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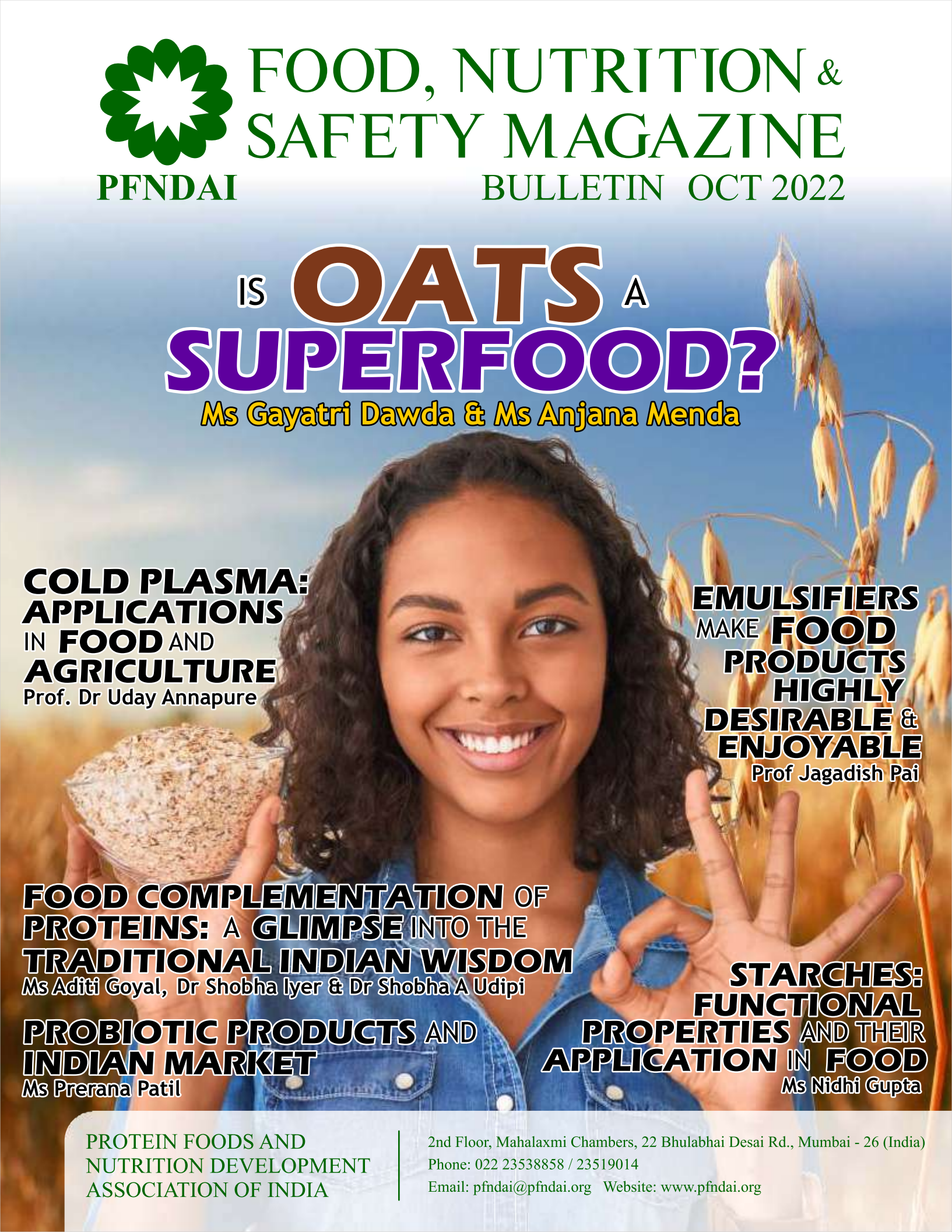
FOOD, NUTRITION & SAFETY MAGAZINE

BULLETIN OCT 2022



IS OATS A SUPERFOOD?

Ms Gayatri Dawda & Ms Anjana Menda

COLD PLASMA: APPLICATIONS IN FOOD AND AGRICULTURE

Prof. Dr Uday Annapure

EMULSIFIERS MAKE FOOD PRODUCTS HIGHLY DESIRABLE & ENJOYABLE

Prof Jagadish Pai

FOOD COMPLEMENTATION OF PROTEINS: A GLIMPSE INTO THE TRADITIONAL INDIAN WISDOM

Ms Aditi Goyal, Dr Shobha Iyer & Dr Shobha A Udipi

PROBIOTIC PRODUCTS AND INDIAN MARKET

Ms Prerana Patil

STARCHES: FUNCTIONAL PROPERTIES AND THEIR APPLICATION IN FOOD

Ms Nidhi Gupta

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PFNDAI Bulletin OCT 2022
PFNDAI FOOD, NUTRITION & SAFETY MAGAZINE

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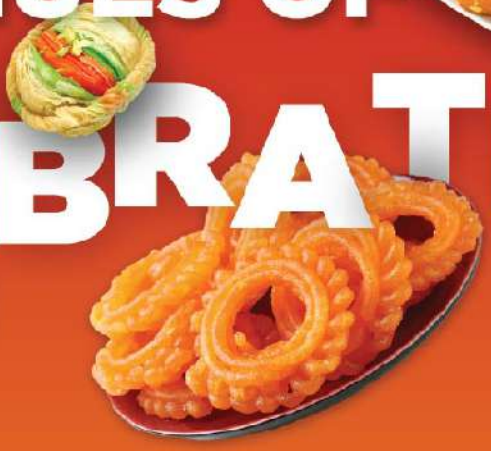

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EDITORIAL

We just had a webinar on Millets, which were declared by Indian government as Nutri-Cereals a couple of years ago. This year, the United Nations General Assembly declared the year 2023 as the International Year of Millets. We still have not probably gone into the fever or excitement for making this a reality. We must realise that just by making a declaration we can't bring in a change that would have tremendous ramifications in the coming decades. We all will have to make sincere efforts to bring in that change.

Millets are quite healthy, although they have some nutritional problems. These are not really insurmountable and CFTRI and Indian Institute of Millets Research (IIMR) have shown the solutions by some easy and effective means of pretreatment and processing.

Several nutritionists and dietitians have shown very nice recipes making ingenious use of millets in a variety of forms. Many products right from the flours and the ready mixes to ready-to-eat snacks and cookies have been marketed. This is certainly having a positive effect on the awareness as well as acceptance of millets in our diets. However, these efforts are not making as much impact as is necessary.

We must realise one thing. We keep talking about climate change and its adverse effects. However, governments are not willing to make any changes to reverse this trend so we are going to face a situation where we may find our agricultural productivity of our main crops like wheat and rice is going to be badly affected.

One set of crops that can withstand these adverse conditions is millets, which do not need a lot of rains and good care of cultivation for their growth. However, if we wait until disasters strike it would be too late to start looking to increase the production of millets and their consumption. The time to start these changes in a major way is now.

We need to popularise the millets through all kinds of media and by all stakeholders. Millets have proteins and most Indians are deficient in proteins. Millets have dietary fibre, which not only can control blood sugar and lower cholesterol but also provide other benefits like satiety and help in weight control for obese. Millets have antioxidants and minerals. We can take care of antinutritional properties by tweaking the preparation methods. We can make all kinds of tasty products and recipes using millets. So let us start working on all these things together as a team.

Prof Jagadish Pai,
Executive Director, PFNDAI

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REGULATORY VIEWPOINT

AUTHOR

Dr Joseph I Lewis,

Chairman, Regulatory Affairs, PFNDAI

Foods for one or more reasons are associated with age. These may be due to physical status, prevailing disorders and medical conditions. They arise at birth or during one's lifespan. What are the criteria to associate age with foods.

To start with, infants are the earliest consumers of foods placed on the market. During the first six months, infant food substitutes are available for infants in good health as well those with conditions like lactose intolerance, allergen, and in born errors of metabolism (IEM). Moving up from 6 to 24 months are infant foods, follow up formula, milk and cereal based complementary foods. These age related foods, under the Food Category System 13.1 and 13.2, must be suitable for the claimed nutritional purpose.

When associating age with foods two things must be clear; consistency in age-person definitions and second, the nutrition and/or physiological criteria that uniquely separates them from general foods. The Labelling and Display regulation defines child or children as 'a person under 18 years of age. The definition embraces all age groups. By this definition the applicability of complementary foods to children turning 18 is quite puzzling. Recognizing its "broadness", the definition then concedes to "age limit for a specific category may be indicated".

Age related recommendations or restrictions may be for several reasons. Apart from specially formulated products (infant foods, FSMP), they could be associated with sensitivity to substances or inappropriateness. The regulation permitting foods with 1-3g plant sterols/ stanols requires a statement that such foods are "not nutritionally appropriate" for children under the age of 5 years, suggesting its cholesterol lowering benefits are more appropriate for other groups. When age-related restrictions change without reason, it raises questions on whether this is from emerging scientific evidence or lack of due diligence.

In 2016 only health supplements were restricted to children above age 5years, while other categories had no such binding. Six years later Nutra draft 2022, stipulates these foods are intended for persons above age 2 years. Schedule IV (Plant and botanicals), however has about 12 ingredients not recommended for children below 5 years and another group restricted for children below 16 years. Apparently, age restrictions here are related to ingredient levels of use and not to product or category. The note attached to the Schedule specifying daily intakes for children between 2-5 years to one fourth adult dosage and one half for children between 5-16 years clarifies this. Products prepared under Ayurveda Aahara too are intended for persons above 2 years.

Apparently there is a cut off point that emerges at age 2 years. Also, from this age onwards food products are acceptable for general consumption, unless there is a specific sensitivity or necessity. It may be noted, EU defines infant as a child up to 12 months and young children between 12 to 36months. Interestingly, Codex under its guidelines on nutrition labelling provides Nutrition Reference Values (NRVs) for the general population identified as individuals older than 36 months.

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IS OATS A SUPERFOOD?

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Marico

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Marico

The epidemic outbreak of metabolic diseases has fuelled the need to find solutions from the natural environment, with more and more people now turning to foods of high nutritional value for improving the quality of their lives and promoting health.[1]

About 40 years ago, the concept of functional foods started to gain momentum. Functional foods are the foods that beneficially affect one or more targeted functions in the body and have a positive physiological effect and/or reduce the risk for disease development when compared to regular foods.[2, 3]

In the more recent years, the term superfood has been introduced to describe natural nutritious foods which contain clinically proven bioactive compounds that strengthen and promote the proper functioning of the human body.[4, 5,7] Example, flax and chia seeds contain bioactives like omega -3 and dietary fibre that can improve the overall health and well-being of the human body. Another category of superfoods that are widely consumed all over the globe are whole grains such as wheat, barley, quinoa, millets, oats, rye, etc.[8]

Oats as the Superior Wholegrain

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β-Glucan

It is a naturally occurring soluble dietary fiber with 1-3, 1-4 β - glycoside bonds

The ratio of 1-3, 1-4 β linkages in oats give rise to water soluble property and higher molecular weight which in turn contributes to increased viscosity

This slows gastric emptying thus delaying the digestion of the food matrix

Protein

Highest protein content among all cereals: 11-15%

High Globulin: Prolamin ratio

Superior Protein Quality: Balanced amino acid profile. Higher lysine (4.2%) which is limiting in wheat and other cereals grains.

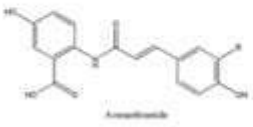
Apparent Protein Digestibility- 85%, Apparent BV- 80%, NPU-68%,

Avenanthramides

Important phytochemicals (low molecular weight, soluble phenolic alkaloids).

Oat avenanthramides are highly bioavailable and have been shown to increase antioxidant capacity in adults.

Potential mechanisms include antiproliferation, anti-inflammation, anti-itching, cytoprotection, and vasodilation.



Polyphenolic Compounds

These include phenolics, lignans, carotenoids, vitamin E, and phytosterols.

They are reported to help lower the risk of hypertension, weight control, blood sugar maintenance, and improve digestive health.

Health Benefits of Oats

Oats is a wholegrain that is unique because of the presence of β-Glucan & phenolic compounds mainly Avenanthramides. Consumption of oatmeal has shown to positively affect blood sugars, lipids & blood pressure. Oatmeal intake improves the diet quality index & assists in weight management.[10, 19, 20]

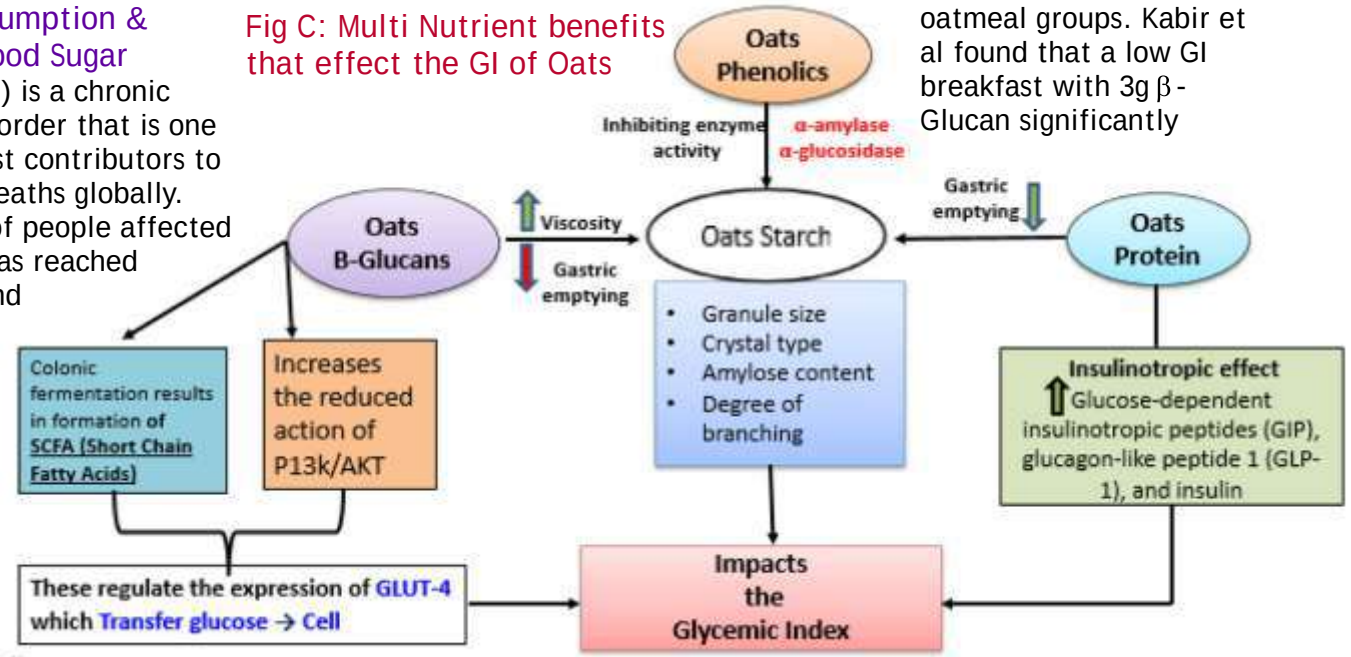
A. Oats consumption & Effect on Blood Sugar

Diabetes (DM) is a chronic metabolic disorder that is one of the topmost contributors to disability & deaths globally. The number of people affected by diabetes has reached 422 million and accounts for 1.6 million deaths worldwide annually. The major reason for type 2 DM is Insulin resistance. Scientific Research has shown low GI foods reduce the risk of DM & also help in the management. Oats amongst other cereals is shown to metabolize slower because of their novel nutritional & chemical composition. Unlike rice &wheat, oat grain is used as a whole grain. This ensures that all nutrients including oat bran are intact.

