PFNDAI

FOOD, NUTRITION & SAFETY MAGAZINE

BULLETIN JUN 2025

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Prof Jagadish Pai

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PFNDAI Bulletin JUN 2025

FOOD, NUTRITION & SAFETY MAGAZINE

Editor: Dr. J. S. Pai

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CSR FOR FOOD PROCESSING COMPANIES

Corporate Social Responsibility (CSR) provisions mandate big companies to spend every year at least 2% of their net profits on permitted CSR activities under Schedule VII.

The permitted activities include those concerning education, gender equality, environment, national heritage, armed forces veterans, sports, PM funds, R&D incubators etc., public funded educational & research institutes, rural development, slum development, disaster management and most importantly, Eradication of Poverty, Hunger & Malnutrition etc. from our point of view.

We have still a very large section of people who are undernourished and deficient in many essential nutrients. Among all people, deficiency affects children the most. Not only is their growth is stunted physically, their mental development is severely affected. This is especially when they are at learning stage, not just during first few years but also during their schooling.

The governmental agencies have realized this and have started some decades ago the mid-day meals. However, these only partially takes care of their needs as many essential nutrients especially the micronutrients are not adequately supplied.

A few years ago, PFNDAI tried some trials and developed some baked foods containing fortified with iron and B vitamins and using some ingredients that would provide some essential micronutrients. Our young scientists prepared excellent tasty and nutritious snacks which were tried in school. The children loved them.

Unfortunately, we could not take a long-term trial as we did not get approval from the school authorities as we were told this would show inadequacy of the mid-day programme they already had.

Anyway, there is a need for some such activity in schools, if not where mid-day meal programme is there but in other schools especially in rural areas. This is where food companies can participate under the CSR activities.

There are many large food manufacturers especially in baked foods manufacturing having excellent R&D and manufacturing facilities with distribution even in small rural towns.

They can prepare excellent tasty and nutritious foods that could be supplied to children in schools, with or without mid-day meal programme.

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- Spices, Condiments and its products
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- Oil seed, oils and its produts
- Sweets.,confectionary and its products
- Bakery products
- Sugar, Honey & jaggery
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- Water
- Ready to eat
- Infant substitute
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- Pesticide residues, PAH, PCB's
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- Natually occurring toxins(NOT,s)
- Heavy metals and minerals
- Minerals & Toxic heavy metals
- Vitamins
- Antibiotics / Residues
- Food Adulteration tests
- Food additives, preservetives and artificial sweetners
- Synthetic food colour
- Antioxidents
- Packaged Drinking analysis as per IS 14543
- Drinking water as per IS 10500
- Process water IS 4251
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SYSTEMS ARE MANAGED BY COMPETENCE RATHER THAN COMPLIANCE

AUTHOR
Dr Joseph I Lewis,
Chairman, Scientific Advisory Committee, PFNDAI

Food systems encompass all processes and infrastructure involved in feeding a population. The expression "farm to fork" includes the entire process, from production and processing to transportation, distribution and retailing to consumption. Systems thinking is knowing that nothing happens in isolation and that every action has consequences. While each works within its boundaries, incompetence or failure in one part allows the onward flow of a flawed or defective product. When traces of ethylene oxide (EtO) were found in spice mixes, brand owners reiterated their compliance with standards instead of introspecting on how EtO could have entered the supply chain. All too often, compliance becomes the destination.

Compliance is point-in-time testing; repeated *ad nauseam* gives an illusion of control. The thinking is that, as employees are pushed through training modules, safety protocols (tick-boxes), or auditor approvals, all will be well until a failure occurs. Often, brand owners are surprised by market failures because changes in materials and workforce capabilities anywhere in the supply chain operate below their surveillance radar. Many mistakenly believe that training and certification elevate compliance to competence. They are certainly linked, but not the same. Compliance refers to following a set of norms or specifications, whereas competence is about the application of skills, knowledge, and experience of relevant science and technology.

To implement a competency model, business and regulatory leadership must first acknowledge that testing a single product cannot ensure consumer safety. This is a false hypothesis. A competency framework begins with accurately assessing resident knowledge, identifying skill gaps, and creating targeted learning programs. For experiential learning, knowledge assets should be tested against real-time food failures that reach the market undetected: do they know how and why these failures occurred?

Competence is not a mechanical comparison with standards, but what can go wrong beyond standards: this is risk assessment. The workforce and senior management assemble periodically to validate experience and track ongoing proficiency: this is risk management. More than compliance, an evidence-based approach protects consumers and a business's brand reputation. Products conforming to standards or manufactured by generally accepted good practices represent minimal expectations from industry.

Cont'd

Continued from Editorial

They can monitor the health and growth of the children including the mental health. This would certainly be extremely valuable to the children. The companies also have many processing units in rural areas or have third party manufacturing units.

If they do not want to interrupt their regular manufacturing for this purpose, they can ask these units to take care of these productions. This will go a long way in achieving their social responsibility and at the same time also achieve one of the greatest tasks needed in our country urgently.

Although some critics of food industry may not like this but they won't be able to show that these products are just tasty as they would be healthy and highly nutritious. The CSR program incentivises public-private partnership funding and can also benefit from industry expertise in formulating nutritious food; however, implementation hurdles exist in sectors like schools, which need reform.

Prof Jagadish Pai, Editor, PFNDAI

REGULATORY VIEWPOINT

Continued from Regulatory Viewpoint

However, traditional compliance thinking is comforting: what is written is what will be done, and what is done will be audited; failure thereafter is attributed to extraneous circumstances.

Reaction to failures has a standardised regulatory response. In the case of the spice controversy, despite knowing EtO is used as a fumigant/ sterilising agent, there was no data to refute its presence or absence in the spice supply chain: no one was testing for an extraneous hazard.

Under a preventive risk-based competency mindset, this would raise a red flag and be acted upon. Immediately after the event, the Spice Board issued comprehensive guidelines on preventing ethylene oxide (EtO) contamination in spices exported from India. Reacting so quickly indicates some awareness of its prevalence.

Instead of tracing how hazards enter supply chains, more regulations are issued, and then we move on. With no learning from failures, complacency sets in. Where are we on the scale: compliant, complacent or competent?

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INDUSTRIAL APPLICATIONS OF PROTEINS

AUTHOR
Dr Shashank Bhalkar,
Executive Director,
PFNDAI

There is a growing interest in Proteins as nutritional and functional ingredients from the food manufacturers. Proteins are one of the very important macronutrients, playing many biological functions in the body. They are complex substances made up of small units called amino acids. They are building blocks of the body and play a role in growth, tissue repair, and maintenance. Many biologically important compounds, such as enzymes, hormones, and immune factors, are formed by proteins.

Because of the large molecular structure and amphoteric nature, they display a range of unique functional properties such as emulsification, gelation, foaming, and binding. This makes them useful in product applications like ice cream, beverages, and cheeses. Their role in nutrition and as an important dietary constituent makes them an important ingredient in the development of food products. This makes proteins useful in a variety of applications in food products, and therefore, they are an important tool for product developers.

Techno- functional properties of the proteins: (1)
Extracted proteins are used as the ingredients for functional and Nutritional properties. They are extracted from natural sources by physical and chemical methods. This is done by the removal of other non-protein fractions such as carbohydrates, fats, and minerals. They could be protein concentrates, isolates, or hydrolysates.

Emulsification: Proteins have emulsifying ability by stabilizing oil in water or water in oil emulsions. This is achieved by forming a protective layer around fat droplets, preventing their coalescence. Typical examples are mayonnaise, salad dressings, and creamy sauces.

Foaming: Proteins create and stabilise foams by entrapping air or gas bubbles within the protein matrix. Aerated foods such as meringues, sauces, whipped toppings, and even ice creams are some of the applications.

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Gelling: Many proteins form gels under the appropriate conditions. They undergo structural rearrangement, forming a three-dimensional network that entraps water or other liquid components. Gelling gives a product stability, texture, and sensory attributes. Examples could be protein bars, jellies and gelled desserts,

Water binding capacity: This property of proteins helps improve moisture retention and juiciness of the product. This is important in meat products where the proteins retain water while cooking, and therefore reduce cooking loss and retain desired texture.

Texture modification: Proteins form a network and hence modify the texture. Typical examples are baked goods like bread, where the gluten structure is responsible. Other examples are pasta or meat analogues, where proteins play a role in the desired texture or bite.

Solubility and dispersibility: This property of proteins is displayed depending on the different food systems. This property helps proteins with their functional behaviour. Soluble proteins find applications in protein fortified beverages, and the dispersibility becomes important for the powder formulations.

Heat-induced coagulation: Many proteins undergo coagulation or denaturation when heat is applied. This makes them find applications such as meat patty, protein-based baked goods,
Coagulation imparts texture and stability to the products.

Enzyme activity: Some proteins have enzymatic activity. Enzymes are biocatalysts and act at their optimum pH and temperature, and are specific to substrates. They transform products and have innumerable applications in food products. The following are some of the common applications.

A. Dairy industry: Chymosin is the enzyme responsible for the coagulation of milk as it acts on Casein to form a curd in cheese processing. In yoghurt and cultured milk products, the lactic acid bacteria produce their enzymes, which convert lactose into lactic acid, contributing to the sour taste and thickening of the milk. Lactase enzymes can be used to prepare lactose-free milk. Amino peptidases are responsible for the flavour development of the dairy products because they release amino acids.

B. Bakery Industry: Proteases and amylases are commonly used to break down protein and starch in the dough, which helps relax the gluten network and enhance the workability of the dough. Fungal proteases modify gluten in the dough, resulting in improved dough elasticity and increased gas retention. Enzymes can improve the texture of bakery products. Xylanases and cellulases modify the structure of fibre, leading to improved texture, moistness, and softness in the bread. Amylases and hemicellulases break down starch and non-starch carbohydrates that help reduce retrogradation and staling and improve shelf-life. Enzymes like proteases, amylases, and cellulases help gluten-free baking that improve texture, volume and shelf-life of these products.

C. Juice Industry: The yield of the fruit juice can be enhanced by the use of Pectinase. Proteinases and Pectinases are also used for the clarification of juices. Enzymes like beta-glucosidase release aromatic compounds by hydrolysing glycosidic bonds, thereby enhancing the flavour of the juice. The undesired enzymes, like polyphenol oxidase and peroxidase, are inactivated by heat or enzyme treatment.

D. Brewing industry: Alpha and beta amylases are used during mashing, whereby starch in the grains is converted into fermentable sugars like maltose. Enzymes are useful in wort clarification.

Proteinases break down proteins responsible for haze in the beer. Beta-glucanases break down beta-glucans that contribute to viscosity and filtration challenges. Adjunct grains like corn and rice used in beer manufacturing are converted to simple sugars by using amyloglucosidase.

E. Meat processing: Papain and bromelain are used to tenderise meat. Proteases and lipases enhance the flavour of fermented aged meats. Enzymes such as nitrate reductase are used in ham, bacon and sausages. They convert nitrate or nitrite into nitric oxide, which react with myoglobin to produce a stable pink colour. Lean meats are produced by using lipolytic enzymes. The enzymes break down the fat into glycerol and free fatty acids, leading to the extraction and separation of fats.

Plant proteins and their product applications: (2)

With the environmental concerns of growing animal proteins and tremendous requirements of proteins given the growing world population, plant proteins are gaining a lot of importance.

The nutritional quality of proteins depends on their digestibility, amino acid profile, bioavailability, processing, and purity. Soy protein isolates are of superior quality, as the PDCAAS is 1. They can form an important ingredient for the protein supplements in adults and infant formulae in case of lactose-intolerant individuals. Soy isolates or concentrates also find application in weight management and sports nutrition products, as well as protein bars.

The Leguminous proteins, like soy, are deficient in sulfur-containing amino acids. Whereas cereals lack Lysine. The combination of these two will be an important strategy for food fortification to get an appropriate amount of essential amino acids. An addition of 30% faba bean flour (protein content 37.5%) increases bread proteins from 11.5 to 16.5% on a dry basis.

Texturised vegetable proteins (TVP): (3) (4)

This is another important application of proteins, where high-protein snacks can be manufactured. They can be produced from lentils, faba beans,or peanut cake after oil extraction. They are rich in fiber and protein.

They can form ingredients in plant-based chilly mixes and veggie burgers as meat substitutes. With rising demand they are now made into a wider range of products using soy flours, concentrates, isolates, other cereal and legume proteins. Several types of TVP are present in the market based on their applications:

- High-protein snacks
- Chunk style TVP
- Structured Meat analogue (SMA)
- Fibrous vegetable proteins
- High Moisture Meat analogue (HMMA)
- Low Moisture Meat analogue (LMMA)
- Textured Meat Protein (TMP)

Protein hydrolysates:

(5)Proteins are hydrolysed by enzymes or Acid/ Alkali. The hydrolysates prepared can display excellent functional properties. The solubility of proteins can be significantly improved. Thus, Soy hydrolysates soluble over a wide range of pH (2 – 9) can be produced, which can have applications depending upon the product requirements, say, fruit juices.

Emulsification properties can be improved by limited hydrolysis by exposing hydrophobic amino acid residues to oil and hydrophobic with water. Foaming capacity increases with hydrolysis, which can give a unique texture to food and beverages like beer, champagne, and ice cream.

Protein hydrolysates and bioactive peptides: (6)

Short-chain peptides are found to be more efficiently utilised compared to an equivalent mixture of amino acids. Recently, there has been growing interest in the novel Bioactive peptides that are being continuously discovered.

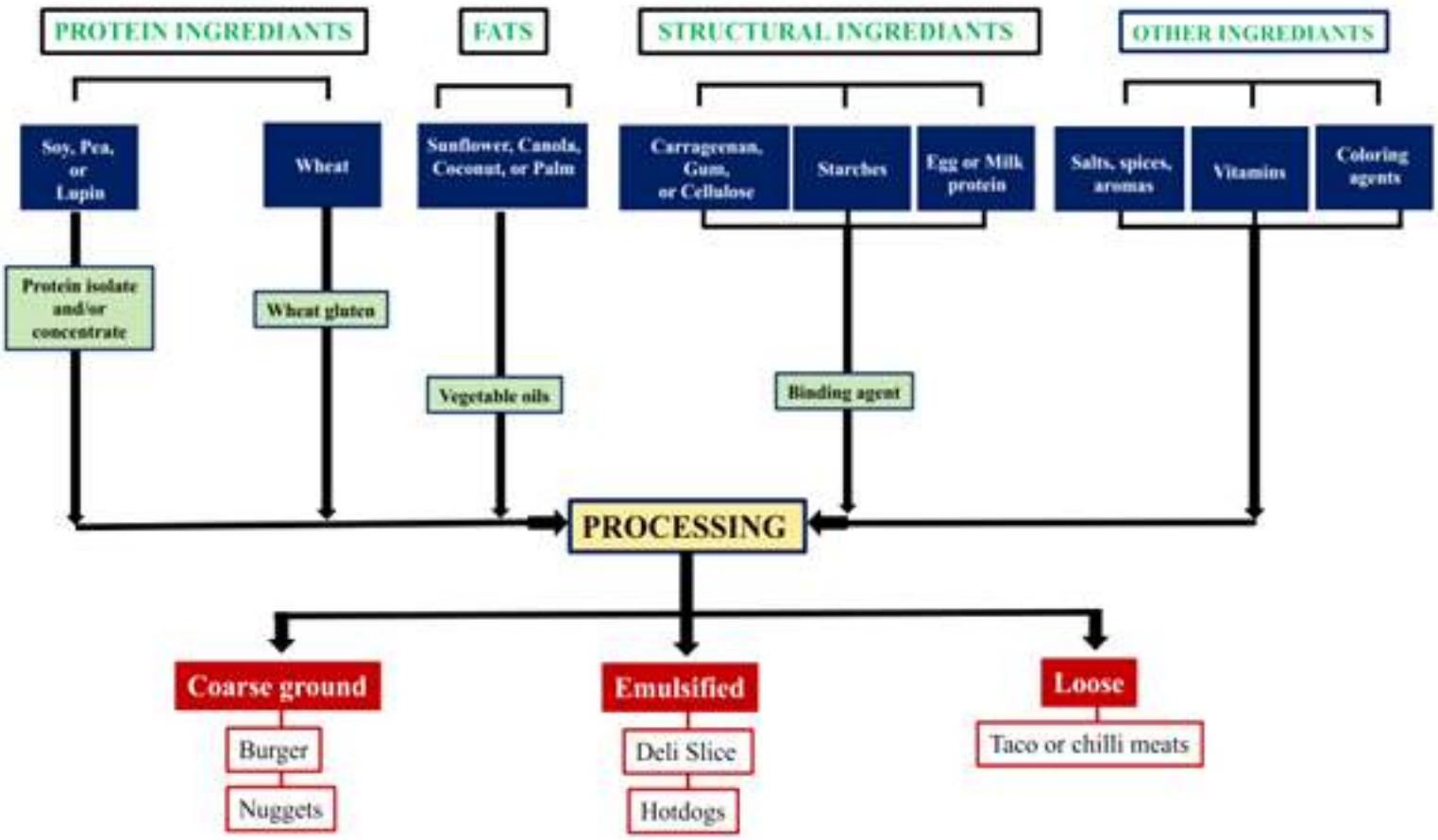
Originally, they are found within the bigger protein molecules and do not exhibit physiological activity. They become active after the cleavage of the parent protein by enzymatic hydrolysis. They have bioactivity, which makes them useful in many applications.

These compounds have medicinal, cosmetic, and nutritional properties. Bioactive peptides with biogenic, opioid, immunomodulatory, salt/metal binding, anti-hypertensive, and antimicrobial properties are produced by enzymatic hydrolysis.

Various animal, plant, and microbial sources are used to derive Bioactive Peptides. Animal sources such as Blood from slaughterhouses, meat and aquatic animals, Camel/ goat milk, eggs, fish are used. Commonly used plant sources are soy, gluten, or by-products like Brewer's Spent Grain, wheat bran, and Okara.

Meat analogues: (7)

With growing veganism and awareness of the advantages of plant-based proteins, products like meat analogues are gaining importance. In the manufacturing of the meat analogues, protein ingredients, fat, structural ingredients, and other



ingredients consisting of spices, salts, flavours with vitamins and colouring agents, are processed together to get a variety of final products depending on applications. The following diagram will explain the process of how these different products are obtained.

Edible films and coatings: Edible films are used to encase the food product, and edible coatings are directly applied to food. These films and coatings prevent water vapour transfer, prolong the shelf life, and provide foods with acceptable aroma, colour, taste and texture. Edible films and coatings can be fabricated with proteins, polysaccharides (Starch, alginate, cellulose, pectin, chitosan), lipids (wax, fatty acids, acylglycerols), or a combination of these.

Protein-based materials are more appealing than others because of their higher tensile strength. They have a strong capacity for intermolecular interaction. Different proteins have their unique structure with different functional properties. Both plant and animal proteins are used for this purpose. Protein properties like solubility, molecular weight, and isoelectric point are crucial for their application in edible films and coatings. Among plant proteins, wheat proteins, soy protein isolates, corn protein, pea protein, and sunflower seed proteins are used. In the animal proteins, whey protein isolate, sodium caseinate, collagen and gelatin, myofibrillar proteins, and egg white proteins are used.

Many bioactive compounds are coated with different protein materials, which gives them stability. They are probiotics, prebiotics, and symbiotics. They can be phenolic compounds like gallic acid, anthocyanins, and catechin.

The following methods are used for the manufacture of coatings and films with bioactive compounds:

- Solvent casting: Protein is dissolved in a suitable solvent, aqueous solution of salt and acid bases in case of globular proteins or an aqueous solution in the fibrous proteins. pH is adjusted if necessary. Bioactive compounds are added. The film is formed after drying

- Extrusion: different protein sources such as egg white, soy, zein, gelatin or pea can be used. In the barrel extrusion method, the temperature is kept between 85 – 150-degree C. Typical extruder set up with screen pack to control the residence time. The pulling station is chilled to collect the film.

Edible coating is achieved by two methods, dipping and spraying, using a suitable plant or animal protein source. Gelatin has been widely used to keep persimmon, tomato, cherry, bread and other fresh foods.

Encapsulation: Freeze drying is extensively used for encapsulation for substances susceptible to heat. These include bioactive substances such as vitamins, antioxidants, and natural colours. Encapsulation can also be done by the coacervation, spray drying and electrospinning methods.

Proteins,because of their unique characteristics, have a wide range of applications in nutritional and other product applications. They display many functional properties. This makes them a very important tool for food scientists and product developers.

