



PFND AI

FOOD, NUTRITION & SAFETY MAGAZINE

BULLETIN JUL 2023

MILK & THEIR PROTEINS APPLICATIONS

Dr Govindarajan R.

**BENEFICIAL EFFECT WITH
PREBIOTIC FIBRES ON THE
GUT MICROBIOME AND
IMPACT ON WELLNESS**

Dr Radha Pujari

**DAIRY BASED
BEVERAGES:**

Ms Nithyakalyani V.

**VITAMIN K2:
LESSER-KNOWN VITAMIN
WITH LARGER ROLE:**

Prof Jagadish Pai

**FOOD SAFETY
AND HACCP**

Dr. Shashank Bhalkar

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SHOULD WE **DISCARD** FOODS FROM ANIMAL SOURCE?

There is a global movement proposing that we only consume plant-based foods not just for sustainability of resources for the planet but also for nutritional reasons.

Recent past has seen a large number of plant-based food products as substitutes for animal based products in the global market along with many articles in scientific and popular publications proposing the shift from animal to plant. There have been such food products as burgers and sausages made plant proteins as well as vegan options for milk, cheese and many other dairy products.

At one time, it looked as if the meat, fish and dairy industry may come into difficulty, but there has been a slow-down of enthusiasm from the consumers after the initial spurt. High price was not the only deterrent but incorporation of many unfamiliar additives may also have contributed although the sensory qualities were quite high.

There are other alternative sources being developed which may make appearance in market soon. Cell culture may possibly avoid the necessity of various additives and may in the long run be economically viable too. However, the consumer reaction needs to be seen to such products which cannot be called plant-based. They also do not involve any live animals.

There has been rethinking among scientists about the need for such a drastic change either for sustainability or nutritional reasons.

There has definitely been overexploitation of animal foods both meat and dairy foods in the high-income countries but consumption of these highly nutritious foods is still low in a large number of countries including India and many Asian and African countries. People here already have deficiencies in nutrients such as proteins, vitamin B12, A & D, iron, zinc and omega-3 fatty acids. It would be difficult to supply in plant-based diet.

Those consuming too much of meat and dairy products should reduce their consumption but to advocate the entire global population to do so would be counter-productive. Yes, we must be prepared for global warming and its effect on food production and to some extent plant-based foods may be able to take care of the problem but making a total change may not be possible nor desirable.

Animal based foods are essential in human diet and can play important role nutritionally. We only need to ensure that we do not consume too much of these which may invite various non-communicable diseases. That is what has happened in the high-income countries. We must also add plant-based foods that supply various other essential nutrients, especially the important dietary fibres which we don't get from animal foods. A good proportion of both animal and plant foods would ensure not just the proper nutrition but the satisfaction of eating tasty foods.

Prof Jagadish Pai,
Executive Director, PFNDIA

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INDIAN PHILOSOPHY OF LIFE RELATED TO FOOD



AUTHOR

Dr B Sesikeran,

Former Director,
National Institute of Nutrition (ICMR)
Hon. Scientific Director, PFNDI

We do get a lot of non-relevant information through the social media. Occasionally someone forwards an interesting piece of information that we would have never known. I am sharing below one such information which amazed me because of its accuracy of science, its relevance to this day and for the future as well as the overall philosophy of life related to FOOD. Nothing on earth is as important as food.

It was equally amazing that this information was documented more than 1500 years back in the Upanishads. These are post Vedic texts more scientific and factual wisdom rather than ritualistic Vedas. These were literally the teachings of great scholars of yesteryears.

Annam in Upanishad

अन्नं ब्रह्मेति व्यवजानात्। अन्नाद्ध्येव खल्विमानि
भुतानि जायन्ते। अन्नेन जातानि जीवन्ति।
अन्नं प्रयन्त्यभिसंविशन्तीति।

TAITTIREYA UPANISHAD SAYS
Annam or food is understood as
the Supreme God.

I remember there was a logo on
the ICMR NIN building which said
"ANNAM BRAHMA"

All the living beings here are
originating from Annam.

This statement seems to indicate
that food or nutrition is needed
right from embryonic and foetal
stages

It is by this Annam that all that
are born sustain their living.

Speaks of the food and nutrition
during all phases of life and the
life cycle approach.

And when they cease their living

existence, they enter the Annam

This clearly refers to the food
chain. Even we humans ultimately
become the elements that find
their way
into
terrestrial
or aquatic
food chain

THAT SHOULD BE OUR SOLEMN
VOW

This para lays stress on us
respecting the food which nature
provides. Disrespect may refer to
wastage, or over consumption or
modification to the detriment of
the original wholesomeness etc.
Maybe our disrespect to food has
led to many of our modern day
maladies.

The very life is Annam.

*The physical body consumes
Annam and therefore the life is
sustained in body'.*

*There can be no life without
body. So verily the material
body that is our physical
existence is entirely dependent
on Annam. Annam subsists on
Annam.*

*So Annam is life as well as the
body,*

*The one who understands that
the life body duo is entirely
manifesting by the power of
Annam or food.. becomes rich in
food and in consumption of
good food..*

*He becomes great, he becomes
rich in progeny and cattle..*

*He becomes resplendent with
spiritual glow..*

*He become very famous.. with
great repute*

Finally the Upanishad or its
authors seem to say - Good Food
is the way to stay HEALTHY
WEALTHY AND WISE

अन्नं न निन्द्यात्। तद्व्रतम्। प्राणो वा अन्नम्।

शरीरमन्नादम्। प्राणेशरीरं प्रतिष्ठितम्।

शरीरे प्राणः प्रतिष्ठितः। तदेतदन्नमन्ने प्रतिष्ठितम्।

स य एतदन्नमन्ने प्रतिष्ठितं वेद प्रतिष्ठति।

अन्नवानन्नादो भवति।

महान् भवति प्रजया

पशुभिर्ब्रह्मवर्चसेन। महान्कीर्त्या॥१॥

One should never
deal with food or
Annam with scant
respect.

Note: I am not a Sanskrit scholar
and I have reproduced as
received.



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THEY BLEND EASILY
IN YOUR RECIPES

APPEARANCE SAVING METHOD IN RULEMAKING



AUTHOR

Dr Joseph I Lewis,
Chairman, Regulatory Affairs,
PFNDI

At school, we were made appearance-ready for inspection visits. Students had to be neatly attired and facilities spruced, polished or painted. The idea was to present an appearance more flattering than the true state of affairs. If inspections, were intended to improve and set things right, the appearance ready presentation ensured this would not happen. In "appearance saving" practice there is no intent to reveal the true state of affairs. The practice is to be seen to be doing something, without intent to solve anything. Like school inspection audits, rulemaking too uses the method.

The method survives on public attention. Quickly spread through web chatter and media posts, attention attracts rules and regulations before science gets a fair chance to

examine the problem. Discussing the problem under formal committees is slow and ponderous; actually outdated in a digital world. Meanwhile attention becomes the problem to be quickly solved by issuing a rule or regulation or by any other means. The thinking, like the Dracula principle is that, if you merely shine a light on the problem it will go away. This is the basis of appearing to be doing something. Only when timely science precedes the rule or regulation, there is true solution with a timeline to fulfil. Take the case of high salt intake.

The appearance saving method would require notifying a rule quickly, taking cues from anywhere, instead of waiting for an exposure assessment on salt intake of Indian populations. Western countries population data, estimates that 71-77% of salt comes from processed and restaurant foods. In India, it's the reverse. More than 80% salt is purchased and added in home cooking. Several surveys and studies provide evidence that the major contribution to salt intake is salt added at home. The average salt intake is 10.7-12 g/day, higher than the 5g/day WHO recommended

intake. China too consumes about 9.3g/day from home cooking alone. There is perhaps a hint that traditional dietary habits predominate.

The issue may require labelling of salt content on pre-packaged foods but the information is unlikely to reduce salt intake to recommended levels. For a rule to be effective, it must be applied at the source of the problem. But this not about salt or other nutrients that have an adverse impact on health. It is the about the appearance of a solution that the public receives. What they get is a message that the problem has received attention; what they don't get is a true solution to reach a health goal.

Attention seeking measures arise from prominent or collectively held opinions. Public health issues deserve measures that are preceded by a scientific opinion formed through relevant expertise. It is increasingly impossible for transparent scientific expertise to prevail. Like the school inspector's visit, a report given on appearances makes everyone feel good, never mind that the issue lingers on. Any rule that cannot tell you how long it will take to achieve its intended goal or purpose, is likely to be made on the appearance saving method.

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Avg. Weight of 10 biscuits (g)	111.2	111.5	114
Avg. Diameter (cm)	5.6	5.5	5.5
Spread ratio	0.66	0.56	0.58
Bite	Slight hard	slight crispy/soft	Soft/crispy

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MILK PROTEINS & THEIR APPLICATIONS



AUTHOR



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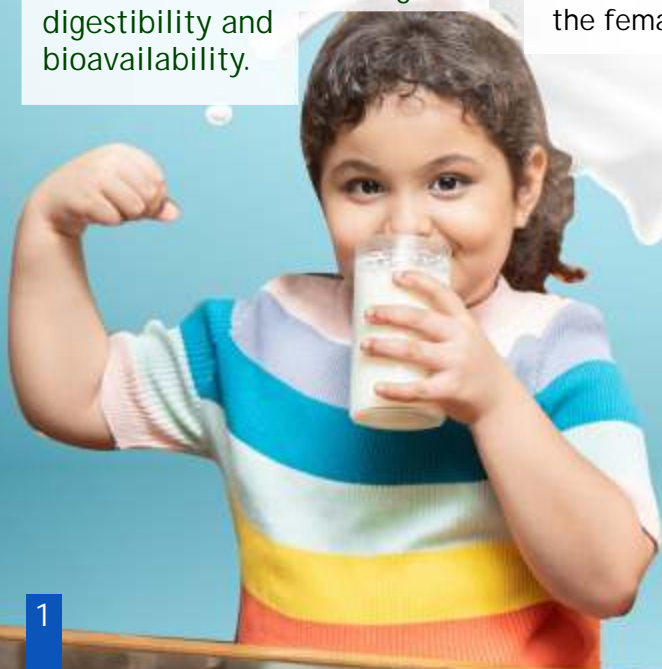
High bioavailability of milk proteins compared to plant proteins is mainly due to its high digestibility, which is partly due to absence of anti-nutritional factors and processing methods[1].

4,500 mammalian species, largely to supply the total nutritional requirements of their newborns. Bovine milk contains approximately 3.9% fat, 3.3% protein, 5.0% lactose, and 0.7% minerals. It provides energy (from lipids, lactose and proteins), essential amino acids, essential fatty acids, vitamins, inorganic elements and water to the neonates. It help young mammals with essential amino acids for the development of muscular and other protein-containing tissues, as well as a variety of biologically active proteins such as immunoglobulins, vitamin-binding, metal-binding proteins, and various protein hormones.

Animal-sourced foods play an important role in our diets specifically for providing energy and protein. Milk and dairy products remain a quality source of dietary protein due to their richness in essential amino acids, high digestibility and bioavailability.

Apart from nutritional source, intact milk proteins are also known for bioactive functionalities like satiating, antimicrobial, mineral binding, anti-lipidemic and anticancer properties[2].

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Milk Protein

Bovine milk includes hundreds of distinct proteins, the most numerous of which are four types of caseins and two whey proteins. The four caseins α s1, α s2, β and K-caseins (Figure 1) account for approximately 80% of the total protein content of bovine milk. These caseins are found in a variety of genetic variations where particular amino acid replacements occur, potentially altering protein functioning. These four caseins combine to form casein micelles, which are supramolecular protein structures [3]. Casein fractions are called phosphoproteins due to the presence of the phosphorous group in the casein structure. They can be precipitated from raw milk at a temperature and pH combination of 20°C and pH 4.6.

α s1

Complete amino acid structure and sequence of bovine α s1-casein are well known. Its B variant contains 199 amino acids and the molecular weight is 23,614. The structure is dominated by acidic amino acid groups possessing net negative charge of 22mV at pH 6.5. Three hydrophobic regions in peptide chain are identified: 1 to 44, 90 to 113, and 132 to 199. The C and D variants consist of Gly, Thr, and Glu, and Ala at positions 192 and 53, respectively. The five genetic variants, A, D, B, C, and E, show decreasing

electrophoretic mobilities in urea containing alkaline gels, and constitute the major components of α s1-caseins[4].

α s2

The α s2-caseins contain the major α s2-CN A-13P, and the minor components α s2-CN A-12P, α s2-CN A-IIP, and α s2-CN A-10P, which are also referred as α s2, α s3, α s4, and α s6, respectively. Amino acid sequence of α s2 casein contains 207 residues with molecular weight of 24,350. Polypeptide chain of α s2 casein contain large number of positively charged side chains exclusively in the C-terminal segment.

β -casein

β -Casein comprises of upto 35% of the entire caseins. The β -CN A1-5P is a single polypeptide chain of 209 residues having molecular weight of 23,982. Seven genetic variants are known, A1, A2, A3, B, C, D, and E. This protein fraction has high net negative charge located in the N-terminal segment (1 to 43) and possess five phosphoserine residues. The C-terminal half (136 to 209) is highly hydrophobic. This concentration of hydrophilic and hydrophobic regions in the terminal ends makes β -casein more surfactant like than other caseins.

K-caseins

About 15 % of the total casein fraction is K-Casein and it is the only casein comprising cysteine. The major casein, K-CN B-1P, consists of 169 amino acid residues with a calculated molecular weight of 19,023. K-Casein occurs in polymeric

form via disulfide bonds extending in sizes from 60 to 600 kDa. Hydrolytic action (Cheese making) by chymosin at Phe 105-Met 106 releases a hydrophobic N-terminal segment (1 to 105) and a hydrophilic soluble C-terminal segment (106 to 169) known as para-K-casein and macropeptide, respectively [4].

Types of Casein available in Market and their uses

Most of the casein based products are derived directly or indirectly from skim milk. These include acid caseins, rennet casein, caseinates, milk protein coprecipitates. The pH of skim milk is adjusted to the isoelectric pH of casein to produce acid caseins. The solubilization of calcium phosphate at this pH disrupts the casein micelle structure. Casein molecules released from micelles bind together to form an insoluble curd. All acid caseins, rennet caseins, and coprecipitates are insoluble in water but soluble in alkaline pH: acid casein at pH 6.7 to 7.5, rennet casein at pH > 9.0 (or disperse at pH 7.5 using complex phosphates). Acid casein is also soluble at pH 3.5, and the acid solution is extremely heat stable and can withstand 1 hour of heating at 140°C [5].





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Caseinates are made by neutralising wet acid curd or reconstituted acid casein powder to pH 6.8 to 7.5 and converting it to Sodium, Potassium, or calcium caseinate. Caseinates made directly from wet curd have a better flavour than caseinates made from converted casein. Because of their water binding and surface activity, soluble caseinates are used in a wide range of products. Sodium and Potassium caseinates can be found in a variety of products, including formulated meat products, margarine, cream substitutes, coffee whiteners, foamed and whipped foods, desserts, instant breakfasts, puff snacks, cheese and milk analogues, and texturized vegetable proteins. Acid caseins are primarily used in breakfast cereals, baked goods, and as a protein supplement in food systems where dispersibility is desired

more than solubility.

Whey Proteins

Whey proteins constitute around 20% of the total protein content in milk. They consist of several proteins fragments, including beta-lactoglobulin, alpha-lactalbumin, bovine serum albumin, immunoglobulins, and lactoferrin. Whey proteins have high biological value (104) and protein digestibility-corrected amino acid score (1.0) making it highly desirable in protein products requiring quick digestibility and assimilation. Whey proteins possess highest concentration of branched chain amino acids (BCAAs) available from any intact protein source.

β -lactoglobulin

β -lactoglobulin is a major whey protein accounting nearly 7% to 12% of total milk proteins. It is one of the milk protein responsible for milk allergies. It is a small protein with 162 amino acid residues that fold up into an 8-stranded, antiparallel β -barrel with a 3-turn α -helix on the

outer surface and a ninth-strand flanking the first strand [7]. β -lactoglobulin have at least three independent binding sites and can bind with variety of ligands.

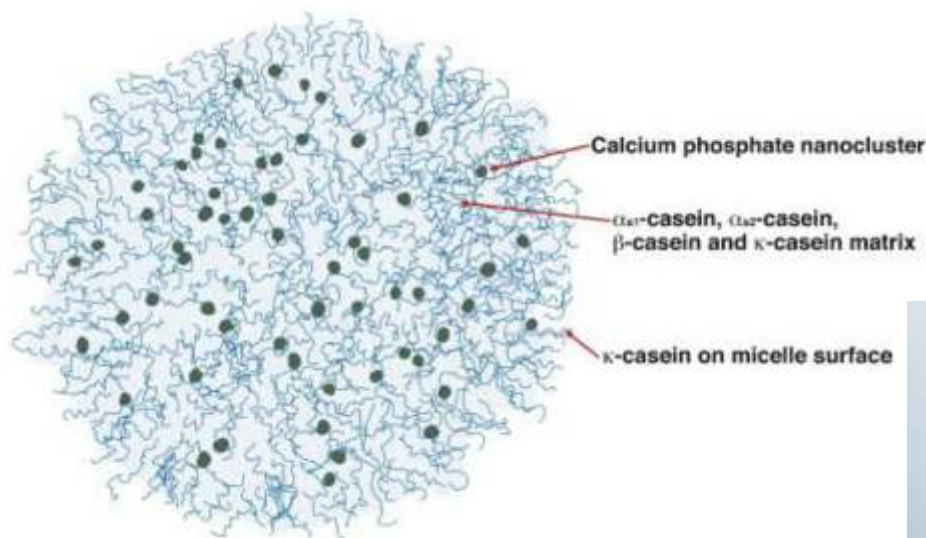
α -lactalbumin

α -lactalbumin is the second most abundant whey protein in bovine milk and the predominant whey protein in human milk. Lactalbumin is a Ca-binding monomeric globular protein of 14.2 kDa with 123 amino acid residues and 4 disulfide bridges. It is made up of α -helical domain and β -sheet domain that are linked by a calcium binding loop. Lactalbumin binds metal ions strongly and is commonly used as a nutritious component in newborn formulae. However, due to the possibility of an allergic reaction to lactalbumin, which causes around 30%-35% of IgE-mediated allergic reactions to cow's milk, lactalbumin is only used in restricted quantities [8].

Bovine serum albumin

Bovine serum albumin is a single-chain 66.4 kDa globular protein with a pI of \sim 4.6 and is a component of the whey protein system in milk, accounting for \sim 1.5% of total milk protein and 8% of the whey protein fraction. It consists of 583 amino acid residues of known sequence and contains 17 intramolecular disulfides and a free thiol group [9].

