivatives, pastas etc.) or animal feed (for poultry, cattle, fish etc.). Besides prebiotic and balanced amino acids source, algae derived compounds implied as therapeutics due to comprising bioactive properties to elicit immunomodulatory, antioxidative, anticancerous, anticoagulant, hepato-protective, and antihypertensive responses. Despite the above potentials, broader research determinations are inevitable to explore these algal compounds until microalgae become a business reality for broader and specific applications in all health domains. However, scale up of algal bioprocess remains

a major challenge until commercial affordability is accomplished which can be possible by discovering their hidden potentials and increasing their value and application prospects. This review provides an overview of the significance of algae consumption for several health benefits in humans and animals mainly as prebiotics, however their functional food and animal feed potential are briefly covered. Moreover, their potential to develop an algal-based food industry to meet the people's requirements not only as a sustainable food solution with several health benefits but also as therapeutics is inevitable.

Consuming medium-chain triglycerides (MCT) may reduce subsequent energy intake and increase satiety compared to long-chain triglycerides (LCT) but this may be dependent on the physical form in which MCT is ingested. Twenty-nine participants completed four trials where they consumed a breakfast containing either LCT or MCT in solid (Con-S and MCT-S, respectively) or liquid (Con-L and MCT-L, respectively) form. Appetite ratings and gastric emptying (GE) were taken at baseline and at 15 min intervals for 4 h. Energy intake was assessed at an *ad libitum* meal and via weighed food records for the remainder of the day. *Ad libitum* energy intake was highest in Con-L (4101 ± 1278 kJ vs. Con-S, 3323 ± 1196; MCT-S, 3516 ± 1058; MCT-L, 3257 ± 1345; $p = 0.001$). Intake over the whole day was significantly lower in MCT-L (7904 ± 3244) compared to Con-L (9531 ± 3557; $p = 0.001$). There were significant differences in GE times ($p < 0.05$), with MCT breakfasts delaying GE to a greater extent than LCT, and MCT-L having the longest GE times. There were no differences in appetite sensations. MCT reduce subsequent intake without affecting subjective sensations of appetite when consumed in liquid form.

Nutrients including carbohydrates, proteins, lipids, vitamins, and minerals regulate various physiological processes and are essential for the survival of organisms. Reduced overall caloric intake delays aging in various organisms. However, the role of each nutritional component in the regulation of lifespan is not well established. In this review, we describe recent studies focused on the regulatory role of each type of nutrient in aging. Moreover, we will discuss how the amount or composition of each nutritional component may influence longevity or health in humans.

Scientific interest in conjugated linoleic acid (CLA) started in 1987 when Michael Pariza's team of Wisconsin University observed its inhibitory effects on chemically induced skin tumors in mice. Numerous studies have since examined CLA's role in cancer, immune function, oxidative stress, atherosclerosis, lipid and fatty acids metabolism, bone formation and composition, obesity, and diabetes. Still it's not clear yet either through which mechanisms CLA produces its numerous metabolic effects. We now know that CLA contents in cow milk fat can be enriched through dry fractionation, but this knowledge doesn't allow sufficient certainty to qualify this nutrient, as a functional food, capable of increasing well being and reducing the risk of disease.

The Food and Drug Administration (FDA) is amending the food additive regulations to increase the maximum dose of ionizing radiation permitted in the treatment of poultry products, to include specific language intended to clarify the poultry products covered by the regulations, and to remove the limitation that any packaging used during irradiation of poultry shall not exclude oxygen. This action is in response to a petition filed by the U.S. Department of Agriculture, Food Safety and Inspection Service (USDA/FSIS).

The Food and Drug Administration (FDA or we) is amending the regulation authorizing a health claim on the relationship between dietary saturated fat and cholesterol and risk of coronary heart disease (CHD) to permit raw fruits and vegetables that fail to comply with the low fat definition and/or the minimum nutrient content requirement to be eligible to bear the claim. We are taking this action in response to a petition submitted by the American Heart Association (the petitioner). The amendment expands the use of this health claim to certain fruits and vegetables that are currently ineligible for the health claim.