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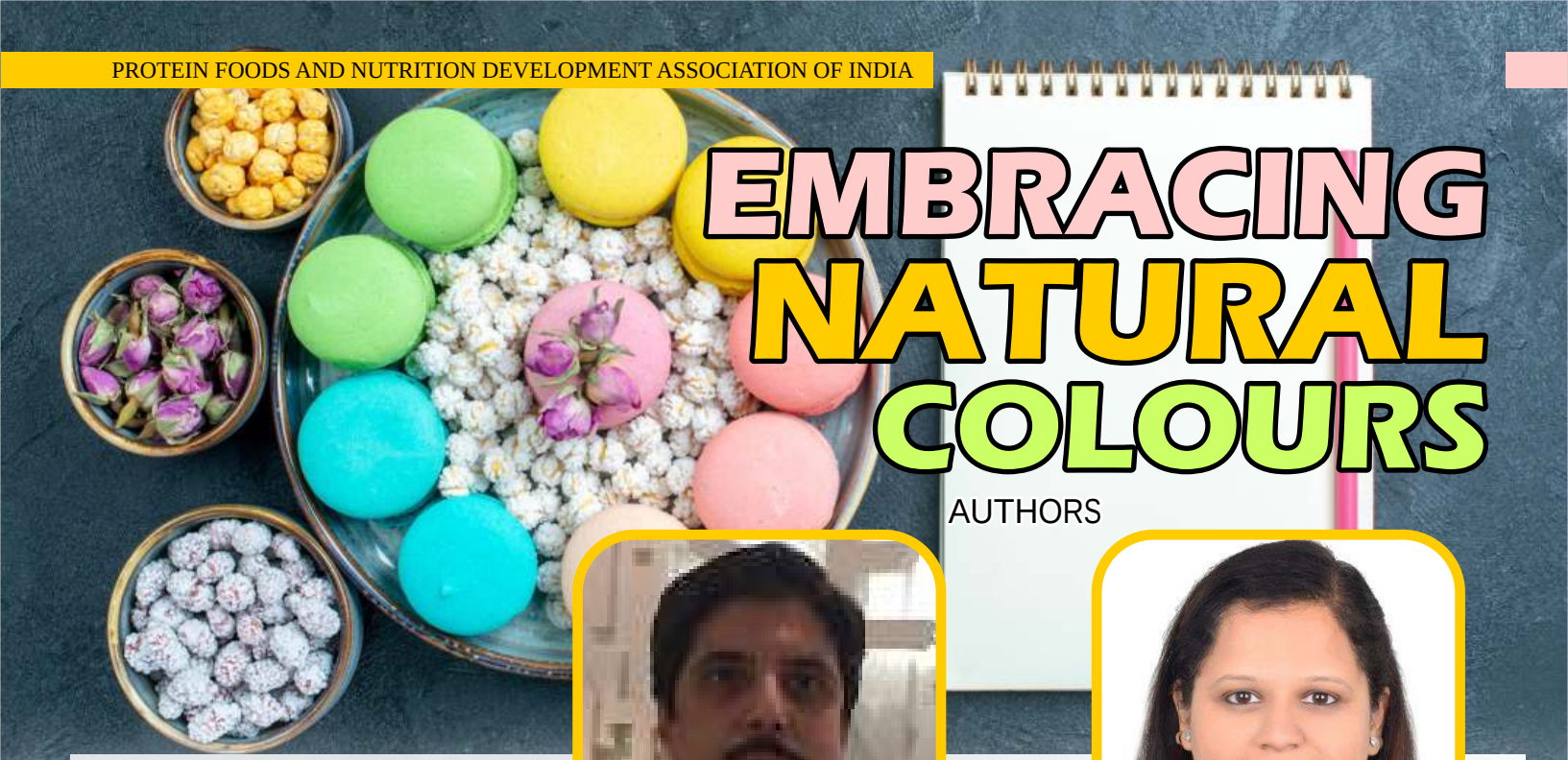

EMBRACING NATURAL COLOURS

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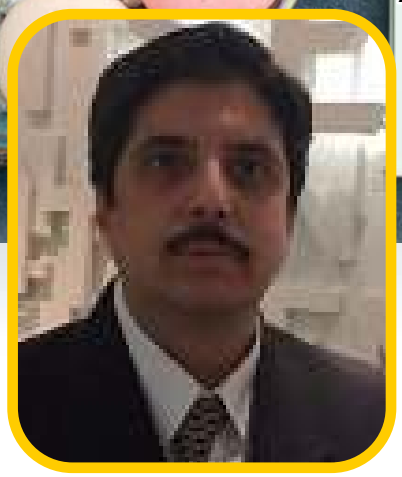

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The U.S. Food and Drug Administration (FDA) has announced new regulations to phase out petroleum-based synthetic dyes from the nation's food supply. This initiative is part of a broader effort to improve public health and safety, thereby reducing exposure to potentially harmful synthetic dyes and promoting the use of safe, natural alternatives.

The FDA's actions reflect growing concerns about the health risks associated with synthetic dyes and the need for more stringent regulations.
The shift from synthetic colours to natural alternatives has been driven by

- Health concerns
- Environmental impact
- Consumer preferences
- Regulatory changes
- Technological advancements

Health Concerns:

Synthetic colours have been linked to various health issues, including allergies, hyperactivity in children, and potential carcinogenic effects. This has led to increased scrutiny and regulation.

Environmental Impact:

The production of synthetic dyes often involves harmful chemicals and generates significant waste, contributing to environmental pollution. Natural dyes aim to reduce the ecological footprint of the dyeing process.

Consumer Preferences:

There is a growing demand for natural and organic products among consumers. People are becoming more conscious of the ingredients in their food, cosmetics, and other products, leading to a preference for natural colourants.

Regulatory Changes: FDA announced that all petroleum-based synthetic dyes will be phased out by the end of 2026. (Dyes include FD&C Yellow #5 (Tartrazine), FD&C Yellow #6 (Sunset yellow), FDC Red #40 (Allura red), FD&C Blue #1 (Brilliant Blue), FD&C Blue #2 (Indigo carmine), FD&C Green #3 (Fast Green FCF)

Technological Advancements:

Advancements in technology have made it possible to produce natural colours that are more stable and vibrant, making them a viable alternative to synthetic dyes.

Range of Natural Colours available that can be explored for synthetic colour replacement.

Turmeric: It is a bright yellow colourant made from the roots of Curcuma Longa. The pigment responsible for the colour are known as curcuminoids, curcumin and related compounds. Turmeric solubility depends on the medium in which the pigment is dispersed. It can be available in water soluble or oil soluble/dispersible forms.

Annatto: Annatto is another yellow colourant obtained from the seeds of Bixa Orellana.

Pigments responsible for the yellow/orange colourant are the carotenoids bixin and norbixin. These are available in water, oil soluble and dispersible forms.

Beta Carotene: Beta Carotene is a precursor to Vitamin A in addition to imparting an orange yellow colour to food products. Beta carotenes are available as Naturals extracts from palm and vegetable sources or are derived from algae, fungus or synthesized. Beta Carotene is oil soluble but can be processed into water dispersible and emulsified forms.

Paprika is extracted from the pod of Capsicum annum or paprika. It contains three main naturally occurring pigments, capsanthin, capsorubin and beta carotene. These combinations deliver a bright orange to red orange colour to food products. These oleoresins are oil soluble but can be emulsified to produce a water soluble/dispersible form.

Lutein: Lutein is extracted from tagetes flowers (marigold). It exhibits fairly good heat, light and pH stability in foods delivering yellowish shade.

Riboflavin is yellow or yellow-orange in colour and in addition to being used as a food colouring principle it is also used to fortify some foods.

Beetroot juice is prepared by pressing beets & subsequent concentration process. Main ingredients, apart from sugar, minerals & protein, are pigments betanin & vulgaxanthin that exhibit colour to food products.

Anthocyanins (Fruits and vegetable source – e.g. Red Cabbage, Grape extract, Black carrot)as a source of red colourant. They exhibit bright red to purple red colour hues at a pH level of 3.8. A higher pH causes the anthocyanin-based pigment to turn to unstable purplish-blue colour.

Chlorophylls and chlorophyllin complex:

Chlorophylls are the most abundant pigments found in nature, responsible for photosynthesis in green plants. The intense green colour is extracted from edible plant material, grass, alfalfa and stinging nettle. Copper-Chlorophyllin is obtained by coppering of chlorophyll followed by its alkaline hydrolysis.

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The improved stability and brightness enable its wide use as a food colour. Copper-Chlorophyllin produces a blue green shade when dissolved in water.

Caramel: Complex mixtures of compounds, some of which are in the form of colloidal aggregates, manufactured by heating carbohydrates either alone or in the presence of food-grade acids, alkalis or salts.

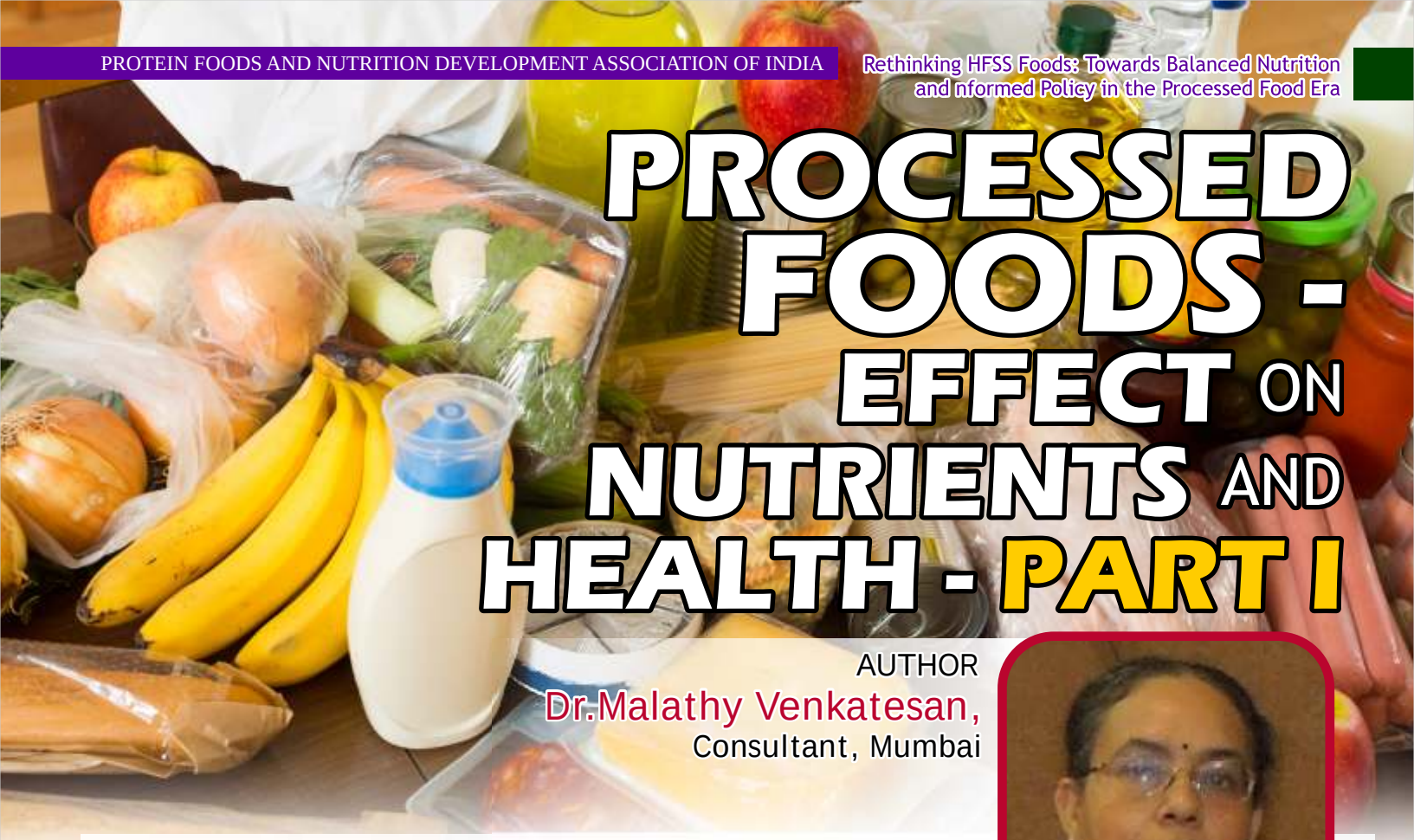
Applications and Challenges: Natural colours are used in various food products, including beverage, dairy, bakery, confectionery and processed meats. Despite their benefits, natural colors face challenges such as stability concerns, consistency, standardization, and cost considerations. Ongoing research and development are addressing these issues to make natural colors more viable for widespread use.

Selection of use of Natural colours in food applications is critical and is based on factors like heat, light, pH, ingredients used in application formulation. Interaction of ingredients also play a role in shelf stability of a colour. These can be addressed easily while working with right ingredients and stable colour selection.

While moving from synthetic to natural colours can be challenging, it's important to understand the key factors involved.

- **Usage Rate:** Usage rates can be high, because colours from natural sources are less highly concentrated than synthetic colours.
- **Cost:** This is a factual assumption if one is comparing natural vs. synthetic colours. However, recalling that colour is at least as important as flavour when it comes to determining consumer preference, natural colours are not necessarily costly.
- **Preparing facility:** to handle increased inventory plus appropriate storage conditions for Natural colours.
- **Securing Supply chain:** Unlike synthetic colours, developing a robust and redundant supply chain security for colours from natural sources is both critical and complex.
- **Preparing Colour partnership:** Since Natural colour may not be a single solution and could be a combination of Natural Colour (Customized suiting applications). Its important to consider addressing technical and supply chain questions concurrently.
- **Addressing adulterants in Natural colour preparations:** Natural colours are spiked with synthetic adulterants to make them more stable or with high load of heavy metals & pesticides

The stability of natural colour isn't really an issue its important to understand criticality in project starting with the right solution. A robust portfolio of natural colour solutions and innovations can tackle most stability challenges for product developers today. Today's consumers are increasingly seeking clean-label and all-natural products. Food and beverage manufacturers must also adapt to a shifting regulatory environment.



PROCESSED FOODS - EFFECT ON NUTRIENTS AND HEALTH - PART I

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Introduction

The definition of Food processing as per the dictionary is “the action of performing a series of mechanical or chemical operations on food in order to change or preserve it”. Thus food has been processed even before documented history to make the food palatable as well as safe for storage.

Traditional crude processing methods included slaughtering, fermenting, sun drying, preserving with salt, and various means of cooking (such as roasting, smoking, steaming, and oven baking). Salt-preservation was especially common for foods that constituted the diets of warriors and sailors, up until the introduction of canning methods. Evidence for the existence of these methods exists in the writings of the ancient Greek, Chaldean, Egyptian, and Roman civilizations, as well as archaeological evidence from Europe, North and South America, and Asia. These tried and tested processing techniques remained essentially the same until the advent of the Industrial Revolution.(1)

Modern food processing technology was largely developed in the nineteenth and twentieth centuries, to serve military needs. In 1809, Nicolas Appert invented a vacuum bottling technique that would supply food for French troops, and this contributed to the development of tinning and then canning by Peter Durand in 1810.The initially expensive and somewhat hazardous use of lead in cans, was slowly replaced with aluminum, tinplate, tin-free steel (TFS) and stainless steel (SS), of which aluminum cans are widely used. Canned goods later became a staple around the world. Pasteurization, discovered by Louis Pasteur in 1862, was a significant advance in ensuring the microbiological safety of food.

In the twentieth century, World War II, and the rising consumer society in developed countries (including the United States) contributed to the growth of food processing with such advances as spray drying, juice concentrates, freeze drying, to provide safe and ready to eat or make foods.

Most commercial canning operations are based on the principle that bacteria destruction increases tenfold for each 10 C increase in temperature. Food exposed to high temperatures for only minutes or seconds retains more of its natural flavor. In the Flash 18 process, a continuous system, the food is flash-sterilized in a pressurized chamber to prevent the superheated food from boiling while it is placed in containers.

Although prehistoric humans stored meat in ice caves, the food- freezing industry is more recent in origin than the canning industry. The freezing process was used commercially for the first time in 1842, but large-scale food preservation by freezing began in the late 19th century with the advent of mechanical refrigeration. Freezing preserves food by preventing microorganisms from multiplying.

Frozen foods have the advantage of resembling the fresh product more closely than the same food preserved by other techniques.The disadvantages of ice crystals formation and subsequent disruption of tissues in freezing technique was removed by use of “freeze drying”where the food product is rapidly dried under freezing temperature without formation of ice crystals.

Drying and Dehydration technology has been used traditionally in many civilizations for centuries. This technique is commonly used in India where farm produce is seasonal. Even staples such as wheat, rice and other cereals are dried into papads for consumption through the year. Dried fruits such as almonds, cashew nuts, raisins, dates are used in every Indian household. Newer additions are exotic fruits such as kiwi, prunes, cranberry, blue berry which are available outside India in large quantities.

The discovery of X-ray technology led to the use of irradiation as a method for large scale preservation of food. This is extensively used for preservation of onions and potatoes.

The preservatives salt, sugar and vinegar has been used historically for increasing the shelf life of food. Indian households traditionally process fruits, vegetables, fish and even meat into pickles with these preservatives.
As the nomadic culture evolved, the need for containers to store food has also emerged. In the early epochs of human history, food packaging was not a field of science or technology but a primal necessity for survival due to uncertainty in consistent availability of food.

Traditional packaging include wrapping with leaves, mud containers, ceramic vessels (especially useful for pickling). Ancient civilizations, like the Egyptians, used papyrus or reeds to wrap food items. The advent of plastic revolutionized packaging technology, enabling the creation of a diverse array of packaging
options that offered versatility, durability, and convenience.(2)

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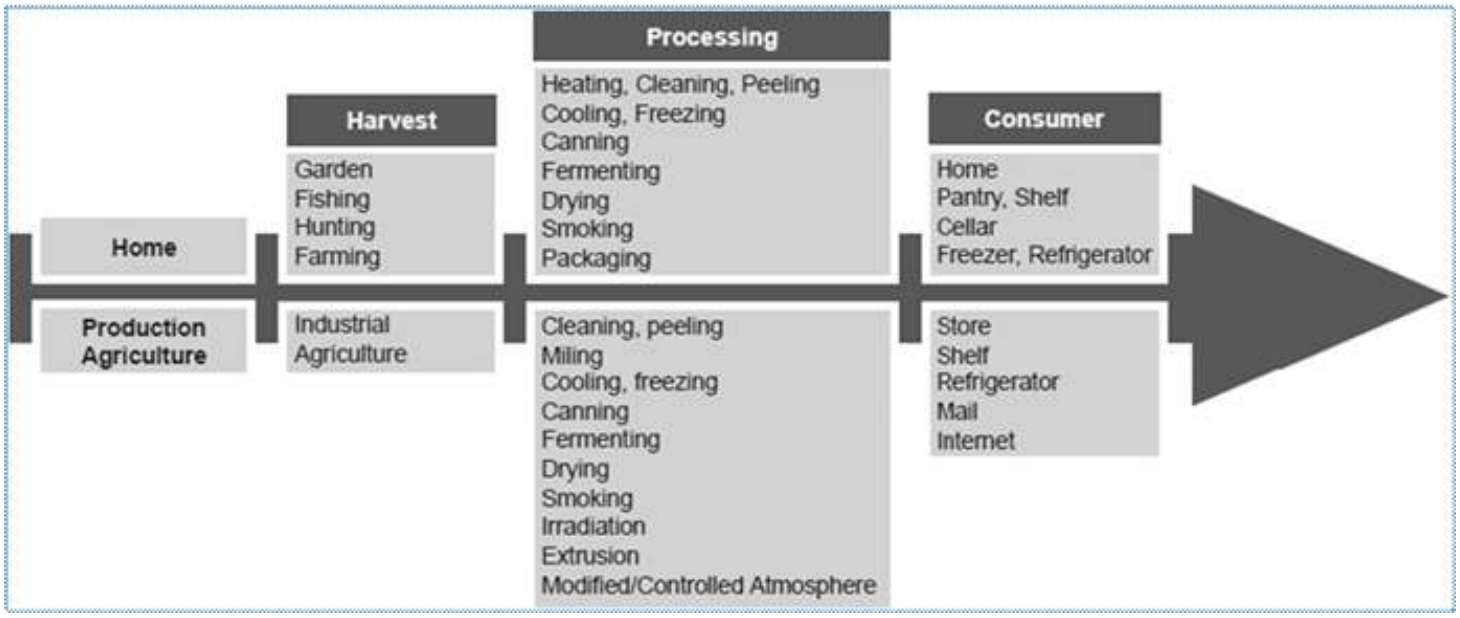
Processes in manufacture of food

Processing can occur at various points along the supply chain. It can be applied proximate to food harvest or capture (e.g. initial processing of agricultural commodities such as flour milling or fish canning) or further downstream when it is applied in the manufacture of formulated food products (e.g. bread, biscuit, noodles, yogurt).

Processing is similar whether home made or in an Industrial system (fig.1) Some of the common processes used in food manufacturing whether at home (small scale) or a food industry include milling, cooling/freezing, smoking, heating, canning, fermentation, drying, extrusion cooking. Many Indian homes preserve grain, fruits and vegetables by drying, drying after extrusion, pickling among other processing methods.

Fig 1: Processes in manufacture of processed food



Some of the benefits of food processing include destruction of food-borne microbes and toxins, improved bioavailability of nutrients, extension of shelf life, improved sensory characteristics and functional properties.

Food processing also encompasses the use of additives which are used to increase quality (e.g. taste and appearance), extend shelf life and improve the safety of foods.
Some advances in food processing have introduced new ways to produce high quality, safe and nutritious foods.

Nutritive value of processed food

1: Milk

Processing of liquid products such as milk and fruit juice is aimed at providing safe and wholesome product to the consumer through the year. In addition to the macro nutrients protein, lactose and fat, vitamins are also an integral part of milk nutritional profile.