Single meal responses of Glucose & Insulin after Oat consumption

6 crossover studies compared oat intake with varying amounts of β-Glucan as compared to control without β -Glucan. A single meal of oatmeal significantly reduced the acute postprandial glucose or insulin responses in all six studies as compared to control. Insulin release & peaks were also lower in oatmeal groups. Kabir et al found that a low GI breakfast with 3g β-Glucan significantly

Fig C: Multi Nutrient benefits that effect the GI of Oats



Source: Inspired from Zhnag K etal. Oat-Based Foods: Chemical Constituents, Glycemic Index, and the Effect of Processing.Foods 2021, 10, 1304.

lowered glucose &insulin responses as compared to a high GI breakfast containing no β-Glucan after a period of 4 weeks.[17,18]

In a study by Wolever et al, 2018, the glycaemic & insulinemic properties of overnight oats in skim milk without any inclusions were checked. It was found that these overnight oats gave 33% lesser iAUC & same effect on insulinemic action. Hunger ratings were also lower in the overnight oats category.[20]

Oat consumption & effect on long-term sugar control

In multiple randomized controlled trials, a significant reduction in fasting blood glucose (FBG) was observed in patients who consumed oats as compared to the control group. One study by Ma X et al in 260 type 2 diabetic patients reported a significant reduction in the postprandial blood glucose (PPBG) after 30 days of an oats diet. A higher reduction was seen in the 100g oat group as compared to the 50g oat group. A significant reduction in insulin resistance from baseline was seen after consuming 3g/d β-Glucan bread. The highest reduction in HBA1C of 2.22% was seen in the 100g oats/day group.[46]

B. Oat consumption & effect on lipid profile

Oat β-Glucan (OBG) is the main soluble fibre in oats, which has been researched for its cholesterol-lowering properties & thus modulating the risk of cardiovascular diseases. Oat β –Glucan intake of 3g/d along with a diet low in saturated fat helps in lowering cholesterol and is approved by food standard agencies worldwide. High molecular weight β-glucan adds viscosity to the food matrix adding to the cholesterol-lowering property. However, this is not the sole reason for its beneficial effect. Research suggests an important role of gut microbiota in maintaining the cholesterol homeostasis in the host.

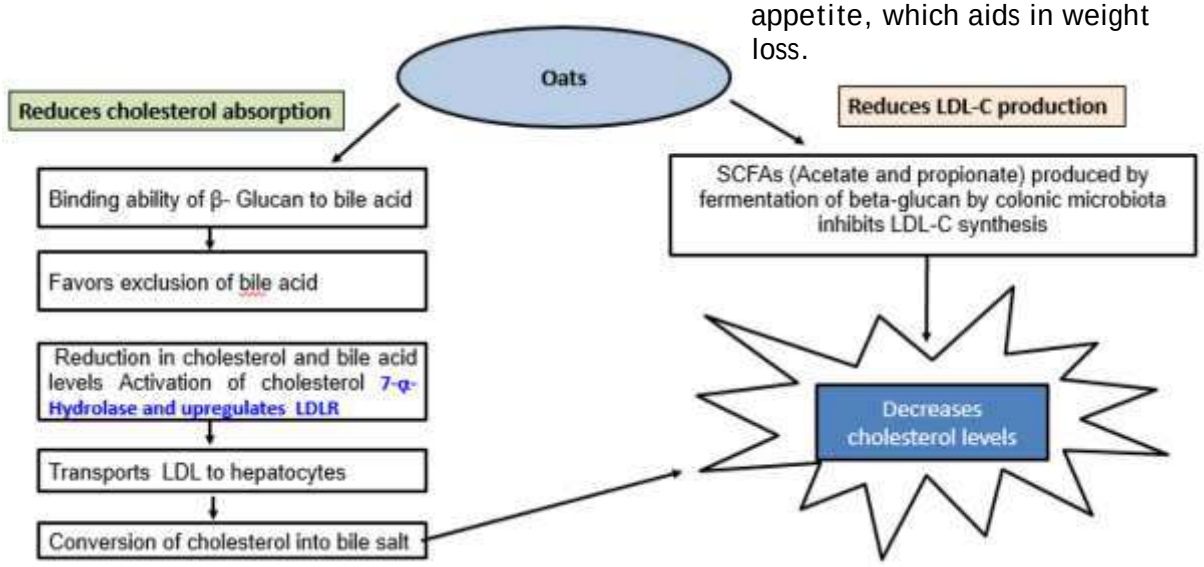
The possible mechanisms for the cholesterol-lowering impact of β-Glucan are demonstrated below in Fig D[25]

Clinical validation of lowering of blood lipids with oats

A randomized controlled trial by Maki C. et al showed that consumption of ready-to-eat cereal containing 3g OBG along with a caloric reduction diet (~500kcal/day) lowered total & LDL-C by 5.4% & 8.7% respectively along with weight loss compared to an energy matched low fibre foods diet after 12 weeks of supplementation. In a randomised, parallel, prospective study by Seema G et al, a daily consumption of 3 g of soluble fibre from 70 g of oats leads to beneficial effects on the lipid parameters, specifically total cholesterol and low-density lipoprotein cholesterol in hypercholesterolemic subjects.[25]

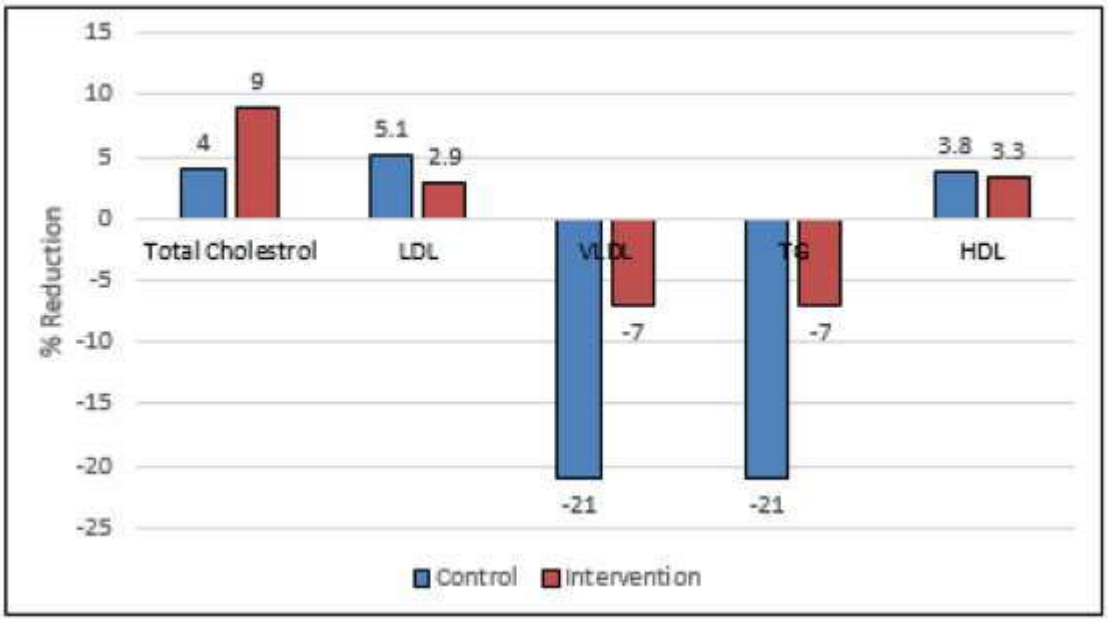
C. Oat consumption &effect on body weight & BMI

According to WHO, obesity has tripled since 1975. In 2016, more than 1.9 billion adults were overweight. Out of which, 650 million adults were obese. Obesity has also increased the number of non-communicable disorders (NCD's) like diabetes, hypertension, CVD, lung disease & cancers.[29] Studies have shown that intake of whole grains aid in weight loss. Oat intake is seen to modulate appetite, which aids in weight loss.



Source: Othman R etal. Cholesterol-lowering effects of oat B-glucan: Mini review. 2011. Nutrition Reviews. Vol. 69(6):299–309

Fig E below shows reduction of cholesterol in control group (usual diet) & Intervention group (Morning 35g oats porridge & Evening 35g Oats Upma)



Source: Gulati, S., Misra, A. & Pandey, R.M. Effects of 3 g of soluble fibre from oats on lipid levels of Asian Indians - a randomized controlled, parallel arm study. Lipids Health Dis 16, 71 (2017).

Multiple mechanisms are involved in the reduction of BMI with oats consumption such as[44]:
1. Reduced satiety
2. Delayed gastric emptying
3. Changes in gut microbiota
4. Gut hormones

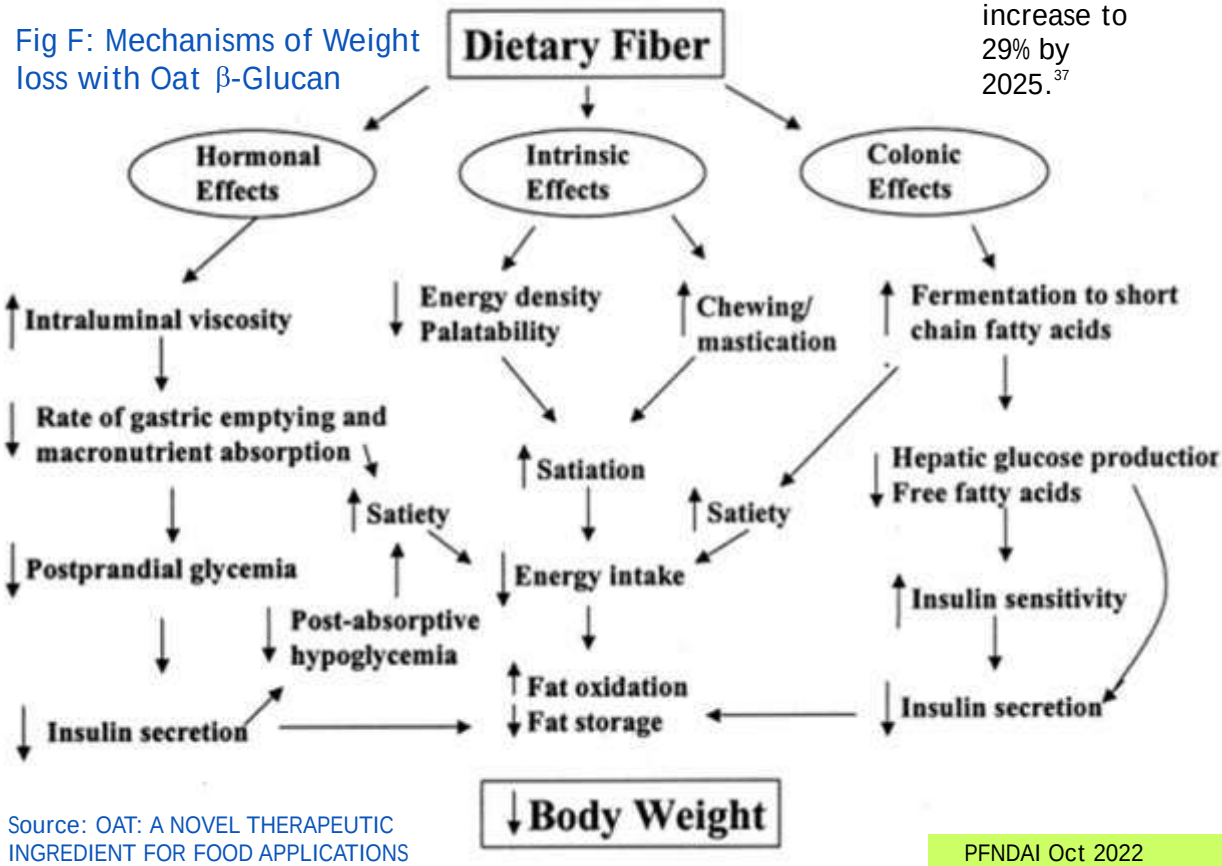
Clinical trials on the effect of oat consumption on BMI & waist circumference:

In a study by Carol N. et al, it was seen that oatmeal consumers had lower waist circumference & she concluded that oatmeal consumers had a lower risk of central obesity & related NCD's as compared to non-consumers.[31]
A study by Maki et al evaluated the effect of oat fibre consumption with a calorie-restricted diet 500 kcals/d deficit on weight loss & reduction in waist circumference over 12 weeks. It was seen that daily consumption of 3g β-Glucan in the form of RTC oat cereal resulted in a higher reduction in waist circumference.[34]
A review of 20 eligible studies found a significant reduction in bodyweight & BMI (>4g/d).[35]

D. Oat consumption & effect on blood pressure

Hypertension is responsible for damage to the heart, kidney & brain. It is one of the leading causes of death around the world. Globally, 26% of the world's population has hypertension (972 million people), and the numbers are expected to increase to 29% by 2025.[37]