Ensete ventricosum is a traditional multipurpose crop mainly used as a staple/co-staple food for over 20 million people in Ethiopia. Despite this, scientific information about the crop is scarce. Three types of food, viz., *Kocho* (fermented product from scraped pseudostem and grated corm), *Bulla* (dehydrated juice), and *Amicho* (boiled corm) can be prepared from enset. These products are particularly rich in carbohydrates, minerals, fibres, and phenolics, but poor in proteins. Such meals are usually served with meat and cheese to supplement proteins. As a food crop, it has useful attributes such as foods can be stored for long time, grows in wide range of environments, produces high yield per unit area, and tolerates drought. It has an irreplaceable role as a feed for animals. Enset starch is found to have higher or comparable quality to potato and maize starch and widely used as a tablet binder and disintegrant and also in pharmaceutical gelling, drug loading, and release processes. Moreover, enset shows high genetic diversity within a population which in turn renders resilience and food security against the ever-changing environmental factors and land use dynamics. Therefore, more research attention and funding should be given to magnify and make wider use of the crop.

Not all viruses harm people. The Food and Drug Administration has approved a mixture of viruses as a food additive to protect people. The additive can be used in processing plants for spraying onto ready-to-eat meat and poultry products to protect consumers from the potentially life-threatening bacterium Listeria monocytogenes (L. monocytogenes).

Although there exist important differences between foods and addictive drugs, ignoring analogous neural and behavioral effects of foods and drugs of abuse may result in increased food-related disease and associated social and economic burdens. Public health interventions that have been effective in reducing the impact of addictive drugs may have a role in targeting obesity and related diseases.

Few studies have estimated the economic burden of chronic diseases (e.g., type 2 diabetes, cardiovascular diseases, cancers) attributable to unhealthy eating. In this study, we estimated the economic burden of chronic disease attributable to not meeting Canadian food recommendations. We first obtained chronic disease risk estimates for intakes of both protective (1. vegetables; 2. fruit; 3. whole grains; 4. milk; 5. nuts and seeds) and harmful (6. processed meat; 7. red meat; 8. sugar-sweetened beverages) foods from the Global Burden of Disease Study, and food intakes from the 2004 Canadian Community Health Survey 24-hour dietary recalls (n = 33,932 respondents). We then calculated population attributable fractions (PAFs) for all relevant food-chronic disease combinations by age and sex groups. These PAFs were then mathematically combined for each disease for each age and sex group. We then estimated attributable costs by multiplying these combined PAFs with estimated 2014 annual direct health care (hospital, drug, physician) and indirect (human capital approach) costs for each disease. We found that not meeting recommendations for the eight foods was responsible for CAD$13.8 billion/year (direct health care: CAD$5.1 billion, indirect: CAD$8.7 billion). Nuts and seeds and whole grains were the top cost contributors rather than vegetables and fruit. Our findings suggest that unhealthy eating constitutes a tremendous economic burden to Canada that is similar in magnitude to the burden of smoking and larger than that of physical inactivity which were estimated using similar approaches. A status quo in promotion of healthy eating will allow this burden to continue. Interventions to reduce the health and economic burden of unhealthy eating in Canada may be more effective if they are broad in focus and include promotion of nuts and seeds and whole grains along with vegetables and fruit rather than have a narrow focus such as primarily on vegetables and fruit.

Most official food composition tables and food questionnaires do not provide enough data to assess fermentable dietary fibers (DF) that can exert a health effect through their interaction with the gut microbiota. The aim of this study was to develop a database and a food frequency questionnaire (FFQ) allowing detailed DF intake estimation including prebiotic (oligo)saccharides. A repertoire of DF detailing total, soluble DF, insoluble DF and prebiotic (oligo)saccharides (inulin-type fructans, fructo-

oligosaccharides and galacto-oligosaccharides) in food products consumed in Europe has been established. A 12 month FFQ was developed and submitted to 15 healthy volunteers from the FiberTAG study. Our data report a total DF intake of 38 g/day in the tested population. Fructan and fructo-oligosaccharides intake, linked notably to condiments (garlic and onions) ingestion, reached 5 and 2 g/day, respectively, galacto-oligosaccharides intake level being lower (1 g/day). We conclude that the FiberTAG repertoire and FFQ are major tools for the evaluation of the total amount of DF including prebiotics. Their use can be helpful in intervention or observational studies devoted to analyze microbiota-nutrient interactions in different pathological contexts, as well as to revisit DF intake recommendations as part of healthy lifestyles considering specific DF.