Figure1: Structure of a casein micelle representing α s1, α s2, β and κ -casein [6]



Lactoferrin

Lactoferrin contains 689 amino acids with five glycosylation sites. The presence of iron binding sites, and its secondary and tertiary structures have been confirmed by [4]. In addition to the Fe^{3+} homeostasis function shared by all transferrins, the structural features of lactoferrin give antimicrobial activity against a wide range of bacteria, fungi, yeasts, viruses, and parasites; anti-inflammatory and anticarcinogenic properties [10].

Applications of whey proteins

Whey protein concentrates (WPCs) (34-80% protein content), whey protein isolate (WPI) (>90% protein), whey with reduced lactose content, demineralised whey, and lactose are all examples of whey products. WPC is obtained through whey ultrafiltration and diafiltration, while WPI is obtained through ion-exchange recovery. These products' proteins are not denatured,

and their functional properties such as high solubility, moisture binding, gelatinization and emulsifying capacities are mostly preserved. Lactose and minerals are also removed, which tend to reduce protein functionality due to complex formation and protein-ion interactions [11].

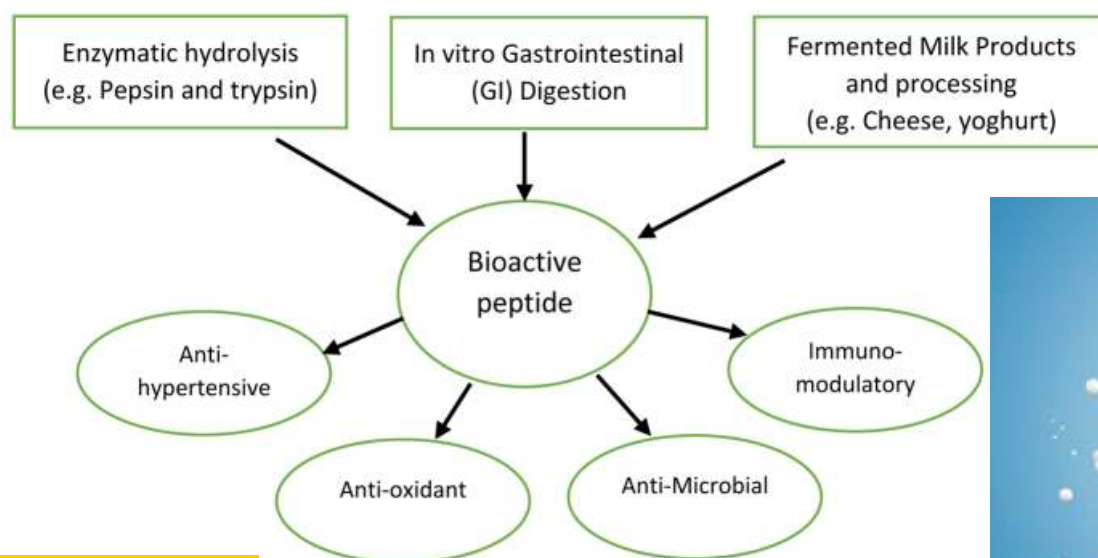
Whey proteins and their fractions are used as protein source for most of the protein drinks, sports drink and bars. They are also used as milk solids in manufacturing of processed cheese and processed cheese analogues. WPI and WPC are also used in the ice-cream preparations for improving the emulsion stability. Whey proteins are widely used in industries to make breads, cakes, cookies, biscuits, crackers, muffins, salad dressings, soups and sauces, mayonnaise, meat and yoghurts. Apart from being used as raw material for food preparations, whey or whey proteins can also be used as a substrate for the production of ethanol, organic acids, single

cell proteins, enzymes, and bacteriocins [12].

Goat Milk Protein

Goat milk is considered as an alternative to cow milk mainly due to its compositional closeness to cow milk, excellent digestibility and potential health benefits. The protein composition of goat milk has higher proportion of casein proteins than cow milk. Alpha-casein is the most abundant type of casein found in goat milk. Whey proteins in goat milk contain relatively higher levels of beta-lactoglobulin and alpha-lactalbumin compared to cow milk. Goat milk proteins are rich in essential amino acids, including valine, isoleucine, and histidine, which play vital roles in human nutrition. Fatty acid profile of goat milk is also different from cow milk leading to differences in products made from goat milk. Goat milk fat has higher levels of short and medium chain fatty acids which results into its easier digestion and impart distinct flavour to the milk and derived products. Goat milk protein contains lactoperoxidase which has been found effective against various bacteria causing cholera, typhoid, pneumonia, dysentery and food poisoning [13].

Figure 2. Production mechanism of bioactive peptides from milk and their physiological functions.





Bioactive peptides in milk and milk products

Bioactive peptides are the functional and physiological active specific protein fragments produced from many food products during gastrointestinal digestion, microbial fermentation and enzymatic hydrolysis. Beyond providing the nutritional benefits, milk and fermented milk products contains bioactive components originating from casein and whey, performing wide range of physiological and biochemical functions.

Amino acid residues for bioactive peptides range from 2-20 and different mechanisms are involved for their release from milk proteins. Different production mechanism and physiological functions of milk

protein bioactive peptides are shown in Figure 2. The biologically active peptides produced through in-vivo gastro-intestinal digestion uses gut

microorganism enzymes or digestive enzymes such as pepsin and trypsin. For production of fermented milk and milk products, many industries use dairy starter cultures having high proteolytic activity. The bioactive peptides are also generated by the action of these organisms. However, due to unavailability of large-scale technologies, the commercial availability of bioactive peptides from milk are quite limited.

Highly proteolytic strains of *Lactobacillus helveticus* is widely used as a microbial starter for the production of traditional fermented milk products, such as Emmental cheese. This strain is capable for the formation of ACE-inhibitory peptides. Highly

efficacious ACE-inhibitory peptides, in fermented milk products produced with *L. helveticus* strains have been identified as Val-Pro-Pro and Ile-Pro-Pro[14]. Many researchers conducted various studies to illustrate the bioactive peptides from different milk proteins in table 1.

Conclusion

Milk proteins, including casein and whey proteins, play a significant role in human nutrition and health. The protein compositions of camel milk, goat milk, and donkey milk differ, contributing to the unique properties and potential health benefits of each type of milk. These milks offer alternative options for individuals with specific dietary needs or preferences.

Understanding the characteristics and amino acid profiles of milk proteins in different animal species can pave the way for their applications in food products.

Table 1. Health-promoting and therapeutic attributes of milk-derived bioactive peptides (Adapted from [15])

Potential Attributes	Source	Peptide Sequence/Fragments
Anti-osteoporotic effect	Milk	VLPVPQK/PepC
	Whey-derived	YVEEL and YLLF
Anti-hypertensive effect	Bovine milk	VLPVPO and VAPFPE
	Buffalo milk casein	VLPVPQK
	Goat milk protein	WY
	Milk/ casein hydrolysate	IPP and VPP
Anti-inflammatory effects	Buffalo casein-derived	YFYPL
Anti-diabetic effect	Goat milk casein	INNQFLPYPY
	Camel milk proteins	VPV, YPI, and VPF
Anti-oxidative effect	Casein-derived	VLPVPQK
	Buffalo casein-derived	YFYPL
	Milk-derived	RHPHPHLSFM, VPYPQR, HPHPHLSFM, YVPR
Anti-microbial effect	Camel milk	Peptidoglycan recognition proteins, lactoferrin, Whey hydrolysate



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BENEFICIAL EFFECT WITH PREBIOTIC FIBRES ON THE GUT MICROBIOME AND IMPACT ON WELLNESS



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parts of the body, the intestine harbours a large and complex flora comprising bacteria, viruses and fungi. The average flora in the intestine is 3.9×10^{13} that is more than the number of human cells in an adult.

Abstract: Prebiotic fibres are conventionally known to serve as substrate for probiotic commensal bacteria. The gut bacteria feed upon these fibres and release metabolites such as shortchain fatty acids (SCFA) in the intestinal tract. The SCFA in turn are known to induce various immuno-modulatory function at different sites in the body. Some prebiotics have been well investigated, with successful human and animal trials demonstrating the strong association between gut microbes and immunity biomarkers leading to improvement in health parameters.

Prebiotics are non-digestible oligosaccharides that stimulate

the growth of probiotic bacteria in the gut, particularly lactobacillus and bifidobacteria.

Prebiotics can be categorized into simple fructans such as inulin and fructo-oligosaccharides (FOSs), more complex galacto-oligosaccharides (GOSs) and starch- and glucose derived oligosaccharides such as resistant starch and polydextrose.

Short-chain fructo-oligosaccharides (scFOS) are one of the most studied dietary prebiotics. It has been bestowed with a plethora of health benefits. The immuno-modulatory function of sc-FOS has been studied at invitro, in vivo and clinical levels. It has been studied individually or in combination with probiotics as synbiotic formulation.

Introduction

In recent years, the gut health has become a topic of concern for many. Compared to other





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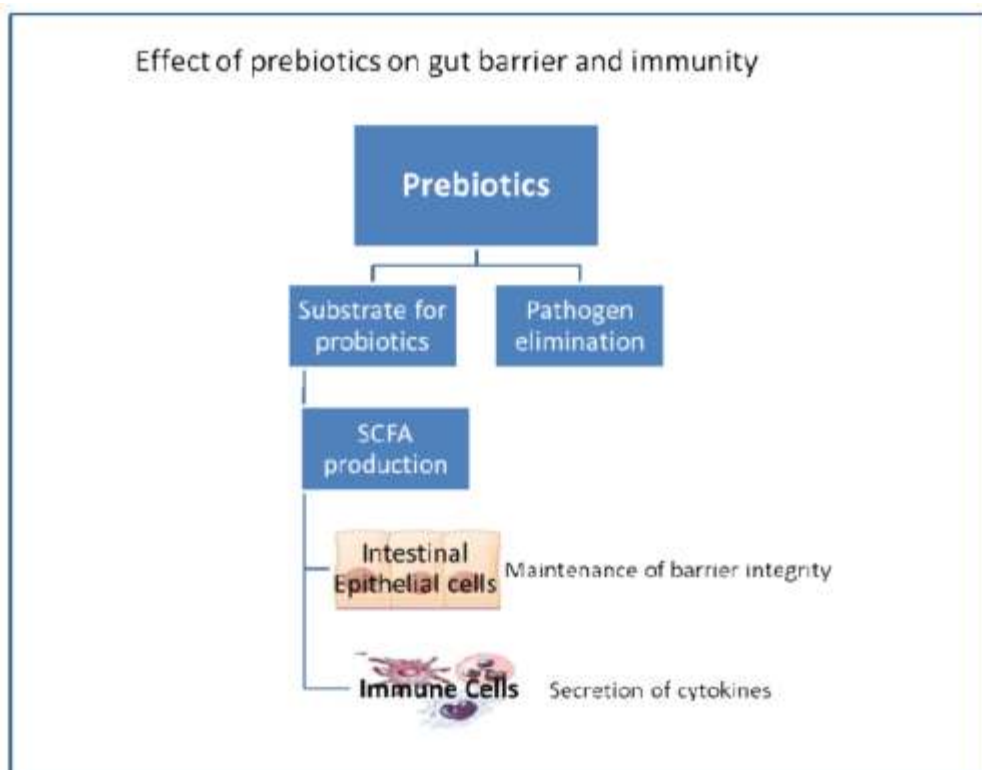
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PREBIOTICS



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A healthy and balanced intestinal flora is crucial for the maintenance of health and well-being. This helps in better nutrient adsorption from food, regulates metabolism and the immune response by producing beneficial metabolites such as the amino acids, vitamins, short-chain fatty acids (SCFAs) and other substances.

The intestinal flora can be divided into three categories based on their effect, probiotics - beneficial effect, neutral bacteria- no effect; pathogens- detrimental effect. Dysbiosis, an "imbalance" in the gut microbial community, may lead to lifestyle disease such as obesity, diabetes, IBS and even colon cancer. Therefore, it becomes necessary to maintain the balance through external supplementation of probiotic bacteria and prebiotics.

Probiotics

Probiotics are defined as live

microorganisms that, when administered in adequate quantities promote health and wellness. They exert beneficial effect on the intestinal health by maintenance of a healthy and balanced microflora, regulating the immune response, better digestion and adsorption of food, prevention of lactose intolerance and improvement of glucose metabolism. Not only the gut, the probiotics can positively impact the brain, skin, eyes and other organs and helps in overall well-being. There are certain important criteria for an efficient probiotic- survival at low gut pH, adhesion to the intestinal mucosa and the epithelial cells, utilize the prebiotic fibres and produce health benefitting metabolites. The probiotic mechanism of action involves prevention of pathogen growth, improvement in the gut barrier effect, production of metabolites

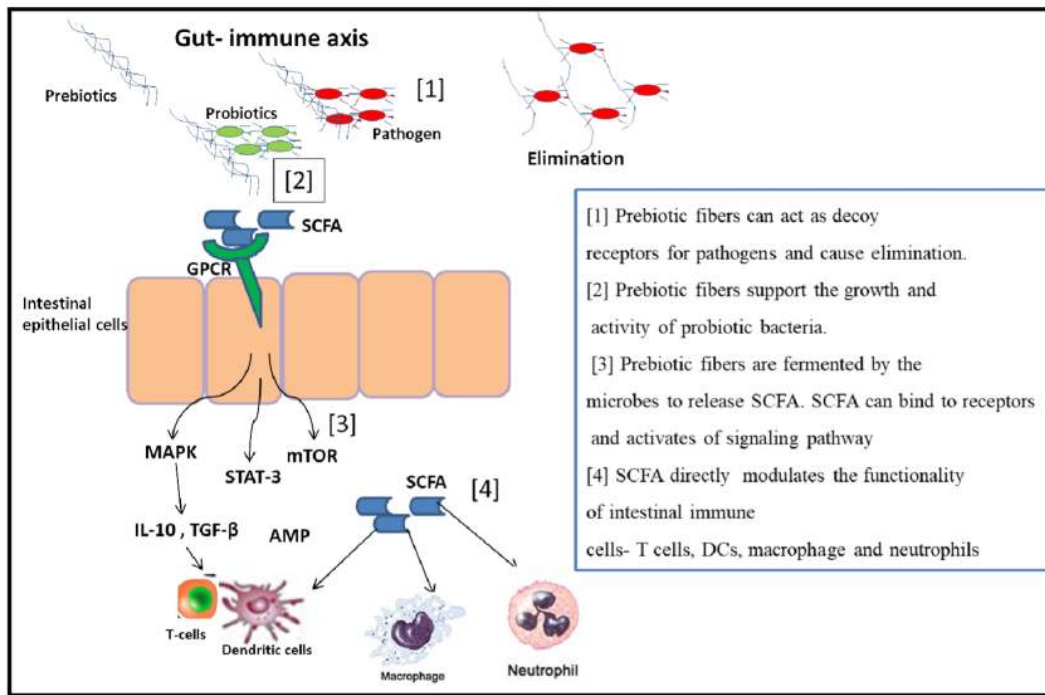
that act as neurotransmitters and act on distal organs. The lactobacillus and the bifidobacteria are the most widely studied and most widely used probiotic bacteria.

Lactobacilli are mostly present in fermented food and they have been studied through in vitro, in vivo and human clinical trials. Lactobacillus species such as *L. plantarum*, *L. fermentum*, *L. gasseri*, *L. acidophilus* etc. are used as commercial probiotics. Studies have documented the anti-inflammatory, anti-obesity, anti-diabetic effects of these probiotics.

Bifidobacterium is a specialized anaerobic bacteria that are ubiquitous inhabitant of the gastrointestinal tract. It has been named bifido as it exhibits a "Y" shaped (bifid) morphology. It grows in the middle and end of the small and large intestine. It produces specific metabolites that maintain the intestinal health.

Both Lactobacillus and Bifidobacteria are an important class of probiotics that find application in pharmaceuticals, cosmetics. Other class of probiotics include the enterococcus, bacillus and saccharomyces species.





How prebiotics help to improve the microbiota and maintenance of health?

It is well known that the way to good health is through our GUT. Human intestine encompasses a wide variety of microorganisms called the intestinal microbiota. This intestinal microbiota plays a significant role in the maintenance of health and immunity. The prebiotics can either directly affect the number and composition of the microbiota, or their metabolites, generated post fermentation, may induce additional benefits in the gut.

There are multiple ways that prebiotics affect gut immunity, the first step being pathogen elimination. During intestinal invasion, the pathogens bind to the epithelial cells followed by colonization. Prebiotics such as Fructo-oligosaccharide, Galacto-oligosaccharide, Inulin can act as decoy receptors that misleads the pathogen by mimicking the pathogen-binding sites. The pathogens binds to these decoy or pseudo

receptors and are eliminated from the gut.

The prebiotic fibres serve as food for the probiotics, the fermentation by-products such as the short chain fatty acids (SCFA) play a role in the maintenance of epithelial barrier integrity. It has also been implicated in the maintenance of gut immune response.

Beneficial effect of Fructo-oligosaccharide

Short-chain fructo-oligosaccharides (sc-FOS) are one of the most widely studied prebiotic fibres consumed by humans. Studies performed at preclinical and clinical level has clearly demonstrated the beneficial effect of the dietary fibre. Human trials have demonstrated that consumption of scFOS leads to an enrichment of the intestinal microflora. The Bifidobacteria and certain Lactobacillus possess certain innate enzymatic abilities that enable them to utilize scFOS for their growth. The stimulatory action

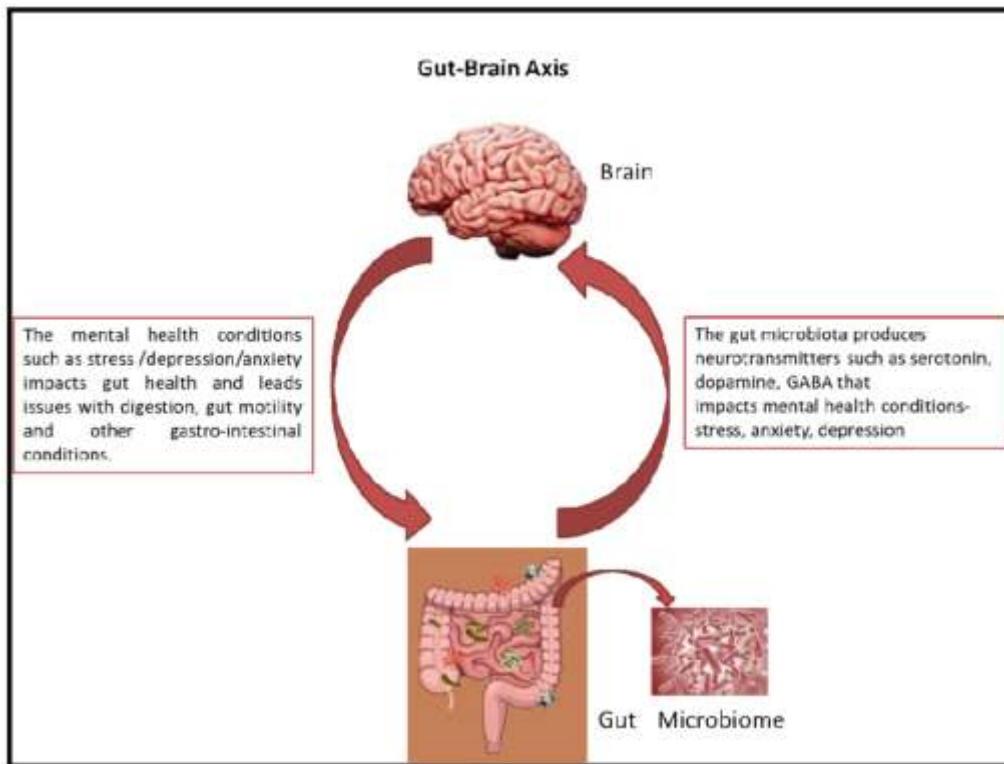
of prebiotics (such as sc-FOS) on the immune system may occur via different mechanisms.