Milk is a good source of most of the vitamins, both water-soluble vitamins including vitamins B1, B2 and B12 as well as fat-soluble vitamins like vitamins A, D and E. Milk boiling on stove is a common processing practice around the globe to reduce the level of natural microbial pathogens found in milk. UHT heat treatment of milk has been considered as a safe way to process the milk, because the short duration of heat application results in improved nutritional retention and better retention of B- vitamin. To evaluate the effect of domestic boiling practice on the contents of water soluble vitamins of loose milk and quantitative comparison of these vitamins in Ultra High Temperature (UHT) treated packaged milk with that of boiled loose milk (table 1) (3)

Table 1: Effect of heat processing on B-vitamin content in milk(3)

Processing	Vitamin B1 µg/100g	% loss	Vitamin B2 mg/100	% loss	Vitamin B3 µg/100g	% loss	Vitamin B6 µg/100g	% loss	Vitamin B12 µg/100g	% loss
Raw milk	45		0.14		0.062		0.035		4.12	
Boiling 10 mins/100C	38	24	0.11	21.4	0.056	9.6	0.023	34.28	3.2	22.3
UHT treatment	43	4	0.135	3.5	0.060	3.2	0.031	11.4	3.8	7.7

Conventional boiling caused destruction of water soluble vitamins in milk, while UHT processing (138°C for 2-4 seconds), retained higher concentrations of B Vitamins. Thus it could be envisaged that UHT treated milk provides better water soluble vitamins' nourishment than conventionally boiled milk.

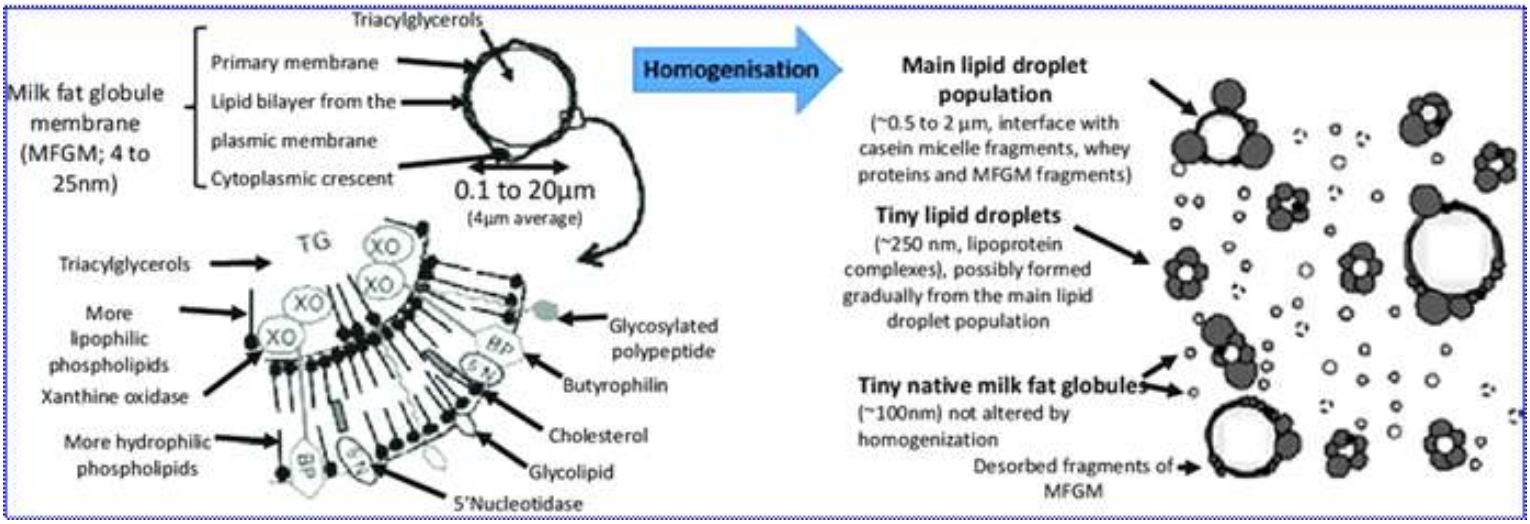
Processing of milk had beneficial effects on fat globules and its digestion. The effects of homogenization, homogenization plus thermal processing including high temperature short time (HHTST) or ultra-high temperature (UHT) treatment on digestion and interfacial properties of milk fat globules during simulated gastrointestinal digestion were investigated.

Compared to raw milk fat globules, homogenization and thermal processing increased the initial digestion rate of milk fat due to reduction in the size of fat globules.

Homogenization increased the release of middle- and long-chain fatty acids, HHTST increased the release of unsaturated fatty acids, and UHT increased the release of all types of fatty acids under gastrointestinal digestion.(4)

After homogenization, available milk proteins (caseins and whey proteins) increased due to reduction in size of casein micelles while glycosylated molecules decreased, both of which were at the surface of milk fat globules, Fig 2. This difference was maintained throughout storage.

Fig 2: Effect of homogenization on milk fat globules and proteins in milk(5)



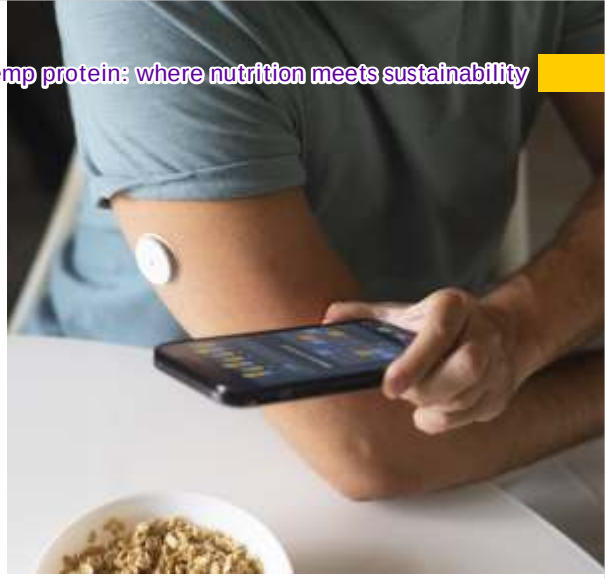
Smaller milk fat globules in homogenized, HHTST and HUHT milk increase surface area, which provides more opportunities for protease, lipase and bile salt to interact during gastrointestinal digestion, and ultimately contributes to a higher digestion rate and higher amount of released fatty acids. On the other hand, direct heating of milk and subsequent cooling results in coalescence of fat globules into a fat layer. It occurs because milk fat globules possess lower density than milk serum and are therefore rise upwards, forming a creaming layer on top of the remaining skim milk.

The typical heat treatment of milk for yoghurt production involves time and temperature combinations of 10-30 min at 70-95°C, acidification of the milk usually through microbial fermentation lowering the pH to around pH 4.5. During production and storage of fermented acid dairy products, e.g., yoghurt, the development in texture and the binding of water takes place, respectively, and these parameters are important to control a high quality yoghurt with a high consumer perception.

The impact of the binding of milk proteins; whey and caseins, to milk fat membrane upon heating and homogenization (UHT) has been studied with regard to acidification of milk and the effect on acidified gel properties (6). The homogenisation of the fat prevents fat separation and reduce whey separation (syneresis) during storage, and furthermore the texture is improved to be firmer with perception of higher creaminess. Thus UHT processing of milk is important for texture as well as storage stability of yogurt.

Looking ahead

Food processing approaches that address the obesity epidemic are critically needed. Food scientists are exploring ways to address this for example, reducing calorie intake while retaining pleasurable food experiences, slowing digestion while enhancing nutrient bioavailability, improving the palatability and acceptability of high-nutrient-dense foods, and enhancing satiety. Modified starches that resist digestive activity have been developed.



The goal of these products is to reduce the rate of starch digestion so that blood glucose concentrations are more evenly maintained, which leads to improved glycemic responses and prolonged satiety, thereby reducing risk of diabetes.

Reducing the amount of fat consumed while keeping the food enjoyable and fun to eat can be achieved by using novel techniques for example, making fried potatoes without oil may be possible by using dynamic radiant frying, which uses a high-heat flux to provide the appearance, taste, and texture of fried food without using additional oil.

While traditional food processing will continue to play a major role in providing food for people, it is expected that there will also be an increasing role for the application of novel and emerging food processing technology for improving the quality of food and processing efficiency. Industrial processing provides safe products in quantities so as to reach maximum consumers.

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COATING & ENCAPSULATION IN FOOD PROCESSING

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Coatings have been used in food preparation for long for many uses.

We have seen chocolate coated almonds for making them exotic. There are coloured sugar-coated confections like M&Ms which look very attractive. Cheeses are coated with wax to prevent drying and increase their shelf life. Variation could be introduced in foods by coating e.g. before frying chicken or fritters could be coated with batter or breading. This coating may contain spices or herbs to add flavour. Famous potato vada is popular because of besan batter with spices adds to the taste.

Coating is commonly applied to improve taste and appearance of food products, especially in confectionery such as cakes, bakery products, chocolate and nuts. Surface can be made smooth and shiny in glazed or sugar-coated confections and in cheese. Many snacks are now coated with a variety of materials sweet, savoury, flavourful etc. Flavouring substances may be carried by oils which may be sprayed onto the products. Breaded snacks like burgers, nuggets, pops made of meats or plant bases are very popular fast foods. Fortification is achieved in many products using this technique.

Besides such traditional coatings, many types of coatings are used to provide additional processing benefits. There are many ingredients that are sensitive to environmental conditions. Some may oxidise, others may lose important volatile components and some may even react with each other. Thus, coating may prevent air coming in contact with some chemicals to oxidise them. Many aroma compounds have highly volatile nature and over time may evaporate and lose them altering the flavours negatively. Some foods with moisture that ensures proper texture of food may lose moisture over time if not prevented by coating. When food products are formulated, there are many compounds that can react with each other and may form undesirable chemicals so coating may also prevent that by forming barrier around the sensitive compounds.

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Thus, coatings in different products may have different purposes and benefits. There are coating that allow aggregation and others cause free-flowing nature. There are also coatings applied with some ingredients to improve the property of foods. The food may lose the mouthfeel and may taste too dry to eat. We can apply powdered flavourings or spices to some snacks but these do not stay on the surface as the food product is stored and transported as there is no firm bonding. Coating can be applied that includes these flavours or spices which will ensure firm adherence to the food product without loss. This way even nutrients can be added to fortified food products and staples.

Coating of Food Products

Coating is done by the application of layer of liquids, slurries or solids onto a product. All sorts of ingredients may be used to make these coating materials which are coated on different shapes or sizes of food products. The properties of coating material such as viscosity, temperature, surface tension, moisture content etc are important in ensure uniform and desired thickness of the coating material. In the case of slurries and solids, the particle size is very important.

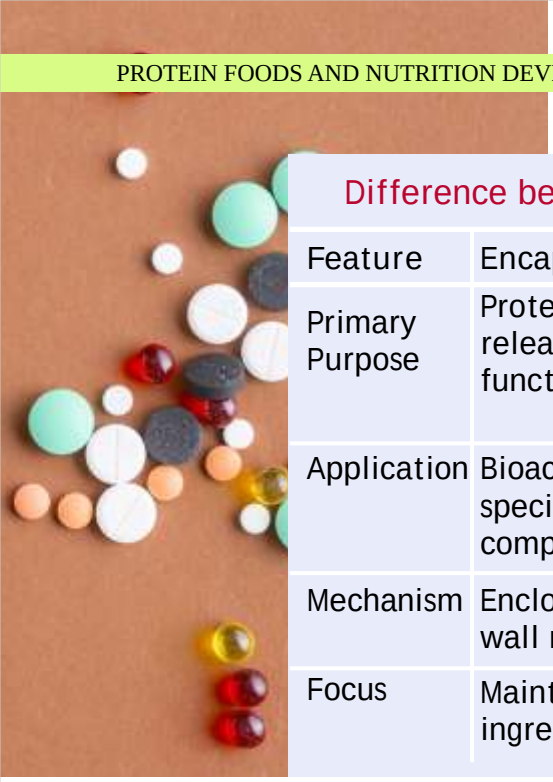
Coating ingredients may comprise of water, resin, wax, sugars, gums, starches, flours, dried flours of grains or potato, oils/fats, and of course flavours, seasonings including spices and herbs, salt in addition to many additives that help in adhesive properties of coating mixture. There can be fruits, nuts, leafy vegetables, egg, milk and meat products may be added to enhance variations in taste.

There are different types of equipment available for coating depending on the type of food product and the coating material. Coating pans have been used even at home scale and are used for confectionery application. There are vat and drum mixers used for larger scale. These are mostly used in batch processes. Coextrusion, conveyor and screw type coating machines could be used for continuous operations for much larger scale. Dipping into a pan is done even by homemakers.

Encapsulation

Encapsulation is also a kind of coating used for protection in food and pharmaceutical industry but its application may be slightly different. Although there are exceptions, coating is usually done for whole food or bigger pieces mostly for taste, texture and appearance purpose but may also provide protection. Encapsulation is commonly used for smaller particles, commonly enclosing a substance within another material, often to protect it from degrading or unwanted interactions. Encapsulated ingredients may be used in food preparation e.g. flavours, spices, nutrients etc., so they remain protected from environment or other components in food itself.

Enteric coating is done for medicine to avoid stomach acid degrading the medicine. Enteric coating can be applied in many orally administered pharmaceutical dosage forms, such as tablets, capsules, granules, pellets, microcapsules, micro and nanoparticles and drug delivery systems. This process is also used in food processing especially for probiotics or omega-3 fatty acids or some pH sensitive nutrients.



Difference between Encapsulation & Coating

Feature	Encapsulation	Coating
Primary Purpose	Protection, controlled release, enhanced function	Sensory enhancement, convenience, shelf life
Application	Bioactive ingredients, specific food components	Food items, entire product
Mechanism	Enclosing within a wall material	Applying a layer on the surface
Focus	Maintaining ingredient integrity	Enhancing overall food experience

Encapsulation is carried out primarily to protect ingredients from oxidation, heat, moisture, or other environmental factors, as well as to control their release. It is often used for bioactive ingredients like vitamins, probiotics, or flavour compounds, to improve their stability, solubility, and effectiveness. The core material (active ingredient) is encased in a wall or coating material (e.g., starch, proteins, lipids). It provides improved stability, controlled release, enhanced functionality of the encapsulated ingredient, and potential masking of undesirable flavours or odours.

Encapsulation and microencapsulation are both processes of enclosing a substance within another, but microencapsulation specifically involves enclosing substances within microscopic particles or capsules. Encapsulation is a broader term that can refer to enclosing substances at various scales, while microencapsulation focuses on the microscopic scale. Encapsulation involves enclosing a core material (e.g., a drug, nutrient, or food additive) within a protective shell or carrier material in order to protect the core material from the environment, control its release, or enhance its properties. For example, hard and soft capsules for pharmaceuticals, coatings on food ingredients, and protecting substances in various industries.

Microencapsulation is a type of encapsulation which involves enclosing substances within microscopic particles (microcapsules, microspheres, or microparticles) ranging from 1 to 1000 micrometres. This is encapsulation at the microscale, offering benefits like improved stability, controlled release, and enhanced bioavailability. Examples are microencapsulated drugs for controlled release, food ingredients for improved stability and flavour, and microcapsules for specific applications. So, microencapsulation is a specific type of encapsulation that focuses on creating microscopic capsules or particles for various applications.

Feature	Encapsulation	Microencapsulation
Scale	Broad: can be at various sizes	Specific: microscopic (1-1000 micrometres)
Particle Size	Not limited	1-1000 micrometres
Specificity	General term for enclosing substances	Specialized term for enclosing at a micro scale
Applications	Wide range of industries and products	Focus on microscale applications
Methods	Various methods, including spray drying, pan coating, etc.	Various methods, including spray drying, coacervation, etc.

Encapsulation technology can be used when core material to be coated can be solid, liquid or gaseous or hydrophilic or hydrophobic. The Protective material or carrier for core active substance can be of a variety of different materials depending on the application.

Encapsulation or microencapsulation is carried out for any of the following reasons:

- Enhance the stability of active substances
- Improve solubility and thereby increase its bio-availability
- To ensure control release action of the core at the right time and with the right amount
- Protect sensitive substances from degradation
- Prevent the undesirable interactions of the active substance with other ingredients
- Convert liquid active ingredient into powder form
- Masks unwanted taste, flavour and odour
- Ensure dust free operation
- Improve blending properties
- Improve flowability

Encapsulation techniques use spray drying, coacervation, liposome encapsulation, inclusion complexation, fluidised bed coating among other methods and the encapsulation materials used may be carbohydrates like starch, maltodextrin, gums etc., proteins like gelatin or whey protein and lipids such as lecithin and phospholipids. Encapsulation materials in the food industry must be food-grade, biodegradable, and able to form a barrier to protect active ingredients. Unlike pharmaceuticals, food encapsulation faces stricter regulatory approval, needing certifications like GRAS (Generally Recognized as Safe) from agencies like the European Food Safety Authority (EFSA) and Food and Drug Administration (FDA).

Key criteria for selecting encapsulation materials include functionality, safety, cost constraints, release type, and stability. Most commonly used materials are polysaccharides, including starch derivatives, plant gums, marine extracts (alginate, carrageenan), and microbial polysaccharides (chitosan, xanthan, dextran). Proteins (casein, gelatin, gluten) and lipids (fatty acids, waxes, phospholipids) are also suitable. Other substances like PVP, paraffin, and shellac are sometimes used. Choosing the right encapsulation material depends on the properties of the active ingredient and its intended application, ensuring stability during processing and storage.

Encapsulation Methods in Food Processing

Encapsulation methods are designed to protect active compounds, often liquids, by forming a stable barrier. Various drying-based technologies are commonly used:

Spray Drying is the most widely used technique in food applications. Provides good quality particles (~40 μm) with desirable sensory and texture characteristics. The advantages are that it is continuous and cost-effective accounts for 80–90% of encapsulated food ingredients.

Extrusion uses polymer solutions (e.g., sodium alginate) in a gelling bath (e.g., calcium chloride). It consists of forcing droplets of polymer and active substance into gelling bath e.g. calcium chloride solution. Gel beads are formed of substance encapsulated in polymer.

Fluid Bed Coating involves suspending powder particles in an air stream and coating them with materials like starch derivatives, proteins, or gums.

Molecular Inclusion Techniques involves for example using cyclodextrins provide reversible encapsulation in aqueous environment while liposomes can encapsulate bioactives through hydrophilic-hydrophobic interactions.

Each technique offers unique advantages depending on the stability, application, and economic feasibility of encapsulation. Cost constraints and material compatibility remain key factors when selecting a method.

Future Developments

The developments will focus on both stability of the encapsulation as well as the efficacy. As food grade materials are prone to degradation there will always be concerns about stability. Newer and safe materials will be tested that would have to be cost effective as well as efficient in protecting the material being coated. The properties of encapsulated material such as flowing or suspending properties will determine its success in the application.

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SORGHUM: A TRADITIONAL SUPER GRAIN

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Sorghum, though uncommon in many countries, is deeply rooted in India's traditional diets. With growing attention toward climate-resilient and healthy foods, this traditional grain is regaining importance as a modern-day supergrain.

Sorghum or commonly known as Jowar, is known for its rich composition of dietary fibre, resistant starch, slowly digestible starch (SDS), phytochemicals, tannins, and plant sterols. These compounds contribute to several protective health effects, offering various functional benefits in sorghum. It has shownpotential to support the prevention of chronic diseases, promote dietary diversity,foster sustainable agriculture, and is a dependable food source in even the most challenging environments. It is a gluten-free grain, hence benefiting celiacs or gluten-intolerant individuals.

Health Benefits of Sorghum Consumption

- **Sorghum and Appetite Control:**

Sorghum whole-grain can be considered an ideal food for weight management, given that higher whole-grain consumption has been linked to more sustainable weight management. Its energy value is estimated at 335 kilocalories/100g. (One jowar bhakri requires around 45-50g of flour.) One of sorghum's key features is its high dietary fibre content, which slows down digestion and gastric emptying. This helps prolong the feeling of satiety and can reduce overall calorie intake. A comparison study between wheat, pasta and sorghum revealed that the rate of gastric emptying was slower after consuming the sorghum porridge versus the other two (1).

Sorghum is rich in polyphenols,especially in pigmented varieties like red or black sorghum,which have been shown to influence hunger-related hormones. These compounds may help suppress ghrelin (the hunger hormone) while boosting levels of satiety-promoting hormones such as glucagon-like peptide-1 (GLP-1) and Peptide YY.

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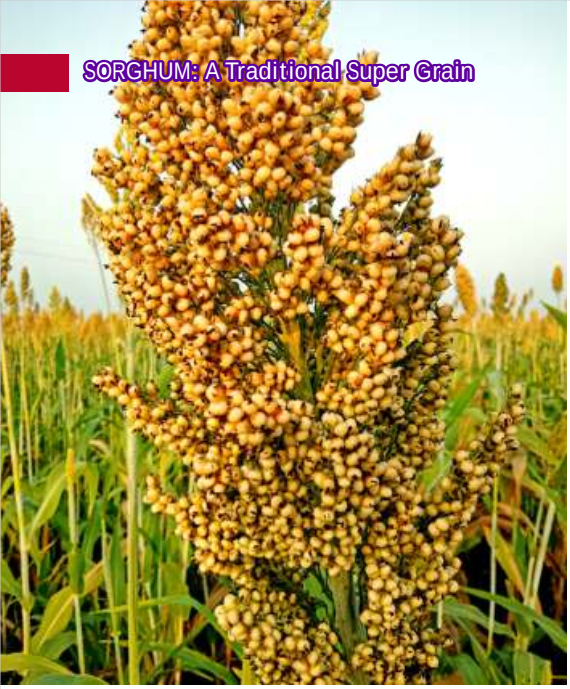

As per a study performed on sorghum biscuits, it was seen that there was an increase in the appetite-related hormones GLP-1, gastric inhibitory peptide (GIP), and Peptide YY. Biscuits made from red sorghum were potentially attributed to a unique flavonoid called 3-deoxy anthocyanidin (3-DXA) found in red sorghum grains. The 3-DXA creates complexes with proteins in the sorghum food matrix, slowing protein digestibility, which is known to extend satiety (2).