We review herein the basis for using dietary components to treat and/or prevent Helicobacter pylori infection, with emphasis on (a) work reported in the last decade, (b) dietary components for which there is mechanism-based plausibility, and (c) components for which clinical results on H pylori amelioration are available. There is evidence that a diet-based treatment may reduce the levels and/or the virulence of H pylori colonization without completely eradicating the organism in treated individuals. This concept was endorsed a decade ago by the participants in a small international consensus conference held in Honolulu, Hawaii, USA, and interest in such a diet-based approach has increased dramatically since then. This approach is attractive in terms of cost, treatment, tolerability, and cultural acceptability. This review, therefore, highlights specific foods, food components, and food products, grouped as follows: bee products (eg, honey and propolis); probiotics; dairy products; vegetables; fruits; oils; essential oils; and herbs, spices, and other plants. A discussion of the small number of clinical studies that are available is supplemented by supportive in vitro and animal studies. This very large body of in vitro and preclinical evidence must now be followed up with rationally designed, unambiguous human trials.

Although many people (and patients) in Japan currently consume health foods such as supplements, few have proper knowledge of their usefulness and safety. In December 2015, the Food Safety Commission of Japan issued a report and 19 messages mainly on the safety of health foods to disseminate appropriate knowledge to consumers. The report divided health food risks into three categories: 1) risks as food (e.g., increased lung cancer risk in smokers consuming excess β-carotenoid); 2) risks as health foods (e.g., short consumption history, drug contamination, poor quality of active ingredients, and interactions with drugs); and 3) risks due to a lack of adequate scientific information on health foods. The risk of insulin autoimmune syndrome caused by α-lipoic acid is relatively high among Japanese individuals because its onset is associated with HLA-DRB1*04:06, an HLA allele occurring frequently in East Asian populations. As for health food-drug interactions, an important pharmacokinetic interaction between drugs and St. John's Wort was described from several viewpoints: different effects on drugs within the same class (depending on the metabolic pathway); interindividual differences in its effects; importance of considering active metabolite involvement; and time course of interaction. An example of an interaction affecting drug efficacy was also introduced. Because the Japanese government now promotes a health-supportive pharmacy program in which pharmacies have a role in supporting the health of local patients/consumers, pharmacists are expected to acquire more scientific information on health foods, evaluate their evidence levels, and provide that information in plain language to patients/consumers.

In the United States the marketing of dietary supplements, of which the majority are herbal supplements, is currently a multibillion-dollar industry involving use from over half of the adult population. Due to their frequency of use and the lack of regulation of herbal supplements by the Food and Drug Administration (FDA) it is important for the health and safety of consumers to know about consistency of supplements and any possible contamination by harmful products, such as heavy metals or microorganisms. The purpose of the study was to determine consistency and contamination within and between bottles of common herbal supplements. Duplicate bottles of 29 herbal supplements were tested for consistency for antioxidant activity, phenolic concentration and flavonoid concentration under methanolic and water extraction. The

supplements were also analyzed for the presence of metals and fungal contaminants. For all of the supplements tested there was high variability around the mean in antioxidant activity, phenolic concentrations and flavonoid concentrations, with coefficients of variation (CV) ranging from 0-120. Zinc was found in almost 90% of the supplements, nickel in about half of the supplements and lead in none of the supplements. Approximately 60% of the supplements contained fungal isolates. Although the majority of the fungi that were found in the supplements are generally not hazardous to human health, many of them could be problematic to sensitive groups, such as immunocompromised individuals. The data, which demonstrates contamination and a lack of consistency, in conjunction with previous studies on supplement contamination, strengthen the case that the FDA should regulate over-the-counter herbal supplements the same way that they regulate food and drugs. Until such time it is crucial that consumers are informed that many of the supplements that they take may lack the standardization that would reduce the chance of contamination and lead to consistency from one pill to the next.