Growth enhancement of Probiotics

It has been shown that a very low dose of scFOS is bifidogenic i.e. it facilitates the growth of bifidogenic bacteria and lactobacilli. This helps in gaining a competitive advantage over pathogen colonization, acidification of colon through production of SCFA in the lumen. The SCFA positively impacts the components of the colonic immune system by activation of different pathways that includes-

- Activating the immune cells residing in the gut such as the immunity boosting T cells; dendritic cells, macrophages specializing in scavenging of potentially harmful microbes, apoptotic cells and cellular debris; the natural killer (NK) cells having antiviral and tumour immuno-surveillance property; and the neutrophils that protect the host by targeting foreign particles that cross the epithelial barrier and enters the gut.





- Improvement in integrity of tight junction proteins that line the paracellular space between the intestinal epithelial cells and prevent the “leaky gut” syndrome, a condition that arise due to weakening of the intestinal walls resulting in leaching of bacteria and toxins into the bloodstream.

- SCFA such as butyrate are anti-inflammatory and helps in reducing inflammation and associated conditions such as inflammatory bowel disease (IBD) and colorectal cancer. Butyrate has also been reported to-induce mucin secretion that protects the intestinal lining from damage.

Increased consumption of fat and low intake of fibres has resulted in increased susceptibility to gut associated inflammatory disorders. Prebiotics positively impact the growth of probiotic bacteria and helps in rebiosis;

in addition, the ability to balance the pro and anti-inflammatory response.

Protection against diarrhoea

Prebiotics, such as scFOS, exhibit efficacy in preventing enteric diseases by selectively stimulating the growth of bifidobacteria and lactobacilli in the gut. In a trial involving children (1-14 years of age) suffering from acute diarrhoea, consumption of sc-FOS (2.5-5 g/day) reduced the duration of diarrhoea events as compared to control group. In another trial comprising children (25 to 59 months) consumption of a solution of 2g scFOS daily for 6 months reduced the number of diarrhea episodes as compared to the placebo group.

Protection against inflammation

Inflammatory bowel disease occurs due to imbalance in the gut microflora. Prebiotic fibres are attributed with the

property of increasing the abundance of the beneficial bifido and lacto bacillus species in the intestine. This has been supported by in vivo and clinical studies. The lactobacilli helps in increasing lactate and butyrate which contributes to the beneficial effect of FOS in reducing of gut inflammatory conditions such as colitis. sc-FOS also helps to reduce the damage caused from oxidative stress and inflammation caused by improper or imbalanced diet.

How interactions between prebiotics and probiotics act on different organ systems?

The potential of the gut microbiome to impact distant organ sites is currently been investigated. The impacts on distant organs, such as the immune system, brain, and skin, have created the following research fields: gut-immune axis, gut-brain axis and gut-skin axis.

The Gut-Immune axis: Effect on immune system

The human gut, comprising the GALT system (gut-associated lymphoid tissue), is the largest human immune tissue. It serves as the first line of defence against any pathogenic invasion. The intestinal immunity is influenced by the interactions between the microbiota and the GALT. The probiotic commensal bacteria release short chain fatty acids (SCFA) in the intestinal tract along with several other metabolites.



8 IMMUNITY NUTRIENTS BANAYE RAKHE IMMUNITY HAR DIN



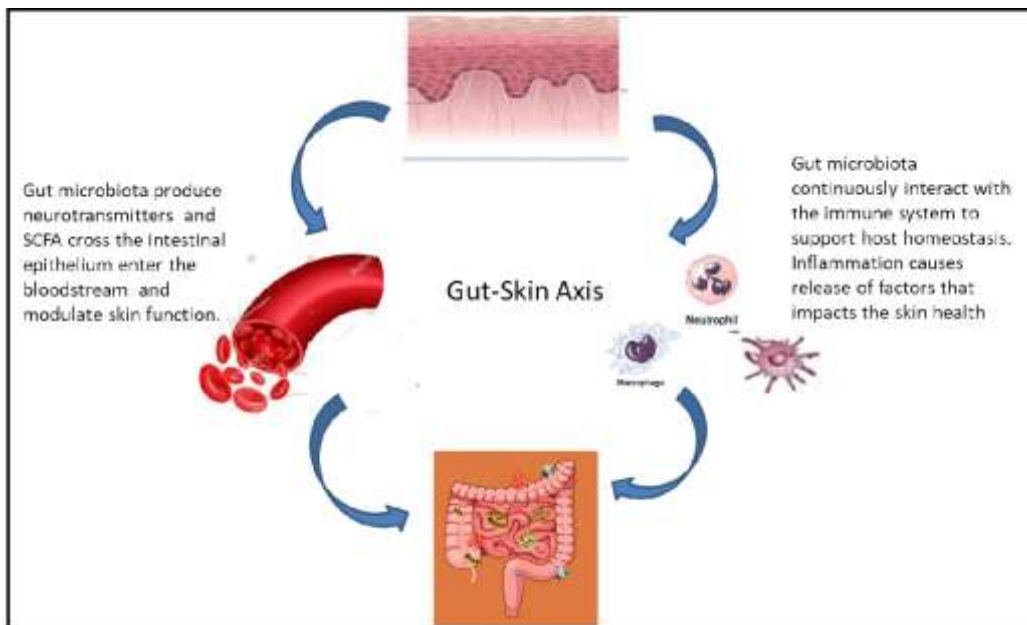
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Subsequently, they then act on the local as well as the systemic immune cells and the gut-associated epithelial cells. The cumulative effect results in the maintenance of the epithelial barrier integrity and modulation of innate immunity through secretion of cytokines, effect on immune cells such as the macrophage, neutrophils recruitment, dendritic cells and T cells.

Gut-skin axis: Effect on skin functions

The gut microbiome also impacts distal organs like the skin. Pre- and probiotics aimed at the intestinal microbiome may be used for targeting skin health. Consumption of probiotic *Lactobacillus reuteri*, demonstrated shiny, thick and healthier looking fur in mice. Human trials have also validated reduced trans-epidermal water loss and skin sensitivity on probiotic consumption. Studies have demonstrated the beneficial effect of probiotics in the management of skin ailments such as, acne vulgaris, atopic

dermatitis, and psoriasis. Similar beneficial health effects have been determined by consuming prebiotics and synbiotics.

Conclusion

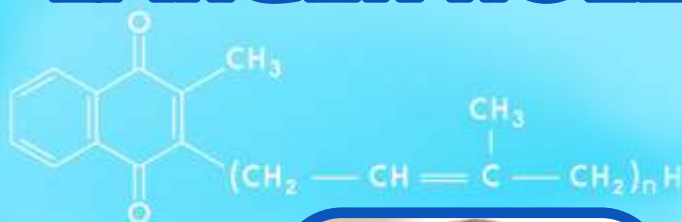
The human gut microbiome is largely unexplored and initiatives such as human gut microbiome initiative (HGMI) are undertaken by the scientific community to decipher the microbial communities and predict predisposition towards various ailments such as diabetes, GI disorders, atopic disorders and other immuno-pathological conditions. The prebiotics and probiotics are being extensively explored for regulating the gut microbiome and influence the health and wellness. Studies have demonstrated that the consumption of prebiotic fibres change the intestinal microbiota. This establishes the importance of prebiotic fibres directed at influencing the gut microbiota for a beneficial effect on human health.

Additionally, the prebiotics

harbours the potential to either directly or indirectly modulate the host immune system. This immuno-modulatory property of the prebiotics and probiotics has been exploited to develop potential applications in health and wellness products as well as adjunct immuno-modulatory therapy for a wide variety of chronic disease conditions.

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More recently, much work has been done on menaquinone or vitamin K2, which has been found to be important in calcium metabolism with improvement of bone health and may have a very critical role in heart health. There are also indications that it may be useful in dental health as well as may help fight cancer. (1)

Vitamin K2 has 10 subtypes, known as MK-4 to MK-13. These are mostly produced by bacteria, each strain producing different form of K2. The forms differ in their number of isoprenyl units in the side chain.

Vit K2 with n isoprenyl units: MK-n

CC1=C(C(=O)c2ccccc2C1=O)C(=C)C(C)C



Dietary vitamin K2 may come from dairy products, especially cheeses, due to bacterial fermentation. Some fermented vegetables like sauerkraut and natto are also important sources. Natto is the richest source producing MK-7 up to 900ug/100g, which is produced from soybeans. Some of the other sources include bovine and pork liver. (3)

Bone Health & Vitamin K2 (4)

Calcium, vitamins D and K2 work together in bone health. Calcium is the main component of bones. From our diet, calcium goes into digestive system where it is digested and absorbed in small intestine. As calcium is needed for various functions of body, it is utilised from dietary calcium. When the diet is deficient in calcium, the body gets it from bones where it is stored. Hence, calcium deficiency can cause erosion of bones of calcium and causes conditions such as osteoporosis. This is a bone disease wherein bone tissues are degraded losing calcium and not enough bones tissue is made or maintained.

Vitamin K2 can help here after calcium-containing food is eaten and vitamin D helps absorb it. Absorbed calcium flows through blood vessels and vitamin K2 may help bones

draw this calcium out of blood and deposit it into bone tissue.

Bone has hard outer shell and spongy inner tissues. It is remodelled with calcium from it released into bloodstream to meet body's metabolic needs including growth & repairs and maintenance. At the same time, calcium from diet is brought and deposited into bone tissue. The whole process is regulated by osteoblasts that build up bone skeleton and osteoclasts that break down the bone. As long as absorption of calcium into bone is greater than or equal to the breakdown (resorption) healthy bone structure is maintained. When breakdown is more than maintenance, there is erosion of calcium from bones and beginning of osteoporosis. (5)

Osteoblasts produce osteocalcin that helps calcium uptake from blood and bind in bone matrix. Osteocalcin is inactive and needs vitamin K2 for activation and for binding calcium. Secondly, vitamin K2 helps keep calcium from depositing on walls of blood vessels. Matrix GLA protein (MGP) that depends on vitamin K2 inhibits calcification and regulates calcium deposition on blood vessels. Thus it helps deposition of calcium where it is needed.

Heart Health

Intake of vitamin K2 has relevance to heart health. Adequate K2 in diet can

lower the risk of adverse effect because it activates MGP, which in turn inhibits calcium being deposited in blood vessel walls, which remain healthy and flexible as shown in rats. (6) This was shown to be true in the population based Rotterdam study, which suggested that adequate intake of menaquinone could be important for cardio-vascular disease prevention. (7) In this study, over 4800 healthy men and women over 55 were given dietary intake of vitamin K2 of at least 32 mcg per day and not vitamin K1. This was shown to reduce 50% death from cardiovascular disease related to arterial calcification and 25% reduction in mortality of all causes.



This has shown the strong possibility of vitamin K2 benefiting in heart disease especially related to arterial hardening due to calcification of blood vessels. Another study of 244 postmenopausal women taking 180 mcg vitamin K2-7 for 3 years showed cardiovascular improvement. (5)



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Benefits against Other Diseases (8)

Vitamin K2 has anti-cancer effects on cell lines like leukemia, lung, ovarian, pancreatic and colon cancers. Growth of cancer is suppressed by K2. In Type 2 diabetes, insulin sensitivity is improved by vitamin K2. Levels of vitamin K2 in serum lowered in patients of Alzheimer's Disease and K2 has the potential to slow down the disease and may be even contribute to its prevention.

In Conclusion

More recently, plenty of research activity is seen with vitamin K2 as it was not steadied earlier. Its importance is being realised as more results show its ability to be helpful in many diseases. Most important may be with osteoporosis and heart disease where it has shown tremendous promise and both are connected by calcium metabolism. Although many promising trends of benefits have been shown more research is needed to show clear link for the benefits.

Deficiencies of vitamin K1

were not found except when the diet is extremely poor as that vitamin is present in many common foods especially green vegetables. On the other hand, vitamin K2 is present in certain animal foods

and in fermented foods such as cheese and sauerkraut, the richest source being fermented soybeans especially natto.

Many Indians do not regularly consume foods containing vitamin K2 so the deficiency is likely, unless fermented foods are consumed regularly or supplements are taken.

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VITAMIN K2



DAIRY BASED BEVERAGES

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Beverages are ready to drink, easily consumable drinks that can be made from a variety of food ingredients or their by-products to which some additives like flavour, colour, acidulant, stabilizers, salt, spices and CO₂ may or may not be added. Beverages have a thirst-quenching effect and some of them maybe refreshing with some nutritional value or in some cases may have a stimulating effect. Dairy based beverages are refreshing, light, naturally nutritious providing host of nutrients in a more palatable and delicious form.

Dairy-based beverages can be classified as:
Unfermented beverages- this

includes flavoured milk, milkshakes, smoothies and milk fortified with vitamins and minerals.

Flavoured Milk: This beverage is popular across all age groups and can be helpful especially for children who are averse to drinking plain milk. It is a good source of calcium, potassium, phosphorus, protein, vitamins A, D and B12, riboflavin and niacin similar to unflavoured milk. It is available in a variety of flavours rose, chocolate, vanilla, pineapple, banana to name some.

Chocolate milk is a favourite among children here's a look at how it is made(1)

Fresh milk from dairy farms is standardised to obtain the desired ratio of fat to solid non-fat. This is followed by pasteurization where the milk

mixture is subjected to High temperature short time (HTST) heating to kill the possible pathogens. Soon after the milk is cooled to 5°C.

The next step is the addition of cocoa powder, sugar, stabiliser (carrageenan) and emulsifier (soy lecithin/mono and diglycerides of fatty esters) slowly so that they are completely dissolved.

This milk is now homogenised, a process which breaks the fat globules and causes them to mix evenly throughout the liquid thus preventing the separation of cream and milk. Milk thereby becomes stable and has an extended shelf life.





The final product is sterilised by UHT processing, this is the preferred way of heat treatment as it enhances the flavour of chocolate without making it bitter or harsh and gives a good mouthfeel along with an extended shelf life. The flavoured milk can be packed in LDPE pouches, PET bottles, cans or in TetraBrik/aseptic packaging.

Stabilization of chocolate milk is an important aspect to be considered during its production and it is affected by the following ingredients used: (2)

Cocoa powder - Since it is insoluble in milk sedimentation can occur giving a chalky taste to the flavoured milk. The stabilisers like carrageenan help in keeping the cocoa particles bound to milk protein and thereby prevent sedimentation. Fine granules of cocoa powder can also help in optimal dispersion.

Stabilization of milk is also affected by the pH of the final product, even if alkalised cocoa powder is chosen then it should maintain the pH of the final product close to that of milk around 7.0 so as to maintain the desired texture of the final product.

Amount of Hydrocolloid added- Carrageenan has to be added optimally, in low amounts sedimentation may happen and a higher amount may result in heavy, gelled body. A higher milk fat

content or usage of more cocoa or a UHT treated product will require less stabiliser to get the desired consistency.

Emulsifiers are added to increase creaminess of milk and give a satisfactory sensory perception and also to prevent creaming in the final product.



Problems encountered in UHT processing of Flavoured Milk:

Fouling and Sedimentation could be a problem during UHT processing of chocolate milk. Optimum efficiency in UHT processing of chocolate milk can be attained by using optimum levels of sugar and carrageenan and also by determining the critical value of apparent viscosity above which these problems occurs. (3)

Milkshakes and Smoothies-These are popular dairy

beverages and consumers often fail to recognise the difference between them.

What is the difference between Smoothie and Milkshake? (4) Smoothies are composed of raw fruits or vegetables with water, fruit juice and puree, yogurt, milk, or soy milk. Other ingredients like crushed ice, sugar, honey, grains, herbs, dairy or vegetable proteins, and enhancers (vitamins, amino acids, and minerals) may also be present. They tend to have high viscosity due to their high solid content and some thickeners like pectin.

Smoothies are good source of nutrients, at the same time they are low on calories and fats. They may be suitable for lactose intolerant people.

Milkshakes on the other hand are prepared using milk, ice cream or iced milk, emulsifier and/or stabilizer and flavourings or sweeteners (e.g., fruit syrup or chocolate sauce). They are high on calories and fats.

Industrial process for the production of milkshake involves basic food processes including mixing, homogenization, and high-temperature short-time pasteurization (HTST) as opposed to smoothies that are prepared by high-speed mixing process following homogenization and heat treatment.





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Fortified Milk-

Milk is a rich source of protein, calcium and fat-soluble vitamins A and D. But during processing (removal of fat) of milk these vitamins are lost to a certain extent. This results in the deficiency of these micronutrients among the population. To overcome this deficiency, countries like India, fortify milk with some of these micronutrients.

Fortification is a simple, powerful, and cost- effective nutrition intervention with a potential to address micronutrient deficiencies on a large scale.

Fermented beverages- They are produced when milk ferments due to the action of specific kind of bacteria like the lactobacilli, which increases the shelf life of the product, also enhances the taste, and improves its digestibility. Cultured buttermilk, acidophilus milk, kefir and some fermented milk with probiotics are some of the fermented dairy beverages.

Cultured buttermilk- Actual buttermilk is the fluid remaining after cream is churned into butter. Earlier this buttermilk was consumed by adding salt, spices to it, but now it is condensed or dried and used in baking and in making frozen desserts. It has now been replaced by cultured buttermilk for which skim milk is commonly used. Pasteurized skim milk is cooled to the



suitable inoculation temperature and then inoculated with appropriate mesophilic starter culture (Lactobacillus lactis and Leuconostoc mesenteroides species).