Fig F: Mechanisms of Weight loss with Oat β-Glucan



Source: OAT: A NOVEL THERAPEUTIC INGREDIENT FOR FOOD APPLICATIONS
J Microbiol Biotech Food Sci / Ramzan 2020 : 9 (4) 756-760

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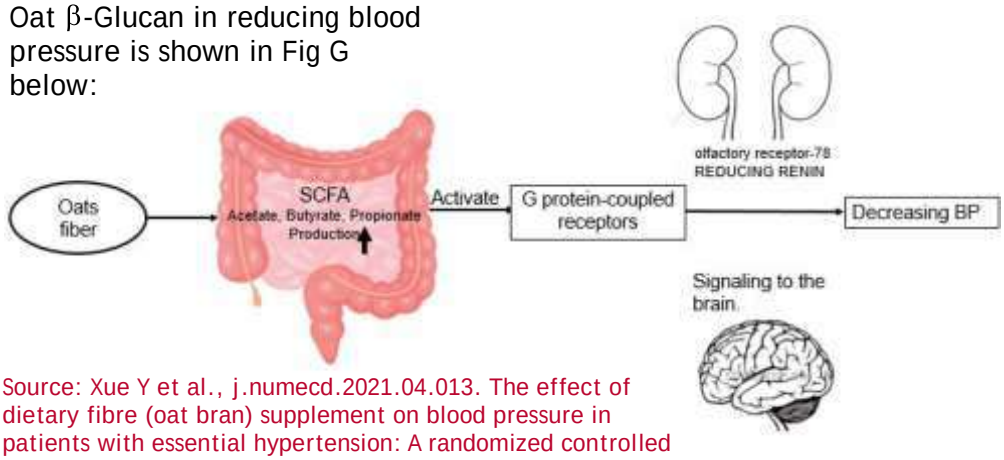
Major mechanism of actions of Oat β-Glucan in reducing blood pressure is shown in Fig G below:



Source: Xue Y et al., j.numecd.2021.04.013. The effect of dietary fibre (oat bran) supplement on blood pressure in patients with essential hypertension: A randomized controlled trial, Nutrition, Metabolism & Cardiovascular Diseases

Other factors responsible for the pathogenesis of hypertension are
a. Oxidative stress
b. Inflammation

Bioactive compounds in oats such as β-Glucan & Avenanthramides have an anti-hypertensive effect because of anti-inflammatory & antioxidant action. The oat phenolics also cause vasodilatation & improve blood pressure control.
Weight loss is often the 1st line of treatment for Hypertension. Many scientific trials demonstrate the inclusion of oats specifically for weight loss & effect on blood lipids[19]

Clinical Validation of Effect on Hypertension:

In a randomized placebo-controlled trial by Jeremy S. et al, 2022, 28 volunteers were given oatmeal intervention (68.1 mg of phenolics), oat bran concentrate + rice porridge (38.9 mg phenolics), or rice porridge /wheat cracker (13.8 mg phenolics). All the 3 groups were matched for macronutrients. After 4 weeks, it was seen that consumption of high phenolics led to significant improvement in systolic blood pressure (SBP), night-time SBP & night-time diastolic blood pressure (DBP).[38]

In a pilot trial by Daniela et al, 2002 on mildly hypertensive subjects taking anti-hypertensive medications, a comparison between intakes of whole-grain oat-based cereals and refined grain wheat-based cereals along with isocaloric diets was carried out. The objective was to study the effects on the need for antihypertensive medications in subjects with high blood pressure for 12 weeks.

It was seen that 73% percent of participants in the oats group versus 42% in the control group were able to stop or reduce their medication by half. The oats group experienced significant reductions in LDL-C & TC versus control group. The study indicated that oat consumption plays a vital role to lower the risk for CVD.[39]

E. Oat Consumption & Effect on Gut Microbiota

Scientific research has illustrated the beneficial effect of oats on diet quality, lipids, blood glucose & blood pressure. However, oat consumption improving the GI function & altering gut microbiota is still an evolving area of research. It is well known that the gut microbiota can alter function & offer many health benefits. Prebiotics are non-digestible carbohydrates that are fermented to produce SCFAs. This mechanism improves the intestinal barrier function, reduces intestinal inflammation, modulates immune function, and reduces the risk of obesity & other metabolic disorders.

A review of the available in-vitro trials, animal as well as human studies show that oats have the potential to affect GI health in humans.

It was seen that the dosage of oats that providing 2.5g to 2.9g β-Glucan is required for reducing the fecal pH & altering gut microbes. Oat bran was required 40g to 100g/day to produce SCFA's & alter microbiome.[42]

In a study by Pieter V. a standardized in-vitro simulation was used to investigate the effect of six oat ingredients on the gut microbial community. Fructoligosaccharides were used as a positive control. Consistent change in fecal pH & gas production demonstrated the fermentation ability of oat ingredients. Mostly propionates were the metabolites along with acetate & lactate. The number of bifidobacteria was greatly increased. This indicates that Oat β-Glucan has a strong prebiotic effect.[43]

Conclusion: Oat compounds have shown efficacy in reducing risk of NCD's. Oats offer wholegrain goodness even after it is processed. It is a versatile grain that can be explored as a functional food especially for paediatric & geriatric populations. Oat consumption has shown to improve overall body functions. It can certainly be called as a "Superfood". To pass on the benefit of this supergrain across masses, the possibility of extending oats to Public distribution system & Government feeding programs must be evaluated.

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COLD PLASMA: APPLICATIONS IN FOOD AND AGRICULTURE

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The fourth state of matter, also known as plasma is formed due to ionization of gas. Cold plasma is a special type of plasma, where the plasma is generated at a significantly lower temperature than conventional plasma sources.

Plasma is generated by providing energy to a dielectric medium such as ambient air or any other gas (usually, oxygen, nitrogen, helium or argon). This energy may be provided by electric discharges, radio-frequency waves, or microwave (Basak & Annapure, 2022). The breakdown of the medium results in the formation of several reactive species, electrons or radicals, which contribute to the functional properties of plasma. Ultraviolet radiation is also produced in this process. Depending on the working principle, cold plasma systems majorly employed in food systems include dielectric barrier discharge (DBD), gliding arc discharge (GAD), radio frequency discharge (RFD) and plasma jets. DBD is one of the mostly used systems, probably due to robustness, and lower cost. The system involves two electrodes with a dielectric medium in between to result in the generation of cold plasma.

For instance, the use of atmospheric pressure plasma generates reactive oxygen species (ROS) and reactive nitrogen species (RNS) which can have varying effects in different food matrices (Basak & Annapure, 2022). Plasma is a “green” process, which does not leave any residue behind and does not require any major solvents. Therefore, cold plasma is a sustainable, eco-friendly, and effective method, which is gaining interest in the food industry.

Cold plasma has been frequently employed for the extension of shelf life of fresh produce. Recent studies have proved the efficacy of plasma in the inactivation of spoilage and pathogenic microbes, along with adequate inactivation of spoilage enzymes. While thermal treatments are well established for pasteurization of fresh produce, they result in the destruction of heat-sensitive nutrients such as ascorbic acid and loss of volatile flavours. Fruit products have several spoilage enzymes responsible for browning (peroxidase and polyphenoloxidase), phase separation and softening (polygalacturonase and pectinmethylesterase).

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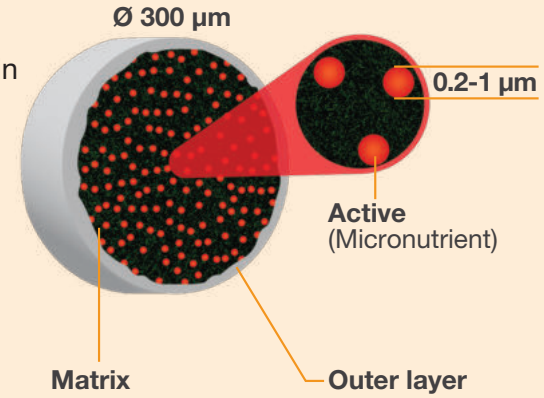

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The inactivation of these enzymes is crucial for the sensory and nutritional appeal of these products. As discussed, cold plasma produces a cocktail of several reactive species and ions, which attack the tertiary and quaternary structure of the enzymes, rendering them inactive (Basak & Annapure, 2022).

Pasteurization, as per US FDA demands a five-log reduction in the most pertinent pathogen in the food product, and cold plasma has been successful in achieving so. The reactive species generated during plasma can attack the cell wall or the peptidoglycan layer of microbes, resulting in cell death. Along with liquid foods such as juices and milk, cold plasma can also be used for surface disinfection of solid foods such as dry fruits, cut-fruits and sliced vegetables (Coutinho et al., 2018). Since bacterial spores, yeasts and moulds get effectively killed by plasma, cold plasma holds immense potential in ensuring microbial safety in meat processing. However, meat is a complex food matrix consisting of sensitive compounds such as myoglobin and lipids, which can be oxidized by the reactive plasma species, negatively impacting nutritional and sensory appeal of meat products (Misra & Jo, 2017). A more detailed investigation on the impact of plasma on the sensitive compounds can help in the scale-up of the plasma disinfection process for several other food products.

Cold plasma is often applied as a “green” alternative to pest control of stored commodities such as wheat. The plasma reactive species have been found to be result in larval and pupal mortality of insects (Sutar et al., 2014). Apart from insect control, plasma has the potential to degrade mycotoxins and pesticides, which contaminate grains and other food crops. Newer concepts like in-package plasma systems are being developed to avoid post process and cross-contamination. This can be very helpful for meat and fish-based products. The major concept of the in-package design involves the packaging of the product in a glass or plastic pack with the required gas mixture. The food package is then placed in a strong electric field, resulting in the breakdown of the dielectric medium, i.e. the gas.

The reactive species generated in the ionized air or gas interact with the food product, and have a longer lasting effect than the conventional plasma treatment (Misra et al., 2019). Another approach of the use of plasma treatment involves the generation of plasma-activated water. Some areas of the solid food may not be accessible for the discharge plasma. In such a scenario, the water is treated with atmospheric cold plasma to result in acidic water rich in hydroxyl radicals, ozone and several peroxides, rendering broad spectrum biocidal properties. The presence of nitrates in plasma-activated water can act as a curing agent for meat (Zhao et al., 2020).

Modification of hydrocolloids has gained significant attention in recent times. Chemical modification of food hydrocolloids such as starch, pectin, and chitosan are essential for improving their functionality in several food matrices. However, such chemical methods are not environment-friendly and require large amounts of chemicals and solvents. The reactive species generated during cold plasma attack the hydrocolloid structure, either introducing new functional groups or breaking down the hydrocolloid structure. Apart from these, cross-linking and grafting of new molecules is also possible by plasma (Thirumdas et al., 2015). For instance, plasma holds great potential in converting large polysaccharides with high molecular weight into smaller fragments. Plasma modification has been previously reported to positively impact the emulsifying, foaming and bioactive properties of polysaccharides and proteins.

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Rigorous and intense plasma treatments can convert large chitosan polysaccharides into chito-oligosaccharides, which have potential prebiotic activity (Prasertsung et al., 2012).

Plasma treatments can influence the rheological and textural properties of carbohydrates and proteins. For instance, plasma can lead to cross-linking between starch molecules, decreasing enzyme susceptibility of the starch and increasing the paste viscosity. Both the properties are highly desirable for starch in any food matrix. Furthermore, plasma results in surface etching of biopolymers, which improves the water absorption, solubility and swelling power. To elaborate, etching can increase the roughness of the surface of grains such as rice, facilitating faster cooking and lesser stickiness (Thirumdas et al., 2015). The lesser hardness of the plasma-treated grains reduces the energy consumption during milling. This increase in hydrophilicity of the starch in the grains allows it to hold more water, thus delaying retrogradation (Thirumdas et al., 2015).

Plant proteins such as soy protein, peanut protein, and gluten are one of the major proteins of concern, due to allergenicity of these proteins. A decrease in immuno-reactivity of these proteins has been reported for several plant proteins. Apart from allergens, several antinutritional factors such as trypsin inhibitors and agglutinins can be oxidized and cleaved by plasma reactive species. Therefore, plasma modification can also improve the digestibility of several plant proteins (Basak & Annapure, 2022). Plasma-activated water can also be employed for the modification of hydrocolloids such as gluten. Kneading of the wheat dough with plasma-activated water can result in cross-linking, leading to improved quality of products such as bread and noodles (Wang et al., 2022).

Apart from food matrices, plasma also induces physical and chemical changes in food packaging. The reactive oxygen and nitrogen species from atmospheric plasma can introduce hydroxyl, carbonyl and carboxyl groups on to the packaging film surface, resulting in surface activation of films and improving printability (Bourke et al., 2018). Physical modification via surface etching increases the adhesiveness between two polymers, facilitating stronger multi-layer films with greater strength. Plasma also improves the biodegradability of films, making them environment-friendly (Pankaj & Thomas, 2016).

Several biochemical changes in seeds and plant tissues can be brought out by plasma. The exposure of the seeds to the non-thermal plasma alters the level of phytohormones and water absorption of seeds, positively influencing germination rates and seedling growth.

Alongside plant metabolism and growth, plasma-treated seeds yield plants with higher adaptability to biotic and abiotic stresses. A more detailed investigation and more research into the plasma activation of seeds can be of great help to the agriculture industry (Waskow et al., 2018). Enhanced germination will be of tremendous help in hydroponic environments. Interestingly, recent studies have shown lower heavy metal uptake by the plants, which were grown from plasma-activated seeds (Mahanta et al., 2022). Plasma-activated water also represents as a “green” alternative to fertilizers in agriculture. The presence of nitrates in plasma-activated water accelerates plant growth, as nitrate is an important nutrient in temperate soils (Guo et al., 2021).

To summarize, cold plasma is a great sustainable nonthermal method for achieving microbial and enzymatic inactivation in fresh produce. Furthermore, the shelf life of stored communities can be increased by plasma treatments due to the excellent biocidal properties of plasma.

While disinfection of fresh and stored produce is achieved by cold plasma, the reactive species generated from plasma can degrade pesticides, and mycotoxins. The functional and structural properties of several food biopolymers can be altered by the crosslinking, degradation, and grafting induced by plasma. The cooking and keeping quality of the grains is also improved. The several antinutritional factors and allergens can also be reduced after plasma treatment of plant proteins. The numerous advantages offered by plasma can be of great significance in agriculture and food industry can be the future area of research.