Seafood derived from wild fish as well as farmed fish has always been an important source of protein in the human diet. On a global scale, fish and fish products are the most important source of protein and it is estimated that more than 30% of fish for human consumption comes from aquaculture. The first part of this paper outlines the hazards and challenges associated with handling fish during farming and capture. The authors describe infectious agents that cause disease in fish as well as humans, zoonotic agents, intoxications due to bacteria and allergies caused by the consumption of fish. Although only a few infectious agents in fish are able to infect humans, some exceptions exist that may result in fatalities. However, the greatest risk to human health is due to the consumption of raw or insufficiently processed fish and fish products. The second part of the paper considers environmental contaminants in seafood that may pose a risk to human health, such as medicinal products and residues associated with aquaculture, persistent lipophilic organic compounds and metals (methyl-mercury, organotin). The authors include an updated overview of the various factors associated with farmed and captured fish that may cause risks to human health after consumption. Moreover, they discuss the challenges (in the widest sense) associated with handling fish during capture and farming, as well as those encountered during processing.

Globalisation is the direct or indirect source and cause of many economic, social, political and cultural processes and phenomena. These processes also affect agribusiness and food production. One of the important developments in recent decades is the ever-increasing scale of food adulteration. Its consequence is a reduction in the level of food safety, both in its health and economic aspects. The latter is due to the presence of impaired, or even adulterated, food on the market, which exposes consumers to non-equivalent exchanges. Sectors particularly vulnerable to these illegal trade practices include meat and fish products.

After publication of the draft Generally Regarded As Safe (GRAS) rule in 1997, the United States (US) Food and Drug Administration (FDA) initiated an Interim Pilot Program encouraging the notification to FDA of GRAS determinations. This paper analyzes GRAS notifications submitted during the Interim Pilot Program along with warning letters issued during the same time period to better understand the evolution of the program and anticipate the future GRAS landscape. The success of the GRAS Notification program is demonstrated by the increasing rate of GRAS Notifications submitted to the FDA during the Interim Pilot Program, as well as the shift from a primarily domestic process to a process featuring an equal to greater contribution of GRAS Notifications from companies outside the US. Analysis of the first 600 GRAS Notifications revealed a number of interesting trends regarding the inclusion and composition of GRAS Expert Panels; differences in notifications for substances with nutritive, processing aid, or effect; and the duration of GRAS Notifications. The review of FDA warning letters associated with GRAS issues provides additional insight into GRAS notices, from the perspective of ongoing post-market emphasis on food safety with the implementation of the GRAS Final Rule.

Predictions of yield for the globe's major grain and legume arable crops suggest that, with a moderate temperature increase, production may increase in the temperate zone, but decline in the tropics. In total, global food supply may show little change. This security comes from inclusion of the direct effect of rising carbon dioxide (CO2) concentration, [CO2], which significantly stimulates yield by decreasing photorespiration in C3 crops and transpiration in all crops. Evidence for a large response to [CO2] is largely based on studies made within chambers at small scales, which would be considered unacceptable for standard agronomic trials of new cultivars or agrochemicals. Yet, predictions of the globe's future food security are based on such inadequate information. Free-Air Concentration Enrichment (FACE) technology now allows investigation of the effects of rising [CO2] and ozone on field crops under fully open-air conditions at an agronomic scale. Experiments with rice, wheat, maize and soybean show smaller increases in yield than anticipated from studies in chambers. Experiments with increased ozone show large yield losses (20%), which are not accounted for in projections of global food security. These findings suggest that current projections of global food security are overoptimistic. The fertilization effect of CO2 is less than that used in many models, while rising ozone will cause large yield losses in the Northern Hemisphere. Unfortunately, FACE studies have been limited in geographical extent and interactive effects of CO2, ozone and temperature have yet to be studied. Without more extensive study of the effects of these changes at an agronomic scale in the open air, our ever-more sophisticated models will continue to have feet of clay.

Since 2016, Ethiopia has passed several proclamations and directives to regulate the promotion of commercial breastmilk substitute (BMS). Ethiopia's market potential will undoubtedly be the gravitating point for international infant formula companies due to growing urbanization, purchasing power, population, and the relatively low use of BMS to-date. The aim of this review is to assess the strengths and weaknesses of the existing laws, standards, and monitoring documents used to regulate the marketing of BMSs in Ethiopia and make future recommendations. The study findings highlighted that the regulation on marketing are comprehensive and strong to limit the promotion of infant formula. On the other hand, the regulation on marketing of follow-up formulas, complementary foods, and growing-up milk by manufacturers and distributors, media houses, and communication and advertisement agencies are underregulated, especially with regards to the international 69.9 regulation. The monitoring and enforcement of the existing marketing regulations remain limited in the absence of a formal coordination mechanism. Several violations of the national BMS regulations were observed. Forty-one percent of mothers reported observing the BMS advertising and logos were detected in 36% of health facilities assessed. In 100% of cases, the infant formula labels contained violations. As the lead national authority mandated to regulate food safety, the Ethiopian Food and Drug Authority needs to update its regulations related to the marketing of BMS to fill the loopholes and revise the national law in line with the international code of marketing of BMSs to protect breastfeeding.