It is fermented at appropriate temperature for a couple of hours. Once the desired ripening happens, further ripening is avoided by cooling the curd by gentle agitation, which also helps break the curd. Dilution can be done at this stage to obtain the desired solid levels and spices and condiments can also be added to improve the flavour. The product is finally cooled to <5°C. Cultured buttermilk is packed in bottles or cartons. (5)

Lassi- It is an Indian yoghurt based beverage, which has a smoothie like consistency. It is prepared by churning curd with water and adding either sugar or salt. Fresh fruits and dry fruits can also be blended with curd to make fruit lassi.

Acidophilus Milk- It is fermented cultured milk that has a therapeutic value. Sterilized, homogenized skim milk is inoculated with pure culture of Lactobacillus acidophilus and fermented, it is then cooled and stored under cold conditions.

Acidophilus milk shows the following potentials:

- Preventing /controlling intestinal infections

- Improving lactose digestion in people who cannot digest lactose
- Help to control serum cholesterol levels
- Exerting anti-carcinogenic activity

Kefir- It is a traditional fermented milk beverage thought to have originated in the Caucasus.

Preparation involves heating whole milk to 95°C for 5 mins to denature the whey proteins and improve the viscosity of the final product. The inoculum is a mixture of bacteria (Lactobacilluscaucasus) and two yeasts (Saccharomyces kefir and Torula kefir). The bacteria ferment lactose in milk to lactic acid, which gives the tangy flavour while the yeast converts the fermentable sugars of milk to ethanol, and CO₂, which gives effervescence, and fizz to kefir. It is fermented around 20°C for about 20 hrs. Fresh kefir is often held for several hours to ripen, which improves viscosity and stability of the coagulum.

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acidophilus and *Lactobacillus bulgaricus*. Sugar and flavour are then added and the product is heated at 75°C for 5 min, cooled to 5°C, packed in pouches and stored in refrigerated conditions.

Whey Based Beverages

A variety of whey beverages, which may be plain, carbonated, containing soy and fruit have been developed and marketed across the world. In India, a number of refreshing whey drinks and beverages have been developed that include whevit, acido-whey, whey-based fruit beverages, whey-based soups, whey-based lassi. These beverages are preferably prepared from paneer/chhana whey, which is acidic and has low protein content. (6)

Whevit- It is an alcoholic whey drink in orange, pineapple, lime and mango flavours developed by National Dairy Research Institute (NDRI) Karnal. The clarified, deproteinised whey is treated with sugar solution followed by addition of citric acid, flavour and colour. It is then fermented using *Saccharomyces cerevisiae* and held at 22°C for 14-16hrs. Finally, it is bottled, pasteurised, cooled and stored at low temperatures.

Acido-whey- It is a non-alcoholic whey beverage developed by NDRI, by fermenting deproteinised whey with a culture of *Lactobacillus*

Studies have been conducted on **whey based fruit beverages** (by mixing appropriate fruit juice/pulp with processed whey), **whey based soups** (by blending the vegetable and corn flour in whey followed by heat processing), **whey based lassi** (developed by NDRI where 60% of milk is replaced by whey), probiotic whey beverages (where whey is fermented using *Lactobacillus* species and *Bifidobacterium* species with addition of sugar and pectin) and have shown positive results.

Whey based beverages are good thirst quenchers and can be used to treat various ailments such as arthritis, liver complaints and dyspepsia. It can help control dehydration as it contains all the electrolytes present in ORS. Preparing whey based beverages helps make use of the by-product of cheese manufacturing process and makes it an environmentally sustainable option.

The Indian milk based beverage market is set to reach USD 5273.9 by end 2026 during forecast period 2019-

2026, mainly due to the consumer awareness of the health benefits of these ready to drink beverages and the hectic lifestyle that they lead. Added to this increased milk production in India has further increased consumption of dairy based products (7)

With such a plethora of nutritious beverages available, the consumer should take advantage and opt for these healthy drinks in place of sodas, colas and other synthetic carbonated drinks.

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FOOD SAFETY AND HACCP

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Unsafe food is a real global concern. Food contaminated with bacteria, viruses, parasites, or chemical substances such as toxins produced, heavy metals, and pesticides can lead to ill health.

This contamination can happen at any stage of food chain, like soil, water, food not stored or processed properly. Contaminated food can cause over 200 diseases which could be from diarrhoea to cancer. Although most of the diseases are gastrointestinal, they can also lead to neurological or gynaecological problems. This is not only public health concern but also has many consequences such as loss of productivity, trade, and tourism. One report (February 2019) from FSSAI says Food borne diseases cost India \$15 billion annually. India and China contribute 49% of total burden of low- and middle-income countries economy in Asia because of Food Borne Diseases.

With increase in globalised trade, the concept of Food Safety has become more important. Food should be maintained safe from "Farm to Fork" which is life cycle of the food from when it is produced till it is consumed by the consumer. Food safety means food handling procedures for the food product applied during food preparation, processing, storage, and distribution of the products. Understanding of proper knowledge of what can go wrong to food during whole operation is crucial.

This could include proper handling and understanding of industrial processes such as proper cooking, processing, segregation, packing and distribution. Consumers at their end must store the food at recommended storage conditions of temperature. Maintaining proper food safety has many positive effects. Safe food protects consumers from food-borne illnesses and causes the socioeconomic consequences which are

discussed earlier. Maintaining proper food safety leads to avoiding wastage by the way of discarding of unsafe food and therefore save cost. There is no unsafe food produced which must be disposed of and can avoid agony of food recalls which also leads to loss of cost and reputation to organisation. Consumption of safe food gives satisfaction and health to consumers leading to improved productivity.

To understand how food gets spoiled by microorganisms, "FATTOM" concept will be very useful. It is simple mnemonic device to remember the factors responsible for food spoilage by microorganisms. Each letter indicates something which is responsible for growth of microorganisms in food. F - Food, A - Acidity, T - Temperature, T - Time, O - Oxygen, M - Moisture.



monitored.

O (Oxygen): Most of the pathogens are aerobic. Foods should be kept in air tight containers to avoid rapid growth of microbes.

F (Food): Microorganisms too thrive on nutrients in Foods like us. Foods which are rich in proteins and carbohydrates are more susceptible to spoilage because of microbiological growth. Therefore, foods like meat, fish, poultry, and milk are perishable. All foods naturally contain microorganisms and therefore lesser initial load will be better.

A (Acidity): Acidity is measured by pH value. Foods with pH of 4.6 to 7.5 are more susceptible to bacterial growth. Whereas foods with low acidity are more susceptible to be attacked by yeasts and molds as well as acidophilic bacteria.

First T stands for "Temperature." Most of the pathogens grow from 60 to 600 C and therefore perishable fresh foods are generally stored under refrigeration below this temperature.

Second T stands for "Time." The microbes inherently containing in foods will grow over time even in unfavourable conditions. Therefore, time for storage of Foods need to be

M (Moisture): Foods with high moisture (aw of 0.9 to 1) get more likely to contaminated faster. Dehydrated products should not be exposed to high humidity otherwise will absorb moisture.

FATTOM helps to understand favourable factors for that foster the growth of food-borne pathogens and therefore underline the importance of using right quality ingredients and storage conditions in the process. It also helps find critical controls in the process. When the food is processed it is not only necessary to start with right quality ingredients but also needs to be protected from various hazards through the chain till it reaches consumers. There are three kinds of hazards viz. **biological**, **chemical**, and **physical hazards**.

Biological hazards include microorganisms like protozoa, bacteria, moulds, viruses, yeasts and parasites. These are invisible biological hazards which make the Food unsafe. When the ingredients are not of proper quality or if the proper plant hygiene is not maintained visible biological hazards like flies, worms, weevils, insect fragments can appear.

Chemical hazards include

many chemicals hazardous to the health. These could be pesticide residues, excessive permissible additives used more than permissible limits, cleaning chemicals used for CIP, mycotoxins, antibiotics residues coming from the ingredients used. They all can cause illness or injury when used in high concentration.



Physical hazards include foreign objects such as glass, plastic, metals, matchsticks, jewellery, stems, seeds, feathers, stones, even bones. They could lead to injuries such as cuts to mouth or throat, can also cause damage to intestine. Particles of sand or hair may not cause damage but are undesirable.

Understanding of these hazards can help to develop quality system to produce safe Food.



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Hazard Analysis Critical Control Point (HACCP) is management system in which food safety is achieved through analysis and control of the three hazards mentioned above in all the food chain i.e., raw material, manufacturing, distribution, and consumption of the product. This is done by identifying hazard, assessment of risk and its control throughout the food chain to ensure that food produced is safe to consume.

The concept was originated in 1960s for very different purpose when NASA, the Pillsbury Company and US army laboratories collaborated to provide safe Food in upcoming space expeditions. CCP (Critical Control Point) was system used to test weapon and engineering system reliability.

The same CCP was used to find out “critical failure areas” in food processing procedures. In early seventies, Pillsbury had to recall one of their infant cereal infant foods because of glass pieces found in the product. Because of this outbreak and earlier success of HACCP with NASA in 1971, there was discussion at US National Conference for Food Protection regarding combining CCPs with GMP.

As an outcome of this FDA asked Pillsbury to establish and manage training program for

FDA inspectors in 1972 wherein other food facilities were first time trained on HACCP. After globalisation of Food trade in 1990s and promulgation of US Seafood regulation in December 1995, it became mandatory that every food exporter to US must comply with HACCP. Therefore, in India, Marine Products Export Authority in India constituted HACCP cell in early 1996 to assist Indian Seafood Industry for the implementation.



According to CODEX, HACCP is based on following seven principles.

1. Conduct hazard analysis.
2. Determine CCPs (critical control points)
3. Establish critical limits
4. Establish system to monitor control of CCPs
5. Establish corrective action to be taken when monitoring indicates that CCP is not in control.
6. Establish procedures for verification to confirm that the HACCP system is working effectively.
7. Establish documentation concerning all records and procedures appropriate to these principles and their application.

The process is implemented in a very systematic manner. As the first step, a multidisciplinary team is

formed which consist of: Production, Packaging, Micro and Analytical Lab, Compliance, Quality systems and Warehouse Managers.

This team studies product for its all characteristics (Chemical, Physical), processing methods and intended use. Process flow diagram is constructed and verified on line for processing, and identifying the steps which are critical. There will be brainstorming session. All potential hazards (physical, chemical, biological) are listed to see that their elimination or reduction to acceptable levels will assure that food produced is safe.

The team then conducts hazard analysis by considering, likely occurrence of hazard and its severity, qualitative/ quantitative evaluation of hazards, production or persistence in food of toxins, chemical, physical agents. The team also decides control measures for each hazard.

The CCPs are then decided by applying Decision tree in the **Figure 1** below. The process step is considered critical when the step is specifically designed to eliminate or reduce the risk to acceptable level. The severity and likelihood of occurrence are deciding factors for determining CCPs based on decision tree.





The severity will be in descending order as follows: Fatality (5), Severe illness (4), Product recall (3), Customer complaint (2) and Insignificant (1). Severity is decided on the intended use whether the consumers are infants or adults, magnitude of illness Frequency (likelihood of occurrences) which is likelihood of occurrence could be as follows: Common occurrence (5), Known to occur (4), Could occur (3), Not expected to occur (2) and practically impossible (1).

Occurrences are based on Experience, Data from past Food borne illness outbreaks, scientific literature, or historical information gathered. A typical example of the CCP in a spray drying process would be pasteurisation step prior to spray drying which will take care of any pathogens.

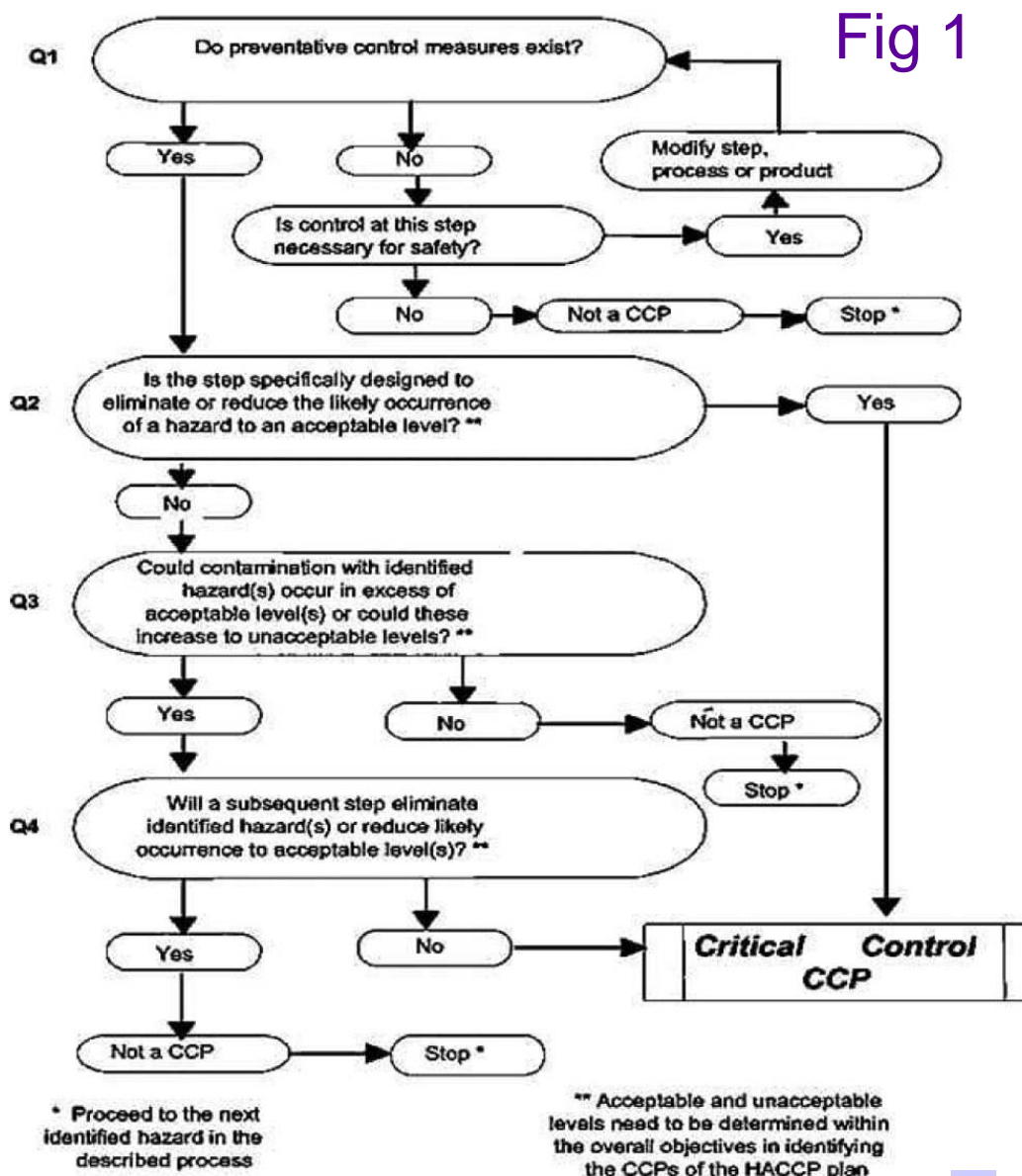
Critical limits are then specified for each CCP based on shelf-life studies and country specific standards. There could be more than one parameter for each critical limit. The criteria include time and temperature for the process, pH, moisture, Aw and sensory parameters. In the above example of CCP, the time temperature for pasteurisation will be critical limit.

Once the CCPs are decided, the monitoring system needs to be established. Monitoring observations and measurements control parameters helps to assess to see whether the CCP is under control. Monitoring is done so that it provides information

before hand to make the adjustments before the critical limits are violated. When monitoring shows trend of violation of CCP, the process adjustments are done prior to occurrence of deviation.

The monitoring is done by a person of authority who can take corrective actions. If the monitoring is not continuous, frequency to be decided which is sufficient to guarantee that CCP is in control. Monitoring parameters should be rapid therefore mainly physical and chemical as micro testing is time consuming.

When the results of monitoring system indicate there is loss of control, specific corrective actions must be established. These actions must bring CCP under control. It also includes that the affected product is disposed of properly. This all should be properly documented in HACCP records. To explain this in a pasteurisation process, if there is loss of control over pasteurisation parameters,





Deviations and corrective actions and any modification is the HACCP system.

Implementation of HACCP gives lot of specific benefits to the organisation. Some of them are as follows:

- It makes informed decisions in Food Safety matters and removes bias, ensuring that right personnel with

there should provision of flow diversion valve so that affected product is drained out.

Verification is necessary and its frequency should be sufficient to determine whether HACCP system is working effectively. Verification includes review of the system, its plan and records of monitoring data and corrective actions. Random sampling and analysis results should confirm that the HACCP system is working properly.

Proper documentation and record keeping is the most essential for effective implementation of HACCP. Hazard analysis, CCP determination, critical limit determination are some examples of documentation. Records may include; CCP monitoring activities,

right training and experience are making decisions.

- There is documented evidence at the time of dispute.
- It makes system cost effective by better controls in the process, lead to identifying failures at early stage resulting in fewer rejections and therefore waste.
- Compliance with regulatory norms.
- Because many disciplines are involved in implementation of the HACCP, there is increased awareness about hazards causing improvement in product quality.
- Food safety failure is not only damaging to human life but also reputation of the organisation.

According to Licensing regulations of FSSAI, to ensure Food safety of Food manufactured in any premise and FBOs shall continuously try

to improve sanitary and hygienic conditions of the premises with a goal of attaining India HACCP standards within pre-determined period.

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WEBINAR ON DIGESTIVE HEALTH

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On the occasion of World Digestive Health Day, Protein Foods and Nutrition Development Association of India organized a webinar on Digestive Health in collaboration with ITC limited on May 29, 2023.

Ms. Dolly Soni, Marketing and Project Manager at PFND AI, welcomed the experts and the attendees and also introduced the speakers and panelists. Dr. J.S. Pai Executive Director PFND AI made the opening remarks.