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EMULSIFIERS MAKE FOOD PRODUCTS HIGHLY DESIRABLE & ENJOYABLE

AUTHOR

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Introduction

While making cakes eggs are commonly used to make the cakes light, fluffy, soft and moist and without eggs, they become dense, hard, dry and not very appealing. Eggs contain lecithin, which is an emulsifier. When egg-less cakes are made one can use lecithin from natural sources like soy or emulsifiers available for many such applications.

Emulsifiers allow mixing of water and oil (or fat). As we know if you try to mix them by stirring there will be small droplets of one floating into other, but slowly they separate into two different layers because they are immiscible. However, in presence of a proper emulsifier they mix without separating.

Emulsifiers are used to make many other products besides cakes. For instance, margarine, spreads, mayonnaise, chocolate, ice cream & frozen desserts, bread and other baked products, creamy sauces, processed meats, and salad dressings are some of the examples. Without emulsifiers they would not look, taste, and feel so good.

Market of Emulsifiers

Emulsifiers are used not just in foods but also in cosmetics and personal products as well as in pharmaceuticals. However, the food industry uses the maximum. The total global emulsifier market size has been estimated around $ 8 to 9 billion and is expected to grow at over 5% rate. The emulsifiers are produced from plant and animal sources but a good proportion is also synthetic.

Indian market is small with about $ 40 million. The rate of growth is estimated at over 6%. Several emulsifiers are permitted to be used in foods by FSSAI and they have been given the INS numbers just like other additives.

What are Emulsifiers & How do they Work?

An emulsion is a mixture of two or more liquids, which are immiscible. For example, oil and water are immiscible and if one tries to mix them, they again separate into two separate layers.

An emulsion is a mixture of two immiscible liquids; one is dispersed phase in the form of droplets in the other continuous phase (Fig 1). If small amount of oil is added to water and blended, then droplets of oil will disperse in water. However, they will separate slowly. If the droplets are very small, then it will take longer time to separate. Emulsifier stabilises an emulsion so the two liquids stay dispersed for a very long time.

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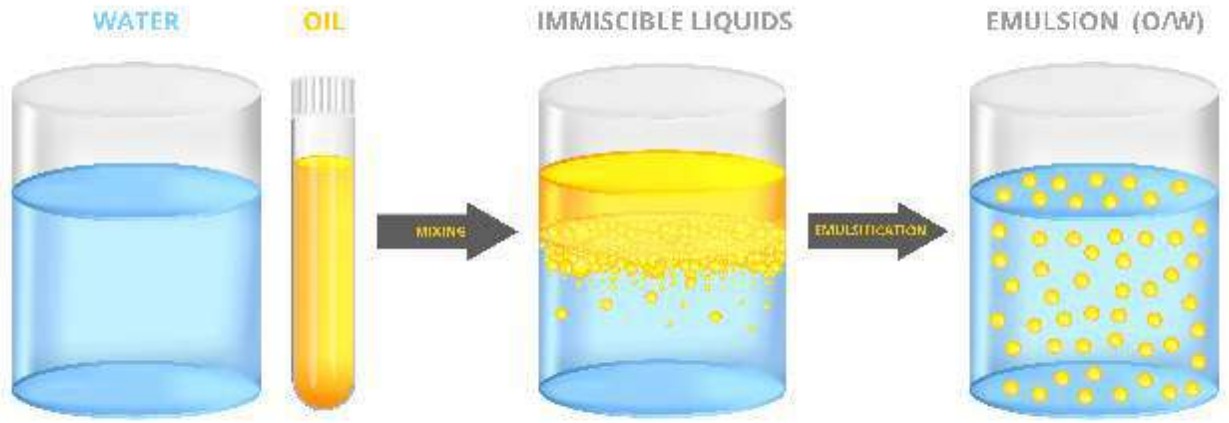


Fig. 1: Water and oil mixture separates in absence of emulsifier

Emulsifiers commonly have two ends namely one hydrophilic, meaning water loving and the other lipophilic, meaning oil loving (Fig. 2). When water and oil are mixed in presence of emulsifiers the droplets of one are surrounded by emulsifier molecules in such a manner that hydrophilic end orients to water and lipophilic end orients to oil and it will stabilise or hold the two, making it difficult to separate from each other. Thus, they stabilise the emulsions.

Milk contains large amount of water in which about 3 to 6% milk fat is dispersed. This is emulsified and stabilised by protein and phospholipids together as milk fat globule membrane so one does not see the fat until after churning when butter separates when the membrane is disrupted. When an emulsion forms, one does not see two separate liquid phases but just one uniform phase. However, this is not really a true solution unlike when sugar or salt dissolves in water making a solution. An emulsion may be called a colloidal solution as it is homogeneous and looks like true solution but it is not.

With water and oil, one can have two different emulsions: 1. oil in water type where oil droplets are suspending in water and 2. Water droplets are suspending in oil. The first type is more common and milk is one example. Salad dressing also has oil in water emulsion. Butter and margarine are oil in water emulsion.

As said earlier, without emulsifiers, oil and water emulsions tend to separate into different layers. The rate at which they separate depends on several factors including the size of dispersed phase droplets as well as the difference in density of two liquids. Smaller the droplet size the longer it will take them to separate. Milk when homogenised makes the fat globules extremely small so cream separation takes very long.

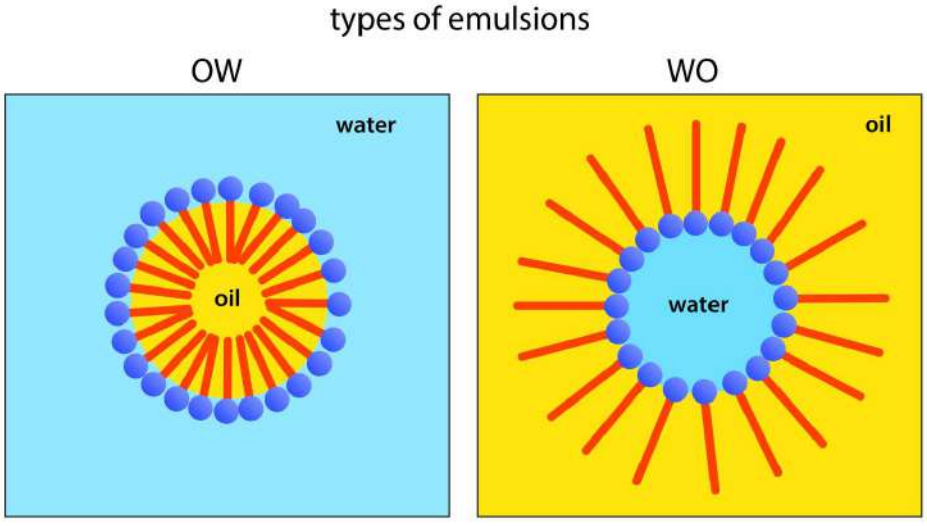


Fig. 2: Emulsifiers orient themselves at interface of water & oil, with hydrophilic (blue end) toward water and lipophilic (red long end) towards oil.

Emulsifiers Make Food Products Highly Desirable & Enjoyable

with combination of several emulsifiers, which is difficult to achieve using natural emulsifiers.

If density of two liquids is very close then also it will take much longer to separate. In flavoured beverages, the flavour substances are commonly oil soluble so besides emulsifiers dispersed phase may contain substances to increase the density of droplets making it closer to the continuous phase so separation is slowed down.

Natural & Synthetic Emulsifiers

As mentioned above, milk has natural emulsifier, the fat globule membrane, which surrounds fat keeping it in the aqueous medium. Egg contains both lipoproteins and lecithin which used to be commonly used for making emulsions e.g. in making mayonnaise. Soy lecithin has also been used for many applications.

However, natural emulsifiers, though still used in some specialty products, were replaced by synthetic ones because of the cost, availability, and uniformity of properties etc.

Sometimes very specific emulsification property may be desired for certain applications, which is possible

There is a long list of synthetic emulsifiers is available for various applications. Mono- and diglycerides and their various derivatives, sodium & calcium steroyl lactylate, diacetyl tartaric esters of monoglycerides, polysorbates, sorbitan esters, and many more are being permitted to be used as emulsifiers in food products.

Formulators choose emulsifiers for a particular emulsion by hydrophilic-lipophilic balance (HLB) of an emulsifier or combination of emulsifiers. For an ideal emulsion emulsifier should be equally attracted to water phase and oil phase.

If the balance is tipped in one or the other direction, it may lose contact with the phase with less attraction making emulsion to break down. Different oils need emulsifiers of different HLB and matching the HLB of emulsifier with that of oil increases the chances of a stable emulsion.

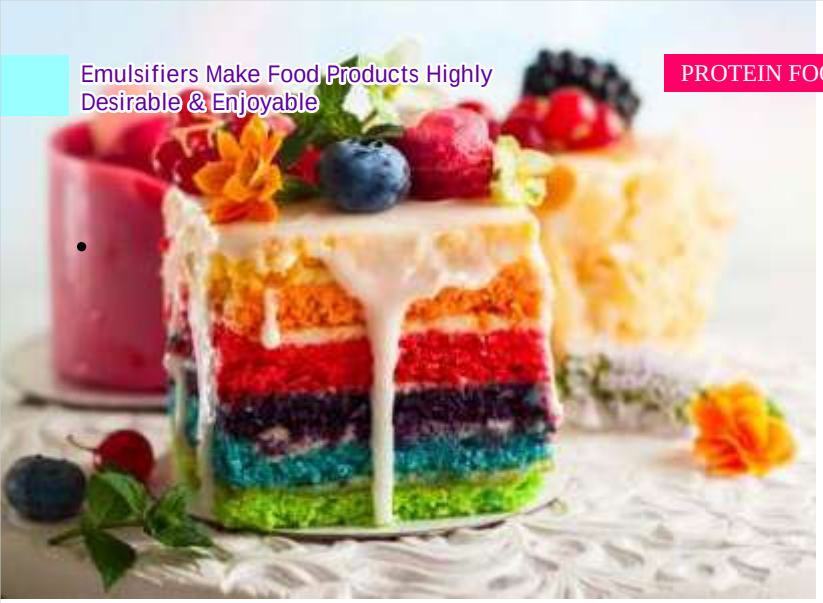
Functions of emulsifiers

There are different mechanisms involved in emulsification by emulsifier.

One mechanism says that emulsification occurs because of reduction of surface tension between the two phases.

Another mechanism states that emulsifier creates a film over the phase that forms globules. This repels globules from merging so they remain suspended in dispersed medium.

Some substances like acacia and tragacanth gums which are hydrocolloids, increase the viscosity of the medium helping the globules remain in suspension for longer period in dispersed phase.



Applications in Foods

Many processed foods are emulsions e.g. margarine, non-dairy creamers, cake batters and beverages. Staling is very commonly seen in baked products because of drying out of crumb. The stale bread becomes leathery and emulsifiers can help retard staling. Small amount of emulsifier added to dough enhances not only volume of bread but gives softer crumb structure and longer shelf life.

Emulsifiers can influence appearance and texture of chocolate providing gloss. Loss of shine with appearance of whitish coating on chocolate surface can be due to fat or sugar bloom. These damage the appearance of chocolate. Emulsifiers can delay and retard the process with improve-ment in shelf life.

Ice cream is both a foam and an emulsion and contains ice crystals and unfrozen aqueous mix. Emulsifiers promote smoother texture and ensure that it does not rapidly melt when served. They also improve freeze-thaw stability.

Similar emulsifiers also improve other desserts like sorbet, milkshake, frozen mousse and frozen yogurt as well.

Researchers are now exploring newer applications for emulsifiers such as in delivery vehicles for vitamins, supplements and various nutraceuticals. Emulsions are used to encapsulate vitamins, carotenoids, omega-3 fatty acids, curcumin and many other bioactive compounds.

Thus emulsifiers have many applications in foods. There are many others in personal care products and in other industries. Emulsions are also applied to environmental technologies including in oil spills. The applications are ever expanding and many aspects of our lives are touched by emulsifiers that have come a long way since the use of eggs in baked foods.

FOOD COMPLEMENTATION OF PROTEINS: A GLIMPSE INTO THE TRADITIONAL INDIAN WISDOM

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It is well known that the protein of cereals, which are the staples of the Indian diet,is not of good quality since lysine is the limiting amino acid in cereals.

Legumes, a major part of our diets, second to cereals, have the limiting amino acid methionine. When cereals and pulses are combined in the same meal or the same recipe, then the protein quality improves.

In 2020, Kurpad and Thomas[1] stated that mung beans can be mixed with cereal in a ratio of 1:2 for the effective delivery of indispensable amino acids. In this context, we calculated the content of these two limiting amino acids, lysine and methionine, in two commonly consumed preparations, i.e., khichadi, dal-rice and chapati with dal in India.

Table 1 presents the lysine and methionine contents of the individual ingredients namely tur dal (Red gram dal), moong dal (Green gram dal), chana dal (Bengal gram dal), rice raw milled, and wheat flour. The amount of these two indispensable amino acids was calculated and compared with the WHO/FAO/UNU recommendations (2007)[2] that are expressed as mg of amino acid per gram of protein.

The recommendation for lysine is 45mg per gram of protein whereas that of methionine is 16mg per gram of protein.

Table 1: Lysine and Methionine content and percent of requirement obtained from select cereals, pulses and cereal-pulse combinations

	Lysine (mg/g of protein)	Lysine % requirement	Methionine (mg/ g of protein)	Methionine % requirement
Rice	37.0	82.2	26.0	162.5
Wheat flour	24.2	53.8	17.7	110.6
Red gram dal	61.6	136.9	8.7	54.4
Green gram dal	60.9	135.3	10.5	65.6
Bengal gram dal	60.6	134.7	11.2	70.0
Khichadi (Rice + Tur dal*)	50.8	113.0	16.3	101.7
Khichadi (Rice + Moong dal*)	51.0	113.3	16.9	105.7
Wheat roti + Dal*	42.6	94.6	13.3	83.0

*All values are based on the content given in the IFCT 2017[3].*For calculations, Cereal: Pulse :: 2:1 was considered.*

Table 1 indicates that methionine is limiting in pulses, and both the cereals are limiting in lysine. However, it is noteworthy that between the two cereals wheat flour is more limiting in lysine than is rice, particularly when the percent requirement met is compared. In all the three dals, a similar trend for methionine is seen. In comparison, the lysine and methionine requirements are met by khichadi regardless of whether turdal or moong dal is used. However, wheat roti and dal despite being a cereal-pulse combination for which the same proportions as khichadi were used, meet only 83% of the methionine requirement and 94.6% of the lysine requirement.