Since the discovery of α-glucosidase inhibitors and their inhibitory effects on the digestion of carbohydrates, promising results have been obtained as to the antidiabetic effects of this family of compounds. Antiangiogenic compounds have been identified that suppress tumor growth via a unique mechanism, confirming that such compounds can act as clinically applicable anticancer agents. Lipid peroxidation and lipid glycation have been suggested to play roles in food deterioration and in the pathophysiology of human diseases such as atherogenesis and diabetes, and antioxidative and antiglycative compounds can potentially be used in the prevention of food deterioration as well as to treat disease. On this basis, this review describes studies of α-glucosidase inhibition by mulberry 1-deoxynojirimycin, antiangiogenic effects of rice bran tocotrienol, and membrane lipid peroxidation/glycation and its inhibitors. These studies are ongoing in our work, with an emphasis on analytical techniques.

Drug nanosuspensions are very promising for enhancing the dissolution and bioavailability of drugs that are poorly soluble in water. However, the poor stability of nanosuspensions, reflected in particle growth, aggregation/agglomeration, and change in crystallinity state greatly limits their applications. Solidification

of nanosuspensions is an ideal strategy for addressing this problem. Hence, the present work aimed to convert drug nanosuspensions into pellets using fluid-bed coating technology.

It is important that hangover products are both safe and effective. The aims of the current study were to evaluate (a) the ingredients of currently marketed hangover treatments, (b) whether companies make disease modification claims for these products, and (c) the extent and quality of any independent scientific evidence on their efficacy and safety. Of eighty-two hangover products identified, the most common ingredients were vitamin B, vitamin C, milk thistle extract (silymarin), dihydromyricetin (DHM), and N-acetyl L-cysteine (NAC), often in combination. Fifty-one products (62.2% of the 82 evaluated products) contained one or more vitamins of which the dose exceeded the corresponding daily recommended intake level. For 9 (28.1%) of 32 products that reported the dose of Vitamin B3 and 2 (8.0%) of 25 products that reported the dose of Vitamin B9 the corresponding tolerable upper intake level was exceeded. Further, in many other cases the dose of other ingredients was not reported (e.g., dosages of DHM and NAC were not reported by 59% and 73% of the products containing these ingredients), and corresponding tolerable upper limits are unknown. A review of scientific literature revealed no peer-reviewed human data demonstrating either safety or efficacy of any of the 82 evaluated hangover products. Further, the product name and/or package/insert included explicit disease modification claims in 64.6% of the products. Finally, 45.1% of the products contain NAC as an ingredient. As NAC is registered as a drug by the US Food and Drug Administration (FDA), it is prohibited as an ingredient in dietary supplements or foods. We conclude that, in the interest of consumers, independent research supporting the safety and efficacy of hangover treatments should be a minimum requirement for hangover treatment claims irrespective whether the products are registered as medicinal drugs or dietary supplements.

Ready-to-eat (RTE) foods have been considered to be reservoirs of antibiotic resistance bacteria, which constitute direct threat to human health, but the potential microbiological risks of RTE foods remain largely unexplored. In this study, the metagenomic approach was employed to characterize the comprehensive profiles of bacterial community and antibiotic resistance gene (ARG) in 18 RTE food samples (8 RTE meat, 7 RTE vegetables and 3 RTE fruit) in southern China. In total, the most abundant phyla in RTE foods were Proteobacteria, Firmicutes, Cyanobacteria, Bacteroidetes and Actinobacteria. 204 ARG subtypes belonging to 18 ARG types were detected with an abundance range between 2.81×10^{-5} and 7.7×10^{-1} copy of ARG per copy of 16S rRNA gene. Multidrug-resistant genes were the most predominant ARG type in the RTE foods. Chloramphenicol, macrolide-lincosamide-streptogramin, multidrug resistance, aminoglycoside, bacitracin, tetracycline and β-lactam resistance genes were dominant, which were also associated with antibiotics used extensively in human medicine or veterinary medicine/promoters. Variation partitioning analysis indicated that the join effect of bacterial community and mobile genetic elements (MGEs) played an important role in the resistome alteration. This study further deepens the comprehensive understanding of antibiotic resistome and the correlations among the antibiotic resistome, microbiota, and MGEs in the RTE foods.