Another important component of sorghum is its resistant starch. Unlike regular starch, resistant starch ferments in the colon and produces short-chain fatty acids (SCFAs) like acetate, propionate, and butyrate. These SCFAs play a role in signalling the brain to reduce appetite and may also support gut health. Sorghum also has a relatively low glycaemic index, meaning it causes a slower rise in blood sugar levels. This helps maintain energy stability and prevents the sudden blood sugar drops that can trigger hunger and overeating. Using a sample of 60 overweight or obese rats, Shen et al. examined the effects of sorghum-resistant starch (RS) on changes in body weight across a course of time. Rats fed a high-fat meal supplemented with 30% sorghum RS gained much less weight than rats fed a diet lacking sorghum RS. Additionally, the sorghum RS groups showed a substantial change in the production of two appetite hormones produced from adipose tissue, leptin and adiponectin, suggesting a possible mechanism of action for sorghum RS in the regulation of food intake and body weight (3).

In all the studies mentioned above, the higher levels of dietary fiber, RS, and slowly digestible starches (SDS) in whole-grain sorghum likely increased satiety due to effects on the glycaemic index of foods and on appetite-regulating hormones. Hence, incorporating sorghum into meals can be a practical strategy for managing appetite naturally.

Sorghum and Glycaemic Control:

Sorghum has shown effects on glycaemic control, making it beneficial for managing blood sugar levels. Its low glycaemic index (GI) contributes to a gradual increase in blood sugar after meals, which helps prevent spikes and crashes that can lead to insulin resistance. Additionally, the high fibre content in sorghum slows digestion and glucose absorption, promoting more stable postprandial blood glucose levels. Research indicates that sorghum-based meals produce lower blood glucose responses and improve glucose metabolism compared to wheat or rice-based meals (4). Variability in blood glucose responses can occur based on the type of sorghum product consumed, influenced by cooking and processing methods.

The glycaemic-lowering properties of sorghum stem from slowly digestible starch (SDS) and resistant starch (RS) present in different cultivars. The complex protein network called prolamin reduces enzymatic breakdown, leading to a slower release of glucose. The SCFAs produced in the colon upon fermentation of resistant starch are linked to improving insulin sensitivity.

Incorporating sorghum in the diet can support blood sugar management. Additionally, pairing it with other low-GI foods, proteins, and healthy fats can enhance its benefits.

- **Sorghum's Effects on Cardiovascular Health**

Sorghum's lipid profile, particularly its content of phytosterols and policosanols, supports heart health by lowering LDL cholesterol and improving blood lipid profiles. The majority of sorghum lipids are neutral Triacyl glycerides (TAG), rich in poly- and monounsaturated fatty acids.

Sorghum is a rich source of 3-deoxycyanidins and tannins, which are not commonly found in other cereals. Previous studies have reported the antioxidant, antihyperlipidemic, and antihypertensive effects of sorghum extracts.

Though human studies are limited, animal studies demonstrate promising cardiovascular benefits

- **Sorghum's Role in Reducing Inflammation and Oxidative Stress**

The root cause of many chronic diseases is inflammation, which arises from an imbalance between the production and elimination of reactive oxygen species (ROS), also known as oxidative stress.

This oxidative stress can lead to both short-term effects, such as acute inflammation, and long-term effects, including cellular damage, particularly to DNA. Such damage can result in mutations that may initiate cancerous transformations (5). Polyphenols play a role in reducing inflammation by interfering with enzymatic activity.

Coloured sorghum, especially the red and brown varieties, contains higher levels of polyphenols, flavonoids, and tannins compared to other grains like wheat and barley, demonstrating significant antioxidant and anti-inflammatory effects.

Red sorghum, which is rich in 3-Deoxyanthocyanins, is especially potent (6). Black sorghum has been shown to inhibit pro-inflammatory cytokines, such as TNF-α and IL-1β, in monocytes and to reduce intracellular ROS in macrophages. Moreover, it is essential for cellular defence against oxidative stress and inflammation, as it helps reduce platelet aggregation.

Even after cooking, sorghum's polyphenols often retain their antioxidant properties, supporting cellular defences in healthy individuals and those with chronic conditions.

However, more clinical trials are needed to verify these benefits across various diseases. Overall, sorghum polyphenols are linked to increased antioxidant activity, which is typically maintained in food products made through diverse preparation methods(7).

Applications in Food Innovations-

To drive innovation in food processing, it is necessary to retain sorghum's nutritional, functional, and sensory qualities, especially its whole grain and fibre-rich attributes, which align with the growing consumer demand for health-focused products.

Sorghum has been used in alcoholic fermentation for a long time, and it has recently gained popularity as a naturally gluten-free grain. Its rich nutrient profile makes it an ideal ingredient for developing nutrient-dense foods.

Additionally, it is a sustainable crop for future food systems. By leveraging these attributes, sorghum can significantly contribute to both human health and environmental sustainability.

However, there are some limitations to using sorghum due to the presence of certain antinutritional factors, including tannins, phytates, trypsin inhibitors, and protein crosslinkers, which can reduce the bioavailability of key nutrients like iron, zinc, and calcium.

To effectively use sorghum in food applications and product development, food processors must apply targeted processing techniques such as germination, fermentation, roasting, and high-temperature extrusion, depending on the specific product type. These methods can often yield significant reductions in antinutrients while preserving or even enhancing the nutritional quality of the products.

Sorghum flour available in the market comes with varying levels of antinutrients, primarily because it is usually minimally processed unless specified otherwise. Flours labelled as made from fermented or sprouted jowar (sorghum) typically have significantly lower antinutrient content compared to those from whole grain jowar.

The fermentation and sprouting processes not only reduce antinutrient levels but also enhance the bioavailability of nutrients, making the flour more nutritious. Choosing high-quality sorghum flour can further provide added benefits, such as improved digestibility and enhanced flavour. One should look for products that specify their processing methods to make informed choices about the nutritional quality of the flour.

Coloured varieties of sorghum may have distinctive taste and flavour profiles compared to regular white sorghum. For instance, coloured sorghum tends to have an earthy and bitter taste, while white sorghum has a mild and neutral flavour. These differences are influenced by their phenolic compounds and tannins.

Some consumers may find the flavours of coloured sorghum desirable, particularly in certain traditional foods, while others may not.In India, various types of sorghum are grown, such as red and brown sorghum, which are used in numerous food applications. However, white sorghum is the most prevalent and widely utilized.

The price range for both coloured and white sorghum is similar, but coloured varieties are slightly more expensive. As a result, white sorghum is extensively used due to its wide availability and extensive cultivation. Coloured sorghum is often utilized as a functional food ingredient or in research markets.

When formulating products with sorghum, there can be challenges, such as poor dough forming ability due to the absence of gluten. To address this, using composite flours, grain mixes, or gluten replacers can improve the structure and texture of the final product. Additionally, the issue of bitterness can be mitigated by incorporating natural sweeteners, spices, or pairing sorghum with other flavourful ingredients.

The Indian food industry is using these strategies and has launched a variety of products made from sorghum, including sorghum murukku, bhujia, and popped sorghum, as well as more innovative options like sorghum puffs and chips.

Conclusion:

Sorghum, particularly its coloured varieties and brans, is a rich source of phenolic compounds that have demonstrated promising health benefits in cell, animal, and human studies. These benefits include enhanced antioxidant capacity and improved regulation of lipid and glucose metabolism.

However, the bioactivity observed can depend on factors like metabolic changes, bioavailability, and the complexity of human physiology. Only a small fraction of phenolic compounds, primarily simpler structures, are absorbed directly into the bloodstream. Additionally, variations in study design and individual differences complicate the interpretation of results.

Therefore, while sorghum has significant potential as a functional food for preventing chronic diseases, more in-depth and well-designed clinical studies are necessary to fully understand its health-promoting properties, as Sorghum can effectively bridge tradition and innovation.

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COMMINUTED POULTRY MEAT PRODUCTS: CONVENIENCE WITHOUT COMPROMISE

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From juicy kebabs to tender koftas, many of our favourite dishes feature comminuted poultry products. These finely ground and blended poultry meats are enjoyed in India and around the world for their delicious taste and versatility in cooking. Comminuted poultry products are made by finely grinding or mincing poultry meat into a uniform mixture. This method alters the meat's texture and makes it easier to blend in other ingredients that improve flavour, consistency, and shelf life(1).

Types of Comminuted Poultry Products

There are various types of comminuted poultry products like sausages, patties, nuggets, hamburgers, etc. Sausages are one of the most versatile comminuted meat products, ranging from fresh to aged or dry-fermented,each with its unique process and unforgettable taste. Sausages come in three main types: fresh, cooked, and cured. Fresh sausages are seasoned and stuffed into casings without further processing. Cooked sausages are heated to a specific temperature (80°C for 15-20 min) to ensure they're safe for consumption. Cured sausages go through a curing process with salts and are often smoked, both of which preserve the meat and impart a unique flavour. Fermented sausages are another type of sausage that is very popular. It comes in two forms, which include dry and semi-dry. Lactic acid bacteria (LAB) are commonly introduced as

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starter cultures to initiate fermentation, which generates lactic acid in the process. This acidification lowers the pH, helping to preserve the sausage and giving it its signature tangy flavour. Dry fermented sausages undergo a long fermentation and drying process, resulting in a dry texture, e.g. salami, pepperoni. Semi-dry sausages are also fermented and cured but retain more moisture as compared to the dried ones, e.g. summer sausage.

Chicken nuggets are small, bite-sized portions of chicken meat that have been finely ground or chopped, then blended with seasonings and other ingredients to enhance flavour and texture. Binders like starches, flours, and proteins are also added during the processing. This helps to hold the meat texture, retain moisture and prevent separation. The mixture is shaped into uniform pieces, typically oval, and then coated with a layer of batter or breadcrumbs. This coating not only adds a crispy texture when cooked but also helps seal in moisture, keeping the nuggets tender and juicy inside. Chicken nuggets can be deep-fried, baked, or air-fried (1).

Processing Techniques for Comminuted Poultry

The basic steps in the preparation of comminuted poultry products include grinding, mixing with spices, forming emulsions, shaping, cooking, smoking, etc. The first step involves preparing the raw materials. The raw materials and the meat selected should be of good quality and free from contamination. This ensures the quality of the final product (1).

1. Grinding

The process begins with grinding the raw poultry and fat.This step breaks down the muscle fibres and fat into smaller particles, setting the foundation for texture and consistency. The portion of the bird used for ground meat is thighs and drumsticks, as it is an affordable cut for ground meat. However, cuts are chosen depending on the desired sensory properties of the final product. Chicken breast offers good texture, while legs and wings provide excellent flavour. Most of the fat is in the skin, which keeps the ground chicken moist and succulent. The grind size can be adjusted based on the specific type of product being prepared.

2. Formation of Emulsions

Emulsification is a process in which minced, or ground fat is bound together with meat, forming an emulsion. For certain products like hot dogs or finely textured sausages, the mixture is further processed by high-speed blending. Emulsifiers like lecithin are also used to emulsify the fat and meat mixture. This results in a smooth, cohesive mixture that enhances binding and stability in the final product.

3. Mixing with Seasonings

After emulsification of ground meat and fat, seasonings like salt, spices, pepper, paprika, etc, are thoroughly mixed. The mixing can be carried out manually or with the help of mixers. Salt aids in drawing out and retaining water in the meat, resulting in a juicier and more tender texture. It also affects how proteins aggregate and bind, which plays a key role in determining the final texture of the comminuted meat product. Additionally, it enhances flavour and serves as a natural preservative. Spices are mostly added for flavour purposes.

Nitrite has also been used in comminuted meat products. It stabilizes meat colour, enhances flavour, and prevents the growth of *Clostridium botulinum*; however, it should be used in limited quantities as excessive use may lead to nitrosamine formation.

4. Shaping the Product

The seasoned mixture is then shaped into its final form, whether it's stuffing into casings for sausages, pressing into patties, or molding into nuggets or meatballs. In the production of sausages and hot dogs, the emulsified meat mixture is filled into natural(animal intestines) or artificial (made from collagen or cellulose) casings, usually with the help of a sausage stuffer or filling machine.

These casings play a crucial role in preserving the product's shape during cooking and act as a protective layer. This can be done by hand or using automated forming machines.

5. Cooking or Smoking

The last step involves thermal processing. Depending on the product, it may be cooked, smoked, fried, or baked. Smoking not only imparts flavour but also aids in preservation. while products like patties and nuggets may be breaded and fried for a crispy finish.

Regulatory Framework for Comminuted Poultry Products

Comminuted poultry products like chicken nuggets, sausages, and patties are regulated by FSSAI standards. These classifications help define what additives are permissible to ensure safety, shelf life, and sensory quality. A range of food additives is permitted, each with prescribed limits to ensure consumer safety. For comminuted poultry products, preservatives like nitrites are allowed up to 80 mg/kg. Antioxidants such as BHA (Butylated hydroxyanisole, INS 320) and BHT (Butylated hydroxytoluene, INS 321) are permitted up to 200 mg/kg and 100 mg/kg, respectively, to prevent fat rancidity and extend shelf life. Permitted synthetic food colours like Brilliant Blue FCF can be used up to 100 mg/kg, while natural colours like caramel are allowed under GMP. Other additives, including phosphates and sorbates, can be added at 2200mg/kg and 1500mg/kg, respectively. These additive limits are enforced to balance food safety and protect public health (3).

Ensuring Food Safety through HACCP and GMP

Producing safe and high-quality comminuted poultry products such as nuggets, sausages, and patties requires a highly controlled environment guided by the principles of HACCP (Hazard Analysis and Critical Control Points) and GMP (Good Manufacturing Practices). These products undergo multiple handling and processing stages, including grinding, mixing, forming, cooking, and packaging, all of which increase the potential for microbial, chemical, and physical contamination if not properly managed.

The HACCP model for poultry slaughter, which sets the foundation for downstream processing, highlights key steps and associated hazards from live bird reception to chilling. Birds must arrive healthy, with transport equipment cleaned to prevent external contamination. Humane slaughter via effective stunning and bleeding is followed by scalding and feather removal, where water temperature and hygiene are closely monitored to prevent bacterial buildup. During evisceration, one of the most critical control points (CCPs), great care is taken to avoid rupturing intestines that may release pathogens

like Salmonella and Campylobacter. Carcasses are then subjected to antimicrobial final washes and rapid chilling to below 4°C, which must be achieved within two hours to suppress microbial growth. These control measures carry forward into further processing, where raw poultry is ground and comminuted.

In the comminution phase, food safety risks multiply due to increased surface area, moisture, and handling. GMP ensures baseline hygiene like sanitized grinders and mixers, hygienic personnel practices, separation of raw and cooked zones, and maintenance of cold chain conditions. HACCP systems build on this by identifying key CCPs such as cooking (achieving ≥74°C internal temperature), ingredient mixing (to prevent contamination). Hazards can be biological (*Listeria monocytogenes, Salmonella*), chemical (cleaning agents), and physical (bone fragments). Robust monitoring and verification systems are essential at each CCP. This includes microbial testing, real-time monitoring of scalding and chilling parameters, and documented corrective actions for any deviation, like detecting foreign matter or temperature failures. Equipment design also plays a vital role: smooth surfaces, easy-to-clean components, and proper drainage reduce the risk of microbial harbourage. Ultimately, the combination of GMP and HACCP ensures that from the moment live birds arrive at the plant to the final packaging of a chicken nugget, food safety is not left to chance. It is a science-driven, documented, and continuously verified process designed to protect the health of the consumer and maintain confidence in processed poultry products (5,6).

Conclusion-

The rising demand for processed and convenience-based protein sources has positioned comminuted meat and poultry products, such as nuggets, patties, and sausages, as a significant and growing segment within the food industry. With the global processed meat market projected to reach USD 756.3 billion by 2035, and India's poultry sector alone valued at 1,00,000 crores, there is significant potential for this segment. However, in India, the dominance of unorganized retail processing poses challenges in terms of hygiene and overall efficiency. The adoption and implementation of HACCP and GMP protocols are important to ensuring product safety, consumer trust, and sustainable growth. With the right practices in place, comminuted meat products can offer both safety and quality for a growing market (2,4).

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ASIA PACIFIC'S GROWING HEALTH AND WELLNESS MARKET

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Introduction

The health and wellness market in the Asia Pacific region is experiencing dynamic growth, influenced by a strong culture of traditional plant-based therapies and an increasing demand for healthier diets and lifestyles. This demand has been driven by the fast-paced urbanization in the region. Traditional Chinese Medicine (TCM) is highly popular in China, while Ayurvedic practices are widespread in India; these approaches are gaining popularity throughout Asia for holistic health and wellness.The rising obesity rates and associated health issues, such as type 2 diabetes and heart disease, are prompting many Asian consumers to revisit traditional wellness practices and choose ways to enhance their diets.

This trend is generating interest in the nutraceutical category, which is seen to bridge nutritional gaps. There is a growing demand for supplements that contain vitamins, minerals, botanicals, and probiotics, as well as fortified foods and beverages.This growth is evident across the Asia Pacific region, particularly in markets such as South Korea, Singapore, Japan, and increasingly, China, where innovative product launches are becoming more common. The Southeast Asian (ASEAN) market is experiencing even faster growth, driven by countries like Thailand, Vietnam, the Philippines, and Indonesia, where a wider variety of nutraceutical products is providing more options for consumers.

According to Future Market Insight's (FMI) Asia Pacific Nutraceutical Products Market Report, the region's nutraceutical market was valued at approximately USD 90 billion in 2023. It is projected to grow at a CAGR of 7% over the next ten years, reaching USD 175 billion by 2033. While the functional food and beverage category dominates the Asian nutraceutical market, FMI indicates that the increasing interest in more specific and personalized solutions is likely to drive demand for supplements.

What's Driving the Health and Wellness Boom in Asia Pacific?

Fast population growth, better healthcare, a growing middle class, and increasing urbanization are all driving strong growth in the health and wellness industry. Urban populations are expected to grow by 50%, adding 1.2 billion city dwellers. This shrinking of the rural population is creating a new wave of urban health and wellness consumers. An ageing population and rising life expectancy in countries like China, Singapore, Japan, and South Korea are boosting demand for fortified foods and drinks to address age-related issues like bone, joint, and brain health.

At the same time, digitalization is transforming shopping habits, and with Asia leading the global e-commerce, it is driving a strong demand for personalized functional foods and supplements. Consumers are also showing strong interest in natural and plant-based ingredients, with many considering them key factors in purchase decisions.

Trends in Functional Foods, Beverages, and Supplements

To meet growing demand for healthier, convenient foods that suit busy lifestyles, the Asia Pacific region is seeing a rise in innovative functional products around areas of gut health, healthy snacking, and personalized nutrition. Mintel data shows 10% of all food and beverage launches in the year to July 2023 featured a functional claim. Products inspired by traditional Asian cuisine are especially popular, as they connect with consumer's cultural preferences for holistic health. According to FMI, key drivers of this trend include health awareness, chronic diseases, urbanization, ageing, traditional diets, scientific advances, innovation, supportive regulations, celebrity influence, and global health concerns. These factors are creating strong opportunities for brands to offer more personalized health solutions.

While supplements are still overshadowed by functional foods and beverages in the region, there's strong growth potential. Rising interest in areas like brain and mood health, sports performance, and beauty from within offers brands a chance to create more targeted products. Digitalization is playing a key role, especially in reaching younger consumers seeking personalized solutions. China leads the regional supplement market, but ASEAN countries show promise, and India is expected to be the fastest-growing market.

Future Market Insight highlights seven key drivers for supplement growth: personalized solutions, brain and mood health, flexible formats, clean labelling, proven safety and efficacy, self-directed consumers, and digital/e-commerce channels.

Influence of traditional medicine on modern wellness

Healthy lifestyle and diet practices in Asia are deeply rooted in centuries-old traditions, making them unique compared to other regions. Many consumers still prefer traditional remedies over pharmaceuticals, relying on nutritious foods and botanical extracts. Ayurveda in India, TCM in China, and Jamu in Indonesia are key examples. Jamu are herbal elixirs passed down through generations for holistic wellness. This growing interest in natural, preventative healthcare creates opportunities for brands to incorporate traditional ingredients like herbs, spices, and superfoods into fortified foods and nutraceuticals. Products that reflect these cultural practices are more likely to gain acceptance, especially in open markets where many consumers still buy traditional food and medicine.