In many Indian communities, pulses are combined with vegetables, for example, dudhi chanadal, cabbage chanadal, aluwadi/patra, dal palak, and green beans paruppu usili. The lysine and methionine content and percent of the requirement for the two amino acids were calculated (Table 2).

Table 2: Lysine and Methionine content and percent of requirement provided by select vegetable-pulse combinations

	Lysine (mg/g of protein)	Lysine % requirement	Methionine (mg/g of protein)	Methionine % requirement
Cabbage	31.2	69.3	10.6	66.3
Chana Dal	60.9	135.3	10.5	65.6
Cabbage chana dal (Veg:Pulse::100:20)	53.5	119.0	11.1	69.1
Bottle gourd	48.1	106.9	9.4	58.8
Chana Dal	60.9	135.3	10.5	65.6
Chana Dal dudhi (Veg:Pulse::75:25)	59.7	132.8	11.1	69.2
Spinach	2186.9	4859.8	621.5	3884.3
Red gram dal	61.6	136.9	8.7	54.4
Tur dal palak (Veg:Pulse::20:25)	217.0	482.3	53.5	334.4
Colocasia Leaves	17.9	39.8	44.3	276.9
Chana Dal	60.9	135.3	10.5	65.6
Patra (Chana Dal Flour + Colocasia Leaves) (Veg:Pulse::25:70)	58.3	129.6	13.0	81.1
Cauliflower	41.3	91.8	10.1	63.1
Chana Dal	60.9	135.3	10.5	65.6
Cauliflower Bhajiya (Veg:Pulse::50:20)	56.7	126.1	11.0	68.6
French Beans	47.7	106.0	8.3	51.9
Red gram dal	61.6	136.9	8.7	54.4
Green Bean ParuppuUsili (French Beans + Tur Dal) (Veg:Pulse::75:20)	57.4	127.6	8.6	53.6

All values are based on the content given in the IFCT 2017

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In the case of cabbage + chana dal, the cabbage by itself provides only 69.3% of the lysine requirement. However, when chana dal is added, the percent requirement met increases to 109%. Dal palak made with spinach is an interesting example because spinach is an excellent source of methionine. A similar trend is seen with colocasia leaves patra/ aluwadi.

The leaves by themselves provide only 39.8% of the lysine requirement but the use of besan (Bengal gram dal flour) improves the percent requirement met to 129.6%. Also, in this preparation, the percent requirement for methionine met by chana dal increases from 65.6% by itself to 81.1% when combined with the leaves. By itself, tur dal(Red gram dal)provides less than 10% of the methionine requirement. But the addition of spinach increases the percent methionine requirement met to 53.5%.

Our effort for this paper had its roots in a paper published by Wolf, Fu and Basu (2011)[4] in which they described their work on "identifying optimal amino acid complements from plant-based foods". In their paper, they mentioned that they did not find a 'statistically significant bias towards grain-legume paring for protein complementation. Further, they suggested that it would be worthwhile to pair plant-based foods based on individual foods rather than food groups. Also, they found that efficient pairing included sweet corn-tomato, sweet corn-cherry, and apple-coconut.

We rarely consider vegetables as a source of protein. This is because, in absolute amounts, their protein content is low. However, a glimpse into traditionally prepared foods indicates that by mixing pulses and vegetables, the protein quality in terms of lysine and methionine can be improved. Needless to say, there are limitations in our approach in terms of digestibility and availability because values for raw foods have been used for calculations. However, we hope that this small exercise based on traditional vegetable-pulse preparations will provide a stimulus for looking at vegetables through a different lens.

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PROBIOTIC PRODUCTS AND INDIAN MARKET

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When we hear the word microorganisms we consider them to be harmful or bad. But, there are some microorganisms which can be beneficial and provide health benefits. These microorganisms are called as probiotics. Probiotics are live microorganisms which upon ingestion in sufficient amount can provide health benefits to the host. We have both good and bad bacteria in our body. Probiotics contain good bacteria and hence upon ingestion help in maintaining a healthy community of microorganisms in our gut. There is another term prebiotic which is often heard along with probiotics. Prebiotics are the non-digestible food components which stimulate the growth of probiotics.

Probiotics have created a lot of buzz recently due to the health benefits they provide. They help strengthen our immune system by providing resistance against pathogens, also help in digesting lactose.

They can provide anti-cancer properties, antimutagenic action, anti-diarrheal properties and help in fighting against inflammatory bowel disease and *Helicobacter pylori* infection, Crohn's disease (Krastanov et al., 2012). Also, help in increasing the nutritional availability of B vitamins (Nagpal et al., 2012).

There are many organisms but not all microorganisms can be probiotic. For a microorganism to be probiotic it should meet certain conditions firstly it should be safe for consumption and have proven health benefits. Also, it should be resistant to gastric acid, bile to be able to survive the intestinal environment after ingestion and they should also have the potential to adhere to the gut epithelial tissue and produce antimicrobial substances in order to exert health benefits on host (Krastanov et al., 2012). When a microorganism has all these properties it can be considered as a probiotic. Some bacteria belonging to *Lactobacillus* and *Bifidobacterium* groups along with some yeast like *Saccharomyces boulardii* are often used as probiotics.

Below are some of the microorganisms which are used as probiotic-

Table 1- Strains used as probiotics

Sr no.	Probiotic	Strains
1.	*Lactobacillus* species	*L. acidophilus* *L. casei* *L. crispatus* *L. gallinarum* *L. gasseri* *L. johnsonii* *L. paracasei* *L. plantarum* *L. reuteri* *L. rhamnosus*
2.	*Bifidobacterium* species	*B. adolescenti?* *B. animalis* *B. bifidum* *B. breve* *B. infantis* *B. lactis* *B. longum*
3.	Other lactic acid bacteria	*Enterococcus faecalis* *E. faecium* *Lactococcus lactis* *Leuconostoc mesenteroides* *Pediococcus acidilactici* *Sporolactobacillus inulinus* *Streptococcus thermophilus*
4	Nonlactic acid bacteria	*Bacillus cereus var. toyoi* *Escherichia coli strain nissle* *Propionibacterium freudenreichii*
5	Yeast	*Saccharomyces cerevisiae* *S. boulardii*

(Kechagia et al., 2013. Health benefits of probiotics: a review. ISRN nutrition)

Probiotic products-

As mentioned above many studies and research has proven the health benefits of probiotics. People are aware of these benefits and they want to incorporate probiotics into their diet in an easy and accessible way. Hence the demand for various probiotic products is increasing.

Most easy medium for incorporating probiotics are the dairy based products like yogurt, cheese which are traditionally fermented. Apart from these dairy based products there are also plant based products which can be used as a medium for providing probiotics to consumer. However, developing a probiotic product can be challenging. Different products have different compositions and properties. So, adding probiotics to food products needs a better understanding of probiotic strains and their suitability. The main aim during probiotic products production is to optimize a process that will ensure probiotic survivability and product efficacy during processing on a commercial scale and throughout consumption.

Probiotic bacteria used in food products, such as *Lactobacillus* and *Bifidobacterium* species are sensitive to oxygen. Hence, the presence of oxygen may represent a threat for their survival. High salt content can reduce the viability of probiotics. So, optimization of the process in a manner that will not affect the viability of probiotics and ensure the intended results upon consumption is very important.We can include probiotics in our daily diet by simply using various food products. Here are some common probiotic foods-

Yogurt-

Yogurt is a traditional dairy product which is prepared by fermenting the milk. Modern yogurt production is a well optimized process that utilizes various ingredients like milk, milk powder, stabilizers, emulsifiers along with the standard pure cultures of *Streptococcus thermophilus* and *L. bulgaricusto* conduct the fermentation process.

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Yogurt is considered as healthy on its own and adding probiotics to it can add extra nutritional and physiological value. So, yogurt is prepared by adding probiotics, prebiotics and considered as the most suitable carrier for delivering probiotics (Hill et al., 2017). When live probiotic strains are added to yogurt along with the standard culture it is called as the "Bio-Yogurt". Mostly probiotic strains like *L. acidophilus; L. casei, L. gasseri, L. rhamnosus, L. reuteri, B. bifidum, B. animalis, B. infantis,* and *B. Longum* are used (Awaisheh, 2012). Yogurt is available in both drinkable and spoon able form and in different flavours.

Ice-cream-

Ice cream is popular product among all age groups. Ice cream contains milk protein, fats and lactose which makes it a good medium for probiotic culture. Also, due to ice cream being a frozen product risk of temperature abuse during storage is low leading to increased viability of probiotics. While manufacturing the ice cream overrun is a beating process by which air is incorporated into the ice cream. Studies have shown that lower over run contributes to increased viability of probiotics. Addition of prebiotics like inulin and fructo-oligosaccharides can increase the viability of strains like *L. acidophilus* and *B. lactis* (Awaisheh, 2012). In ice creams containing probiotics the other ingredients which are used also matter as they can affect the sensory attributes of ice cream. Usage of highly acidic fruit juices and flavours in probiotic ice cream should be avoided as it reduces the pH affecting sensory properties and viability of probiotic strains. In such case of negative impact sublethal stress conditions can be used for increasing the resistance of probiotic culture to acid (Pimentel et al., 2022).

Cheese-

Cheese is one of the most common food consumed worldwide. The main step in cheese manufacturing is curd formation which can be achieved by using rennet or acid. Cheese has high protein content which protects the probiotics against high acidic conditions in gastric transit. And also, the high fat content provides additional protection to probiotics. Viability of probiotic bacteria during cheese processing and storage is the major challenge associated with the development of probiotic cheese. Probiotic bacteria should be technologically suitable for the incorporation into cheese products so that to retain both viability. Most of the probiotic cheeses have been developed by the addition of probiotic bacteria into cultured cheese. Probiotic soft cheese is developed using *L. acidophilus* and *L. reuteri*. cheddar cheese was produced by using *L. acidophilus, L. casei, L. paracasei* and *Bifidobacterium spp* (Awaisheh, 2012).

Cereal based products-

Cereal based fermented products have been used for many years now but utilization of probiotic characteristics of the involved microorganisms has gained attention recently. Cereals are a good source for proteins, carbohydrates, vitamins, minerals, and prebiotic content (non-digestible poly and oligosaccharides). So, they can be a good medium for probiotics. Also, fermentation increases the bioavailability of nutrients to probiotics which increases their bioavailability (Awaisheh, 2012). Many products like soymilk, soy-based yogurt, vegetarian frozen desert, fermented soy tempeh, soy cheese, sour dough bread (from rye, wheat), are available which can provide good number of probiotic bacteria. Also, there are cereal based probiotic infant foods available in the market.

Chocolate- Chocolate is one of the most popular product worldwide for its taste, flavour and also health benefits due to presence of polyphenolic and flavonoid compounds. Now many manufacturers of chocolate have tried to make it even healthier by adding probiotic strains like *L. acidophilus* and *B. animalis*. Developing a probiotic chocolate can be challenging as it should serve purpose without affecting the taste and flavour of chocolate.Probiotic milk chocolate can be prepared by addition of lyophilized probiotic strains (Homayouni et al., 2016).

Probiotic Drinks- Probiotic drinks are the most popular form of probiotic products. These are prepared by fermenting milk or plant extracts. These drinks contain live probiotic strains like *Lactobascillus casei*. The main advantage of having this drink boosts our immunity and digestive health. These drinks are available in different flavours. Also, buttermilk containing probiotics is popular as a probiotic drink. Kefir is also a great example of traditional fermented milk based probiotic drinks.The dairy based probiotic drinks are popular but lactose intolerance, veganism calls for non-dairy drinks. So, many fruits and vegetables like apple, cantaloupe, cashew apple, orange, black currant, bottle gourd, bitter gourd, beetroot, carrot and tomato have been used for preparing probiotic drinks. Being a rich source of nutrients fruits and vegetables, they serve as a suitable medium for probiotics (Sosalagere, 2021).

Indian Probiotic market- The Indian probiotic market reached a value of INR 2.6 Billion in 2021 and it is expected that the market may reach INR 7.7 billion by 2027 (IMARC). Indian probiotic industry is growing steadily. People have become aware of the benefits probiotics can provide and hence they want to make healthier choices for themselves. COVID-19 has especially affected this market sector as people now know the importance of having good immunity. Milk is considered the most suitable medium for probiotics and India is the major producer of milk in the world. Indian market consists of mainly probiotic drinks and yogurts. There are other products as well like probiotic ice cream, chocolates, biscuits, bread, fruit juices etc. So, with the right amount of awareness probiotic products can become an important sector of Indian health food market in near future.

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STARCHES: FUNCTIONAL PROPERTIES AND THEIR APPLICATION IN FOOD

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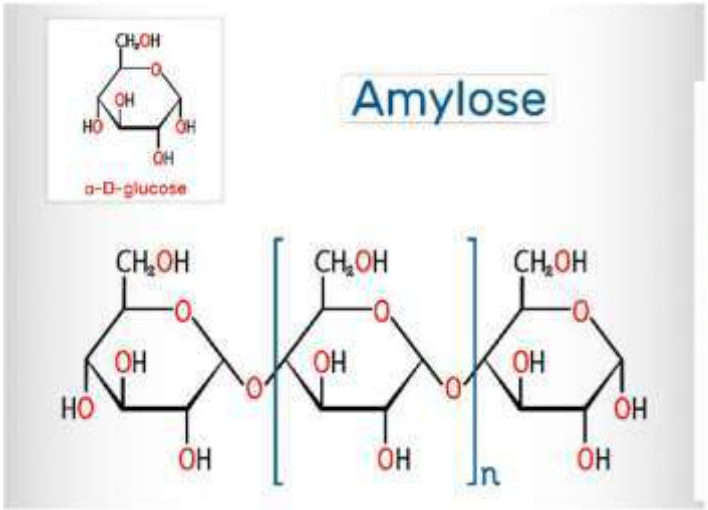
Starch, is the most abundantly found carbohydrate in plants. It is the most common carbohydrate in staple foods including grains and cereals. It is used as an important energy source for humans. It is found in potatoes, wheat, rice, and other foods and varies in appearance based on the source.