In the context of a food product label, the term "claim" refers to information that attributes value to the product. The term extends to many different types of information, from product identity, descriptors of intended use, and identification of characteristic properties to the physiologic effects in the body of substances in the food, including the reduction of risk of disease. Food labeling, which includes claims, provides information that consumers want and use to improve their diets. Consumers prefer short statements on the front label claims to longer, more detailed information, including ingredients statements and a nutrition panel. Three types of claims are permitted in the United States. Nutrient content claims describe the level of the nutrient in the food relative to an established daily value, e.g., "Excellent source of choline," and are subject to composition limits for other nutrients, such as total fat, saturated fat, and cholesterol. Health claims describe the relation between a food substance and the risk of disease, e.g., "Adequate calcium and vitamin D throughout life, as part of a well-balanced diet, may reduce the risk of osteoporosis."

They must undergo a premarket evaluation by the FDA to ensure that there is significant scientific agreement about the relation in question. The third type of claim, structure-function (SF) claims, has recently come under scrutiny, particularly regarding their use on infant formula. Such claims represent a food's effect on the structure or function of the body for maintenance of good health and nutrition. These claims must be truthful and not misleading, but are not subject to premarket approval before use. The purpose of this perspective is to describe the origins and unique niche of SF claims, and to comment on recent proposals to further regulate such claims on infant formula.

The recently discovered SCFA-activated G-coupled protein receptors FFA receptor 2 and FFA receptor 3 are co-localised in l-cells with the anorexigenic 'ileal brake' gut hormone peptide YY, and also in adipocytes, with activation stimulating leptin release. Thus, SCFA such as acetate and propionate show promise as a candidate to increase satiety-enhancing properties of food. We therefore postulate SCFA may have a role in appetite regulation and energy homeostasis. SCFA can be delivered either directly within food, or indirectly via the colon by the provision of fermentable non-digestible carbohydrates. A review of studies investigating the effects of oral SCFA ingestion on appetite suggests that while oral SCFA ingestion is associated with enhanced satiety, this may be explained by product palatability rather than a physiological effect of SCFA. Colon-derived SCFA generated during microfloral fermentation have also been suggested to explain satiety-enhancing properties of non-digestible carbohydrates. However, findings are mixed from investigations into the effects of the prebiotic inulin-type fructans on appetite. Overall, data presented in this review do not support a role for SCFA in appetite regulation.

This study investigated the influence of an organic mineral-supplemented broiler diet on the quality of nuggets. The resulting chicken nuggets were enriched with inorganic and organic forms of Zn and Se. The nuggets were processed by incorporating extracts from food industry by-products (rosemary [R_H and R_L], hydroxytyrosol [HYT], pomegranate [P], grape [GS], and Harpagophytum [H]). The physiochemical, microbiological, and sensory characteristics of the chicken nuggets were evaluated over a 12-month period of frozen storage. The addition of natural extracts did not affect the pH, proximate composition, or color (CIELab) of the nuggets among samples. However, significative differences were found between month of analysis (range from pH 6.16 to 6.63; luminosity from 62.51 to 84.74; redness from 0.16 to 7.14; and yellowness from 10.80 to 33.77). In addition, the combination of phenolic compounds with Zn and Se retarded microbial growth and reduced protein and lipid oxidation, thus maintaining the sensory quality and extending the shelf life of this product. For instance, the combination of R_L + GS reduced in 75% the microbiological growth regarding the control sample (C), while samples that incorporated R_H + P or HYT + P + H presented 50% less than C. In addition, upon only incorporating organic minerals Zn and Se, microbiological deterioration is reduced in 15%. This mix was significantly effective at reducing the oxidative reactions of lipids and proteins by 40% and 50%, as measured after 9 and 12 mo of frozen storage, respectively. The addition of the natural extracts and Zn and Se did not adversely affect the acceptability of the meat product.