Welcome address was given by Dr. Shashank Bhalkar, Assistant Director PFND AI. He welcomed the gathering to the webinar and pointed out the importance of digestive health in nutrient absorption and in maintaining robust and healthy microbiome within the body, as a good digestive system helps in ruling out digestive issues like bloating, constipation, heart burn and other serious digestive



Dr. Shashank Bhalkar

disorders. He further added that endocrine disorders, auto immune diseases and IBS are a result of ill maintained digestive health. May 29 was launched as the World Digestive Health Day in 2004 on the occasion of the 45th anniversary of World Gastroenterology Organization and the theme this year is "Your Digestive Health- A Healthy Gut from the Start" with goal to promote both healthy diet and lifestyle. He opined that more than genes or medications a fibre rich diet helps to promote healthy bacteria in the gut. This being "International Year of Millets", as per WHO, he hoped for millets (with their high fibre content) to be highlighted in the context of gut health. He announced the launch of White Paper a "Happy Tummy" initiative taken by ITC along with PFND AI to address the issue of digestive health using

dietary solutions. He concluded by hoping the webinar would be thought

provoking and knowledge enhancing session that will benefit all the attendees.

Following the welcome address, a short video message from Dr. Sesikeran, Chairman Scientific Advisory Committee, Honorary Scientific Director PFND AI and former director NIN ICMR was played.



Dr Sesikeran B

Explaining the importance of digestive health, Dr. Sesikeran mentioned that several clinical conditions can be managed by proper diet that favours proliferation of beneficial bacteria.

SPEAKERS



Combination of good bacteria and dietary fibre provides healthy microbiome which also results in good immune response in the consumer. Wrong type of bacteria leads to chronic systemic inflammation that leads to a number of co-morbid conditions. Diets rich in oligosaccharides, fibre, probiotics and fermented foods are best for good digestive health is what he had to say. He urged that replacing refined and ultra-processed food with traditional foods like millets, fruits, vegetables and fibre rich foods help in better gut health and thereby overall

health improves. He concluded with the hope that the webinar deliberations would help consumer choose right kind of food for betterment of gut health.

The first speaker **Dr. Shashank Joshi, Eminent Diabetologist & Endocrinologist at Lilavati Hospital, Bandra, Mumbai** started his talk by mentioning that the world today is Fibropenic meaning a world with low fibre intake associated with high income lifestyle. This results in low stool bulk, slow transit, high intraluminal pressures and presence of luminal

carcinogens amongst the population culminating in colon cancer, diverticulosis, diabetes inflammatory bowel disease, certain cancers.

He stated that inspite of dietary recommendations individual fibre consumption is low in India, mainly due to the trend of skipping breakfast, frequent snacking of low fibre high calorie food items, individual's dietary knowledge or attitude, changing dietary habits and adopting fad diets. He further defined dietary fibres as carbohydrate polymers with 10 or more monomeric units that are not hydrolysed by endogenous enzymes in the small intestine and went on to classify them as Edible / natural, isolated (added) and synthetic (functional) dietary fibres.

He discussed different types of fibres based on their solubility and ability to be fermented and their functions, for e.g. soluble viscous fibres (β glucan, pectin, guar gums) that delay gastric emptying, and help in lowering cholesterol, Fermentable fibres (guar gum, pectin, inulin, FOS), have a prebiotic effect, non-fermentable fibres (Psyllium) and insoluble fibres (resistant starch, wheat and rye bran, potato fibre) which help in laxation and regularity of bowel movement.



He mentioned that it is a misconception that all insoluble fibres are non-fermentable, as evidence points out that majority of fibres bring about changes in composition of microbiota due to competitive interactions.

He warned that fibre overload must also be avoided as it could cause abdominal pain, flatulence and for people with celiac disease high fibre foods like wheat, rye, barley must be avoided as it could trigger allergic reactions. The points he mentioned to step up fibre intake and minimize side effects are as follows:

- Prioritize fresh, local, seasonal fruits, vegetables, wholegrains, millets
- Choose high fibre, low sugar cereal for breakfast
- Make salads, unstrained soups part of the daily diet
- T2DM patients should have high fibre foods or use fibre supplements

High fibre food must be supplemented with large quantity of fluids to avoid constipation. Vegans, vegetarians and people whose diet patterns show higher plant food proportion have been observed to have greater protection against chronic diseases.

Dr. Shashank pointed out that WHO recommends atleast 400 gms (5 portions) of fruits and vegetables a day though this may vary across the globe and also refined grains need to be replaced by whole grains and legumes which are often overlooked as fibre sources.



Protein Foods & Nutrition Development Association of India
in collaboration with
ITC Limited
organizes webinar on
"Digestive Health"



Dr. Shashank Joshi



Mr. Vivek Ohri



Dr. Shobha Udipi



Dr. Shashank Bhalkar



Mr. Indranil Chatterjee



Ms. Naaznin Husein



Ms. Sujatha Jayaraman



Dr. Sunil Chandy



Dr. Jagadish Pai



Ms. Dolly Soni

He went on to describe the effect of dietary fibre on gut health, fermentable fibres improve gut microbiome composition and also provide healthy metabolites like short chain fatty acids, acetates, propionates which help in appetite regulation, lowering cholesterol, are anti-inflammatory, anti-carcinogenic and contribute to healthy gut wall. All this can be achieved by following a

prudent diet rather than the western diet which is high in fat and sugar. is what he had to say.

Next he spoke about cohort studies which proved that greater intake of whole grains was inversely associated with colorectal cancer incidence. The increased intake of wholegrains reduced the risk of colon cancer by 16% and rectal cancer by 24%.



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He was of the opinion that only a few common fibre supplements have clinically shown health benefit so their role in disease treatment is not yet defined. Older adults having lower dietary energy requirement may need fibre supplement but for most people the recommended fibre intake can be reached through a normal balanced diet. In conclusion he expressed that health care professionals and

consumers should realise that it is important to have the right amount and right type of fibres and the need to enhance microbial biodiversity of the gut microbiota. He further stated that our aim should be to improve gut microbial ecology by increasing Symbionts (anti-inflammatory species) and decreasing Pathobionts (proinflammatory species) which can be attained by a healthy diet and lifestyle and also with the help of pre and pro biotics.

This was followed by a short question and answer session where he explained the importance of drinking sufficient water and the right type of water and cleaning salad fruit and vegetables thoroughly before consuming. His view on FODMAP diet for reducing symptoms of IBS was that the effect may vary among individuals and so it has to be carefully planned according to the individual's adaptability, also to reduce hyperacidity in case of high fibre diet food must be eaten in small frequent intervals, slowly and chewed properly.

The next speaker **Mr. Vivek Ohri, Sr Brand manager at ITC Ltd** had taken up "Happy Tummy" as his topic. He discussed the results of a survey conducted with 500 mothers on digestive health, it showed clearly that people do recognise digestion and internal health as a very important aspect for being healthy but whether they

follow the routines to maintain digestion was questionable. This formed the core of his presentation. He classified Digestive needs as remedial (that can be managed with medicines), maintenance (continuous process with use of natural ingredients, supplements and healthy snacks), wellness (spread over a longer time frame and may include weight management, nutrient absorption).

He took the attendees through the educative platform "Happy Tummy" a proprietary of Ashirwad multigrain Atta launched by ITC pertaining to digestive health. The platform helps a person evaluate their Digestive Quotient (DQ) by answering simple questions on diet, lifestyle and habits. A score out of 100 is obtained post which there are other ways to engage on the platform like free nutritional counselling, articles and informative videos, meal plan, fibre meter test and also an option to interact with an expert. He mentioned that the platform had 28lac visitors, 5-7 lac DQ tests, 70K+fibre meter test and 40K+ free consultations to date.

Some interesting insights from the above pool was a low DQ score of below 40% in 68% users who did not consume

fruits, 88% users who drank less than 8 glasses of water everyday, 90% users who did not consume multigrain daily, 34% users who faced severe stress, 62% users who slept less than 6 hours, 65% users who had no physical activity.

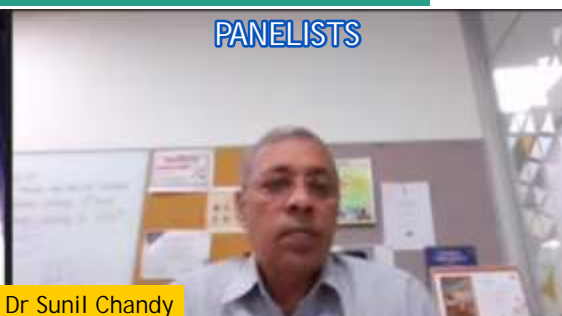


Mr. Vivek Ohri

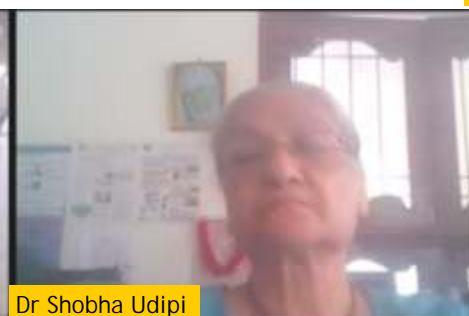
PANELISTS



Dr Shashank Bhalkar



Dr Sunil Chandy



Dr Shobha Udipi



Ms Sujatha Jayaraman



Ms Naaznin Husein



Mr Indranil Chatterjee

He wound up the presentation by saying that on the World Digestive Health Day it is their responsibility as a brand to educate consumers to eat healthy (by including dietary fibres) to lead a better lifestyle with more physical activity and reduced stress.

A very interesting and informative panel discussion was held following this. The panelists included

- Dr Shobha Udipi (Hon Director, Integrative Nutrition and Ayurceuticals, Medical Research Centre-Kasturba Health Society),
- Mr Indranil Chatterjee (Regional Product Line Manager - Business Unit Protein, IFF)
- Ms Naaznin Husein (Founder Director-Freedom Wellness Management, Chairperson - Nutrifly India Dietetics),
- Dr. Sujatha Jayaraman (Head R&D Beverages and Nutrition, South Asia, Hindustan Unilever Ltd.)
- Dr. Sunil Chandy (Chief Medical Officer, ITC Limited).

The panel moderator was Dr Bhalkar.

The first question on getting

maximum benefits from cereals and millets despite the presence of antinutrients was posed to Dr. Udipi. She agreed that cereals and pulses do have phytates and phenolic compounds that could be called antinutrients, but traditional methods like soaking, germination and fermentation do reduce their antinutrient content. At the same time she was wary of reducing the antinutrients to very low levels as they do have health benefits especially with respect to non-communicable diseases.

To the next question on role of fruits and vegetables in digestive health Mr. Indranil pointed out that fruits are rich in vitamins, minerals and dietary fibre which have a positive impact on digestive health. Dr. Shobha added that the phytochemicals in fruits and vegetables have antioxidant and anti-inflammatory effect which is why both fruits and vegetables should form an important part of our diet.

Dr. Sujatha responded to a question on kind of foods that help maintain gut health by mentioning that

a balanced diet with a fair share of dietary fibre helps to maintain gut health which thereby impacts the overall health. She pointed out that several studies correlate diverse food intake to a better gut health both in terms of diversity and proliferation of gut microbiome.

Dr. Sunil Chandy explained how soluble and insoluble fibres help gut health wherein he said that soluble fibre forms a gel with water and slows digestion whereas insoluble fibre absorbs water and adds bulk to the stools. Whole meal bread, whole cereals, strawberries avocado are some examples that he gave of food items rich in insoluble fibre.

Next Ms. Naaznin responded that brain fog, unclear thinking, massive weight gain, PCOS in young girls, skin changes, psoriasis, acne, insulin resistance even Parkinson's and Alzheimer's to a query on the side effects of gut dysbiosis.





To a question on how the acceptability of millets be improved, Dr. Shobha opined that millets are versatile and tasty products can be made using them, nowadays pastas, noodles, semolina, pizza bases are also made with millets. So a right way has to be worked out for the acceptability of millets. She however warned that some caution is required in millet consumption as some of them (especially ragi) have a high glycemic index

Ms Naaznin explained what are the functions of millets and whole grains with respect to gut health by saying that millets are rich in micronutrients and can be added to wheat flour or swapped in some preparations or simply paired with pulses to give a better GI and fibre profile making the meal wholesome.

Dr. Shobha addressed the query on vegetarian diet being recommended for better gut health in place of non-vegetarian diet, by pointing out that the main difference between the two diets is the dietary fibre content, which is beneficial for gut microbiome in addition to presence of vitamins, minerals, phytochemicals, nutrients in them and antioxidant and anti-inflammatory property of fruits and vegetables.

Dr. Sujata explained in detail the role of phytochemicals in

gut health improvement by indicating that phytochemicals like flavonoids and catechins have antioxidant and antimicrobial property and they are metabolised in the gut to produce useful metabolites, that favour the proliferation of gut microbiome and the antimicrobial property helps growth of good microbiome while keeping a check on the pathogens, resulting in improved immune response.

To a question on common causes and remedy for heart burn and acid reflux among Indians Dr. Sunil listed obesity, hiatus hernia, pregnancy, smoking, alcohol carbonated beverages and lying down immediately after a meal as the causes and the remedy was to have small frequent meals.

Ms. Naaznin agreed to a query on sportspersons having digestive issues due to variations in climate that they encounter, stress and the intensity of physical activities they take up.

For a query on prebiotic and probiotic role in digestive health Dr. Shobha explained the difference between them, prebiotics are the substrates which are metabolised by the organisms to produce metabolites beneficial to the digestive health. While probiotics are the live organisms that are consumed to improve the gut microbial profile.

Answering to question on

incorporating dietary fibres in food, Mr. Indranil explained the challenges that are involved. Special techniques have to be used to incorporate the dietary fibre so that the sensory profile of the final product is not altered. In UHT products, the dietary fibre must mix well stabilise, suspend and must also tolerate the high temperatures involved.

There was a question on effect of physical activity and exercise on gut health to which Dr. Shobha, indicated that exercise is important for immune protection and for stability and diverse microbiota, it also enriches microbial proliferation. Exercise is important for eubiosis.

The last question on how to choose the unavoidable fast food was addressed by Dr. Sunil, he advised that fast food indulgence should be occasional, followed by choosing fast foods with low sodium, low preservatives, fatty acids and avoidance of carbonated beverages. Portions need to be kept small and fried food can be replaced by baked or stir fried food and water should be the choice of beverage.

White Paper on Happy Tummy – a study by PFNDIA in collaboration with ITC Ltd was launched once the panel discussion was over. The webinar culminated with the vote of thanks proposed by Ms. Dolly Soni.



REGULATORY ROUND UP



AUTHOR

Dr Shashank Bhalkar,

Asst Director, PFNDAI

assistantdirector@pfndai.org

Dear Readers,
Following are
notifications
/orders after last Round
Up.

[Enforcement of plastic waste management rules](#) . Plastic Waste Management Rules 2021 from Ministry of environment, Forest and Climate change prohibits the manufacture, import, stocking, distribution, sale of single use plastic items. This includes ice cream sticks, plates, forks, spoons etc. The rule also prohibits use of packing films around sweet boxes. This order instructs FSOs and DOs for effective compliance of the rules and ensure that no packing films are used to wrap sweet boxes by any FBOs in their jurisdictions.



[Directions to FSSAI notified laboratories for](#)

[Organic testing](#). This order is meant to promote use of Organic Products. These labs are told to optimise their laboratories and procedure to test Organic Products as reliable testing will ensure their authenticity.

[Seeking public comments on methods by scientific panel on sampling and analysis](#) :

Methods are approved by scientific panel on following:
1) Vitamin and Mineral preparation of Fortified Rice Kernels (FRK). 2) Vitamin B9 from premix for FRK. 3) Vitamin B12 from premix for FRK. 4) Iron in FRK and 5) Iodine and Iron from Double Fortified salt. Comments/ suggestions/ views are requested in a particular



format from the stakeholder in 30 days from the date of publication on website (3rd July 23). Details of the methods are given on the website.



[Extension of timeline for FSSAI-NABL integrated assessment](#) : Earlier timeline of 3rd June 2022 is now extended to 31st March 24 for validity and recognition of FSSAI notified laboratories. In case of fresh proposals, the laboratories should have obtained FSSAI-NABL integrated assessment. Those notified under Section 43(1) and 43(2) of the FSSA act and not obtained such assessment should do so prior to expiry of their NBL accreditation.

RESEARCH IN HEALTH & NUTRITION

Meat, eggs and milk essential source of nutrients especially for most vulnerable groups, new FAO report says

Governments should promote the benefits of sourcing food from land-based animals but take into account challenges linked to livestock including environmental issues
FAO/Giuseppe Bizzarri
25/04/2023

Rome - Meat, eggs and milk offer crucial sources of much-needed nutrients which cannot easily be obtained from plant-based foods, a new report issued today by the Food and Agriculture Organization of the United Nations (FAO) says.

This is particularly vital during key life stages such as pregnancy and lactation, childhood, adolescence and older age, says the study, entitled Contribution of terrestrial animal source food to healthy diets for improved nutrition and health outcomes.

It's the most comprehensive analysis yet of the benefits and risks of consuming animal source foods and is based on data and evidence from more than 500 scientific papers and some 250 policy documents.

Meat, eggs and milk provide a range of important macro-nutrients such as protein, fats and carbohydrates and micro-nutrients that are difficult to obtain from plant based foods in the required quality and quantity, the report says. High quality protein, a number of essential fatty-acids, iron, calcium, zinc, selenium, Vitamin B12, choline and bioactive compounds like carnitine, creatine, taurine are provided by foods from terrestrial animals and have important health and developmental functions.

Iron and vitamin A are among the most common micronutrient deficiencies around the world, particularly in children and pregnant women. Globally, more than 1 in 2 preschool aged children (372 million) and 1.2 billion women of child-bearing age suffer from the lack of at least one of three micronutrients: iron, vitamin A or zinc. Three quarters of these children live in South and East Asia, the Pacific and sub-Saharan Africa. Not surprisingly, according to the report, consumption of food from terrestrial animals

(including milk, eggs, meat) varies widely around the world. A person in the Democratic Republic of the Congo consumes on average only 160 grams of milk a year, while someone in Montenegro consumes 338 kilograms. Looking at eggs, a person in South Sudan consumes 2 grams on average a year compared to an average 25kg for a person in Hong Kong. The average person in Burundi consumes just 3 kilograms of meat a year, compared to 136 kilograms for someone living in Hong Kong.

If consumed as part of an appropriate diet, animal source foods can help with meeting the nutrition targets endorsed by the World Health Assembly and Sustainable Development Goals (SDGs) related to reducing stunting, wasting among children under five years of age, low birthweight, anemia in women of reproductive age, and obesity and non-communicable diseases (NCDs) in adults. But at the same time, the livestock sector "must contribute to addressing a range of challenges," write FAO Deputy Director-General Maria Helena Semedo and Chief Economist Máximo Torero Cullen in a foreword to the report.