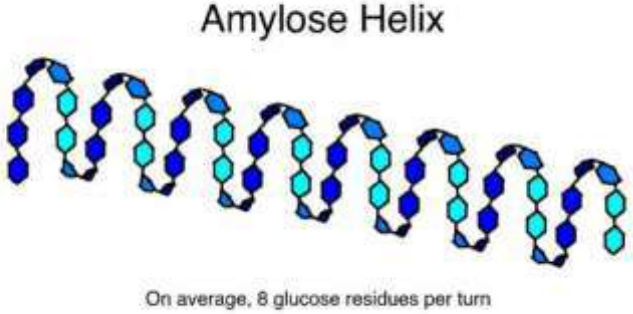
Crops like Cassava, arrowroot, sago, sweet potato or yam serve as tropical starches as they have the capacity to grow under hot and humid climate conditions. These crops are very proficient in supplying calories even to the very poorest people of the world hence categorizing them as quintessential subsistence crops. However, competing with other mainstream starch products such as wheat, potato, or corn becomes a challenge as it becomes difficult to break out of this subsistence crop practices.

The need for other mainstream starch crops exists due to the functional characteristics of the starch from other mainstream starch crops of value added products. These value added products are less susceptible to market fluctuations, as these are application specific. Locally produced starch crops need more research and product development work to match the quality and functionality required set by the international starch industry.

What is Starch : Types, Structure, and Benefits

Starch is a polymer of glucose chains consisting of Amylose and Amylopectin chains. Amylose is a straight chain and made up of α-D glucose units bonded through α(1-4) glycosidic bonds. They are tightly packed molecules and thus difficult to solubilize and possesses a tendency to retrograde.





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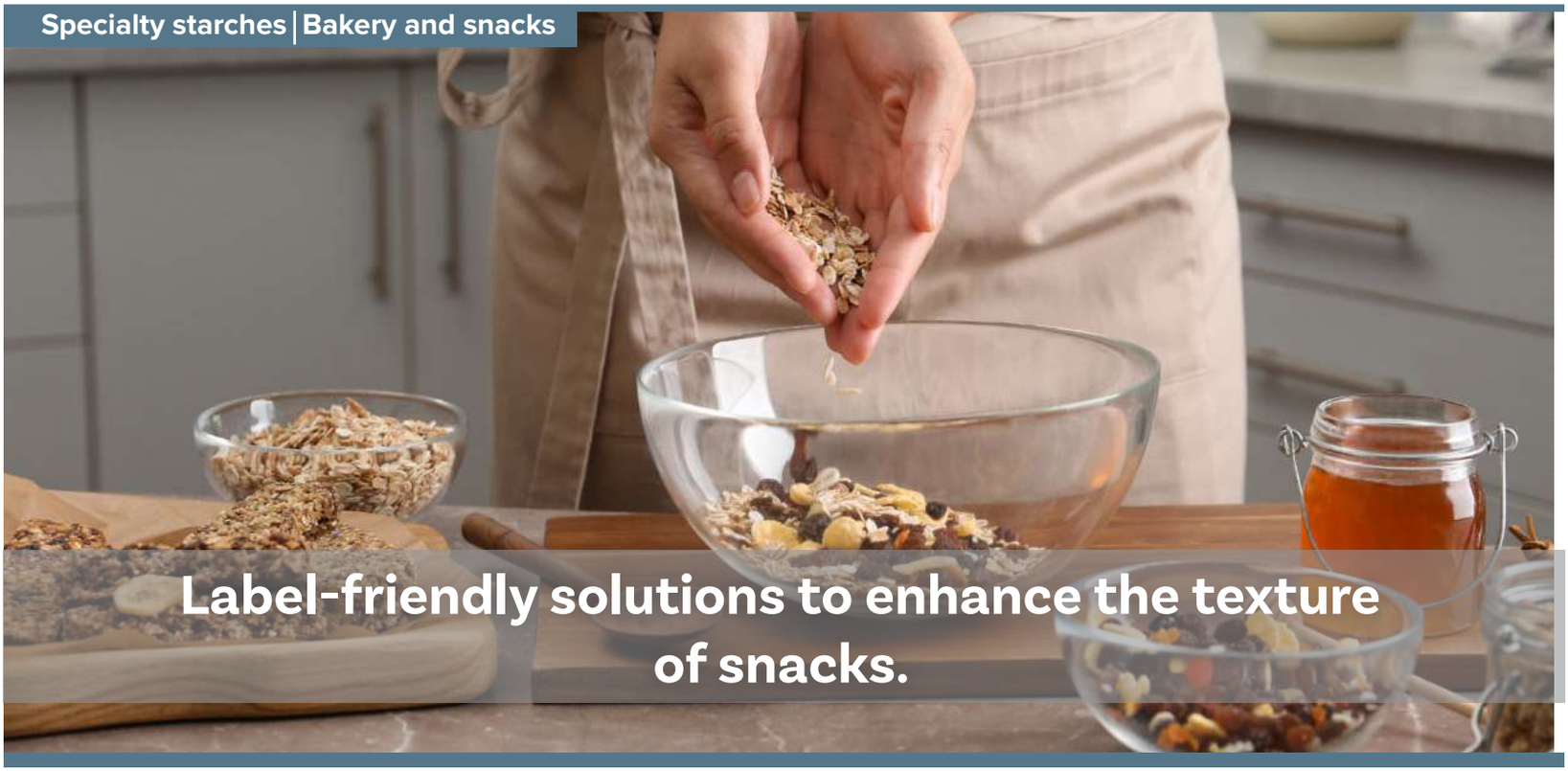

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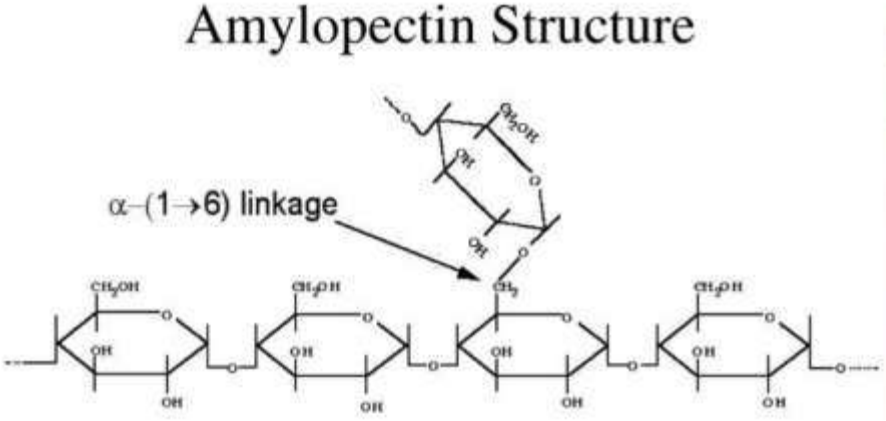

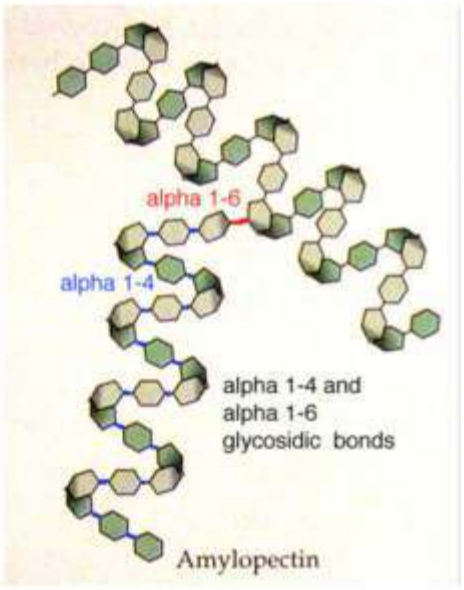

Foods with high amylose content offer lower glycemic index as Amylose gets digested slowly. The other form in which starch is found in plant foods include Amylopectin. Amylopectin is a branched chain polymer which digests rapidly and tends to make high GI foods.

Amylopectin are easier to solubilize and hold their gelatinized and hydrated structure better. Most starches contain 70% to 80% amylopectin as starch. Resistant Starch (RS) is yet other form of starch which again has 4 forms (RS1, RS2, RS3 and RS4). RS1 (Physically inaccessible) are found in whole or partly milled grains, RS2 (Resistant granules), RS3(Retrograded) found in cooked and cooled potato, bread and cornflakes, RS4(Chemically modified) found in processed foods containing modified forms of starch.

Modified forms of Starches in Foods

Depending on the functional role of the starches in foods, the choice and application varies in food systems. There are various functions which starches offer like:- specific viscosity, thin boiling, viscosity resistance, freeze thaw stability, gel texture, clarity, opacity, flow properties, mouthfeel to mention a few.

However, starches in their native form do not offer quality functional properties as compared to their chemically modified forms. Many chemical modifications of starches like hydrolysis, esterification, etherification and oxidation make starches suitable for baked goods, soups, salad dressings etc. Modified starches include physical, enzymatic and chemical modifications which offer properties for thickening, gelling, emulsification etc. They have been used in canned foods, baked foods, salad dressings etc.

Physical modification of starch changes the size of starch granules and improve its water retention. Physical methods include different combinations of moisture, pressure, shear, temperature and irradiation. These modifications are simple, safe and cheap. Pre-Gelatinized Starch (PGS) is a starch which undergoes cooking process until complete gelatinization and drying process using drum drying, spray drying and extrusion. PGS offers enhanced swelling and solubility capacity and also cold water dispersion. Its application is found in baby foods, soups and desserts as a thickener to form pastes.

Non-thermal physical modifications of native starches are the desirable alternative to traditional processes. Traditional heat treatments cause loss of vitamins, nutrients, and change the organoleptic properties of foodstuffs. High pressure technology, ultrasound treatment, microwaves and electric pulses are few of the non thermal technologies offering physical modifications. High pressure technology in food industry is applying the pressure from 400 to 900 MPa. High pressure generally restricts swelling capacity and increases paste viscosity (Li et al., 2014)

Ultrasound is another physical treatment of starch modification. It is used to suspend starches which have previously undergone gelatinization. Starch properties such as swelling capacity, solubility and viscosity of the paste are modified. The modification depends on the sound, frequency, temperature and process time.

Many chemical modifications of starch exists which make significant changes in starch behaviour, gelatinization capacity, retrogradation and paste properties. Food industries require several functional properties and hence deploys these modified starches.

Cross-linked starch is the interconnection of linear or branched chains. This modification increases the starch rigidity by forming a 3-D network. Crosslinking in starch enhances the degree of polymerization and molecular mass. Depending on reagent used for crosslinking, the product is classified as monostarch and distarch phosphate and phosphateddistarch phosphate. Cross linked starches are widely used in preparing soups, gravies and puddings as thickeners. Cross linking usually takes place in the amorphous region of the starch granule.

Acetylated starch is a modified starch, which reacts with free hydroxyl group in the branched chains of the starch polymer to produce a ester. Acetylation results in native starch modification using reactive reagents such as anhydrous acetic acid, vinyl acetate in presence of alkaline catalyst. Introduction of acetyl group reduces resistance of bonds between starch molecules. Acetylated Starch has applications as texturizer, stabiliser and encapsulating agent.

Application of Starches in Food

Starches are also classified as waxy and non-waxy starch. While Waxy starch is made up of 100% amylopectin with low or no amylose content, non-waxy starch on the other hand has 20%-30% amylose and 70% amylopectin. Flour from Waxy wheat may be used to extend the shelf life of baked goods. Waxy wheat flour exhibit better processing properties, water holding capacity, dough development time, swelling power. This helps in reducing the speed of retrogradation during storage.

Application of Starches in Foods

Starch Source	Use and Functional Role in Food
Tapioca Starch (Acetylated)	Encapsulating agent as helps to slow down release of crucial bioactive compounds
Native Tapioca Starch	Thickener for fruit fillings
	Helps in rising up the quality of jasmine rice bread gluten-free quality
Corn Starch	Thickening agent in infant formula
	Helps in reducing sponge cake texture compared to wheat flour
	Corn Syrup production
Wheat Starch	Gelling properties in foods (used in breadfruit cookies formulations)
Potato Starch	Good pasting and gelling agent
	Production of potato starch film
Sour Starch (from Cassava Starch)	Used in bread making and pastry production. Also used for gluten free breads
Rice Starch	Acts as an emulsion stabiliser, improves gelling properties when added with hydrocolloids such as CMC and HPMC
Sweet Potato	Widely used in Chinese food industry
Jackfruit seed	Increase quality of chocolate aroma and for encapsulation of rice bran oil
	Reduced calorie chocolate cake
	Gelatinisation
	Flour production
Mango kernel	Composite film production
	Coating purpose - almond

Starches have also been used as a fat replacer. In order to develop reduced fat products, starch has been used to imitate fat-based products. Starch has been modified by hydrolysis to form a fat replacer. Maltodextrin is widely employed as fat replacer besides other starch hydrolysis products. Products like low-fat yoghurt, low-fat ice cream, low-fat butter/margarine, low-fat mayonnaise have been developed using starch.

Starches have also been used as encapsulating agents to contain flavour compounds. Flavour compounds are unstable and require microencapsulation techniques to contain them and prevent their oxidation. Starches like waxy corn, regular barley, regular corn, waxy corn and waxy barley have been used as wall materials for the microencapsulation of essential oils.

Flavour-Starch complexes are prepared by mixing flavours and gelatinized starches followed by lyophillization. Octenyl Succinylated Starches hold the flavour better than the native starches.

Resistant Starch is used as a functional fibre and allows high fibre nutritional claim in food products. Resistant Starch delivers benefits of insoluble fibre and some benefits of soluble fiber. Commercial RS is a high amylose starch which is modified by biochemical or physical processing to maximize total dietary fibre.