Evidence mapping is a useful methodology for characterizing existing research on a broad topic and identifying gaps in the scientific literature. Evidence mapping entails conducting a systematic literature search and extracting information on study details, often in the form of a database. Researchers at Tufts University and the North American branch of the International Life Sciences Institute created the Diet-Related Fibers & Human Health Outcomes Database, which is publicly available and updated annually. The database captures intervention studies examining dietary fiber and 10 predefined physiological health outcomes, including weight/adiposity, blood pressure, gut microbiota, and bone health. The database and subsequent potential for evidence mapping may be particularly useful in light of new food labeling requirements by the US Food and Drug Administration that require fibers to have accepted scientific evidence of a physiological health benefit in order to be labeled as "dietary fiber." Following the success of the fiber database, Tufts University and the General Mills Bell Institute of Health and Nutrition collaborated

to develop a whole grain database and evidence map. This work successfully highlighted the need for better consistency in how whole grains are reported with respect to amount and type of whole grains and intervention compliance.

This study examined total usual micronutrient intakes from foods, beverages, and dietary supplements (DS) compared to the Dietary Reference Intakes among U.S. adults (≥19 years) by sex and food security status using NHANES 2011-2014 data (n = 9954). DS data were collected via an in-home interview; the NCI method was used to estimate distributions of total usual intakes from two 24 h recalls for food and beverages, after which DS were added. Food security status was categorized using the USDA Household Food Security Survey Module. Adults living in food insecure households had a higher prevalence of risk of inadequacy among both men and women for magnesium, potassium, vitamins A, B6, B12, C, D, E, and K; similar findings were apparent for phosphorous, selenium, and zinc in men alone. Meanwhile, no differences in the prevalence of risk for inadequacy were observed for calcium, iron (examined in men only), choline, or folate by food security status. Some DS users, especially food secure adults, had total usual intakes that exceeded the Tolerable Upper Intake Level (UL) for folic acid, vitamin D, calcium, and iron. In conclusion, while DS can be helpful in meeting nutrient requirements for adults for some micronutrients, potential excess may also be of concern for certain micronutrients among supplement users. In general, food insecure adults have higher risk for micronutrient inadequacy than food secure adults.

In the context of the professionalization of ancient medicine, the Hippocratic authors started to address the difference between food and medicine. They saw, however, some advantage in acknowledging the continuum between food and medicine. Scholars should avoid drawing too strict a boundary between ancient dietetics and pharmacology and should instead adopt a multi-disciplinary approach to the therapeutics of the Hippocratic texts.

Government, academia, and the food industry can play a significant role in the identification of healthy foods and ingredients important for weight management and health. The U.S. Food and Drug Administration developed regulations that define specific food categories for weight management and health. These categories include foods for special dietary uses and medical foods. Medical foods are classified for use in specific disease states and require a physician's recommendation and continuous monitoring. The European regulations specify energy-restricted foods as a subcategory of food for particular nutritional uses, which includes infant formula, medical foods, and foods for sports. European standards for energy-restricted diets have been established, leaving little flexibility for change. Three categories exist (i.e., very-low-calorie diets [450 to 800 kcal], low-calorie diets [800 to 1200 kcal], and meal replacements [200 to 400 kcal]). No claims on anticipated weight loss can be made even where significant clinical research has demonstrated long-term efficacy, thereby preventing informed choice management. Dramatic changes in lifestyle (e.g., disruption of the family unit, altered eating occasions, fast foods, and food grazing) have resulted in an epidemic of obesity and chronic disease. Regulating food selection or dietary patterns to limit the epidemic is not realistic. However, stimulating government health agencies and the food industry to increase public awareness through educational programs and regulating the definition of acceptable methods and products can provide an environment for change. A consensus is needed among academia, government, and industry for appropriate food labeling and claims. These actions are needed to help individuals make healthy food selections and maintain a healthy weight. Public health initiatives should change consumer attitudes with programs that are simple, affordable, effective, and accessible.