Top 3 Health & Wellness Trends in Asia

1. Sports Nutrition

Sports nutrition is growing rapidly across Asia as more people take up active lifestyles and exercise regularly. There is a rising demand for protein supplements, pre-workout drinks, and energy bars, especially in cities. Although the COVID-19 pandemic caused a temporary slowdown when gyms closed, the market is now recovering strongly as interest in health and wellness continues to rise. China is the leading producer of sports nutrition products; however, India is expected to see strong growth in the future. Products like low-carb, high-protein snack bars and sports drinks dominate the market. Adventurous flavours and natural ingredients, including botanicals and plant-based sources, are becoming increasingly popular in product formulations.

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2. Healthy Ageing

The ageing population in Asia Pacific is expected to triple by 2050, reaching 1.3 billion. This has increased demand for products that support healthy ageing. Nutritional products rich in omega-3s, vitamins, and collagen are popular to help keep vitality, cognitive function, joints, and skin in good condition. Prebiotics and probiotics are popular in anti-ageing formulations. Antioxidants like vitamins C and E, and resveratrol are also important. Fortified dairy products are popular for improving digestion and providing calcium, which is especially important for post-menopausal women to help prevent osteoporosis. People with lactose intoleranceare likely to accept lactose-free options. Many consumers prefer functional foods over supplements as they are affordable and fit the traditional eating habits.

3. Cognitive Health and Mental Wellbeing

Awareness of mental and cognitive health is growing in Asia, leading to higher demand for products that support cognitive and emotional well-being. Functional botanicals are becoming more important, with the market doubling between 2018 and 2020. New products often focus on emotional and overall wellness, using ingredients like adaptogens, nootropics, and botanicals such as ashwagandha. Supplements lead this category, often containing omega-3s, B-vitamins, and magnesium, which help brain function and protection. In India, products with brain and mood-enhancing properties are especially popular, making up 30% of such supplements compared to 13% in the rest of Asia.

Key Markets and Sourcing Trends in Asia's Nutraceutical Industry

Asia's nutraceutical industry is expanding rapidly, supported by increasing health awareness, rising incomes, ageing populations, and traditional health practices. Key regional markets, China, India, Japan, and ASEAN countries, each present unique dynamics in terms of consumer behaviour, product innovation, and sourcing opportunities.

China

According to FMI, China leads the Asia Pacific nutraceutical market, holding a 31.2% share in 2022, and valued at around USD 28.24 billion in 2023. This growth is driven by higher health awareness, disposable income, and a rapidly ageing population. Consumers favour fortified foods and beverages over supplements, particularly those targeting immunity and digestive health. These are often formulated with Traditional Chinese Medicine (TCM) ingredients and natural extracts. Unilever recently launched a functional hydration beverage range in China, targeting significant demand for beverages with electrolytes that support hydration, sleep, and immune health.

India

India's nutraceutical market is seeing robust growth, driven by rising health consciousness and a growing urban middle class. According to FMI, it held a 17.8% share in 2022, with a value of USD 16.11 billion in 2023. New products include functional foods, beverages, and supplements aimed at weight management, heart health, and cognitive function. Ayurvedic herbs and spices feature prominently due to strong cultural preferences for natural remedies. Supplements are gaining popularity among consumers seeking targeted nutrition. ProV Foods, for example, has launched its Activated Nuts range, which uses a proprietary drying process to enhance the nutrient benefits of the nuts.

Japan

Japan places a strong emphasis on preventive healthcare and healthy ageing, supported by its ageing population and a culture focused on wellness. It accounted for 27.9% in 2022, translating to approximately USD 25.25 billion in 2023. Health claims in Japan are closely regulated, focusing on scientifically proven benefits

supported by clinical studies. Consumers in Japan prefer functional foods and beverages over supplements. Products frequently include ingredients like collagen and probiotics to address age-related concerns such as joint and skin health. In Shiseido's ampoule supplement range, a beauty-from-within beverage shot is a recent example, combining ginseng, peptides, and green tea extract.

ASEAN Countries

ASEAN countries represent the fastest-growing nutraceutical segment in Asia, fuelled by rapid urbanisation and evolving dietary patterns. The market was valued at USD 15.42 billion in 2023, with projections of USD 35.82 billion by 2033, growing at 8.6% CAGR. Popular products target regional health concerns such as diabetes and metabolic health, often using traditional herbs and indigenous ingredients. Functional foods and beverages are the preferred formats due to their accessibility and convenience. Singapore leads in innovation, with companies launching functional snacks range for on-the-go health needs.

Sourcing Nutraceutical Ingredients in Asia

Asia is a major hub for sourcing nutraceutical ingredients, offering rich biodiversity and strong traditional medicine systems. While large global players still dominate supply, Asia is home to scalable manufacturers such as Sabinsa (India), Kaneka (Japan), and Shanghai Tsumura Pharmaceuticals (China).

Key ingredients sourced include omega-3s, B-vitamins, magnesium, collagen, biotin, as well as traditional and emerging botanicals like ashwagandha, echinacea, camucamu, CBD, and melatonin. Fortified products often contain ingredients like oats, soy, flaxseed, and dairy-based pre/probiotics, especially in yoghurt. Sourcing, however, requires navigating complex trade and regulatory frameworks. Each country has its own safety, efficacy, and quality standards, and certifications such as Good Manufacturing Practices (GMP), Halal, and organic that are often essential. While these requirements can be demanding, they also enhance credibility and meet growing consumer expectations around safety and transparency.

Conclusion

The nutraceutical market in Asia offers a wide range of opportunities for industry players, driven by shifting consumer preferences, ageing populations, and evolving regulatory frameworks. There is considerable room for innovation in categories such as sports nutrition, healthy ageing, and cognitive and mental wellbeing. Consumers are increasingly drawn to convenient options like fortified beverages, nutritional sprinkles, and dissolvable oral strips. Traditional botanicals such as those used in Ayurveda, Traditional Chinese Medicine (TCM), and Jamu also continue to gain popularity due to their cultural familiarity and long-standing heritage. As many Asian countries experience a rise in the ageing population, the demand for products that promote long-term health and extend a person's "healthspan" is expected to grow. In this context, markets like Japan, which have managed ageing demographics for decades, can serve as useful models for innovation. While functional foods and beverages remain the dominant segment, the supplements market holds potential to grow significantly, especially in India and ASEAN countries.

Disclaimer: The above write-up is based on VitaFoods Asia's 'Understanding Asia Pacific's booming health and wellness market' report. (https://www.vitafoodsinsights.com/market-trends/understanding-asia-pacific-s-booming-health-and-wellness-market-report-)

SEMINAR ON INNOVATIVE FOOD INDUSTRY- RESPONSIBLY CATERING TO THE NUTRITIONAL AND ECONOMIC PROGRESS IN INDIA

HELD AT HOTEL KOHINOOR CONTINENTAL MUMBAI

By
Ms Anuja Padte,
Food Scientist, PFNDAI

On May 30th, 2025, the Protein Foods & Nutrition Development Association of India (PFNDAI) organized a significant seminar titled "Innovative Food Industry- Responsibly Catering to the Nutritional and Economic Progress in India."

This event aimed to highlight the positive contributions of the food processing industry to India's economy and its role in upgrading the nation's nutritional status. The seminar garnered substantial support from a wide array of industry leaders. Vista Processed Foods Pvt Ltd was the Platinum sponsor, while Gold sponsorship was provided by Nestle India Ltd, Coca-Cola India Pvt Ltd, Abbott Healthcare Pvt Ltd, Right to Protein (powered by USSEC), Nutricircle Ltd, Herbalife International India Pvt Ltd, and Hindustan Unilever Ltd (HUL). Further backing came from Silver sponsors: Kellanova, Marico Ltd, Mother Dairy Fruit and Vegetable Pvt Ltd, Zydus Wellness Products Ltd, Barentz Distribution India Pvt Ltd, and Roots Formulation Pvt Ltd. Contributions for souvenir advertisements were made by Venky's India Ltd, Hardcastle Restaurant Pvt Ltd, Fermenta Biotech Ltd, and Food Ingredient Specialities Pvt Ltd. The event also featured stall sponsorships from Nutricircle Ltd, Ingredion India Pvt Ltd, and Roots Formulations Pvt Ltd, and received overall event support from Vasta Biotech Pvt Ltd.

Ms. Dolly Soni, PFNDAI's Manager of Marketing & Projects, expertly hosted the seminar, introducing all the speakers and panellists for the event.

Dr. Shashank Bhalkar, Executive Director of PFNDAI, opened the seminar on "Innovative Food Industry: Responsibly Catering to Nutritional and Economic Progress in India." He addressed current challenges, particularly negative perceptions of processed foods fuelled by unscientific terms and social media.

Dr. Bhalkar outlined the day's agenda, emphasizing the seminar's goal: to highlight processed foods' significant contributions to nutrition and the economy. He urged experts and attendees to actively participate, share experiences, and approach discussions with an open mind, while also thanking the event sponsors.

Dr. Shatadru Sengupta, PFNDAI Chairman, tackled the misconceived criticism of processed foods. He acknowledged labelling concerns but argued that blaming them solely for ill health, while idealizing "home food," overlooks their significant benefits. Dr. Sengupta stressed processed foods' vital role in delivering nutrients, providing economic benefits (taxes, employment), and reducing waste. While affirming industry responsibility for nutrition and innovation, he urged against unfair targeting. He concluded that PFNDAI organizes such seminars to scientifically clarify the link between nutrition, innovation, and health, boosting awareness for all.

Dr. J S Pai, Editor PFNDAI delivered the keynote address, in which he acknowledged the distinguished speakers, and the panel assembled for the day's seminar. As consumers are demanding healthier food products, he urged industry to use technology to conserve nutrients in foods while processing and also prepare fortified or enriched food products using innovative techniques. He expressed confidence that the participants would find the seminar to be both informative and productive.

Following this, Dr. Prabodh Halde, Treasurer PFNDAI introduced the Guest of Honour, Dr. Harinder Oberoi, Director NIFTEM. Dr Oberoi addressed the issue of misinformation from social media influencers, urging the food industry to promote positive aspects of food and leverage food technology for food security.

He introduced the "SWASTH" initiative to raise awareness about HFSS and UPF, clarifying that packaged food isn't the sole cause of NCDs. Dr. Oberoi also touched on scientific food formulation, prebiotics, and probiotics, concluding that Food Science & Technology encourages entrepreneurship and calling for industry unity to tackle challenges.

Dr. Prabodh welcomed and introduced Chief Guest Mr. Hemant Patil (Chairman, Balasaheb Thackeray Haridra Research & Training Centre). Mr. Patil spoke emphasizing the agribusiness and food industry's 70% contribution to India's income and the critical role of food processing, including traditional preservation methods.

He shared personal experiences, like accessing food in Siachen, highlighting the food industry's innovative solutions to logistical challenges. Mr. Patil also discussed Haldi plantations, species, and turmeric export challenges.


LAMP LIGHTING

The lamp lighting was done by the guest of honour and chief guest Mr Hemant Patil and other dignitaries.

The theme for the first session was Food Processing Promotes Nutrition & Health. This session was moderated by Dr Sanjog Surve, Independent Consultant. Dr Surve spoke on "Behind the Label - Glimpse of Food Processing in India" highlighting that consumer opinion is the "true label" for processed foods, emphasizing the role of regulations for transparency. He explained that food processing aims to improve safety, nutrition, taste, and texture, drawing parallels with home cooking while noting industrial advantages in scale and efficiency.

Dr. Sanjog categorized processing methods and discussed the regulated use of food additives. He positioned food processing as a vital sector for employment and food security, while addressing NCD concerns by arguing that "excess food" is the real issue, not just processed food. He concluded by advocating for science-driven innovation and a "Farm to Fork to Fitness" model for India.

Mr Abhijit Shribas Associate Director – R&D India Kellanova presented on "The Role of Processed foods in Modern Diet: Bridging Convenience & Health". He outlined the evolution of food processing across various sectors and highlighted significant barriers in the Indian food processing sector, including low farm yields, logistics issues, and distribution bottlenecks. He emphasized modern consumer demand for convenience (longer shelf life, ready-to-eat options, portability) and addressed India's nutrition gaps like child malnutrition and anemia, citing NFHS 5 data. He detailed how the food industry is responding through fortification, reformulation, and consumer awareness. He concluded by advocating for balanced innovation, leveraging AI and biotech, effective policies, and farm-to-table integration for future nutrition and sustainability.

Ms Naaznin Husein, Founder Director Freedom Wellness Management gave a talk on "Complete Food a Myth, Balanced Diet a Sanity". She defined a balanced diet as incorporating optimal proportions from five major food groups, tailored to individual needs (age, activity, health). Ms. Husein detailed the benefits of a balanced diet, including improved physical and mental health, immune support, and weight management. She also highlighted how dietary needs vary across life stages and the importance of diversity for comprehensive nutrient intake. The discussion covered practical challenges in maintaining a diverse diet (meal prep, eating alone, circadian rhythms) and cited healthy dietary patterns like Mediterranean and Japanese diets as examples. Finally, she touched on meeting specific nutritional needs, the flaws of the "complete food" concept, healthy

snack selection, and innovations in personalized meal planning and disease management through food swaps.

Second session was on the theme "Curbing Unhealthy Habits with Responsible Marketing" chaired by Dr Ashish Bhobe, Experienced R&D Leader, Innovation Strategist in Food Start-up and Mentor.

Ms. Shilpa Wadhwa, Head of Nutrition, Health & Wellness at Nestlé India, spoke on Formulating to Promote Nutrition and discussed formulating food products for enhanced nutrition using cutting-edge ingredients and processing technologies. Her presentation covered India's current nutritional status, the evolution of nutrition science, and the importance of addressing deficiencies. She highlighted the rise of plant-based diets, probiotics, prebiotics, and traditional ingredients in modern formats. Ms. Wadhwa also detailed advanced processing techniques like cold-pressing, high-pressure processing for nutrient retention, and microencapsulation for protecting bioactive compounds. She emphasized the need for industry collaborations to drive innovation and meet consumer demands for healthier food options.

Dr. Sujatha Jayaraman, Vice President - R&D HUL Foods discussed Innovation Opportunities from Increased Nutrition Awareness, focusing on FAO's 2025 emerging food innovations like by-product valorisation, new production tech, and personalized nutrition. She highlighted the growth of the Indian processed food market due to shifting consumer demands for health, convenience, and snacking, alongside government and private sector support. Key trends include demand for healthy, clean-label, and sustainable foods, influenced by digital platforms. She covered gut health, protein, millets, smart proteins, and alternative options, also addressing climate change impacts like Type 5 diabetes and zinc deficiency. Dr. Jayaraman emphasized clean-label foods, regenerative agriculture, and holistic nutrition, citing Knorr's Future 50 Foods. She concluded with the importance of traditional processing (especially fermentation) and India's potential as a global food basket.

Ms Mili Bhattacharya, Director, Scientific and Regulatory Affairs, Coca-Cola India and South-west Asia gave talk on "Responsible Marketing of Processed Foods – Creating a Positive Consumer Experience and building Trust based on True value". Ms. Mili emphasized processed foods' role in food and nutrition security and the governance of food marketing. She stressed that processing ensures safety, quality, and sustainable food systems, with additives rigorously assessed. She detailed food marketing's multifaceted nature, covering everything from research to brand building. India's regulatory framework ensures truthful labelling, valid claims, and scientifically backed advertising.

Finally, Ms. Mili highlighted sustainability, cultural relevance, and responsible marketing to children. The future, she concluded, requires multistakeholder engagement, adapting to evolving consumer needs, and upholding truthfulness, fairness, and inclusivity.

The Session on "Food Industry the Enabler from Farm to Fork" was moderated by Dr Uday Annapure. The Session started by presentation of Dr Nandita Iyer, Medical Doctor, Health and Lifestyle coach. She focused on Soy as a Solution to Human Nutrition needs in India. Highlighting the "Right to Protein" campaign, she addressed the protein deficiency issue, explaining protein's importance and debunking misconceptions. Soy is presented as a complete, affordable protein source with numerous health benefits, including heart health, muscle maintenance, and potential cancer risk reduction. The sustainability of soy production is emphasized, as well as dispelling myths around its hormonal effects, thyroid impact, and GMO status. The presentation also provided practical suggestions for incorporating soy into daily diets and emphasizes the role of professionals and policymakers in promoting soy consumption for better nutrition in India.

Dr. Bhoopendra Singh, Director of Supply Chain at Vista Processed Foods Pvt Ltd, spoke on Value creation in the food supply chain as a critical journey to alleviate poverty. He emphasized how enhancing the "farm to fork" journey directly impacts poverty reduction. Dr. Singh explained that every step in the food value chain adds value, from farming to retail. However, challenges like low farmer income, post-harvest losses, poor storage, and unequal market access impede its effectiveness.
He showcased Sahyadri Farms in Nashik as a successful example, highlighting its farmer-owned, integrated supply chain, global reach, and innovative practices that led to increased farmer incomes and rural employment, demonstrating the tangible benefits of effective value creation.


Dr. Joseph Lewis


Dr. Sujatha Jayaraman


Mr. Yogish B T


Dr. Prabodh Halde


Mr. C S Jadhav


Ms. Subhaprada Nishtala

The event concluded with a panel discussion, led by Dr. Joseph Lewis, Chairman of the Scientific Advisory Committee, PFNDAI. The distinguished panel comprised Dr. Sujatha Jayaraman (Vice President - R&D HUL Foods), Mr. Yogish B T (Senior Manager - Global Regulatory Affairs, Herbalife International India), Dr. Prabodh Halde (Head - Global Regulatory Affairs, Marico Limited), Mr. C S Jadhav (CEO and Co-Founder, Nutricircle Ltd), and Ms. Subhaprada Nishtala (Founder – Food Adroit & Hon VP AFST (I)).

The panel discussion, moderated by Dr. Joseph Lewis, explored "Science-based policy ensures certainty and predictability in business: Are we adequately leveraging it?" Key topics included the importance of science-based policy for a stable business environment, navigating current regulations, the need for industry proactiveness and consumer focus, challenges in regulatory understanding, and the critical role of trust between industry and regulators for effective collaboration.

Finally, Ms. Simran Vichare delivered a vote of thanks. She expressed gratitude to all the sponsors, speakers, panellists, delegates, and the PFNDAI team members and volunteers for their invaluable contributions in making the event a resounding success.

PANEL DISCUSSION

REGULATORY ROUND UP

AUTHOR
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Dear Readers, Please find below new notifications, orders, etc. since the last round-up

Notice dated 01.05.2025 inviting stakeholder comments on Consultation paper regarding restriction of registration facility for certain food products/categories : Gazette notification dated 17.10.2024 omitted the mandatory BIS certification of critical products such as Food for Infant Nutrition, Milk Powder and condensed Milk, Packaged drinking water, and Mineral water. This helped to simplify the regulatory process; however, compliance to ensure product safety and quality became difficult. To strengthen compliance, the registration of certain high-risk products is proposed to be restricted, and pre-inspection made mandatory. A meeting was held between ministries and concerned industry associations on 25/04/2025 to discuss this, and a consultation paper is to be published. (which is given in Annexure 1). Comments and suggestions were requested within 30 days from 01.05.2025.

Validity Order of FSSAI notified Food Testing laboratories dated 08.05.2025 : This order provides a list of FSSAI-approved laboratories with validity of their accreditation as on 08.05.2025. These can be used to carry out analysis of samples taken under the FSSA Act 2006 and regulations.

FSSAI Notice dated 20.05.2025 for inviting stakeholder comments on "Introduction of Fixed Renewal Cycles and Prolonged Validity for FSSAI Licenses" : The present provisions of FSS (License and registration of Food Businesses Regulations 2011) allow FBOs to select a validity period for license and registration between one to five years. This flexible system poses a challenge to the FBOs operating in multiple states of remembering the expiry dates. Based on the requests from FBOs for uniform expiry dates, and long-term validity of licences and registrations, the food authorities have proposed to offer options to choose renewals as per the convenience of FBOs or to explore long-term validity options (up to 10 years)

for licenses under categories Trade/ Retail head. A detailed consultation paper is given in Annexure 1, and stakeholders were requested to submit their comments/suggestionswith proper justification/ rationale within 30 days from 20/ 05/ 2025.

Mandatory Submission of Closure Report on expiry of FSSAI License/Registration: This order is to all FBOs whose License / Registration has expired in FY 2024 -25. These FBOs are directed to send a closure report confirming no food business activity is conducted on the premises where the License / Registration has expired. They should also confirm that the new license/registration has been obtained and give a reason for the non-renewal. In case of non-renewal, the FBO should submit the reasons for closure of the business/ non-renewal of the License / Registration through the FoSCoS portal. Operating a Food business after expiry of the license is an offence under Section 31 of FSSA 2006.

Guidelines for acceptance of recycled Polyethylene terephthalate (PET) as Food Contact Material (FCM-rPET): This gazette notification is a guideline for the use of recycled Polyethylene terephthalate as a food contact material. The guidelines are quite elaborate. They include the various processes that can be used to recycle the PET, recycling process requirements, including input, process validation, and output, with proper records. The guidelines also describe the labelling requirements for the recycled PET materials. Requirements of relevant documentation to be maintained by manufacturers, converters, beverage bottlers, Food packers, and FBOs are given. The manufacturer must apply for authorization of the recycling process in the specific format to the Food Authority and obtain necessary approvals.