"These include issues related to the environment (e.g. deforestation, land-use changes, greenhouse-gas emissions, unsustainable water and land use, pollution, food-feed competition), herd management (e.g. low productivity, overgrazing, poor animal welfare), animal health related issues (e.g. diseases, antimicrobial resistance), human-livestock related issues (e.g. zoonotic and food-borne diseases) and social issues (e.g. equity)."

As to evidence of risks from consuming animal source food, the report says that consumption of even low levels of processed red meat can increase the risk of mortality and chronic disease outcomes, including cardiovascular diseases and colorectal cancer. However, consuming unprocessed red meat in moderate amounts (ranging from 9 to 71 grams per day) may have minimal risk but is considered safe with regards to chronic disease outcomes.

Meanwhile the evidence of any links between milk, eggs and poultry consumption in healthy adults and diseases such as coronary heart disease, strokes and hypertension is inconclusive



(for milk) or non-significant (for eggs and poultry). The recent First Session of FAO's Committee on Agriculture Sub-Committee on Livestock encouraged governments to update national dietary guidelines to consider where appropriate how meat, eggs and milk can contribute to specific nutrient requirements during the life course of humans.

How to get your children to eat more fruits and vegetables

Science Daily April 18, 2023

Their experiment shows that children will eat significantly more fruits and vegetables if they on average stay at the table for only ten minutes more -- 30 minutes in total.

On average, they ate about 100 grams more fruits and vegetables. This represents about one of the five recommended daily portions of fruits and vegetables and is as much as a small apple or a small bell pepper. The results of the study have been published in the US journal JAMA Network Open.

"This outcome has practical importance for public health because one additional daily portion of fruit and vegetables reduces the risk of cardio-metabolic disease by 6 to 7 percent," explains Jutta Mata, professor of health psychology at the University of Mannheim. "For such an effect, a sufficient quantity of fruits and vegetables



must be available on the table -- bite-sized pieces are best," the health psychologist adds.

50 pairs of parents and 50 children participated in the study. The average age of children in the study was 8 years and the average age of parents was 43 years. An equal number of boys and girls participated. The participants were served a typical German dinner with sliced bread, cold cuts, and cheese, as well as fruits and vegetables cut into bite-sized pieces.

"The duration of the meal is one of the central components of a family meal which parents can vary to improve the diet of their children. We had already found hints of this relation in a meta-analysis on studies looking at the qualitative components of healthy family meals. In this new experimental study, we were able to prove a formerly only correlative relationship," says Ralph Hertwig, Director at the Center for Adaptive Rationality of the Max Planck Institute for Human Development.

The study also shows that longer family meals did not lead to the children eating more bread or cold cuts; they also did not eat more dessert. Researchers assume that the bite-sized pieces of fruits and vegetables were easier to eat and thus more enticing.



Study links nutrients, brain structure, cognition in healthy aging

Science Daily April 25, 2023

In a new study, scientists explored the links between three measures known to independently predict healthy aging: nutrient intake, brain structure and cognitive function. Their analysis adds to the evidence that these factors jointly contribute to brain health in older adults.

Reported in the Journal of Nutrition, the study found that blood markers of two saturated fatty acids, along with certain omega-6, -7 and -9 fatty acids, correlated with better scores on tests of memory and with larger brain structures in the frontal, temporal, parietal and insular cortices. Watch a video about the research.

While other studies have found one-to-one associations between individual nutrients or classes of nutrients and specific brain regions or functions, very little research takes a comprehensive look at brain health, cognition and broad dietary patterns overall, said Aron Barbey, a professor of psychology, bioengineering and neuroscience at the

University of Illinois Urbana-Champaign.

"Our findings reveal that we can use nutrient biomarkers, cognitive tests and MRI measures of brain structure to account for much of the variation in healthy aging," Barbey said. "This allows us to better understand how nutrition contributes to health, aging and disease."

The researchers collected data from 111 healthy older adults with MRI structural scans, blood-based biomarkers of 52 dietary nutrients and cognitive performance on tests of memory and intelligence. By combining these measures using a data-fusion approach, the team found associations between dozens of features that appear to work in tandem to promote brain and cognitive health in older adults.

Diet Modulates Gut Microbiota

14 Apr 2023
Nutrition Insight

Researchers in Italy revealed that diet may be the main modulator of the gut microbiota (GM) and highlighted the GM's role in various human physiological functions, such as nutrient extraction, metabolism and biosynthesis of bioactive molecules.

The study found that diet modulates GM composition and that high-fat, high-sugar and low-fibre diets are associated



with microbial dysbiosis, which can lead to chronic diseases such as obesity. Moreover, the study found that targeted nutritional regimen and the appropriate use of probiotics can modulate GM to achieve a favourable composition, including an increase in *Bacteroidetes* and the enrichment of *Verrucomicrobiaceae*, while decreasing *Proteobacteria*.

The study, published in Nutrients, investigated the effects of two dietary interventions, a low-calorie and a two-phase ketogenic plus low-calorie diet, and found that the two-phase diet was more effective in decreasing abdominal



circumference, reducing insulin levels and increasing good bacteria. Both diets decreased the abundance of *Proteobacteria*,

which is associated with dysbiosis and the risk of disease.

Finally, an international team of scientists reviewed current evidence on the effects of dietary intake of seaweed on preventing and treating metabolic syndrome via modulation of the gut microbiota and the production of short-chain fatty acids.

Metabolic syndrome is a group of conditions that increase the risk of various diseases. The GM is known to be involved in the pathogenesis of metabolic syndrome.

In animal studies, seaweed-derived bioactive components were found to modulate the gut microbiota by reversing the *Firmicutes* to *Bacteroidetes* ratio, increasing beneficial bacteria and decreasing harmful ones. This, in turn, improves gut barrier functions, reduces inflammation or oxidative stress and influences glucose and lipid metabolism. The study, soon to be published in *Frontiers in Nutrition*, found that seaweed-derived compounds have the potential to be used in interventions and drug development.

By William Bradford Nichols



The hidden power of Japanese food ? inhibiting the development of liver fibrosis

26-APR-2023 EUREKALERT

Japanese food is popular worldwide and has been registered as a UNESCO Intangible Cultural Heritage.

There is a scoring system named "the 12-component

modified Japanese Diet Index (mJDI12)," which focuses on the intake of the Japanese diet pattern. It includes 12 foods and food groups: rice, miso soup, pickles, soy products, green and yellow vegetables, fruits, seafood, mushrooms, seaweed, green tea, coffee, and beef and pork. Scores range from 0 to 12, with higher scores indicating a diet that conforms to the Japanese food pattern.

A research group led by Dr. Hideki Fujii M.D. and Associate Professor Yoshinari Matsumoto at the Osaka Metropolitan University analyzed the relationship between meals rated by mJDI12, muscle mass, and liver fibrosis progression in 136 patients with non-alcoholic fatty liver disease (NAFLD) attending the Osaka Metropolitan University Hospital.

The research group found the following: the group with a higher mJDI12 showed a lower degree of liver fibrosis progression. Moreover, among the Japanese diet patterns, a high intake of soy products, seafood, and seaweed showed a suppressive effect on liver fibrosis progression. In addition, the group with a higher intake of soy products had higher muscle mass, and the group with higher muscle mass had a lower degree of liver fibrosis progression.

"This study indicates that the Japanese diet pattern may be effective as a dietary treatment for NAFLD patients. We hope that further intervention studies will lead to the establishment of an effective diet for those



patients," concluded Professor Matsumoto.

Their findings were published in *Nutrients*.

Maternal and early-life high-fat diets result in a taste for salty food

24-APR-2023 EUREKALERT

We are all aware of the importance of eating healthy food, especially during pregnancy. A high-fat diet has dramatic consequences on the metabolism.

It can lead to obesity, diabetes, chronic liver disease, and possibly cancer. Previous works have demonstrated that eating high amounts of fat during pregnancy affects the taste preference and metabolism in offspring. In most households, children and parents eat the same food. In other words, mums eating a high-fat diet will likely feed their children fatty foods. What are the consequences of maternal and early-life exposure to high amounts of fat on the offspring? This is what researchers from Tokyo Medical and Dental University (TMDU) have explored in a study published in *Scientific Reports*.



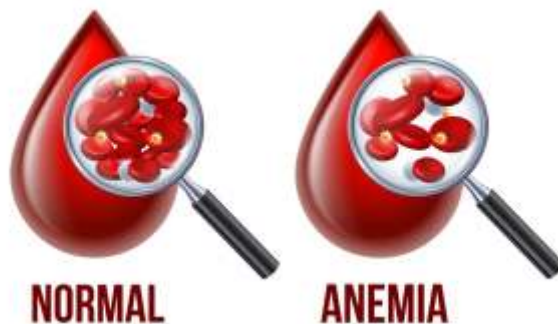


The researchers used a rat model to investigate the effect on taste preference of a two-generational (i.e., pregnant mother and young newborns) exposure to a high-fat diet. Pregnant and lactating females were fed a high-fat diet, while a control group received a standard diet. After weaning, the offspring from each group received the same diet – babies from mothers fed a high-fat diet during pregnancy and those fed a standard diet continued receiving a high-fat diet and a standard diet, respectively.

Young rats from the high-fat diet groups gained more weight and consumed more energy than their counterparts from the standard diet groups. "We wondered if the different diets had affected the taste preferences of the rats," explains Takashi Ono, senior author. "It is well established that taste impacts food intake. If something tastes good, the brain reward circuits are activated, and you will likely eat more of it." The researchers tested the animal preference for the five basic tastes: bitter, sour, salty, sweet, and umami, using a two-bottle challenge, in which two bottles – one containing water and the other one water with taste – were added to the rat cage. Offspring exposed to a high-fat diet during gestation and early life preferred salty water. In contrast, they showed no specific preference

for the other tastes when compared with the standard-diet group.

What mechanisms underlie this preference? The researchers investigated the levels of proteins involved in perceiving the salty taste. "The protein and gene expression of AT1 increased in the taste buds of female offspring exposed to a high-fat diet. This happened as early as three weeks after birth," explains Saranya Serirukchutarungsee, lead author of the study. "AT1 is known to be associated with a preference for salty taste and evidence suggests that it is likely that AT1 affects the salty taste preference by increasing sodium intake in taste bud cells."



Important role of intestinal immune cells in iron deficiency identified for the first time

20-APR-2023 EUREKALERT

Iron deficiency is one of the five main causes of impaired health. It affects 30 percent of the world's population, particularly women.

Why iron deficiency can occur, even if enough iron is supplied through the diet, has not yet been sufficiently clarified in

scientific research. For the first time, a research team from MedUni Vienna has discovered that certain immune cells in the intestine play an important role in iron absorption in the body. The study results may provide a new approach for possible therapeutic measures and were recently published in the journal "Blood".

Approximately one to two milligrams of the trace element must be supplied daily through food and finally absorbed in the duodenum for a balanced iron metabolism. For the first time, the research team led by Nyamdelger Sukhbaatar and Thomas Weichhart from MedUni Vienna's Centre for Pathobiochemistry and Genetics has now shown that certain immune cells (macrophages) in this section of the intestine control iron absorption. Specifically, the research revealed that the activation of macrophages directly in the duodenum leads to a halt in iron availability in the body. "We were able to determine that the macrophages in the duodenum eat away the iron transport molecule transferrin, so to speak. This means that the iron remains in the intestinal cells and can no longer enter the bloodstream," explains first author Nyamdelger Sukhbaatar.





New approach for therapeutic options

Against the background of their study results, the research team is currently investigating whether the macrophages in the intestine and their regulation of transferrin could also be disturbed in inflammatory bowel diseases, intestinal infections or gastritis. Potential therapeutic approaches already exist: In animal models, clinically approved drugs (mTOR inhibitors or serine protease blockers) were able to increase the amounts of transferrin and restore iron availability for the organism. Whether or not these treatment options can also be used in humans is to be researched in further studies as well.

Balanced iron metabolism is important for health

A balanced iron metabolism is an essential prerequisite for health. Iron is an important component of the blood pigment haemoglobin, which is responsible for transporting oxygen in the red blood cells. If the body lacks this trace element, anaemia is the result. Equally fatal is an excess of iron triggered by certain genetic diseases such as haemochromatosis, whereby the excess iron deposition destroys many organs in the long term. Therefore, our organism has developed some, partly redundant mechanisms

to absorb the precise amount of iron. Nonetheless, the most common causes of iron deficiency and anaemia include not only iron-deficient nutrition, but also impaired iron absorption despite sufficient availability of iron in the diet. The new study suggests that immune cells in the duodenum might be responsible for iron absorption problems.

Functional nutrition: the role of food in disease prevention and management

21-04-23 / Food Matters Anna Turns

For certain conditions like type 2 diabetes, diet can influence the 'disease burden', or level of impact on a person's health.

Diet can also play an instrumental role in disease remission. As Duane Mellor, Registered Dietitian and Senior Lecturer at Aston University, explains, "For some people, changing diet is a way of reversing the physiology to bring the glucose under control in the case of those susceptible to type 2 diabetes."

The Norfolk Diabetes Prevention Study found that, for people with pre-diabetes, losing just a few kilograms in weight and sustaining small lifestyle changes that included a healthy diet and regular physical activity for two years, reduced



their risk of developing type 2 diabetes by up to 47%.

Unwin, an advocate for low-carb diets, has run studies that have demonstrated the reversal of diabetes in a number of his patients, while a 2014 study by the Second University of Naples showed that a low-carb Mediterranean diet (including oily fish, colourful fruit and vegetables, and olive oil) increases the rates of remission in people with type 2 diabetes. After one year of following the diet, 15% of participants achieved remission and, after six years, the percentage was 5%.

Prevention is better than cure

"In many conditions, you are working with someone's medical issue to optimise their quality of life and health, so diet is a very powerful tool but not a direct, curative tool," according to Mellor. "It's a way of manoeuvring the situation to maximise health in people with a clinical condition."





New form of omega-3 could prevent visual decline with Alzheimer's disease

Anne Frances Johnson, March 27, 2023 Am Soc. Biochem & Mol Biol.

For the first time, researchers have developed a form of the omega-3 fatty acid docosahexaenoic acid (DHA) that is capable of crossing into the eye's retina to ward off visual declines related to Alzheimer's disease, diabetes and other disorders.



The DHA found in fish oil capsules and other supplements is typically in a form called triacylglycerol (TAG) DHA. Although TAG-DHA has benefits in other parts of the body, it does not reach the eyes because it cannot travel from the bloodstream into the retina. For the study, researchers created a new lysophospholipid form of DHA, or LPC-DHA. In studies using mice, LPC-DHA successfully

increased DHA in the retina and reduced eye problems associated with Alzheimer's-like processes.

"Dietary LPC-DHA is enormously superior to TAG-DHA in enriching retinal DHA and could be potentially beneficial for various retinopathies in patients," said Sugasini Dhavamani, a research assistant professor in the Department of Medicine at the University of Illinois at Chicago. "This approach provides a novel therapeutic approach for the prevention or mitigation of retinal dysfunction associated with Alzheimer's disease and diabetes."

In healthy eyes, DHA is concentrated in the retina, where it helps maintain photoreceptors, the cells that convert light into signals that are sent to the brain. DHA deficiency in the retina is associated with vision loss. People with Alzheimer's disease, as well as those with diabetes, retinitis pigmentosa, age-related macular degeneration and peroxisomal disorders, frequently have abnormally low levels of retinal DHA, and visual impairments are common as a result.

While boosting DHA can help to



prevent such declines, increasing retinal DHA content has been challenging with currently available supplements. For a dietary supplement to deliver DHA to the retina, the DHA must be able to first be absorbed from the intestine into the bloodstream and then cross from the bloodstream into the retina.

"Increasing the retinal DHA at clinically feasible doses has not been possible until now because of the specificity of the blood-retinal barrier that is incompatible with the specificity of the intestinal barrier," said Dhavamani. "This study uses the novel approach of dietary LPC-DHA that overcomes both intestinal and blood-retinal barriers and improves retinal function."



FOOD SCIENCE & INDUSTRY NEWS

Re-engineering ultra-processed foods can feed the gut, protect the liver and support the brain, study flags

03 Apr 2023 Nutrition Insight

Ultra-processed foods can be much healthier with a little re-engineering, according to an international team of researchers who recently evaluated the entire commercial F&B portfolio of the Kuwaiti Danish Dairy Company (KDD) - comprising some 180 items. Together with KDD, the authors researched and reimagined their entire portfolio to develop nourishing, delicious, affordable and commercially viable food and beverages that support metabolic health and well-being.

'The study, published in



Frontiers in Nutrition, focused on three health principles - protecting the liver, feeding the gut and supporting the brain. These organs significantly impact overall metabolism and disease. For each organ, they identified vital strategies to improve health.

To feed the gut, higher quality soluble and insoluble fibre is critical. Other features include reducing processed carbohydrates, and incorporating more whole and intact food,

providing prebiotic nourishment such as dietary fibre and including probiotic nutrition to serve gut microbiota. The liver can be protected by reducing fructose, total sugar intake, environmental toxins and glycemic load. Appropriate hydration is also essential. To



support the brain, the authors focused on nutrient-dense foods with healthy and brain-essential fats, healthy proteins and nutrients that help govern neurotransmitter function.

Across KDD's portfolio, the researchers identified four critical areas of focus - sugar, fibre, omega 3 fatty acids and emulsifiers or stabilizers. The company has already re-engineered chocolate milk and ice cream by reducing sugar and removing all added sugars. However, many new types of ingredients are needed to re-engineer all products for optimal metabolic effects.

Sugar reduction was an essential goal in re-engineering foods. The team decided to limit sugar content to one teaspoon per serving to maintain taste while limiting the negative impact on metabolic health. KDD now plans to develop a range of no-added sugar products.



turmeric that gives the spice its bright yellow colour, has been shown to have anti-inflammatory, antioxidant and immunity-



They also evaluated how the extracts affected the colour of the yogurt as well as the taste with a panel of "expert tasters."

Limiting the sugar content in juice was challenging for the company. Solutions offered include diluting or replacing juice with water, adding other ingredients such as juice flavours, oils, essences or sweeteners. Other functional inclusions such as herbs, flowers, spices, vitamins, minerals, probiotics and prebiotics (fibre) can also give additional health benefits.

By Jolanda van Hal



Curcumin's contributions: How the extract could boost the health effects and shelf-life of yogurt

03 Apr 2023 Nutrition Insight

Curcumin can effectively be used as a natural preservative in probiotic yogurt, extending shelf life as it naturally impedes the growth of fungi and bacteria and increases health benefits, according to new research.

Curcumin, an extract from

boosting properties. The researchers state that they were able to use a highly purified version of the extract to preserve dairy products with no loss in flavour.