Conclusion

Hence, functional benefits of modified starches are immense. They play a major role in the food industry for their valuable technological role. Modified Starches offer improved characteristics than their native counterparts and offer benefits in developing products with improved texture, rheological properties and other functional benefits thus helping in the development of the food industry.
More research is needed to explore the benefits of resistant starch as it could be utilised in developing healthy foods which are increasing in demand. Since RS reduces the caloric value of food products,

lowers blood glucose and increases the insulin demand in the body and acts pretty much similar to dietary fibre it should be explored further as a prebiotic.

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REGULATORY ROUND UP

By
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Dear Readers

Advance Happy Deepavali Wishes.

Food Authority has published a draft regulation introducing Front of the Pack Labelling in the present Labelling and Display Regulation, 2020. The salient points of the amendment are as follows

FOPL is applicable only to pre-packaged foods

- FOPL is exempted for those foods which are exempted from the nutritional declaration under Labelling and Display Regulation, 2020.
- FOPL will be effective from the date of final notification and must be complied within 4 years after the final notification.
- High Fat, Sugar and Salt (HFSS) thresholds are defined for a food to be considered as a HFSS Food. This definition is not applicable to food products which carry milk logo.
- Saturated Fat, Total Sugars and Sodium are considered as nutrients of concern
- As published previously by FSSAI, Health Star Rating has been chosen for the FOPL . This is drawn from Australian Health Star rating system but modified to suit Indian context. It is termed as Indian Star Rating (INR)
- It is proposed to take the levels of nutrients of concern (Saturated Fat, Total Sugars, Sodium and Energy) in a food into account and set these off against the positive nutrients – Fruits and Vegetables, Nuts, Millets, Legumes, Dietary fibre and Protein.
- All calculations are based on 100 g on 100 ml basis.
- Food products are categorized into two categories – Category I - Solid Foods (Incl. Dairy products and beverages) and Category II - Liquid Foods (excluding Dairy Products)
- The points (both for nutrients for concern and positive nutrients) for categories I and II are read from Table 2 and 3 respectively. The points accrued for positive nutrients are added up and is subtracted from the total points relating to nutrients of concern. This is subjected to certain conditions.
- The star rating, for the identified category, is obtained based on the net points from Table 6.
- The star rating of foods shall range from 0.5 to 5. This shall be declared on the front of the panel in a specified manner with a punch line “Go for More Stars” just below the star logo.
- FOPL declaration of Indian Star Rating is exempted for foods falling under categories listed in Schedule IV.
- Dietary fibre declaration is now mandatory as a part of Nutritional fact table.
- Ingoing percentage of positive ingredients like Fruits and Vegetables, Millets, Nuts and Legumes, that are considered for the calculation of positive points, must be declared.

The calculations are little difficult to understand to begin with. It would have been extremely useful if some examples are worked out for better clarity. Fruits and vegetables can be added in concentrated forms like powder, puree or juice concentrates. It is not clear as to how to take these aspects into consideration. The exemption list is too long and must be pruned. In my opinion, it should have been restricted only to Alcoholic Beverages (as they may get more stars thus encouraging consumption) and foods under Category 13 which are formulated to meet the specific dietary requirements.

It is little inexplicable that exemptions are given for Ghee (high saturated fat), Egg Products (High Fat), all types of Sugars including honey (High in energy and total sugars), Seasoning and Condiments (High in Salt). It is not clear why products with milk logo have been kept out of the HFSS definition. Products like Ice cream, Shrikhand, Cheeses will be exempted from the HFSS definition though they may contain salt, sugar and fat above the threshold limits. The draft requires detailed study and Industry bodies must take it up with FSSAI, the contentious issues.

All are requested to send in their comments and suggestions either online or in a prescribed format

Deadline for the declaration of Unit Sale Price on pre-packaged foods has been extended to 01 December 2022.

Legal Metrology now permits companies to nominate persons in lieu of company directors who will ensure compliance and held responsible for any violations. This is similar to the concept of Nominee in Food Safety and Standard Rules. It is hoped that the nominee would be given all the authority to ensure compliance.

FSS Rules 2011 is amended and includes changes in sampling, including the label review in the duties of food analysts etc. FBOs may expect more labelling queries from the Authority

Final notification introducing standards for fermented soybean curd products.

Final notification amending the FSS (Labelling and Display) Regulation, 2020. Certain products derived from allergen are not considered as allergen and exempted from allergen declaration. Minimum height of letters and numerals in relation to principal display has been amended (in favour of Industry). Labelling exemptions are provided for packages with less than 30 sq.cm surface area. Please note that these changes have already been operationalized.

As you are aware, FSSAI issued a notification in August 2022 which required the submission of Health Certificate with the import consignment of high - risk foods. As other documents like sanitary certificate is also required, FSSAI has now permitted to combine the sanitary and health certificate.

Latest list of FSSAI approved laboratories

Graphic specification of Vegan Logo has been notified.

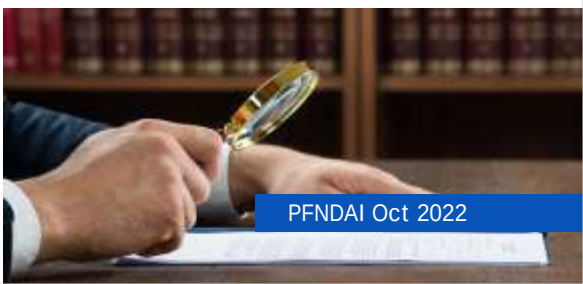
FSSAI is taking a serious view of restaurants, Hotels, catering services issuing bills without FSSAI license number. Ensure compliance.

FSSAI has published final testing method for Iron, Folic Acid and B12 in fortified rice.

FSSAI withdraws the online mode of training of FoSTaC courses vide its order 08 September 2022.

FSSAI vide its letter dated 05 September 2022 has clarified that blended oils, fat emulsions, etc as an intermediary ingredient shall be sold only to industrial consumer to ensure that these products do not enter retail outlets. Such packs shall be clearly marked “Not for Retail Sale to Consumer”.

Latest compendium of regulations is published.



RESEARCH IN HEALTH & NUTRITION

Higher protein intake while dieting leads to healthier eating

Science Daily June 27, 2022

Eating a larger proportion of protein while dieting leads to better food choices and helps avoid the loss of lean body mass, according to a Rutgers study.

An analysis of pooled data from multiple weight-loss trials conducted at Rutgers shows that increasing the amount of protein even slightly, from 18 percent of a person's food intake to 20 percent, has a substantial impact on the quality of the food choices made by the person. The study was published in the medical journal Obesity.

"It's somewhat remarkable that a self-selected, slightly higher protein intake during dieting is accompanied by higher intake of green vegetables, and reduced intake of refined grains and added sugar," said Sue Shapses, author of the study and a professor of nutritional sciences at the Rutgers School of Environmental and Biological Sciences (SEBS). "But that's precisely what we found." In addition, the researchers found a moderately higher intake of protein provided another benefit to the dieters: a reduced loss of lean body mass often associated with weight loss.

Weight-loss regimens that employ calorie restrictions can often spur dieters to reduce the intake of healthy foods that contain micronutrients such as iron and zinc. Ingesting higher levels of proteins is often associated with healthier outcomes, but the link between protein intake and diet quality is poorly understood, according to researchers.

"The impact of self-selected dietary protein on diet quality has not been examined before, to our knowledge, like this," said Anna Ogilvie, co-author of the study and a doctoral student in the Department of Nutritional Sciences at Rutgers SEBS. "Exploring the connection between protein intake and diet quality is important because diet quality is often suboptimal in the U.S., and higher-protein weight loss diets are popular."

The data was collected from more than 200 men and women participating in clinical trials at Rutgers funded by the National Institutes of Health over the past two decades. The analysis of food records and diet quality for this study was funded by the Institute for the Advancement of Food and Nutrition Sciences in Washington, D.C. Participants were between the ages of 24 and 75 and registered a body mass index that categorized them as either overweight or obese. All participants were encouraged to lose weight by following a 500-calorie-deficit diet and met regularly for nutrition counselling and support over a six-month period.

The participants were given nutrition advice based on the guidelines of the Academy of Nutrition and Dietetics and the American Diabetes Association. They were encouraged to allot 18 percent of their caloric intake to lean protein, such as poultry,

unprocessed red meat, fish, legumes and dairy, and to expend the balance of their calories on fruits, vegetables and whole grains. They were discouraged from ingesting saturated fats, refined grains, sugar and salt.Participants kept detailed food records, which researchers analyzed for diet quality, specific categories of foods consumed and ratios and specific sources of protein.

The participants who self-selected their protein intake were then characterized by researchers into a lower-protein approach with 18 percent of overall calories coming from protein or a higher-protein approach with 20 percent of the overall food intake coming from protein.

The study concludes:

- Both low- and high-protein groups lost the same amount of weight -- about five percent of their body weight over six months
- Higher-protein groups individuals chose a mix of healthier foods to eat overall
- Higher-protein group individuals specifically increased intake of green vegetables and cut back on sugar and refined grains
- Higher-protein group individuals were better able to retain their lean muscle mass when full-fat dairy products, egg yolks and red meat are consumed.

Lack of diversity of microorganisms in the gut or elevated metabolite implicated in heart failure severity

Science Daily June 20, 2022

Some people who experience heart failure have less biodiversity in their gut or have elevated gut metabolites, both of which are associated with more hospital visits and greater risk of death, according to a systematic review of research findings led by Georgetown University School of Nursing & Health Study researchers and colleagues.

The gut microbiome is a delicately balanced ecosystem comprised primarily of bacteria as well as viruses, fungi and protozoa. The microbiome can affect cardiovascular disease, which is a leading cause of death in the United States; heart failure, affecting over six million Americans annually, is often the end-stage of progressive cardiovascular disease.

For their overview, the investigators looked at seven years of genetic, pharmacologic and other types of research findings from around the world to generate a wide perspective on how the microbiome can influence heart failure. The investigators zeroed in on one harmful metabolite, trimethylamine -N-oxide (TMAO) that can be produced by churning gut microbiota

"To diagnose and manage heart failure we rely on certain findings and test results, but we do not know how poor heart function influences the activities of the gut, including the absorption of food and medications," says Kelley Anderson, PhD, FNP, CHFN, associate professor of nursing at Georgetown and corresponding author of the study. "There is now an appreciation of a back-and-forth relationship between the heart and elements in the gut, as clearly the heart and vascular system do not work in isolation -- the health of one system can directly influence the other, but clear connections are still being worked out scientifically."

The investigators parsed 511 research articles published between 2014 and 2021 that connected the microbiome with heart failure and winnowed their focus to the 30 most relevant articles. In recent years, more advanced technology, particularly tools that can closely examine the biological roles of DNA and RNA in the body, provided more detailed insights into the gut/heart relationship and those studies were of particular interest.

The researchers could not pinpoint the effects of diet on the interplay between the microbiome and the cardiovascular system due to a lack of strong data from the studies they reviewed. The investigators noted that nutrition is an important component of overall cardiovascular health, so having the opportunity to explore the impact of diet in relation to the microbiome is a promising area for future research efforts.

In terms of possible interventions to mitigate negative impacts of the microbiome on heart disease, Anderson noted that there are ongoing studies evaluating the use of antibiotics, prebiotics and probiotics, all of which can impact the microbiome, as well as intestinal binders that glom on to and help shuttle harmful elements out of the gut.

"We are currently developing a forward-looking study to evaluate the microbiome in patients with heart failure. We are particularly interested in the symptomatic experience of patients with end-stage heart failure as well as disease-related weight loss and wasting during this stage of cardiovascular disease," says Anderson.

The benefits of exercise in a pill? Science is closer to that goal

Science Daily June 15, 2022

Researchers at Baylor College of Medicine, Stanford School of Medicine and collaborating institutions report today in the journal Nature that they have identified a molecule in the blood that is produced during exercise and can effectively reduce food intake and obesity in mice. The findings improve our understanding of the physiological processes that underlie the interplay between exercise and hunger.

"Regular exercise has been proven to help weight loss, regulate appetite and improve the metabolic profile, especially for people who are overweight and obese," said co-corresponding author Dr. Yong Xu, professor of pediatrics- nutrition and molecular and cellular biology at Baylor. "If we can understand the mechanism by which exercise triggers these benefits, then we are closer to helping many people improve their health."

"We wanted to understand how exercise works at the molecular level to be able to capture some of its benefits," said co-corresponding author Jonathan Long, MD, assistant professor of pathology at Stanford Medicine and an Institute Scholar of Stanford ChEM-H (Chemistry, Engineering & Medicine for Human Health). "For example, older or frail people who cannot exercise enough, may one day benefit from taking a medication that can help slow down osteoporosis, heart disease or other conditions."

Xu, Long and their colleagues conducted comprehensive analyses of blood plasma compounds from mice following intense treadmill running. The most significantly induced molecule was a modified amino acid called Lac-Phe. It is synthesized from lactate (a by-product of strenuous exercise that is responsible for the burning sensation in muscles) and phenylalanine (an amino acid that is one of the building blocks of proteins).

In mice with diet-induced obesity (fed a high-fat diet), a high dose of Lac-Phe suppressed food intake by about 50% compared to control mice over a period of 12 hours without affecting their movement or energy expenditure. When administered to the mice for 10 days, Lac-Phe reduced cumulative food intake and body weight (owing to loss of body fat) and improved glucose tolerance.

The researchers also identified an enzyme called CNDP2 that is involved in the production of Lac-Phe and showed that mice lacking this enzyme did not lose as much weight on an exercise regime as a control group on the same exercise plan.

Interestingly, the team also found robust elevations in plasma Lac-Phe levels following physical activity in racehorses and humans. Data from a human exercise cohort showed that sprint exercise induced the most dramatic increase in plasma Lac-Phe, followed by resistance training and then endurance training. "This suggests that Lac-Phe is an ancient and conserved system that regulates feeding and is associated with physical activity in many animal species," Long said.

"Our next steps include finding more details about how Lac-Phe mediates its effects in the body, including the brain," Xu said. "Our goal is to learn to modulate this exercise pathway for therapeutic interventions."

Do our genes determine what we eat?