Discontinuation of the term 100 on Food product labels and related promotional materials: There is a growing trend of using the term "100%" on food product labels and across various promotional platforms. FSSAI has issued an advisory to discontinue the use of the term "100%" on food product labels, packaging, and promotional content, as this terminology is ambiguous, misleading within the current regulatory framework, and prone to misinterpretation. Hence, all the FBOs are advised to stop using any such claim as it conveys a false sense of absolute purity or superiority, potentially leading consumers to believe that competing products in the market do not comply with prescribed standards. However, deadlines are not specified.

RESEARCH IN HEALTH & NUTRITION

Lactic acid bacteria can improve plant-based dairy alternatives

A new study maps how specific lactic acid bacteria can enhance both the flavour and nutritional quality of plant-based dairy alternatives.

Plant-based dairy alternatives -- such as soy, oat, and almond drinks -- are produced without animal ingredients for consumers seeking plant-based substitutes for milk and yoghurt. However, many of these products have shortcomings such as flavours that do not always appeal to consumers, and nutritional profiles that may fall short of those of cow's milk.

A new review, led by DTU and Novonesis researchers, explores how lactic acid bacteria may help address these challenges. By analysing existing literature, the authors map how fermentation with selected bacterial strains can reduce so-called off-flavours and degrade anti-nutrients. The latter enhancing the nutrient bioavailability in plant-based dairy alternatives.

Lactic acid bacteria can reduce unwanted bitter and earthy flavours by converting undesirable compounds into neutral or pleasant ones.These bacteria can break down anti-nutrients, increasing the bioavailability of minerals such as iron, zinc, and calcium.Bacteria naturally found in plants are better suited to ferment plant-based dairy alternatives, as they have evolved to thrive in plant environments.

The researchers suggest that this fermentation process can also help improve the sensory and nutritional aspects of other alternative protein sources, including insect-based foods and microbial proteins. This highlights the potential of fermentation as a key technology in the development of sustainable and nutritious food products.

https://www.sciencedaily.com/releases/2025/04/250408121847.htm

High blood pressure? Eat more bananas

New research from the University of Waterloo suggests increasing the ratio of dietary potassium to sodium intake may be more effective for lowering blood pressure than simply reducing sodium intake.

High blood pressure affects over 30 per cent of adults globally.It's the leading cause of coronary heart disease and stroke and may also lead to other afflictions like chronic kidney disease, heart failure, irregular heartbeats, and dementia.

This study from the University of Waterloo explores how the ratio of dietary potassium to sodium intake plays a crucial role in regulating blood pressure. Traditionally, reducing sodium intake has been the primary recommendation for managing high blood pressure, but this research suggests that increasing potassium intake may be even more effective.

While excessive sodium intake raises blood pressure, potassium has the opposite effect. The study suggests that consuming more potassium-rich foods—such as bananas and broccoli—can help lower blood pressure more effectively than simply cutting sodium.

Early humans consumed diets rich in potassium and low in sodium, which may explain why our bodies are better adapted to such a balance. Modern Western diets tend to be high in sodium and low in potassium, contributing to widespread hypertension.

Researchers developed a computational model to analyse how potassium and sodium interact in the body. This model successfully identified how different intake ratios affect blood pressure regulation. The study found that men develop high blood pressure more easily than pre-menopausal women, but they also respond more

positively to an increased potassium-to-sodium ratio.

This research highlights the importance of dietary balance in maintaining cardiovascular health. It suggests that public health recommendations should focus not only on reducing sodium but also on increasing potassium intake. The findings could lead to new dietary guidelines and strategies for preventing hypertension.

https://www.sciencedaily.com/releases/2025/04/250414124820.htm

Protein sources change the gut microbiome -- some drastically

A new study by researchers from North Carolina State University shows that protein sources in an animal's diet can have major effects on both the population and function of the microscopic life within their gut.

These microorganisms, known as the gut microbiome, can impact various aspects of our health. The findings could help lead to a better understanding of how to prevent and treat gastrointestinal diseases currently affecting the quality of life of millions of people globally.

This study from North Carolina State University explores how different protein sources significantly impact the gut microbiome in mice, affecting both microbial composition and function. The study found that changing protein sources—such as egg whites, brown rice, soy, and yeast—led to major shifts in gut microbiome composition.

Brown rice and egg white diets increased amino acid degradation, meaning microbes were breaking down proteins rather than synthesizing their own amino acids. Some amino acids can degrade into toxins or influence the gut-brain axis, which may have health implications.

Unexpectedly, protein sources also affected the breakdown of glycans (long sugar chains attached to proteins). Some microbes altered enzyme production, potentially impacting gut health.

One bacterium dominated in mice fed egg whites, producing enzymes similar to those that break down mucin, the protective lining of the gut. This could have negative effects on gut health.

This research highlights how dietary protein choices may influence gut health, potentially affecting digestion, metabolism, and even neurological functions. The findings could lead to new dietary recommendations for improving gut microbiome balance.

A balanced diet with a variety of protein sources—such as plant-based proteins, fermented dairy, and lean meats—may help maintain a healthy gut microbiome. Foods like yogurt, kefir, and fermented cheese contain beneficial bacteria that support gut health. Fatty fish such as salmon and sardines may help reduce gut inflammation and support microbiome diversity.

https://www.sciencedaily.com/releases/2025/04/250430142243.htm

Global shortage of essential nutrient poses health concern

This study from Case Western Reserve University highlights a global shortage of omega-3 fatty acids, which is largely driven by environmental factors such as rising ocean temperatures, overfishing, and pollution.

Omega-3s are essential for brain, eye, cardiovascular, and endocrine health, yet 85% of the world's population does not get enough of them in their diets.

The shortage is due to environmental challenges that make it harder to access uncontaminated omega-3 sources.

Low omega-3 intake is linked to chronic inflammation, which increases the risk of heart disease, cancer, preterm birth, and mental health issues. Industrialized diets contain 20 times more omega-6 fatty acids than omega-3s, which disrupts the body's ability to use omega-3 effectively.

This research underscores the need for public health initiatives to increase the production of omega-3-rich foods while reducing harmful omega-6 intake. It also highlights the environmental impact of food systems and the importance of sustainable fisheries.

https://www.sciencedaily.com/releases/2025/04/250430142353.htm

Maintaining muscle health: HMB emerges as science-backed sarcopenia solution

With an aging global population, maintaining muscle health has become a significant public health priority, particularly for individuals over 50.

Two recent scientific reviews have reinforced HMB (β-hydroxy β-methylbutyrate) as a clinically validated nutrient that helps preserve muscle mass, strength, and function.

HMB is a naturally occurring compound derived from the amino acid leucine, known for its dual role in stimulating muscle protein synthesis and reducing muscle breakdown. These properties make it a promising intervention for preventing sarcopenia, the progressive loss of muscle mass and function in aging individuals.

Analysed 21 randomized controlled trials with 1,935 participants aged 50+.Found significant improvements in muscle health outcomes. The most effective results were observed at a daily dose of 3 g over at least 12 weeks. Provides actionable insights for clinicians and product developers targeting muscle health in older populations.

Examined HMB's role in managing sarcopenia, which is now recognized as a formal disease. Suggested clinical applications for integrating HMB into nutrition protocols for older adults. Highlighted HMB's effectiveness in preventing muscle loss due to chronic diseases, inactivity, and aging.

Research indicates a daily intake of 3 g of HMB is necessary for optimal benefits. Achieving this dosage through diet alone is virtually impossible, requiring supplementation. Proper HMB intake plays a crucial role in muscle growth, recovery, and sarcopenia management.
TSI Group, creators of MyHMB, emphasize HMB's growing relevance in healthy aging solutions. With strong scientific support and increasing demand for proactive wellness strategies, HMB is positioned as a pivotal nutrient for both brands and healthcare providers.

Shawn Baier, VP of Business Development at TSI Group, states: > "HMB is no longer just a promising ingredient. It's a proven solution for one of the most pressing health challenges of our time: preserving muscle and quality of life as we age."

HMB supplementation is a validated strategy for combating muscle decline in aging populations. 3 g daily intake for at least 12 weeks is recommended for optimal results. Regulatory and clinical perspectives increasingly support HMB's inclusion in muscle health protocols. Brands and healthcare providers have a unique opportunity to integrate HMB into aging-focused nutritional solutions.

https://www.nutritioninsight.com/news/tsi-group-hmb-muscle-health-aging-sarcopenia.html

Sea lettuce packs 29 times more vitamin B12 than beef, research finds

Recent research highlights sea lettuce (Ulva fenestrata) as an exceptional source of true vitamin B12, containing 29 times more B12 than cooked beef when processed into a dried protein ingredient.

This discovery has major implications for plant-based nutrition, offering a sustainable alternative to animal-derived B12 sources.

Sea lettuce and Palmaria palmata contain significant levels of vitamin B12, while dulse and sugar kelp do not.Blanching at 60°C for 3 minutes reduced B12 content by 45% in Ulva but still retained levels sufficient for an EU "High in Vitamin B12" nutritional claim.

Room-temperature storage in darkness for up to 4.8 months effectively preserved B12. Oven-drying, freeze-drying, and

freshwater soaking maintained B12 content.

A new extraction method resulted in a dried protein ingredient with 60% more B12 than untreated Ulva.On a moisture-equivalent basis, this ingredient contained 29 times more B12 than red meat. However, preparation of the protein ingredient caused some B12 losses. Just 2.9 g of Ulva protein powder meets the recommended daily intake of vitamin B12.

Plant-based diets reduce greenhouse gas emissions & land use, but they risk lower B12 intake. Seaweed cannot synthesize B12, but some species contain it via symbiosis with cobalamin-producing bacteria. Integrating seaweed into plant-based diets (either as whole foods or protein ingredients) may help maintain nutrition while supporting environmental sustainability. Spirulina-based biomass with biologically active B12 could also serve as a carbon-neutral alternative.

This study suggests that U. fenestrata and its protein ingredients are strong dietary sources of vitamin B12. However, improving preservation techniques, validating analytical methods, and conducting bioavailability research will be key for industrial applications.

https://www.nutritioninsight.com/news/sea-lettuce-vitamin-b12-beef.html

High vegan protein intake does not guarantee sufficient quality, research flags

A study from Massey University, New Zealand, assesses protein intake and quality in long-term vegans, revealing that while three in four met total protein requirements, nearly half fell short on lysine and leucine when digestibility factors were considered.

Protein Intake vs. Amino Acid Sufficiency

78.8% of male and 73% of female participants met total protein requirements. When adjusted for digestibility, only 50% met daily needs for lysine and leucine—two critical amino acids for muscle maintenance and immune function.

Variability in Amino Acid Profiles

Essential amino acid content in plant-based foods varies widely, making lysine and leucine particular concerns in vegan diets. Many plant foods contain lower quantities of these amino acids, limiting bioavailability.

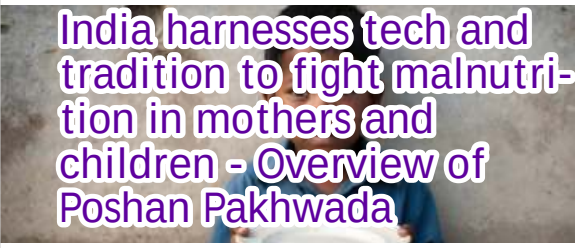
Importance of Balanced Plant-Based Sources

Legumes, nuts, and seeds emerged as valuable sources of lysine and leucine. Soybeans, lentils, pumpkin seeds, hemp seeds (for leucine) and lentils, chickpeas, kidney beans, tempeh (for lysine) provide key nutritional support.

Health Considerations & Risks

Lysine supports collagen production and immune health, while leucine is vital for muscle function and blood sugar regulation. Excessive intake of isoleucine (a leucine isomer) is linked to obesity-related concerns. High protein diets (>22% caloric intake) may increase heart disease risk, as leucine contributes to arterial plaque formation.

in diets (>22% caloric intake) may increase heart disease risk, as leucine contributes to arterial plaque formation.
Optimal plant-based food combinations to balance essential amino acid intake require further study. Meal-based amino acid requirements may vary by sex, age, and body composition. Understanding long-term vegan dietary impacts is critical for ensuring nutritional adequacy.
https://www.nutritioninsight.com/news/vegan-protein-essential-amino-acids-lysine-leucine.html



India harnesses tech and tradition to fight malnutrition in mothers and children - Overview of Poshan Pakhwada

India is celebrating the seventh edition of its annual nutrition awareness drive from April 8–22, focusing on:Maternal and infant nutrition; Childhood obesity; AI-powered health monitoring

This initiative is part of Poshan Abhiyaan, the government's broader effort to improve public nutrition, with a special emphasis on the first 1,000 days of a child's life—a crucial period for physical and mental development.

The campaign promotes: Antenatal care, balanced diets, and proper hydration. Use of the Poshan Tracker App, a real-time digital platform monitoring nutrition delivery and child development.

Anganwadi Centers (rural child care centers) are now integrated with the app, enabling: Real-time tracking

of child growth metrics, meal distribution, and education services. Self-registration for beneficiaries, improving accessibility for pregnant women, lactating mothers, adolescent girls, and children.

Maternal Care and Traditional Diets

Anganwadi Centers are being positioned as "frontline nutrition clinics," promoting: Breastfeeding; Maternal health care; Local nutrient-rich foods, particularly in tribal areas. Research reveals a rural paradox where protein deficiency remains widespread, even in households with access to protein-rich foods.

Childhood Obesity and Malnutrition Management

Recognizing that malnutrition includes both undernutrition and overnutrition, the 2025 drive addresses childhood obesity by:Encouraging schools to ban unhealthy foods (high-fat, high-sugar, high-salt).Scaling up the Community-Based Management of Acute Malnutrition Protocol, introduced in 2023, to support Anganwadi workers with:Appetite tests; Timely referrals; Structured treatment approaches at the grassroots level

India's Broader Nutrition Strategy

India's Public Distribution System, the world's largest food assistance program, is helping:Reduce child stunting; Boost household income; Curb the effects of climate shocks UNICEF emphasizes the need for gender-responsive strategies, as adolescent girls in South Asia face heightened nutritional risks.Women's organizations play a key role in improving access to nutrition by overcoming social and economic barriers. Government efforts focus on nutrition tracking, maternal health, childhood obesity, and traditional diets.AI-powered solutions and community-based protocols enhance nutrition accessibility.Gender-sensitive interventions are crucial for addressing disparities.India's food assistance programs show transformative impacts on child nutrition and economic stability.

https://www.nutritioninsight.com/news/india-harnesses-tech-and-tradition-to-fight-malnutrition-in-mothers-and-children.html

Nutritional Support to Combat Tuberculosis in India

Providing food baskets containing macronutrients and micronutrients to tuberculosis (TB)-affected households in India could prevent 361,000 deaths and 880,700 cases by 2035. The intervention is cost-effective, with an estimated cost of US$167 per disability-adjusted life-year (DALY) saved.

Undernutrition is a major driver of TB, accounting for about 20% of global cases. TB both exacerbates and is worsened by undernutrition, creating a vicious cycle. RATIONS Study in Jharkhand: The first trial to show that protein-rich nutritional support reduces TB incidence in households and improves treatment outcomes. If 50% coverage of TB patients and families is achieved between 2023–2035: 4.6% of TB deaths could be averted. 2.2% of new TB cases could be prevented.

Higher BMI is inversely related to TB incidence. Providing calories and proteins may be critical to immune function and resilience. Surprisingly, normal-BMI individuals showed more protective effects, prompting questions about mechanisms at play and the need for more targeted studies.

Challenges Highlighted:

Nationwide modelling may overlook regional disparities in TB and undernutrition. Scaling up is resource- and infrastructure-intensive, particularly in remote or underserved areas. Two critical limitations: TB transmission from outside the household. The study did not factor in drug-resistant TB, which has poor outcomes in malnourished populations.

Wider Context:

The findings align with the success of India's Public Distribution System, noted for reducing child stunting and building climate resilience. Gender-focused nutrition policies are essential, particularly for adolescent girls in South Asia.Women's groups play a vital role in driving equitable nutrition access.

https://www.nutraingredients-asia.com/Article/2025/02/10/prebiotic-infant-formula-aids-gut-immunity-danone-funded-study/

Processed food rethink? Researchers call for plant-based product reclassifications

Researchers from the University of Turku, Finland, argue that current processed food classification systems may misrepresent the nutritional value of plant-based foods.

They advocate for a system based on biochemical composition, particularly phytochemical retention, rather than simply labelling foods based on processing levels.
Many plant-based foods (e.g., tempeh, soy chunks) are classified as ultra-processed, despite retaining beneficial phytochemicals. The label creates consumer confusion and may discourage healthy choices. Researchers highlight that processing is not inherently negative, but the classification system often fails to distinguish between nutrient-rich and nutrient-degraded processed foods.

Phytochemicals indicate how well a food retains its original plant composition post-processing. Foods lacking phytochemicals suggest heavy industrial processing that alters nutritional value. This approach would provide a more accurate health assessment than existing processing-based classifications.

Errors in categorization make ultra-processed food classifications difficult for both scientists and consumers to interpret. Some nutrient-dense fermented foods (e.g., tempeh) are misclassified, despite no evidence linking them to negative health outcomes. Consumers may avoid beneficial foods due to misleading categorizations.

Processing techniques do not inherently determine a food's health impact. Fermentation, for example, enhances nutrient availability and should not be grouped with processing methods that degrade bioactive compounds. Industry should shift focus to preserving phytochemical richness, rather than simply classifying foods by processing level.

Labelling foods based on biochemical composition would require validated phytochemical analysis methods, which are currently unavailable. If consumer demand grows, industries and regulators may develop the necessary methodologies.

Balancing shelf life, convenience, and nutrition is possible through techniques like fermentation. Spices and whole plant materials can preserve phytochemical richness while enhancing sensory properties. Highly processed plant-based proteins are still too new for definitive health assessments, but ongoing research is addressing this.

https://www.nutritioninsight.com/news/ultra-processed-foods-labels.html

Trending fibre fortification solutions promote broad-spectrum health benefits

Consumers are increasingly aware of fibre's benefits, particularly for gut health, immunity, and cognition.

However, most fail to meet recommended daily intake levels, prompting the nutrition industry to explore new delivery formats and fortification strategies.

Beyond Digestive Health

Fibers are now promoted for prebiotic benefits and metabolic advantages, including blood sugar management. The rise of GLP-1 medications has accelerated demand for nutrient-dense foods in smaller portions.

Expansion of Fiber Fortification

Innova Market Insights reports an 18% year-over-year growth in sports nutrition products with fibre claims (2022–2024). Brands focus on soluble fibres, such as oligofructose and soluble corn fibre, which offer formulation versatility and health benefits.

Consumer Awareness & Preference Shifts

Demand is rising for clean labels and natural plant-based fibre sources. Consumers increasingly recognize fibre's role in gut health, cognitive function, and immunity.

Functional food manufacturers will prioritize credible health claims while balancing taste and texture.

Digestive Health & Regulatory Advancements

Prebiotic and probiotic ingredients gain traction as research validates their digestive benefits. The FDA's 2021 approval of acacia gum as a dietary fibre was driven by scientific evidence of its role in blood glucose management. Clinical research on acacia fibre shows 88% of users saw reduced bowel pain, with notable reductions in bloating (75%) and stomach aches (65%).

Strategic Industry Focus
Transparency in climate-friendly food production is increasingly vital. Manufacturers aim to preserve fibre bioactivity while ensuring consumer education and trust. Prebiotic fibres emerge as a potential avenue for insulin response improvement and satiety, paralleling trends in Ozempic & GLP-1 drugs.

https://www.nutritioninsight.com/news/fiber-prebiotics-gut-health-immunity.html

Beauty-from-within: Innovations in collagen, probiotics, and botanicals

Booming Interest in Ingestible Beauty

The nutricosmetics market is expanding, with consumers seeking beauty-from-within solutions that enhance skin, hair, and nail health. Consumers prefer natural, sustainable options but demand scientific proof of efficacy. Experts from Lubrizol Life Science, Rousselot, Balchem, and ADM emphasize the importance of innovative formulations and transparent scientific backing.

Key Ingredients Driving Growth

Validated Nutrients: Vitamins & Minerals: Vitamin C, iron, and zinc boost immune health and enhance external beauty.
Botanical Extracts: Ayurvedic ingredients like curcumin offer antioxidant and anti-inflammatory benefits.
Probiotics & Prebiotics: Gut microbiota health is linked to digestive and skin wellness.

Collagen & Functional Nutrients: Collagen Peptides (e.g., Peptan) enhance skin elasticity. Vitamin C & E protect against oxidative stress. Biotin strengthens hair and nails. Carotenoids & Fatty Acids support skin hydration and inflammation reduction. Hyaluronic Acid improves skin moisture from within.

Innovations in Product Formats

Consumer-Friendly Delivery Formats: Capsules (most popular for ingestible beauty). Powders, bars, beverages, gummies. Snack-based formats, such as collagen crisps. Gummies & sparkling waters featuring botanical extracts. Use of advanced extraction &flavor modulation to improve sensory appeal.

Sustainability and Ethical Sourcing

Consumers prefer eco-conscious and transparent sourcing. Circular economy practices and certifications like Friend Of the Sea bolster brand credibility. Plant-based ingredients, such as acerola-derived vitamin C and plant-based vitamin E, align with clean-label trends.