"It is well known that curcumin has anti-microbial, anti-inflammatory and immune-boosting effects," says Dr. Magdalena Buniowska-Olejnik, lead author of the study and researcher at the Institute of Food Technology and Nutrition at the University of Rzeszow, Poland. "However, it is insoluble in water, which is one of the main reasons why our bodies are not able to absorb sufficient amounts for it to have a biological effect," she continues. "We wanted to see if it was possible to create a dairy product containing curcumin in a bioavailable form that would also appeal to the consumer."

The research team coupled a yogurt with live probiotics with NOMICU L-100, a form of curcumin that they say is both easily dissolved in water and easily absorbed by the body. Next, the research team compared it with yogurt mixed with a standard form of curcumin and compared how well each ingredient inhibited the growth of fungi, yeast and bacteria over a 28-day period.



"We found that NOMICU L-100 was better at inhibiting the growth of yeast, fungi and bacteria than the standard turmeric extract," states Buniowska-Olejnik. "It maintained the recommended levels of the 'good' lactic acid bacteria that are contained in fermented, live yogurts."

Dr. Maciej Banach, a professor of cardiology at the Medical University of Lodz, Poland, and researcher on the study, explains that: "NOMICU is the first highly purified curcumin available in the market that does not contain any other artificial additives and which has one of the best bioavailability due to the fact it dissolves well in water."

"In addition, its colour was toward the green end of the yellow spectrum, whereas NOMICU L-100 shifted the colour toward the red end, making it look more attractive," explains Buniowska-Olejnik.

"NOMICU imparted a sweet, rich, creamy flavour to the yogurt, which remained stable to the end of the 28 days storage in the fridge."

Edited by William Bradford Nichols



A little secret... it's the fat that makes food so fabulous

19-04-23 / Food Matters

Are you familiar with the word oleogustus? If you're not, don't panic. A few years ago you had probably never heard of umami either, now it trips off your tongue. And of course you're familiar with sweet, salty, bitter and sour. But oleogustus?

A few years ago, food scientists concluded that fat had a 'taste' in the same way that sweet or salty does, and that it therefore deserved a special name. Hence oleogustus, which is a combination of two Latin words (Oleo means 'fat', or 'oily', and Gustus, which means 'taste'). Oleogustus is yet to break into casual conversation in the same way as sweet, salty, bitter and sour.



Or even in the same way umami has, although Japanese scientist Kikunae Ikeda first coined 'Umami' in 1908, so it took a hundred years for Heston Blumenthal to get it trending. Maybe it will take some time for the importance of oleogustus to bed in, but as far as the food and drink

industry is concerned it doesn't matter in the slightest that oleogustus hasn't entered the popular vernacular. What should be of concern to the food and drink industry is just how influential fat and oil is when it comes to the overall makeup of a finished product.

It's concerning because the amount of tweaking and reformulating and reducing and reproducing going on by food scientists today would make even Kikunae Ikeda feel dizzy. Yet as part of those processes, what fat brings to the party is still being underestimated. And any amount of effort that goes into creating or reformulating a product can be torpedoed by the wrong type of fat.

Unfortunately, this happens regularly, because many food scientists and R&D departments are unaware of the holistic impact on a product that oleogustus can have.

The role of specific fats and oils in formulated foods is often massively underestimated," says Dr Kaly Chatakundu, Commercial Director at AAK. "The perception of sweetness, juiciness, the flavour delivery, the shelf life, the cost and even the carbon footprint depends greatly, and often



unexpectedly, on the type of fat used. For example, the perception of sweetness in a cookie can depend as much on the type of fat as the type of sweetener. A reduction in sugar of 15-20% but with the same perception of sweetness as full sugar can be achieved simply by changing the type of fat rather than doing anything else."

Often when formulating, he says fat and oil is viewed "almost like a filler. You do your clever stuff with your starch, your flavour, your sweetener, and then you make up the rest of the recipe with any margarine, rapeseed oil, sunflower oil etc and that's it. And if the recipe doesn't work, you think 'let's go back to the starch, let's go back to the flavour, let's go back to the sugar'.

But fat should be considered as a functional food ingredient in its own right. That requires knowledge and awareness, so company often hires personnel from the wider food ingredient industry, rather than just the fats and oils industry, because the synergy between fats and oils and other ingredients is a very untapped but exciting area of food science. We've got more innovation scientists than the fats and oils industry would normally hire."



Fortified Extruded Rice Fights Hidden Hunger

Food Technology Magazine
Miranda Grizio May 1, 2023

A clever approach to rice fortification uses extrusion technology to transform broken rice into fortified rice analogues that look, taste, and cook like regular rice. This affordable process has the potential to reduce micronutrient deficiencies wherever rice is a staple food—including Indonesia, where a pilot study showed it can reduce the prevalence of anemia in teenage girls.



Micronutrient deficiency, also known as “hidden hunger,” affects an estimated two billion people or about one in four people worldwide. In Indonesia, it’s about one in two (IPB University 2022). The inability of many to afford fruits, vegetables, nuts, and animal-based foods has led to diets that lack diversity and

key micronutrients, such as iron, iodine, folic acid, zinc, and vitamin A.

Food fortification (particularly when government mandated) is an effective

strategy for reducing vitamin and mineral deficiencies in populations because it does not require consumers to change their behaviors. The ideal fortified food is regularly consumed by the population, has a low risk of excess consumption due to a predictable consumption pattern, and is relatively low in cost.

With 97.7% of Indonesians consuming rice daily (Ministry of Health Indonesia 2015), rice was the perfect choice for the 2016 fortification pilot study conducted by the Food and Nutrition Society of Indonesia.

In collaboration with the Better Rice Initiative Asia, the German Agency for International Cooperation, and nutritional ingredient manufacturer DSM, this fortified rice was tested on 108 Indonesian girls aged 14 to 18 with symptoms of anemia.

Indonesian food company PT Fits Mandiri produced the fortified extruded rice for the study using the hot extrusion method. The standard process begins with broken rice, which is ground into flour and blended with water and a micronutrient premix to form a dough.

The dough is then extruded into fortified kernels that look like rice, of which 0.5%–2% are added to regular rice. For this study, the micronutrient premix contained

iron, zinc, thiamin, niacin, folic acid, vitamin B12, and vitamin A (targeting over 75% of the Recommended Dietary Allowance) with the fortified kernels blended at 2%.

One major benefit of extrusion-based rice fortification is that it uses broken rice, a lower grade rice that costs less. In Indonesia, from 2.6% to 46.6% of rice kernels are broken during the milling process, depending on the variety. The hot extrusion method also leads to a more robust product compared with dusting and coating methods, in which rinsing and excess cooking water often wash away micronutrients and taste and color issues are common.

For the 15-week pilot study, the girls were given the extruded fortified rice at 450 grams per day for six days a week. At the study’s end, the results showed a significant increase in ferritin and folic acid levels in the test group compared with the control group and a decrease in the prevalence of anemia by 41.4%.



7 in 10 Indian consumers crave more flavour adventure in the sweet bakery category

Mintel May 23, 2023

New research from Mintel shows that Indian consumers are yearning for a heightened level of flavour adventure from sweet bakery products, with 70% of consumers agreeing that the usual offerings in the category are becoming boring.

Compared to more mature sweet bakery markets, flavour innovations in India remain limited. For example, between December 2019 to November 2022, the number of individual flavours in sweet bakery launches in the UK was more than fivefold compared to India during the same period, according to Mintel Global New Products Database. India's launch activity in the category continues to focus on classic

favourites like chocolate and vanilla. These two flavours also

continue to dominate the category with chocolate accounting for 32% of the total launches and vanilla contributing 14% between January 2022 to December 2022.

On a broader scale across the Asia-Pacific region, pistachio has witnessed an exponential rise as a flavour in the sweet bakery category, with a staggering growth of 1200%

over the last three years through December 2022. Furthermore, 79% of Indians agree that introducing novel flavours motivates them to consume sweet bakery products. About one-third of consumers have expressed interest in more innovative sweet bakery products, particularly those featuring seasonal flavours (32%) and flavour combinations (30%).

Seasonal flavours: A growing interest

In particular, India is lagging in seasonal sweet bakery product innovation as only 4% of all new sweet bakery product launches in India, between September 2021-22, were seasonal. In comparison, 16% of all new sweet bakery product launches globally were seasonal in the same time period. Seasonal flavours have become a top interest in the sweet bakery category among Younger Millennials aged 26-32, with 38% (compared to 32% of consumers overall) looking forward to more flavourful seasonal innovations.

Anamika Banerji PhD, Food and Drink Analyst, Mintel Reports India, said, "Introducing product innovation that features seasonal flavours can be a good route to spark new interest and attract more consumers. The vast variety of seasonal fruits (eg jamun, mango) and sweet goods (eg carrot halwa) prepared during different seasons and festivals throughout the year can serve as flavour inspirations for packaged sweet bakery products."



Ready-to-bake products attract young Indians

Ready-to-bake mixes offering consumer involvement and flexibility, while simplifying the baking process, have gained popularity among young Indians aged 18-34. This is particularly true for students and metropolitan dwellers, with 31% and 32% respectively, expressing a desire for this format.

For consumers interested in "ready-to-bake at home" sweet bakery products, freshness is a key value. Over three-fourths (79%) of these consumers agree that it is worth paying more for packaged sweet bakery products that ensure freshness. According to Banerji, the focus on freshness could be what's motivating them towards the ready-to-bake format, which offers the experience of eating freshly baked treats.

Additionally, nearly four in five (78%) consumers who seek ready-to-bake products find it inconvenient to source all the ingredients needed for a recipe. Mintel research indicates that this cohort finds the premix/DIY kit format a suitable solution as it offers convenience and assures freshness.





Better-for-you sweet bakery: An emerging opportunity

Sweet bakery is seen as an indulgence-led category, with 77% of Indians agreeing that such products lift their mood. However, there is a rising demand for healthier alternatives; made with whole wheat flour (33%), all-natural ingredients (32%), and rich in nuts (31%) are the most important factors for consumers choosing a healthy, sweet bakery product. Consumers, especially those in metropolitan and Tier 1 cities, are increasingly looking for healthier sweet bakery products than what's currently available in the market (24% and 27%, respectively).

"Better-for-you versions that reduce or take away the guilt while maintaining the taste and fun element will offer permissibility. This presents a promising opportunity for the sweet bakery sector in India to innovate and cater to evolving consumer needs," Banerji concluded.

Tweaking Vegetables' Genes Could Make Them Tastier—and You'll Get to Try Them Soon

By Meghan Bartels on May 10, 2023 Scientific American

Today's Brussels sprouts taste better than you might remember from childhood. It's

not that your refined adult palate appreciates them better. Rather a new variety has displaced the original vegetable. You can thank plant breeders for the change. And modern breeders, armed with new gene-editing technology, are looking to replicate Brussels sprouts' reinvention.

In the late 1990s scientists identified specific chemicals, called glucosinolates, that made Brussels sprouts taste bitter. Plant breeders started growing old seeds, previously discarded for producing paltry harvests, to identify tastier versions with lower levels of these compounds.



Then they crossed these delicious but low-yield plants with modern, more prolific individuals until they found a descendant that made plenty of tasty sprouts, transforming the once maligned vegetable from a bitter pill into a popular side dish.

But other veggies haven't fared as well. That's because most breeding decisions favour plant traits that matter to vegetable growers, not vegetable eaters.

"I'd say disease resistance is probably the major focus these days of most breeding programs because that's what imperils the ability of the farmer to grow the crop," says



Harry Klee, a professor emeritus of horticulture at the University of Florida, who specializes in tomatoes. "Quality traits are really completely ignored."

In addition, breeders who focus on consumer crops must navigate the controversy surrounding genetically modified organisms (GMOs). Although all domesticated species now have different genetics than their ancestors, in agriculture, the term GMO refers to a plant that carries genes imported from a completely different species—and these changes are subject to stricter regulation.

But newer techniques are allowing breeders to work within the context of a plant's own genome, making tweaks that don't trigger complicated rules.

Flavour is challenging to target because different people have different preferences—plus, even under the best conditions, flavour quality is more complex than something like yield. "We've spent a lot of time and money figuring out what flavour is, and most breeding programs don't have the capacity to measure those things," Klee says.



Sorghum Bran Rises as an Ingredient for Enhancing Gluten-Free Bread

Jessica Ryan April 24, 2023
USDA

Sorghum bran, often a low-cost by-product of sorghum milling, can enhance gluten-free bread's nutritional value without compromising its flavour, according to a study published in the Journal of Food Science.

While gluten-free foods are in demand to meet consumers' medical needs and dietary preferences, these foods sometimes are deficient in nutrients and lack taste and texture that appeals to consumers. In gluten-free bread, wheat flour is typically replaced with refined flour and starches from other sources.

Adding dietary fibre, a carbohydrate found in whole grains that has important health benefits, to gluten-free bread can lead to a hard texture and more rapid staling.

USDA's Agricultural Research Service (ARS) researchers studied sumac sorghum bran, classified as a brown tannin-

containing variety with antioxidant properties and dietary fibre, as a possible substitute for wheat flour in gluten-free bread. "In our study, we used optimization models to create a gluten-free bread with enhanced dietary fibre while preserving other desirable bread attributes such as colour, texture, and flavour," said Ryan Ardoyn, research food technologist at ARS.

"This meant finding the optimal amount of sumac sorghum bran to use in the bread to get the nutritional benefits without compromising taste and texture. We found that people liked the gluten-free bread that contains 14.2% sumac sorghum bran and would be just as willing to buy this bread. There was no difference in perceived bitterness found between the bread with and without the sorghum bran."

"The potential health benefits provided by tannin-containing sorghum bran in gluten-free foods can benefit consumers who must avoid gluten as well as those seeking other food options," said Ardoyn.

Simple addition to corn bran could boost grain's nutritional value 15-35%

19-APR-2023
EUREKALERT

What if, by adding a couple of cell layers inside a corn kernel,



the grain could become significantly richer in essential nutrients like iron, zinc, and protein?

Such an improvement could benefit people who rely on corn for a large portion of their diet, as in many parts of the global south. In a new study, University of Illinois scientists show it's possible to increase iron up to 35% and zinc up to 15% compared to parent lines simply by adding cell layers in the bran.

"People have been using traditional means to breed corn with higher micronutrients and protein for many, many years. It takes a lot of effort and time. For us to show increases like this with just a single trait, it's like, why didn't we do this a long time ago? It's so simple," says study co-author Jack Juvik, professor in the Department of Crop Sciences, part of the College of Agricultural, Consumer and Environmental Sciences (ACES) at U of I.





Juvik and co-author Michael Paulsmeyer, now a post-doctoral scientist with the USDA, focused on the aleurone layer, typically a single layer of cells sitting just inside the outer coating of a corn kernel. Although it only makes up about 2% of the total volume of the kernel, the aleurone is rich in proteins and micronutrients.

A few rare corn varieties produce multiple aleurone layers (MAL) naturally, but until now, no one had looked at how these extra layers could be manipulated to affect the nutritional quality of the grain.

Juvik and Paulsmeyer sourced two MAL lines - a yellow variety, with five to six aleurone layers; and a blue variety, with three aleurone layers - from the Maize Genetics Cooperation Stock Center. They quickly started making crosses with normal corn varieties to learn how the MAL trait is inherited and how it can change the grain's nutritional value.

How students can reduce food waste and help fight climate change

21-04-23 / Food Matters BELLS HANN

Food waste is a large contributor to greenhouse gas emissions and plays a huge role in the climate change crisis. It is no secret that we need to make some changes. Some drastic changes.

The Food Waste: The Student Perspective report found that people aged 18-34 waste more food than people within other age groups. This highlights the importance of tackling food waste amongst university students and coming together to reduce greenhouse gas emissions.

Project Drawdown lists reducing food waste as one of the top ways we can slow down global warming. This involves many aspects of the food industry, from farming to processing, but also includes the food thrown away in households across the globe.

Goal 12.3 of the United Nations Sustainable Development Goals aims to

halve global food waste by 2030. If you're reading this and you throw away edible food, you can be part of the change. The brilliant thing about changing the way we use food and finding new, creative ways to avoid waste, is that every single person can play a part.

Limiting food waste does mean using up your stock before it is past safe consumption and eating up leftovers when you make a little too much, but it also involves learning about what you can actually eat, especially when it's a little less obvious.



Take cauliflower, for example, did you know that you can eat the WHOLE of the cauliflower, leaves and all? Top tip: roast the leaves up with a little olive oil, salt and pepper for an easy, nutritious snack packed full of polyphenols.



REGULATORY NEWS

Beyond The Headlines: CSPI continues call for FoP labels, CRN says no one product can meet all needs

14 Apr 2023 Nutrition Insight

This week in nutrition news, the Center for Science in the Public Interest (CSPI) revealed that several new organizations had joined in the call for mandatory front-of-package (FoP) nutrition labelling in the US.

Also, the Council for Responsible Nutrition (CRN) responded to a study showing that many prenatal vitamins in the US lack essential nutrients. Meanwhile, Isopure, a leading low-carb protein supplement brand, partnered with activist Ripudaman Bevli in India to highlight environmental sustainability.

The momentum for mandatory FoP nutrition labelling in the US is growing as new organizations join the campaign to encourage the US Food and Drug Administration to develop labels that show



whether there are high levels of added sugars, sodium and saturated fat in packaged, processed foods. A new poll commissioned by the CSPI also found strong public support for the proposal.

The 17 organizations that filed a supportive comment with the FDA include the American Cancer Society Cancer Action Network, American Heart Association, American Public Health Association, Consumer Federation of America and Consumer Reports.

The comment argues that FDA needs to take bold action to improve the nation's diet and health, given that the average American adult consumes 50% more sodium, 40% more added sugars and 40% more saturated fat than the daily recommendations. According to the CSPI, the FDA's docket has so far received over 7,700 public comments, the overwhelming majority of which support the petition.



Several organizations are continuing to call on the FDA to implement mandatory FoP nutrition Labels.

CRN has responded to a study published in the American Journal for Clinical Nutrition that highlighted the levels of specific nutrients in some dietary supplements commonly used or marketed to pregnant women.

CRN notes that supplements should be part of a comprehensive nutritional program for pregnant women, that includes healthy food

sources for nutrients and states that supplements should not be used as a substitute for healthy eating, particularly during pregnancy - though they can help fill nutritional gaps.

Additionally, the organization stated that, though the dietary supplement industry offers products to serve people during pregnancy, no single product can meet everyone's precise nutritional needs.



IFT Issues Report Featuring Key Traceability Insights

May 17, 2023 Official IFT Blog
Sara Bratager

Our expert analysis of a 2021 FDA food traceability challenge shows promise for low-cost, tech-enabled solutions.