One of the hazards involved in the use of antibiotics in animal feeds is that it may lead to the development of bacterial drug-resistance. An analysis of the phenomenon shows that this possibility largely depends on the size of the bacterial populations involved and on the possibility of selective multiplication of the resistant mutants that may be present. Additional factors involved in the development of resistance are the

type of drug applied and the time during which the bacteria are in contact with it.Animal experiments and general practical experience show that resistance, especially in E. coli, Salm. typhimurium and Staph. aureus, may considerably increase as higher doses are added to the feed. Therefore, the lowest effective level for growth promotion (5-20 p.p.m. of penicillin or tetracycline) is to be preferred over higher levels.AS TO THE PRACTICE OF FOOD PRESERVATION BY MEANS OF ANTIBIOTICS, A DANGEROUS SITUATION MAY ARISE IF TWO FACTORS COMBINE: emergence of bacterial resistance in Salmonella and perhaps other pathogenic bacteria in the animal as a result of the addition of a certain antibiotic to feeds, and subsequent use of the same substance for preservation of the meat.

Food spoilage makes foods undesirable and unacceptable for human use. The preservation of food is essential for human survival, and different techniques were initially used to limit the growth of spoiling microbes, e.g., drying, heating, salting, or fermentation. Water activity, temperature, redox potential, preservatives, and competitive microorganisms are the most important approaches used in the preservation of food products. Preservative agents are generally classified into antimicrobial, antioxidant, and anti-browning agents. On the other hand, artificial preservatives (sorbate, sulfite, or nitrite) may cause serious health hazards such as hypersensitivity, asthma, neurological damage, hyperactivity, and cancer. Thus, consumers prefer natural food preservatives to synthetic ones, as they are considered safer. Polyphenols have potential uses as biopreservatives in the food industry, because their antimicrobial and antioxidant activities can increase the storage life of food products. The antioxidant capacity of polyphenols is mainly due to the inhibition of free radical formation. Moreover, the antimicrobial activity of plants and herbs is mainly attributed to the presence of phenolic compounds. Thus, incorporation of botanical extracts rich in polyphenols in perishable foods can be considered since no pure polyphenolic compounds are authorized as food preservatives. However, individual polyphenols can be screened in this regard. In conclusion, this review highlights the use of phenolic compounds or botanical extracts rich in polyphenols as preservative agents with special reference to meat and dairy products.

Nutrition interventions may have favourable as well as unfavourable effects. The Maternal and Infant Nutrition Interventions in Matlab (MINIMat), with early prenatal food and micronutrient supplementation, reduced infant mortality and were reported to be very cost-effective. However, the multiple micronutrients (MMS) supplement was associated with an increased risk of stunted growth in infancy and early childhood. This unfavourable outcome was not included in the previous cost-effectiveness analysis. The aim of this study is to evaluate whether the MINIMat interventions remain cost-effective in view of both favourable (decreased under-five-years mortality) and unfavourable (increased stunting) outcomes.

With the growing popularity of the functional food market, bioactive ingredients from natural sources are discovered one after another for their ability to promote better health and prevent chronic diseases. Emulsion, widely occurring in many food systems, has become a popular vehicle to facilitate the incorporation of bioactive components into the food system. Depending on the designated functionality, an emulsion can be developed with various physical and chemical properties. To ensure the successful development of a high-quality emulsion-based system to serve their purpose in food, knowledge of the analytical methods that could efficiently evaluate their quality parameters is important for investigators who work in this field. In this work, important emulsion properties are overviewed, and techniques that are commonly used to assess them are provided. Discussions and recommendations are also included to make suggestions on advantages and disadvantages when selecting suitable techniques and methods to characterize these quality parameters of emulsion systems.

Mesoporous silica particles (MSP) are structures of silicon dioxide arranged so that they are able to create pores between 2 and 50 nm. The high volume of pores and the internal surface of the MSP make them excellent supports for the encapsulation of bioactive molecules. In addition, the possibility of including molecules acting as molecular gate onto their outer surface allows the design of smart delivery systems.

Gated-MSP show "zero release" of the encapsulated molecule, but after the application of a specific external stimulus, the cargo is released as a specific response to the stimulus. This article describes the features of the MSP used in the encapsulation of bioactive compounds, the most important molecular gates to create controlled release systems, as well as examples of application of MSP for the encapsulation and controlled release of food ingredients and nutraceuticals. These applications include the modulation of the bioaccessibility of food ingredients or nutraceuticals as well as the protection of their stability against external agents degradation.