Market Challenges and Opportunities

Functional ingredients must withstand processing conditions to maintain efficacy. Resilient solutions like spore-forming probiotics and postbiotics can improve shelf stability.The industry shifts toward a holistic beauty approach, integrating nutritional science with skincare.Nutricosmetics are rapidly evolving, blending scientific innovation, sustainability, and convenient delivery formats.
https://www.nutritioninsight.com/news/beauty-from-within-collagen-probiotics-botanicals-supplement-trends.html

Spirulina-based smoked salmon poised for commercial launch within six months

This study highlights the commercial launch of spirulina-based smoked salmon, a sustainable alternative to traditional salmon amid the overfishing crisis.

The European Food Safety Authority (EFSA) has approved texturized fresh spirulina as a non-novel ingredient, paving the way for seafood analogue commercialization. AlgaeCore is ramping up production to hundreds of tons per year to meet growing demand.The company transforms fresh spirulina into fish alternatives that are rich in protein, sustainable, and nutritionally dense.

The texturization process requires no complex equipment—fresh spirulina is combined with natural ingredients and processed using a pasta roller-like machine.

Dual Technology Approach: Decolorization removes chlorophyll, redirecting it into supplements or food colorants. Texturization creates a high-moisture vegetable protein that mimics the fibrous texture and glossy finish of smoked salmon. The spirulina-based smoked salmon is designed to replicate the taste, texture, and appearance of traditional smoked salmon, with customizable spirulina content (40%-100%).

This innovation offers a sustainable seafood alternative, addressing environmental concerns while providing a nutrient-rich, plant-based option. The product is expected to hit retail shelves within six months.
https://www.foodingredientsfirst.com/news/spirulina-based-smoked-salmon-poised-for-commercial-launch-within-six-months.html

"Beanless" cocoa and coffee substitutes amid global shortages

Compound Foods has launched a fermentation-based "beanless" coffee and cocoa ingredient platform to address global shortages, climate pressures, and price fluctuations in traditional coffee and cocoa production.

The 2023-2024 global cocoa market faced a 478kt deficit, the largest in over 60 years, due to crop failures in West Africa. The company maps molecular compounds responsible for taste, aroma, and performance, using seeds, cereals, and fibres to create a whole-food base, followed by fermentation and roasting. The beanless solution uses less water and reduces carbon emissions, with most ingredients sourced and processed in the US, minimizing geopolitical risks.

In blind taste tests conducted with Purdue University, 60% of tasters preferred Compound's coffee over premium brands like Blue Bottle and Stumptown. Initially focused on beanless coffee, the company fast-tracked cocoa-free alternatives in response to the 2024 supply crisis.

While cocoa costs remain high, forecasts suggest a potential surplus in the 2024/25 season, though uncertainty remains regarding mid-crop developments. Other companies, including Cargill, Bunge, and Planet A Foods, are also exploring alternative cocoa solutions.

https://www.foodingredientsfirst.com/news/compound-foods-climate-smart-coffee-cocoa.html

Bio-based preservation to address shelf life and food waste concerns amid clean label push

https://www.foodingredientsfirst.com/news/clean-label-shelf-life-solutions.html

This study from Layn Natural Ingredients explores how bio-based preservation technologies can extend shelf life and reduce food waste, aligning with the growing clean label movement in the food and beverage industry.

Layn focuses on plant-based antioxidants and antimicrobials, such as rosemary extract, green tea extract, pomegranate extract, and acerola extract, to replace synthetic additives. SustaNX Antioxidant, polyphenol-rich preservative is available in oil-dispersible liquids and water-soluble powders, demonstrating four times better performance than mixed tocopherols.

Managing oxidation and microbial stability in plant-based foods is difficult without synthetic preservatives. Layn's solutions help maintain texture, freshness, and nutritional quality. The company is developing biodegradable ingredients and exploring recyclable and compostable packaging to minimize environmental impact. Innovations such as high-pressure processing, bio-preservation, and nanotechnology in packaging are being explored to enhance food safety and shelf life.

This research highlights how natural preservation methods can support clean label demands while improving food sustainability. The findings suggest that bio-based solutions could transform the industry by reducing reliance on synthetic preservatives.

Sustainable alt-palm oil with microalgae to tackle deforestation

Checkerspot has developed the world's first high-oleic palm oil alternative using microalgae fermentation, offering a sustainable solution to deforestation concerns linked to traditional palm oil cultivation.

The oil is formulated entirely from Prototheca moriformis, closely matching the fatty acid profile of conventional high-oleic palm oil with 55% oleic acid and 32% palmitic acid.

This non-GMO ingredient bypasses conventional agriculture, reducing reliance on palm plantations, which contribute to 5% of tropical deforestation. The fermentation process has been scaled from lab to industrial levels, achieving oil titres up to 145 g per litre and 70% oil content in dry cell weight.

The ingredient is positioned as a viable alternative for food, nutrition, and personal care, where high-oleic palm oil is widely used. The microalgae platform provides a domestically produced, reliable alternative to volatile global supply chains.

Thisfermentation-based oil production is moving toward commercial viability, with partnerships already underway in the alt-palm oil market. The company aims to reduce environmental impact while ensuring consistent, scalable production.

https://www.foodingredientsfirst.com/news/checkerspot-microalgae-sustainable-palm-oil.html

Are F&B firms falling behind because of over reliance on outdated systems?

This report from TraceGains highlights how outdated technology is holding back the food and beverage (F&B) industry, with many companies struggling to modernize their systems.

Reliance on Manual Processes: 69% of F&B brands still use paper documents, spreadsheets, faxes, and email for daily operations.

Slow Digital Adoption: More than half (55%) of companies are not fully automated, and only 6% have fully integrated digital solutions.

Implementation Challenges: 60% of businesses are stuck in the implementation phase, unable to complete their digital transformation.

Economic Pressures: 62% of F&B leaders cite broader economic concerns, while 23% point to ingredient and material shortages affecting innovation.

Regulatory Compliance: 24% of companies would fast-track technology purchases if required to meet compliance mandates.

This research underscores the urgent need for modernization in the F&B industry. While 82% of companies recognize technology adoption as a top priority, many struggle with complexity, cost, and implementation delays. The findings suggest that legacy systems are increasing inefficiencies and regulatory risks, making digital transformation essential for long-term success.
https://www.foodingredientsfirst.com/news/are-fb-firms-falling-behind-because-of-over-reliance-on-outdated-systems.html

Future-proofing fats: Taste, traceability and tech drive innovations amid health, cost and climate pressures

This article explores innovations in edible fats and oils, driven by health-conscious consumers, sustainability concerns, and evolving market demands.

Nearly 40% of consumers globally say rich flavour enhances their food experience. Companies are shifting toward natural, minimally processed fats without artificial additives.

Dairy vs. Vegetable Fats: Milk fats provide better texture, flavour, and emulsification compared to margarine or hydrogenated vegetable fats. Consumers increasingly prefer Omega-3-rich oils and plant-based alternatives. The industry faces price volatility, supply chain disruptions, and new regulations.

AAK's Bio-Boilers: Reduce CO2 emissions by 50,000 metric tons annually.

Cargill's Sustainable Oils: Includes responsibly sourced palm oil, coconut, rapeseed, and sunflower oils.

Uelzena's Butterfat Solutions: Helps replace palm oil while improving texture and stability.

Future Alternatives: Microbial and lab-grown fats are expected to play a major role in sustainable food production.

Future-proofing fats: Taste, traceability and tech drive innovations amid health, cost and climate pressures

How are spent grains and coffee addressing nutrition and taste?

Spent Grains and Coffee: Recent research led by Reza Ovissipour at the National Institute for Cellular Agriculture at Texas A&M explores how spent grains and coffee byproducts can contribute to nutrition, sustainability, and taste enhancement.

Spent Coffee Grounds & Cocoa Alternatives: Fermented spent coffee grounds produce a chocolate-like aroma, offering a potential solution to the global cocoa shortage. This could serve as a clean-label and environmentally friendly alternative to traditional cocoa.

Protein Fortification: Both spent grains and coffee contain valuable proteins that can be combined with other sources to enhance nutritional value. Ovissipour's lab developed a protein-rich chocolate brownie using these byproducts, which showed higher digestibility and nutritional benefits compared to conventional protein bars.

Sustainable Food Production: Spent barley from breweries, typically used in animal feed, has been identified as valuable for human nutrition. Spent coffee grounds, sourced from local coffee shops, contain nutrients that can be repurposed rather than discarded as waste.

Market Interest & Future Applications: CPG companies from the US to Asia have shown interest in using these findings to develop protein bars and other food products. Ovissipour plans to present these innovations at the Coffee Expo in Houston to attract venture capital and industry partnerships.

Insect-Based Protein & Fermentation: The lab is also exploring fermentation-based insect protein, which could improve market acceptance by transforming insect-derived nutrients into microbial and fungal proteins. This approach enhances flavour, nutrition, and digestibility, making insect protein more appealing to consumers.

These findings highlight innovative approaches to sustainable food production, addressing cocoa shortages, protein fortification, and waste reduction.

https://www.foodnavigator-usa.com/Article/2025/03/05/food-byproducts-could-address-cocoa-shortage-and-protein-fortification/

Sweet and salty flavours: It's all in your head

This article presents fascinating insights into the interplay between sensory perception and flavour enhancement strategies for reducing sugar and salt intake.

The key takeaway is that sweet and salty flavours can be manipulated through aroma compounds and sensory cues to enhance perceived taste without increasing actual sugar or sodium content.

Flavour perception involves multiple senses—taste, smell, sight, sound, and touch—that combine in the brain to shape the eating experience. Certain sugary smells, such as molasses, vanilla, and honey, can amplify sweetness perception by up to 30%. Non-nutritive sweeteners like Reb M (stevia) and monk fruit, combined with bulk sweeteners like allulose and erythritol, can reduce sugar content while maintaining sweetness.

Umami (savoury) and kokumi (fatty) compounds help increase salt perception by 30%. Fermented ingredients and salty-smelling compounds (e.g., ham, sardine, chicken flavours) can further enhance saltiness in congruent applications. Sweet and salty aromas are volatile and work best as distillates, while umami-rich compounds like mushroom extract require extraction for concentration. This approach aligns with consumer demand for clean-label products that reduce sugar and sodium intake while maintaining desirable taste profiles.
https://www.foodnavigator-usa.com/Article/2025/02/25/how-sweet-and-salty-flavors-can-help-reduce-sugar-and-sodium-consumption/

Fish Protein Startup Boosts Nutrition in Rwanda

https://www.ift.org/news-and-publications/food-technology-magazine/issues/2025/march/columns/food-security-fish-protein-startup-boosts-nutrition-in-rwanda

This article highlights Triumvirate Food, a youth-founded Rwandan startup that has expanded from selling dried fish to producing a fish protein supplement aimed at improving childhood nutrition.

In Rwanda, one in three children under five (nearly 800,000) suffer from stunting, making this locally produced supplement a crucial intervention. Entrepreneur Amani Twagirayezu identified the potential of sambaza, a small indigenous fish from Lake Kivu, to improve nutrition. His background in agribusiness and rural development helped him establish Triumvirate Food as a dried fish producer.

The startup received support from USAID's Feed the Future Rwanda OroraWihaze Activity, enabling expansion. The fish powder supplement is designed for young children, mixed into porridge for protein enrichment. Moisture control is critical: fish are dried to 65% moisture, milled, then further dried to less than 20% before vacuum-packing, ensuring a six-month shelf life.The product undergoes third-party lab testing for nutrition, contaminants, and pathogens.

Fish co-ops, 80% women-owned, near Lake Kivu supply the raw fish. Market testing showed children enjoyed the taste and ate more when the supplement was added to their porridge. Families also used the fish powder as a seasoning for traditional meals like green banana, potato, cassava leaves, and amaranth.

Future Plans: Radio ads to boost awareness. Rwanda Standards Board food safety certification to expand market access. Exploring sales to early childhood development centers and international aid programs like the World Food Programme. Assessing expansion into Kenya and Burundi.

This initiative aligns with Food Science for Relief and Development (FSRD), which applies food science and technology to enhance food security, health, and economic prosperity in humanitarian efforts.

Why colour is just as crucial as taste

This article explores the critical role of colour in food perception, emphasizing how natural hues influence consumer choices and align with health and sustainability values.

Colour's Influence on Sensory Perception: Research dating back to 1936 highlights how colour affects taste perception. The dairy industry in the 1930s opposed colouring margarine yellow to distinguish it from butter, demonstrating early concerns about colour's impact on consumer perception.

The FDA's de-authorization of red dye no. 3 has intensified discussions on replacing artificial colours with natural alternatives. Reformulating products with natural colours like beetroot, turmeric, matcha, and spirulina is challenging but aligns with consumer demand for clean labels.

Interest in sustainable food and beverage options grew 18.4% between Dec. 2022 and Dec. 2024. Ube, a purple yam from the Philippines, saw an 18% increase in popularity in 2024. Food presentation plays a psychological role in setting expectations and enhancing enjoyment.

Marketing Strategies for Natural Colours: Brands must clearly communicate reformulations to consumers, using messaging like "no artificial colours, same great taste". Colour psychology influences purchasing decisions—bright colours signal freshness, while muted tones suggest sophistication.

Natural colours are not just aesthetic choices—they enhance sensory experiences, reinforce health perceptions, and drive consumer trust.

https://www.foodnavigator-usa.com/Article/2025/02/25/why-color-is-just-as-crucial-as-taste/

Innovation, nutrition, and education are growth opportunities in Asia's plant-based sector – experts

This article explores growth opportunities in Asia's plant-based sector, emphasizing innovation, nutrition, and education as key drivers for industry success.

Creating New Categories: The plant-based industry initially mimicked meat products, but experts suggest developing entirely new categories tailored to nutrition, wellness, and specific demographics (e.g., elderly consumers).

Positioning Plant-Based as Nutritious: With Asia's aging population, brands can highlight health benefits to make plant-based options more appealing. Consumer education is crucial to overcoming misconceptions about plant-based foods.

Sustainability & Government Support: A top-down approach (government-led initiatives) can encourage adoption through strategic marketing and policy changes. Quantifying environmental impact (e.g., carbon savings from reduced meat intake) could motivate businesses to support sustainability goals.

Consumer Perception Challenges: Taste and texture remain major barriers—brands must optimize ingredient sourcing and processing techniques to improve sensory appeal. Price perception is another hurdle, as meat is often seen as a status symbol in Asia. Many consumers view plant-based meats as overly processed, requiring healthier formulations and better marketing.

Cultural Relevance & Local Traditions: Asia has a strong tradition of vegetarianism, but Western-inspired plant-based formats (e.g., meat patties) do not align with local dietary habits. Experts suggest leveraging traditional Asian ingredients to create culturally relevant plant-based products.

To drive plant-based innovation, brands must change consumer perceptions, improve affordability, and encourage innovation through nutrition-focused formulations and sustainability education.

https://www.foodnavigator-asia.com/Article/2025/03/12/innovation-nutrition-and-education-in-asias-plant-based-sector/

Do bio-actives hold the key to improving nutrient density in food?

This article explores how bio-actives—naturally occurring compounds with health benefits—can enhance nutrient density in food without altering taste or appearance.

Ayana Bio, a plant cell cultivation company, is scaling up production of bioactive ingredients from holy basil and sage to integrate them into packaged foods and beverages.

Bioactive Production & Benefits: Rosmarinic acid (sage) and rosmarinic, ursolic, and oleanolic acids (holy basil) offer anti-inflammatory, antioxidant, and antimicrobial properties. Sage production can yield up to 10% rosmarinic acid in powder form, which can serve as a natural preservative and antioxidant.

Plant Cell Cultivation vs. Precision Fermentation: Unlike precision fermentation, which commercializes single ingredients, plant cell cultivation replicates the full phyto complex found in nature. This method avoids climate change-related agricultural challenges and reduces adulteration risks in botanical sourcing.

Stealth Health & Consumer Appeal: The "stealth health" trend focuses on nutrient-dense foods that maintain taste and texture. Ayana Bio envisions bio-actives in everyday foods, such as adding broccoli bio-actives to macaroni and cheese without affecting flavour or colour. The company avoids flavonoid production, ensuring flavourless powdered bio-actives for seamless integration.

Market Expansion & Investment: Ayana Bio is raising a Series B round to support commercialization. The company aims to make bio-active ingredients price-competitive with existing alternatives.

Bio-actives could revolutionize food formulation offering functional health benefits while preserving sensory appeal.
https://www.foodnavigator-usa.com/Article/2025/03/19/ayana-bio-plans-to-scale-up-its-bioactive-production-for-food/

India: In the World's Most Populous Country, Health is Putting Plants on the Plate

India's plant-based food market is undergoing a significant transformation, driven by health consciousness, urbanization, and rising disposable incomes.

The sector has grown 18% in the last three years, reaching 300 crores ($36M) in 2024, and is projected to expand 18-fold to 5,500 crores ($690M) by 2034.

Health & Nutrition Awareness: 60% of Indians suffer from lactose intolerance, increasing demand for dairy alternatives. 80% of adults are protein-deficient, prompting interest in plant-based proteins.

Market Expansion & Consumer Trends: Plant-based dairy leads growth, with 20% sector expansion in 2024. Soy milk (45%) is the most popular, followed by almond milk (31%) and oat milk (12%). 51% of Indians plan to drink more plant-based milk, while 43% want to eat more plant-based meat.

Challenges & Industry Evolution: Taste & price gaps remain barriers to adoption. Cold supply chain issues and lack of VC funding hinder growth. Startups are bootstrapped, requiring capital-efficient awareness strategies.

Government & Industry Recommendations: Launch a National Plant Protein Mission to scale infrastructure and investment. Level the playing field by addressing regulatory and tax disadvantages (e.g., plant-based foods taxed at 18% vs. animal proteins at 5%). Expand collaborations with restaurants, caterers, and airlines to increase accessibility.

India's deep-rooted vegetarian culture positions it as a potential global leader in plant-based food exports.

https://www.greenqueen.com.hk/india-plant-based-food-market-vegan-meat-dairy-milk-ipsos/

Chocolate — with potential health benefits

This study explores how synbiotic chocolates—infused with prebiotics, probiotics, and flavourings—can enhance health benefits while maintaining taste and texture.

Probiotic & Prebiotic Benefits: Probiotics (e.g., Lactobacillus acidophilus and Lactobacillus rhamnosus GG) improve gut microbiome balance, aiding digestion and reducing inflammation. Prebiotics (corn and honey) support probiotic survival, creating synbiotic foods.

Chocolate Formulation & Sensory Impact: Five chocolate samples were tested, including a control and four synbiotic variations. Orange flavouring lowered pH, increased moisture, and enhanced protein levels. Synbiotic chocolates had higher antioxidant levels than the control. Probiotic viability lasted over 125 days, longer than previous studies.

Structural & Taste Considerations: Synbiotic chocolates had less "snap", indicating structural disruption. Researchers preferred orange-flavoured chocolates, citing vibrant citrus notes and a luxurious texture.

This research suggests that synbiotic chocolates could offer functional health benefits, including gut health support and antioxidant properties, while maintaining consumer appeal.

https://www.acs.org/pressroom/presspacs/2025/march/chocolate-with-potential-health-benefits.html

Research flags online shopping features to unlock healthier food choices

Researchers at Duke-NUS Medical School in Singapore conducted a randomized trial to evaluate whether simple digital interventions in an online grocery platform could improve the nutritional quality of shoppers' carts.
The study was designed to test low-cost, scalable digital tools that could nudge consumers toward making healthier food choices.

328 individuals shopped three times within three to six weeks using NUSmart, an online grocery store developed for the study. One group shopped at a standard online store, while the second group used a version with additional digital features promoting healthier choices.

The enhanced version included: Traffic light labelling (green, amber, red) indicating nutritional quality. Sorting groceries by Nutri-Score, prioritizing healthier choices. Real-time cart feedback to track nutritional quality. Healthier alternative suggestions with easy swap options.

Shopping with these digital interventions led to healthier food choices across all three grocery orders. Average Nutri-Score improvement: Participants' grocery carts improved from grade C to B, indicating better dietary selections. Nutritional impact: These features led to reductions per serving in: Calories: ↓12.86 kcal, Total fat: ↓1.21 g, Saturated fat: ↓0.85 g, Sugar: ↓0.82 g, Sodium: ↓156.64 mg.

Effectiveness of Front-of-Package Labels
Traffic light labels: Foods were categorized into green (best), amber, and red (least healthy) based on their Nutri-Score. Sorting by nutrition value: Healthier options were prioritized, while the control store listed items alphabetically. Cart feedback system: A pie chart showed the nutritional composition of the cart, allowing real-time tracking. Healthier alternatives feature: Participants were presented with up to four healthier alternatives that could be easily swapped.

Implications and Expert Insights
Scalability of interventions: Assistant professor Soye Shin highlighted the potential of these tools to improve diet quality and health outcomes as online shopping gains popularity. Behavioural nudges: Professor Patrick Tan emphasized that smart interventions at the right moment could significantly impact population health. Retail partnerships needed: Professor Eric Finkelstein stressed that incorporating these features into real-world online grocery stores is crucial for maximizing benefits.

Prior studies found that online nutritional labels were more effective in improving food choices than price discounts. US experts advocate for mandatory access to nutrition information in e-shopping, which is often missing. The US FDA has delayed finalizing new regulations, raising concerns about consumer understanding of what qualifies as "healthy."