Two decades ago, Microsoft Word did not even recognize the term “traceability.” But as cases of mad cow disease, spinach outbreaks, and seafood fraud escalated throughout the late 1990s and early 2000s, the term rocketed into the food industry lexicon. Traceability practices soon became commonplace as food industry actors sought to avoid, or remediate, the damaging impacts of outbreaks and recalls. Early traceability efforts were largely paper based, but within a decade, several digital solutions had emerged to support internal traceability and food safety efforts.

Though paper-based traceability practices are far from obsolete, the pool of traceability solutions available to food industry actors has continued to expand. The advent of cloud-based computing and SaaS (software as a service) solutions reduced the internal infrastructure needed to support traceability, improving the accessibility of traceability technology across the food chain. From

barcoding and mobile apps to blockchain, new technologies have advanced the practice of traceability and the capabilities of traceability solutions.

Yet, while traceability practices have undoubtedly improved over time, end-to-end traceability remains aspirational. Food supply chains have become longer, more complex, and increasingly globalized, making it harder to move traceability data through the food system. The scope and duration of recalls that have recently wreaked havoc on the U.S. food system, with consumer illness and product shortages, illustrate the need for continued improvement in the traceability space.

Addressing this need for improvement, the U.S. Food and Drug Administration (FDA) released the New Era of Smarter Food Safety Blueprint in July 2020, initiating a technology-focused approach toward bettering the safety of our food system. The first of the Blueprint’s four core elements is Tech-Enabled Traceability, and to support this approach, the FDA hosted the Low- or No-Cost Tech-Enabled Traceability Challenge in 2021. The goal of the challenge was to encourage stakeholders to develop traceability hardware, software, or data analytics platforms that were low cost or free to the end user.

The challenge attracted global participation, with 90 innovative solutions submitted. The experts at

IFT’s Global Food Traceability Center (GFTC) used the submissions to evaluate the usability, cost, and interoperability of tech-enabled traceability.



The GFTC’s assessment was optimistic about the availability of traceability technology, with nearly 70 percent of the submitted solutions commercially available and representing the full range of supply chain segments, as well as a variety of commodities. The diversity in solution type, technology, and purpose among submitted solutions reflects the diverse spectrum of traceability use cases and stakeholders.

Examining ultra-processed food: Expert panel delves into misconceptions, confusion and challenges

27 Apr 2023 Nutrition Insight

FoodDrinkEurope gave a presentation on the misconceptions around ultra-processed foods (UPF) with an expert panel discussing whether processed foods always equal being more unhealthy.



Touching upon the issues in Europe of nutritional imbalance and obesity, the panel argues that processing foods is inevitable while emphasizing the need for increased education and transparency from the food industry.

"For us, it's unclear what is meant by UPF and we also see that consumers are confused. It's also unclear what we as the food sector, need to do about UPF and if we need to do anything," says Gert Meijer, chair at the European technology platform Food for Life. He argues that the food sector is convinced that we need processing to produce foods for healthy and sustainable diets.

is no proven relationship between the degree of processing and the healthiness of a food product. "We need to transform agricultural raw materials into food products. I think the food industry with the larger scales can typically do that with more control, compared to at home."

"But the point is that the classification system has not been scientifically validated, so it doesn't help us understand the relationship between food intake and health. We think the food's nutritional composition, structural eating rate and digestibility impact human health but not the level of food processing. But we have an issue in the food industry - a lack of consumer trust."

When asked why there is a lack of trust from consumers and if that mistrust is valid, Meijer told NutritionInsight: "We are totally to blame as the food industry

because we are working behind closed doors for factories to make our products. The main reason is that we don't want to educate our competitors to know more than they already know, but there is also no transparency of what we do in the factory, so consumers have no idea what food processing looks like," he continues. "Many of the steps we do in factories are steps we also do in our kitchen if we cook. Of course, there are more extreme examples, but letting

consumers know what is being done is very helpful."

"There is nothing chemical or secret about the process, it's fascinating if you look at how we make frozen pizzas. It's exactly the same process as making a pizza at home, but we do ten pizzas in a row, and then it's immediately slightly baked, frozen and distributed, but it's nothing different from if you cook a pizza at home." When asked where the lack of trust comes from, he says, "you don't want others to touch your food, and we, the food industry do that, but not transparently. So we also don't give consumers a reason or opportunity to trust us."

Continuing on the lack of trust, Håkansson adds, "nothing can be used as an ingredient or preservative if we don't have evidence that it is safe. Consumers often worry a lot about chemical additives or preservatives in food. As food engineers or processing professionals, we worry more about the safety issues of microorganisms and everything else. In my perspective, that is a larger health issue." He further notes that many treatments are carried out to ensure safety but adds that food engineers should be better at communicating these actions.



Andreas Håkansson, associate professor in Food Engineering at Lund University, Sweden, defines food processing as "when we do something to change a food using heat, chemistry or force. We all do food processing at home daily when we cook, for example, when we fry a piece of salmon, grate carrots, or boil potatoes." He adds that the initial reason for food processing was to increase food's nutritional availability and make them easier to eat. Meijer further adds that there



Edith Feskens, professor and chair of global nutrition at Wageningen University & Research, the Netherlands, comments: "I think, in general, it's basic psychology. Eating is emotion and identification with other people or cultures. Not knowing exactly what's inside is a little bit scary. Overall, people are worried if it's a chemical name, but if you say it's vitamin C, it's okay. Not having everything under control makes consumers insecure.

Based on that, they become less trustful. Being transparent and more educational, such as with labelling or health scores, is the only way to improve this," adds Feskens.
By Beatrice Wihlander

Need for nuance in public health guidance related to consumption of sugars

April 26, 2023 Eurekaalert -

The role of sugars in public health continues to be urgently debated among nutrition scientists and health professionals - yet the science behind the effects of various fructose-containing sugars (e.g., sucrose/table sugar, high-fructose corn syrup, fructose/fruit sugar) on overweight and obesity has been unclear.

A new comprehensive review, "Important food sources of fructose-containing sugars and adiposity: a systematic review and meta-analysis of controlled feeding trials," recently published in The

American Journal of Clinical Nutrition, elevates the importance of focusing on the types of foods and diets consumed, as well as total calories, when associating consumption of sugars with weight gain.

Evolving evidence has indicated that the effect of fructose-containing sugars on adiposity may vary among food sources. For example, research has consistently shown that consuming sugar-sweetened beverages (SSBs) at excess calorie levels leads to increased body weight and elevated obesity risk. Yet, evidence is unclear about the potential impact on adiposity related to the consumption of other food sources of fructose-



containing sugars such as fruit, which are associated with numerous health-promoting benefits.

The systematic review and meta-analysis examined 169 clinical trials among 10,357 adults with or without obesity who had or were at risk for cardio-metabolic diseases. The review included the effects of 14 different food sources of fructose-containing sugars on the individuals: SSBs; sweetened milk; sweetened dairy alternative (soy); 100% fruit juice; fruit drink; fruit;



dried fruit; mixed fruit forms; sweetened cereal grains and bars; sweets and desserts; honey; added nutritive (caloric) sweetener; mixed sources with SSBs; and mixed sources without SSBs. Researchers assessed intake levels with a median dose of 9% to 20% of total energy across four different levels of energy control, with median follow-up of 6-18 weeks.

The review demonstrated that the effect of fructose-containing sugars on adiposity may be mediated by controlling calories consumed (energy) and that the effect varies among the types of fructose-containing food sources. Excess energy intake at high doses (=100 g/d) of SSBs, fruit drinks, and mixed sources with SSBs generally leads to increases in adiposity. Most other food sources consumed at high doses (=100 g/d) show no harmful effects on adiposity irrespective of energy control, with some sources even showing generally moderate beneficial effects, including fruit, 100% fruit juice, dried fruit, and honey at doses of 50 g per day or less. GRADE was generally moderate signifying the research provides a good indication of the likely effect.



Nutri-Score labelling system set to change to encourage healthier food choices

26-04-23 / Food Matters Live
FIONA HOLLAND

The scientific committee behind the Nutri-Score has made changes to the calculation method of the nutritional profile of produce, which will be implemented by the end of 2023, to help consumers make better-informed and healthier food and drink choices.

The system is to be changed in the countries that have adopted Nutri-Score and belong to the Scientific Committee of the labelling system: Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland and Spain. Once the changes have been implemented, companies will have another two years to alter their labels accordingly.

The calculation algorithm has been revised in two stages, which the Committee says will make the system more effective in classifying food and drinks in line with the main dietary requirements in European countries. The first stage, completed in June 2022, improved the calculation method for solid food products, giving foods like

poultry for example a better score than red meat on the alphabetical scale.

The Committee has also just completed alterations to the scoring system for beverages, meaning sweetened drinks like Diet Coke will no longer receive high scores, with studies showing sweetener-based beverages aren't much healthier than those containing sugar.

Up until now, the drink received a "B" score, suggesting it was healthier than olive oil, which received a "D". The classification has also been edited to include dairy and plant-based milks, with skimmed and semi-skimmed cow milk receiving a higher score than whole milk.

First implemented in France in 2017, followed by the other six countries between 2018 and 2021, the Nutri-Score labels are meant to make it easier for consumers to understand the nutritional value of food and drinks. However, the system has often come under fire for its inaccurate representation of the nutritional profile of produce.

Last March, both France and Italy heavily criticised the system's low-score for alcoholic drinks, and in May, the European Food Safety Authority put the validity of the labels into question, encouraging the European Commission to rethink its proposal to make it compulsory across the bloc.



'Most shoppers don't know what HFSS is'

Flora Southey & Oliver Morrison
19-Apr-2023 - Food Navigator

Junk food high in fat, salt or sugar (HFSS) is on industry's radar. In the UK, rules limiting the location of HFSS foods in shops has already come into play, and it's expected more junk food restrictions - including multi-buy deals - are on the way.

As food makers work to reformulate HFSS product to comply with incoming legislations, 'healthy' food is front of mind. While it's likely non-HFSS will take a greater market share in the UK, the laws don't reflect whether consumers want healthy food choices. So where does 'health' fit on the purchase decision hierarchy? The market insight provider -owned by FoodNavigator publisher William Reed - has consulted its Eating & Drinking Out Panel and Convenience Tracking Panel in the UK to find out.

How much consumers understand about brands' HFSS reformulation efforts is a grey area. "HFSS has become an industry term," explained Flora Zwolinski, senior insight manager at Lumina Intelligence. "The vast majority of consumers have absolutely no idea what HFSS is."





Asking a 1,500-strong national representative sample weekly survey questions instantly reveals a significant finding: health is not the number one priority for consumers when making purchase decisions.

"We know that value is the number one most important thing to consumers," explained Flora Zwolinski, senior insight manager at Lumina Intelligence. "And in the context of cost-of-living at the moment, value is becoming increasingly more so." Indeed, 77% of consumers surveyed identified as being 'very value led' this year, compared to 73% last year. Being 'very quality led' has taken a hit this year - down from 73% last year to 70% in 2023. 'Health' is further down the agenda, with 38% of respondents identifying as 'very health conscious' this year. While low, this is an uptick from last year's findings (37%). "Normally in recessionary periods, it's not uncommon to see health take a bit of a backseat, as healthier products can be a bit expensive, so it's not really at the forefront of consumers' agendas," explained the senior insight manager at FoodNavigator's recent Positive Nutrition Summit in London.

Zwolinski puts this unlikely finding down to COVID-19, with consumer interest in health and wellbeing increasing as a result of the global pandemic. Within this

segment of 'very health conscious' consumers, the level of health consciousness varies. "Not all shoppers are as health conscious as each other," explained the senior insight manager.

Analysing age and salary helps paint a picture of which demographics most value health. According to Lumina Intelligence data, health is more important to younger shoppers, particularly those aged between 25 and 44 years of age - largely of the Millennials generation.

These same shoppers are also very value-led. "Value doesn't necessarily mean cheap," explained the senior insights manager. "Value for money is all about communicating the product's worth, telling consumers what they're going to get from these healthy products." Concentrating solely on value, Lumina Intelligence's data suggests that consumers on the lowest incomes are the least health conscious while also being the most value-led. Unsurprisingly, those with the highest incomes have the luxury to be the most value-led and the most health conscious, we were told.

Of course, not all consumers fit into this demographic. Analysing reasons consumers select establishments when eating out-of-home reveals that familiarity and location convenience far outweigh health. "Health is actually really far down the decision hierarchy," explained Zwolinski.

"What's more important to consumers is familiarity,

meaning they've been there before and know it tastes good, and importantly, that it's close to where they are. Convenience is really key, as is good value for money. "So you can have an amazing health proposition that has lots of health benefits, but if it doesn't taste that great...if it's not convenient for shoppers, and it costs a lot, the span of consumers you're going to...resonate with will be quite small." However much we try to pigeonhole consumers, they are not unilateral: even the most health-conscious shoppers want to treat themselves sometimes.

Within the 'very health conscious' shopper segment, 14% of out-of-home missions are treat-led, and 27% of the time they buy chips. "It's about really understanding that shoppers want to eat treats sometimes as well as wanting a health offer at other times," explained Zwolinski. From a convenience market perspective, 11% of the time 'very health-conscious' shoppers are on a treat-led mission and 14% of the time they're buying confectionery.

"Health-led shoppers still want a treat, they don't want to go out and just have lettuce," continued the senior insights manager. "They want something interesting, tasty, different. The winning formula is around positioning it as a bit of a treat, making sure taste is prioritised, and using this to help deliver value to consumers."



Government role crucial to ensure widespread affordable nutrition via staple foods

By Pearly Neo 10-May-2023 - Food Navigator Asia



foods - which means that the foods selected for fortification must be common across the population. This would mean adding micronutrients to everyday foods, like Vitamin A to sugar or

Vitamin D to oil - but also ensuring that the taste and colour of these are not affected to prevent consumers from rejecting these."

The role of governments is crucial to introduce affordable proper nutrition to mass consumers via the fortification of staple foods, particularly in countries with large populations such as India and China. This was the conclusion of an expert panel at the Gulfood 2023 event in Dubai discussing food fortification for consumers, comprising DSM EMEA and South Asia Business Development Manager Sridhar NB and BASF Middle East Food Fortification Lead Suliman Daraghmah.

Although many food firms have been looking at the fortification of products with vitamins, minerals and other functionalities to improve their appeal, the panel found that the only way for fortification to really make a difference to public health would be via staple foods. "Over three billion people worldwide cannot afford healthy diets, especially when these tend to be about five times more expensive than diets that serve to just meet energy needs alone," Daraghmah told the floor.

"To really make an impact, there is a need to not only fortify foods to increase their nutritional value, but also increase public access to these

Sridhar added that especially in countries with large populations such as India, the fortification of foods has been recognised as a public effort, with various staple foods such as salt, rice and wheat flour having seen fortification on a mass scale over the past few years. "To make a difference via fortification means needing to fortify in the millions of tons in a country such as India - this requires incorporating the nutrients higher up in the value chain and building the required capacity to do so, which is where the government plays a very crucial role," he said. "There is also the need to conduct consistent testing of these fortified staples to ensure the food safety aspect of this, and this means that lab testing capacity is also very important.

"This also means that quality standards need to be set for product fortification, so as to ensure both the safety and quality of the products entering the food system." A similar strategy is being employed in China, which recently announced a detailed proposal to mandate the nutritional fortification of



various staple foods from dairy to rice, wheat flour and oil.

Practical implementation aside, the fortification of staple foods at a governmental level is also important to ensure the affordability and accessibility of these to the public. "Food fortification may appear on the surface to be a cheap endeavour by just adding in the micronutrients - but in reality, making this effective is an expensive undertaking," Sridhar added. "For example, shelf life is a very major consideration when it comes to fortification because there is a lot of work that needs to be done to ensure that the shelf life is not affected.

"We know that adding something like Vitamin A can reduce the shelf life of the fortified product from two years to one year, and this is a shortcoming that needs to be overcome otherwise it will not be possible to get widespread industry support. "This is work that requires a lot of research and development, and also needs to reach many people in order to be effective, so it is very important to get the adoption of more governments to maximise the impact."





Millet measures: India sets new food safety standards for traditional cereal in anticipation of production boom

y Pearly Neo 05-Apr-2023 - Food Navigator Asia

India has implemented new comprehensive food safety and quality standards for millets in the country in anticipation of a production and demand boom as the United Nations has designated 2023 as the International Year of Millets.

Millets have long been a part of traditional Indian diets before falling out of style over the years as a staple in favour of more commercialised crops such as wheat and rice - but now the Indian government believes that revitalisation of the sector could be on the way in the wake of the UN dedicating 2023 to the cereal.

"Most millet crops are native to India, and they are highly tolerant to drought and other extreme weather conditions, requiring low chemical fertiliser or pesticide inputs," Food Safety and Standards Authority of India (FSSAI) CEO Kamala Vardhana Rao said via a formal statement. "Millets

are also gluten-free, low in glycemic index (GI), rich in dietary fibre and in micronutrients including calcium, iron, phosphorus and more - these should ideally be an integral part of our daily diet. With the UN General Assembly having declared 2023 as the International Year of Millets, 2023 will provide an opportunity to increase global production, improve processing efficiency and better use of crop rotation, as well as to promote millets as a major component of the food basket. As such, FSSAI has specified a comprehensive group standard this year for millets that has been notified in the Gazette of India and will be enforced on September 1 2023."

There are many variants of millets, and at present only a few individual types are covered by food safety or quality standards under the law such as the more common sorghum and finger millets. The new standards now cover food safety and quality parameters for 15 types of millets, enabling legal action and consequences for food firms bringing unsafe or low-quality products into the food supply.

"The comprehensive food standard will apply to the millet variants amaranthus, barnyard millets, brown top millets, buckwheat, crab

finger, finger millets, fonio, foxtail millets, Job's tears, Kodo millets, little millets, pearl millets, proso millets, sorghum and teff," the agency stated. Eight parameters will be monitored under this standard including moisture, uric acid, extraneous matter, defects, immature or shrivelled grains and more so as to ensure the standardisation of good quality millets across both the domestic and global markets. Both whole and dehulled millets will be subject to these standards [so as to] prevent any poisonous, toxic or noxious millets as well as any contaminations from entering the food system."



Basic requirements are for moisture content to be not more than 13% by mass, for immature or shrivelled grains to be not more than 5% by mass and uric acid content to be not more than 100mg/kg. The presence of other types of edible grains - usually cheaper types - in bags of millets and other more expensive grains is not uncommon in India, and in order to put a halt to this FSSAI also included a clause specifying a 2% limit for these other edible grains.