The next phase will assess effectiveness in populations with lower socio-economic status and limited nutritional knowledge to determine broader applicability. Researchers aim to evaluate whether these interventions lead to lasting dietary improvements.

This study demonstrates that simple digital interventions in online grocery shopping can significantly enhance diet quality and encourage healthier food choices. While promising, real-world implementation with retail partnerships is necessary to fully realize the benefits of these tools.

https://www.nutritioninsight.com/news/online-grocery-shopping-healthier-food-choices-digital-tools.html

Sweetener showdown: ISA defends sucralose in diabetes and healthy weight management

The International Sweeteners Association (ISA) refutes claims that sucralose alters brain appetite regulation, citing extensive research demonstrating its neutral effect on hunger and appetite.

A recent study found increased hypothalamus activity after sucralose intake, but ISA argues that sucralose, like water, lacks the caloric content of sugar, explaining the differing brain response.

Role in Weight Management Debate on Sweeteners and Obesity: The WHO advises against non-sugar sweeteners for weight loss, citing limited long-term benefits. ISA and other experts dispute these conclusions, arguing that sweeteners help reduce caloric intake and support weight control. The UK Scientific Advisory Committee on Nutrition acknowledges short-term benefits but emphasizes alternative approaches.

Scientific Findings on Weight Management:A year-long study with 493 participants found that: Those consuming sweetened beverages lost 7.5 kg. The water-drinking group lost 6.1 kg.ISA maintains that sweeteners aid adherence to a healthier, energy-reduced diet.

Support for Diabetes Management

Sucralose and other low- and no-calorie sweeteners help diabetic individuals manage sugar intake. Scientific consensus affirms they do not spike blood glucose, impact insulin secretion, or alter insulin levels. Organizations like the American Diabetes Association, Diabetes Canada, and Diabetes UK endorse their use.

Need for Clear Consumer Education
ISA emphasizes science-based information to combat misconceptions and fears surrounding sweeteners. The controversy over aspartame's classification as "possibly carcinogenic" illustrates consumer confusion due to conflicting research interpretations. ISA stresses the importance of science literacy, urging stakeholders to communicate clear, unbiased data.

ISA continues to advocate for sweeteners as safe, effective tools for reducing sugar intake and maintaining metabolic health, particularly in weight management and diabetes care.
https://www.nutritioninsight.com/news/international-sweeteners-association-sucralose-diabetes-weight-loss.html

UK experts call for mandatory nutrition labelling and new tax on salt and processed foods

To combat the UK's worsening obesity crisis, researchers propose extending the sugar tax to all processed foods and introducing a salt levy to incentivize reformulation and reduce harmful consumption. Revenues should fund subsidies to improve access to healthier foods for low-income groups.

Expand Sugar Levy beyond soft drinks to include: Child-targeted products: *milkshakes, breakfast cereals*; Processed foods: *biscuits, yogurts, cakes, sweets*
Introduce a Salt Tax, targeting widespread high sodium content in snacks and processed meals.
Reinvest levy revenue into making nutritious food more affordable, avoiding regressive economic effects.
Establish mandatory front-of-pack labels (e.g., traffic lights, warning symbols) to replace ineffective voluntary schemes.

The existing sugar tax has been effective, but its narrow scope limits impact. Reformulation incentives can drive healthier product development — a strategy proven effective in beverages. *Voluntary action* by food companies has failed to deliver meaningful progress. Strong regulation creates a level playing field and addresses competitiveness concerns, which deter companies from unilateral changes.

Policy & Health Integration
Forming a Food Strategy Advisory Board is the government's first step toward holistic food reform. Regulations should simultaneously: Tackle climate risks (e.g., targets for red/processed meat reduction, pesticide and GHG cuts); Improve health outcomes (e.g., standardizing sugar targets,

tracking company sales of unhealthy foods); Advance social sustainability through fairer access and farmer equity.

Labelling Reform
Current labels fail due to: *Lack of universal standards; Complex consumer behaviour; Mixed signals on health vs. sustainability*

Mandatory front-of-pack systems like "traffic light" labels are more effective at conveying risk. Label education is crucial to reduce confusion and promote healthier choices.

A robust regulatory framework can support: Public health and environmental resilience & Economic stability and national security

https://www.nutritioninsight.com/news/uk-mandatory-nutrition-labeling-salt-tax.html

Clean labels: How consumer perception drives ingredient transparency and innovation

This article explores the clean label movement in the food and beverage (F&B) industry, highlighting how consumer perception drives ingredient transparency and innovation.

Nearly two in three consumers say clean labels impact their purchasing decisions, and 50% are willing to pay more for such products. There is no formal regulatory definition for clean labels, meaning companies must navigate consumer expectations and regional ingredient regulations.

The movement began in the late 1990s, initially focused on avoiding genetically modified foods, later expanding to removing additives, E-numbers, and artificial colours. The clean label sector is projected to be worth $90 billion by 2033, driven by health-conscious consumers seeking recognizable ingredients.

Natural preservatives can lead to shorter shelf life and product spoilage. Consumers demand short ingredient lists and natural alternatives to synthetic additives. Growing concerns over processed foods are shaping clean label innovation.

Sensient Flavors & Extracts: Uses botanical extracts for natural flavouring and alternative solutions for salt and sugar reduction. IFF's Texstar: An enzymatic solution that enhances texture in dairy and plant-based products while reducing carbon footprint. Clean Label Project Advocacy: Consumers are increasingly scanning QR codes to verify supply chain transparency.

The clean label movement is reshaping the food industry, with brands adapting to consumer expectations for healthier, transparent, and sustainable products. As government regulations evolve, companies must innovate to stay ahead.
https://www.foodingredientsfirst.com/news/navigating-clean-label-demand.html

Tackling food fraud: Breaking down supply chain vulnerabilities with digital prevention strategies

This study highlights the growing threat of food fraud, which undermines food safety, public trust, and economic stability. Experts estimate that food fraud affects 1% of the global food industry, costing between $10-$40 billion annually.

Most Targeted Products: Honey, olive oil, seafood, and dairy are high-risk for fraud. Supply Chain Vulnerabilities: Fraud tactics are evolving, making detection difficult. Regional Fraud Cases: Recent food fraud seizures in Italy, Spain, India, and Bolivia highlight the global scale of the issue. Food Fraud Theory: Developed in 2011, it frames fraud as a public health and economic risk, distinct from food safety. Regulatory Action: The Sarbanes-Oxley Act (SOX) helps companies assess vulnerabilities and manage risks.

Prevention Strategies
Digital Tools: AI, DNA sequencing, and sensors are enhancing fraud detection. Multi-Layered Approach: Companies should use complex passwords, two-factor authentication, and digital wallets to reduce vulnerabilities. Industry Collaboration: Workshops and risk management frameworks help businesses stay ahead of fraud tactics.

https://www.foodingredientsfirst.com/news/global-food-fraud-rise-expert-prevention.html

INFOODMATION: Unpacking the media's influence on what we eat

INFOODMATION is a research initiative that examines how media influences food choices, from advertisements to social media trends.

The project aims to combat misinformation, promote responsible food marketing, and shape policies for a healthier and more sustainable food system.

Consumers, especially children and vulnerable groups, are constantly exposed to food and beverage promotions. Many of these messages shape dietary habits and beliefs without people realizing it. INFOODMATION seeks to uncover these hidden influences and ensure food messaging serves public health rather than commercial interests.

The Three-Step Approach INFOODMATION tackles this challenge through: Mapping – Identifying key players, including governments, private companies, and civil groups, to understand their communication strategies. Assessment – Evaluating the impact of food messaging on consumer choices, meal habits, and overall lifestyle. KnowledgeHub – Translating insights into best practices, policies, and a centralized hub to drive positive change.

Researchers at Wageningen University and Research are analysing how regulatory structures affect informed food choices. They aim to bridge the gap between policy, media influence, and consumer behaviour to empower individuals in navigating today's complex food landscape.

INFOODMATION also explores how different consumer segments, including those with lower media literacy, interpret and react to food messaging. By engaging stakeholders throughout the process, the project hopes to create long-term impact.

https://www.wur.nl/en/newsarticle/infoodmation-unpacking-the-medias-influence-on-what-we-eat.htm

India takes a 'positive step' in fixing July 1 every year as date for amendment of food labelling and display regulations

https://www.foodnavigator-asia.com/Article/2025/03/04/this-initiative-will-provide-clarity-and-predictability-for-compliance-planning-for-food-business-operators-improving-trust-among-consumers-said-industry-experts/

India has taken a significant step in food labelling regulations by fixing July 1 every year as the date for amendments to the Food Safety and Standards (Labelling and Display) Regulations, 2020. This move by the Food Safety and Standards Authority of India (FSSAI) aims to provide clarity for food businesses and improve consumer trust.

Food business operators now have a consistent timeline for compliance, reducing risks associated with inconsistent deadlines. Any necessary updates to product labels, including ingredient lists, nutritional details, and other mandated information, must be implemented by July 1 each year. Businesses will have at least 180 days from the date of notification to comply with amendments. The fixed date minimizes financial losses, allowing businesses to transition smoothly while phasing out old stock.

While labelling changes are manageable within six months, ingredient reformulation may require at least a year for development and stabilization. Small and medium enterprises may need longer transition periods to manage stock liquidation and compliance effectively. Products with longer shelf lives (e.g., 24 months) may face compliance challenges if old stock remains in circulation. Businesses can request additional time to use old labels beyond the deadline by paying a fee to FSSAI.

The consumer-centric measure strengthens trust in the food industry and aligns with FSSAI's commitment to public health. Greater transparency in food labelling enables informed decision-making and boosts confidence in food safety. A fixed timeline minimizes confusion by preventing the overlap of old and new labels.

This regulatory change is expected to streamline compliance, reduce marketplace confusion, and ensure food labels consistently reflect accurate and updated information.

Digital health interventions could educate consumers on salt intake, potentially leading to lower blood pressure, say researchers

Researchers in China have explored the potential of digital health interventions to educate consumers on salt intake and manage blood pressure.

Their study followed up on a 12-month randomized controlled trial (RCT) that used an app-based education program to reduce salt intake and systolic blood pressure (SBP) in schoolchildren's adult family members.

The RCT showed a reduction in salt intake and SBP among adults. One year after the trial, the effect on salt intake faded, but the SBP lowering effect remained. The Knowledge, Attitude, Practice (KAP) score related to salt intake continued to improve. Researchers emphasized the need for continuous efforts to maintain salt reduction in real-world settings.

The AppSalt Program: Developed as an mHealth app-based education program. Encouraged schoolchildren to educate their families about salt intake.

Had a 97% retention rate and an 80% completion rate for salt reduction courses. Reduced salt intake by 0.82 g/day and SBP by 1.64 mm Hg after 12 months.

Adults' salt reduction effect weakened over time, but SBP remained lower at 24 months. Children showed no significant changes in salt intake or blood pressure. Both adults and children maintained improved KAP scores, though the impact was smaller.

Implications for Public Health: Digital health tools like mobile apps can support behaviour change. School-based interventions can influence family dietary habits.

Continuous education and support are needed to sustain salt reduction efforts. The study highlights the importance of a healthy food environment in shaping dietary choices.

This research suggests that mobile health apps could play a key role in long-term salt intake management and blood pressure control.

https://www.foodnavigator-asia.com/Article/2025/03/04/digital-health-interventions-could-help-manage-salt-intake-lower-blood-pressure/

Gluten-free in the spotlight under new Singapore pre-packaged food rules

Singapore has introduced new regulations for pre-packaged food, focusing on gluten content and ingredient labelling clarity. These amendments, formalized by the Singapore Food Agency (SFA), stem from public consultations in 2020 and 2022.

Regulation 250B defines gluten-free and reduced-gluten foods. Gluten-free: Must contain 20mg/kg or less of gluten. Reduced-gluten: Can contain up to 100mg/kg of gluten but must be processed to lower gluten levels. Labelling Restrictions: Products must not be labelled "gluten-free" unless they meet strict criteria. Naturally gluten-free foods cannot be labelled as "special dietary" or similar terms.Gluten-free or reduced-gluten substitutes must contain similar vitamins and minerals as the replaced food.

Ingredient Labelling: Water should not be listed unless it is an individual ingredient or part of brine, syrup, or broth. Water evaporated during manufacturing or making up less than 5% of the product does not need to be declared. Enforcement begins January 30, 2026. Online platforms selling pre-packaged food are not required to display labelling information due to extraterritorial limitations. These changes aim to enhance transparency, protect consumers, and ensure accurate food labelling.

https://www.foodnavigator-asia.com/Article/2025/03/03/singapore-tightens-pre-packaged-food-labelling-regulations-with-focus-on-gluten-online-platforms-excluded/

Reformulation, health concerns lead innovation in key APAC staples

Staple foods like rice, edible oils, sugar, and salt have traditionally seen limited innovation.

However, in response to growing consumer demands for healthier alternatives, reformulation, and sustainability, companies and governments have been driving efforts to introduce changes. While innovation in staple foods has been slower compared to sectors like snacks and beverages, notable breakthroughs have emerged in various areas.

Grain Innovation: Rice, Wheat, and Millets

Efforts in rice and wheat innovation have mainly occurred at the upstream agricultural level, such as developing climate-resistant rice and pest-resistant wheat. Governments in Japan and South Korea are actively promoting rice flour as a wheat substitute to reduce dependency on imports following the Russia-Ukraine war. South Korea aims to replace 10% of wheat flour demand with rice flour by 2027. Japan has committed JPY3bn (US$20mn) to expand rice flour usage in bakery and noodle production, targeting 130,000 tons of rice flour production by 2030.

Millets are gaining attention as a nutritious and sustainable alternative to rice and wheat, particularly in India. Millets offer higher protein and fibre content with a lower glycaemic index, making them a strong candidate for staple food substitution. Innovations in millet-based products, such as noodles, pasta, and bakery goods, are expanding rapidly.

Consumers, especially millennials, are shifting away from carbohydrate-heavy white rice. Increased demand for brown rice and Basmati rice (due to its lower glycaemic index) is rising. Smaller pack sizes are becoming popular in Middle Eastern markets, reflecting changing household structures.

Edible Oils: Edible oil innovation remains limited compared to other staple foods, though efforts in enzymatic degumming and healthier oil processing are emerging. Sustainability in oil processing is a growing priority, with a shift toward low-trans-fat and high-nutrient oils.

Vegetable oils, especially palm oil, are widely used in Asian and Middle Eastern cuisine. Health trends are driving demand for specialty fats, smaller portion sizes, and reduced-fat products. Consumers are shifting toward lower-fat diets, impacting the demand for fried foods and traditional cooking oils. In the Middle East, rising incomes and population growth are driving interest in specialized, higher-nutrition products. Sustainability concerns around palm oil, driven by EU deforestation regulations (EUDR), highlight the need for added funding for sustainable practices.

Sugar & Salt:
India's Indian Nutrition Rating (INR) and Singapore's Nutri-Grade labeling have pushed beverage brands toward sugar-free reformulations. Coca-Cola India introduced zero- and low-sugar variants for its beverages in response to demand. Singapore's Nutri-Grade scheme prompted brands like Vietnam's Luave instant boba tea to reformulate their products by reducing sugar from 14% to 5%.

Salt innovation primarily focuses on lower sodium formulations as part of wider reformulation efforts. Regulations and consumer awareness are shaping how salt is used in processed foods.

Salt and fat usage differs from beverages as they are typically small components of a dish, varying based on consumer or chef discretion. Reformulation poses technical challenges due to salt's multifunctional role in food (e.g., moisture retention, preservation, flavour enhancement). Lower salt levels could impact taste, food safety, and shelf-life, complicating reformulation efforts.

Sodium reduction costs vary by food category: Up to 25% reduction: Ketchup and sauces can maintain cost parity. 25%-50% reduction: Could increase costs by 10%. Snack seasonings & bouillon cubes: May incur 10%-20% additional costs. Higher prices for reformulated products may deter consumers from switching to lower sodium alternatives.

Alternative Approaches & Innovations

Ajinomoto has promoted amino acids' umami flavour as a

sodium replacement. Kirin developed an electric spoon that enhances perceived saltiness using a unique current waveform. Indonesia is particularly vulnerable due to high sodium intake, with daily consumption ranging from 5.76g to 7.43g (particularly in chili sauces, salted fish, and meatball soups).

Expansion of Singapore's Nutri-Grade System

Singapore announced that its Nutri-Grade system, which initially focused on sugar, will be expanded to include salt and fat. This move has raised concerns within the food industry, particularly around reformulation challenges, costs, and consumer adoption.Indonesia is also developing a Nutri-Level front-of-pack labelling (FOPL) system, similar to Singapore's Nutri-Grade.

https://www.foodnavigator-asia.com/Article/2025/03/05/healthier-reformulation-substitution-lead-innovation-in-grains-edible-oil-and-other-apac-staple-food-sectors/

Going digital: Vietnam launches online food safety system handbook for food industry

Vietnam has launched a digital food safety system to enhance food safety management and monitoring, particularly for food poisoning outbreaks.

This initiative was developed in partnership with South Korea and officially enforced on February 18, 2025. To facilitate implementation, the government has published a 33-page handbook with step-by-step instructions for food and beverage companies.

The Vietnam Food Administration (VFA) now requires all food safety applications and responses to be conducted online via the Ministry of Health's Administrative Procedures Information System. The system aims to improve efficiency and streamline administrative procedures.

Food businesses must submit applications and documents digitally for:Food safety certificates, Good Manufacturing Practice (GMP) eligibility certificates, Certificate of Free Sale (CFS) issuances, New food additive declarations, Health food declarations, Advertising content approvals.
In addition to the online system, Vietnam has established the VFSA, a national food safety risk assessment centre. The VFSA focuses on scientific advisory roles, resource development, and food standards formulation. The goal is to harmonize Vietnamese food safety regulations with international standards while ensuring consumer confidence in domestic food products.

Implications for the Food Industry: Efficiency & Transparency: The digital system reduces paperwork, improves traceability, and enhances regulatory compliance. Consumer Trust: Strengthening food safety regulations boosts confidence in Vietnamese food products. International Alignment: The system aligns Vietnamese food safety standards with global best practices, facilitating trade and exports.

https://www.foodnavigator-asia.com/Article/2025/03/05/going-digital-vietnam-launches-online-food-safety-system-handbook-fo-food-industry/

HFSS product placement regulation hits unhealthy food displays

The UK's Food (Promotion and Placement) (England) Regulations 2021 have significantly impacted the display of high-fat, sugar, and salt (HFSS) products in supermarkets.

The legislation, implemented in October 2022, restricts HFSS product placement in key locations such as store entrances, aisle ends, and checkouts.

HFSS product displays dropped from 38% to 6% in restricted locations. The regulations apply to retail outlets over 2,000 square feet with 50 or more employees.

Confectionery saw the biggest reduction, while ready meal space increased by 14% and drinks by 3%. Convenience stores saw a 50-percentage point reduction, while supermarkets saw a 28-percentage point decrease in HFSS product displays. Non-HFSS food displays remained unchanged, suggesting a shift in product placement rather than an overall reduction in food availability.

A systematic review from 2020 indicated that better availability and prominent positioning of healthy foods—alongside reduced visibility of unhealthy foods—can lead to improved dietary behaviours.This regulation aligns with broader efforts to reduce obesity and improve public health by limiting impulse purchases of unhealthy foods. Given your interest in nutrition and regulatory frameworks, how do you see similar policies influencing consumer trust and industry practices globally?

https://www.ingredientsnetwork.com/hfss-product-placement-regulation-hits-unhealthy-news126621.html

India proposes mandatory milk product logo, plus larger sat fat, sugar, salt labels

The Food Safety and Standards Authority of India (FSSAI) has proposed three key amendments to food labelling regulations under the Food Safety and Standards (Labelling and Display) Amendment Regulations, 2025.

These changes aim to enhance transparency, improve consumer trust, and strengthen compliance.

Mandatory Milk Product Logo: All milk and milk-based products, including composite milk products, must carry a white drop enclosed within a blue square box. The size specifications vary based on the front-of-pack display area (e.g., for a 100cm² display, the square must be at least 6mm per side, with the drop measuring 4.56mm in height and 3mm in width). Larger packaging will require proportionally larger logos.

Enhanced Nutritional Labelling for Sugar, Salt, and Saturated Fat: The per-serve percentage contribution to Recommended Dietary Allowance (RDA) for added sugar, saturated fat, and sodium must be displayed in bold letters with an increased font size. This builds on a July 2024 mandate, though specific font size requirements were not provided in either instance.

Clear Labelling for Coffee-Chicory Mixtures: Every package containing a coffee-chicory mixture must declare the percentages of coffee and chicory content. These declarations must be displayed on the front of the package, in capital letters within a rectangular box on the principal display panel.

Regulatory Context & Industry Impact: The FSSAI previously ordered online and offline platforms to delist plant-based products that used dairy-related terminology, prompting plant-based brands to adjust their labels.

These new labelling rules aim to increase consumer awareness, reduce misleading claims, and streamline compliance for food businesses. Public comments on these amendments are open from February 18 to April 20.

These labelling changes reflect India's ongoing efforts to strengthen food regulations, enhance consumer trust, and improve transparency in the marketplace.

https://www.foodnavigator-asia.com/Article/2025/03/12/india-proposes-mandatory-milk-product-logo-plus-larger-sat-fat-sugar-salt-labels/