Study could pave the way to personalized nutrition guidance based on our taste perception

Science Daily June 14, 2022

Preliminary findings from a new study involving more than 6,000 adults found that taste-related genes may play a role in determining food choices and could, in turn, influence cardio-metabolic health. It is one of the first studies to examine how the genetics tied to perception for all five tastes -- sweet, salt, sour, bitter, and umami (savoury) -- are associated with consumption of food groups and cardio-metabolic risk factors.

The findings suggest that the genes that determine taste perception might be important to consider when developing personalized nutrition guidance aimed at improving diet quality and reducing risk for diet-related chronic diseases like obesity, type 2 diabetes and cardiovascular diseases.

"We know that taste is one of the fundamental drivers of what we choose to eat and, by extension, our diet quality," said Julie E. Gervis, a doctoral candidate in the Cardiovascular Nutrition Lab at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University. "Considering taste perception could help make personalized nutrition guidance more effective by identifying drivers of poor food choices and helping people learn how to minimize their influence."

For example, if people with strong bitter taste perception tend to eat fewer cruciferous vegetables, it might be recommended that they add certain spices or choose other types of vegetables that better align with their taste perception profile. "Most people likely don't know why they make certain food choices," said Gervis. "This approach could provide them with guidance that would allow them to gain more control."

Gervis will present the findings online at NUTRITION 2022 LIVE ONLINE, the flagship annual meeting of the American Society for Nutrition held June 14-16. Although previous studies have looked at genetic factors related to single tastes in certain groups of people, this new study is unique in that it examined all five basic tastes across a broad sample of U.S. adults.

It is also the first to assess whether genetic variants responsible for taste perception are associated with intake of certain food groups and with cardio-metabolic risk factors.

To do this, the researchers used data from prior genome-wide association studies to identify the genetic variants associated with each of the five basic tastes. They used this information to develop a new measure known as a "polygenic taste score" that provides a single estimate of the cumulative effect of many genetic variants on perception for a given taste. A higher polygenic taste score for bitter, for example, means that a person has a higher genetic predisposition to perceive bitter tastes.

The researchers then analyzed the polygenic taste scores, diet quality and cardio-metabolic risk factors for 6,230 adults in the Framingham Heart Study. The risk factors included waist circumference, blood pressure and plasma glucose, and triglyceride and HDL cholesterol concentrations. Overall, the analysis identified certain associations between taste-related genes with food groups and cardio-metabolic risk factors. The data revealed that genes related to bitter and umami tastes might play a particular role in diet quality by influencing food choices while genes related to sweet seemed to be more important to cardio-metabolic health.

For example, the researchers found that study participants with a higher bitter polygenic taste score ate nearly two servings less of whole grains per week compared to participants with a lower bitter polygenic taste score. The investigators also observed that having a higher umami polygenic taste score was associated with eating fewer vegetables, particularly red and orange vegetables, and that having a higher sweet polygenic taste score tended to be associated with lower triglyceride concentrations.

The researchers caution that the findings from this specific group of adults are not necessarily generalizable to everyone. "However, our results do suggest the importance of looking at multiple tastes and food groups when investigating the determinants of eating behaviours," said Gervis. "Going forward, it will be important to try to replicate these findings in different groups of people so that we can understand the bigger picture and better determine how to use this information to devise personalized dietary advice."

Benefit of supplements for slowing age-related macular degeneration

After 10 years, AREDS2 formula shows increased efficacy compared to original formula, benefit of eliminating beta-carotene

Science Daily June 2, 2022

The Age-Related Eye Disease Studies (AREDS and AREDS2) established that dietary supplements can slow progression of age-related macular degeneration (AMD), the most common cause of blindness in older Americans.

In a new report, scientists analyzed 10 years of AREDS2 data. They show that the AREDS2 formula, which substituted antioxidants lutein and zeaxanthin for beta-carotene, not only reduces risk of lung cancer due to beta-carotene, but is also more effective at reducing risk of AMD progression, compared to the original formula. A report on the study, funded by the National Institutes of Health, published in JAMA Ophthalmology.

"Because beta-carotene increased the risk of lung cancer for current smokers in two NIH-supported studies, our goal with AREDS2 was to create an equally effective supplement formula that could be used by anyone, whether or not they smoke," said Emily Chew, M.D., director of the Division of Epidemiology and Clinical Application at the National Eye Institute (NEI), and lead author of the study report. "This 10-year data confirms that not only is the new formula safer, it's actually better at slowing AMD progression."

AMD is a degenerative disease of the retina, the light-sensitive tissue at the back of the eye. Progressive death of retinal cells in the macula, the part of the retina that provides clear central vision, eventually leads to blindness. Treatment can slow or reverse vision loss; however, no cure for AMD exists. The original AREDS study, launched in 1996, showed that a dietary supplement formulation (500 mg vitamin C, 400 international units vitamin E, 2 mg copper, 80 mg zinc, and 15 mg beta-carotene) could significantly slow the progression of AMD from moderate to late disease. However, two concurrent studies also revealed that people who smoked and took beta-carotene had a significantly higher risk of lung cancer than expected.

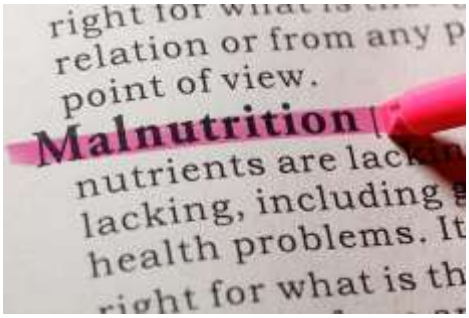
In AREDS2, begun in 2006, Chew and colleagues compared the beta-carotene formulation to one with 10 mg lutein and 2 mg zeaxanthin instead. Like beta-carotene, lutein and zeaxanthin are antioxidants with activity in the retina. The beta-carotene-containing formation was only given to participants who had never smoked or who had quit smoking. At the end of the five-year AREDS2 study period, the researchers concluded that lutein and zeaxanthin did not increase risk for lung cancer, and that the new formation could reduce the risk of AMD progression by about 26%. After the completion of the five-year study period, the study participants were all offered the final AREDS2 formation that included lutein and zeaxanthin instead of beta-carotene.

In this new report, the researchers followed up with 3,883 of the original 4,203 AREDS2 participants an additional five years from the end of the AREDS2 study in 2011, collecting information on whether their AMD had progressed to late disease, and whether they had been diagnosed with lung cancer. Even though all the participants had switched to the formula containing lutein and zeaxanthin after the end of the study period, the follow up study continued to show that beta-carotene increased risk of lung cancer for people who had ever smoked by nearly double. There was no increased risk for lung cancer in those receiving lutein/zeaxanthin. In addition, after 10 years, the group originally assigned to receive lutein/zeaxanthin had an additional 20% reduced risk of progression to late AMD compared to those originally assigned to receive beta-carotene. "These results confirmed that switching our formula from beta-carotene to lutein and zeaxanthin was the right choice," said Chew.

The study was funded by the NEI Intramural program (EY000546) and through contracts (AREDS2 contract HHS-N-260-2005-00007-C; ADB contract NO1-EY-5-0007; AREDS Contract NOI-EY-0-2127, and contract HHS-N-263-2013-00005-C). The AREDS2 contracts were supported by the NIH Office of Dietary Office of Dietary Supplements, the National Center for Complementary and Alternative Medicine, the National Institute on Aging, the National Heart, Lung, and Blood Institute, and the National Institute of Neurological Disorders and Stroke. The study took place at the NIH Clinical Center.

Millions of children at risk of death from severe malnutrition

27 Jun 2022
Nutrition Insight



UNICEF is warning an "explosion of deaths" is imminent in the Horn of Africa, while almost eight million children under the age of five are at risk of death from severe wasting in 15 countries.

The agency states the number is increasing by the minute and holds this is a result of drought, the pandemic's ongoing effects and soaring food prices, intensified by the war in Ukraine. "There is no time to waste. Waiting for famine to be declared is waiting for children to die," says UNICEF executive director, Catherine Russell. Severe wasting is a condition in which a person's body weight becomes too thin for their height. It is said to be "the most visible and lethal form of malnutrition."

The 15 most affected countries are Afghanistan, Burkina Faso, Chad, Democratic Republic of the Congo, Ethiopia, Haiti, Kenya, Madagascar, Mali, Niger, Nigeria, Somalia, South Sudan, Sudan, and Yemen. UNICEF is targeting these countries in an acceleration plan to help avert an "explosion of child deaths and mitigate the long-term damage of severe wasting."

Time running out

UNICEF says there is only a small window of opportunity to help save these children. UNICEF's report comes on the heels of last month's warning that the price of ready-to-use therapeutic food (RUTF) would likely rise by 16% in the coming months. These price hikes are themselves a result of the war in Ukraine perpetrated by Russia. Countries like Somalia imported up to 92% of their wheat from these two countries. Supply lines for this vital commodity have been completely severed.

"If the world does not widen its gaze from the war in Ukraine and act immediately, an explosion of child deaths is about to happen in the Horn of Africa," underscores UNICEF's deputy regional director for eastern and southern Africa, Rania Dagash. Research shows that the longer these children are deprived of essential nutrients, the worse the damage will be. Children suffering from this form of malnutrition can experience severe and lingering effects on their cognitive abilities.

The agency estimates that around 386,000 Somali children are facing life-threatening malnutrition. It also states that more than 1.7 million children are in a crisis of malnutrition spanning Ethiopia, Kenya and Somalia. This is the resulting "domino effect" of a report several scientists issued in April. "Death rates are also concerning," reports UNICEF. "This year, in some of the worst affected areas in the Horn of Africa, three times as many children have already died from severe acute malnutrition with medical complications in in-patient treatment centers compared to the whole of the previous year."

Urgent support needed

UNICEF is calling on world leaders to commit to a US$1.2 billion package that may save millions of children from a slow death. They have also asked that world leaders prioritize severe wasting in response to all global food crises. "Somali children are living on the frontlines of the climate crisis now – this is not going away – we need to see significant step-change from the donor community to adequately support families to weather these cyclical climatic shocks," says Russell.

Beyond that, UNICEF emphasizes the need to work for long-term goals. They also ask for a focus on both pre and neonatal nutrition, along with the acquisition and dispensation of RUTFs. UNICEF states that these long-term solutions should include nutrition, water quality and educatio n.

In May, DSM, UNICEF and nutrition think tank Sight and Life extended their partnership to address malnutrition on a global scale. The cooperation will provide better nutrition for sub-Saharan Africa and Asia while also aiming to expand to Latin America for the first time.

Edited by William Bradford Nichols

Gut microbiome may hold key to shaping future nutritional guidelines, study finds

13 Jun 2022
Nutrition Insight

The gut microbiome is being pegged as the "black box" of nutrition research as diet-microbiome interactions are anticipated to contribute to the foundation of dietary physiological effects. According to researchers from the University of Alberta, Canada and the University College Cork, Ireland, dietary guidelines could be improved, modified and innovated based on data on diet-microbiome-host connections.

"Although the human gut microbiota plays an essential role in the physiological effects of nutrition and the onset of chronic disease, national dietary recommendations worldwide are only now beginning to take advantage of scientific advances in the microbiome field," the researchers note. According to the study, microbiome-focused endpoints should be incorporated into all aspects of nutrition science to enhance the evidence base for dietary guidelines. This can also lead to the development of food products reducing chronic disease risks, the scientists add.

Uniform food-based dietary advice

The research focused on how the gut microbiota regulates and promotes the physiological effects of dietary compounds, dietary habits and specific foods. The findings were utilized to help explain nutrition debates, develop creative nutritional advice and establish an experimental paradigm for incorporating the microbiome into nutrition research. The researchers discovered a high level of consistency in national food-based dietary advice from various countries with different dietary patterns.

Other prominent nutritional platforms concur with these recommendations, such as the EAT-Lancet Commission on healthy diets and sustainable food systems and the Harvard T.H. Chan School of Public Health. Reformulation of processed foods, rather than elimination, has been proposed as a way to improve the diet quality of populations. Such approaches will demand a breakthrough in food

engineering that tackles the links between diet, microbes and hosts (diet-microbe-host interconnections).

Once the properties of the microbiome and health-promoting taxa were identified, the researchers suggested that nutritional methods may be utilized to target them. Due to the highly personalized reaction of gut microbiota to diet, microbiome assessments were a significant component of precision-nutrition strategies focusing on chronic illness prevention and therapy, among other individual-specific aspects.

Processed foods, whole grains and legumes

The research discovered that all dietary guidelines recommended whole-plant foods such as fruits, vegetables, legumes, whole grains, and nuts over processed meals with added salt, saturated fats, or sugar. Additionally, processed foods' fermentable ingredients may promote excessive bacterial growth in the small intestine and an unfavourable microbial metabolic and compositional profile. In addition, it harms the immunity and endocrine systems.

The evidence for whole grains' ability to reduce the risk of chronic diseases was substantial. The microbiota may play a causal role in the health effects of whole grains, according to a study combining human studies and mechanistic analyses in mice. Several dietary guidelines recommend that plant-associated protein foods be consumed often because of their benefits to human and environmental health. A growing body of evidence suggests that the gut microbiome plays a role in the health benefits of legumes. Furthermore, evidence from observational and intervention research suggests that eating fatty fish – a dietary source of omega 3 fatty acids – is beneficial for heart health and your gut flora may mediate these health advantages.

Microbiome research and Mediterranean diet

The Mediterranean diet incorporates a variety of food kinds that are beneficial to host interactions. Fruits, vegetables, legumes, nuts, whole grains, and olive oil are recommended as dietary requirements, as are eggs, poultry, fish, and dairy products in moderation, and processed and red meats and processed foods in moderation. Several recent microbiome studies support the Mediterranean diet's importance in dietary recommendations. Indeed, recently updated dietary guidelines advise eating habits that resemble the Mediterranean diet, such as the dietary approaches to stop hypertension.

NutritionInsight previously reported on the Microbiome Movement – Human Nutrition Summit that explored scientifically validated nutritional interventions that promote human health and reduce disease risk through the microbiome. Meanwhile, research conducted by Gelesis unveiled the link between a healthy gut microbiome and weight management.

By Nicole Kerr

Vegan diets may benefit weight management and improve insulin sensitivity, study finds

09 Jun 2022
Nutrition Insight

Veganism enhances the quality of one's diet, resulting in weight loss and improved insulin sensitivity, according to a US-based Physicians Committee for Responsible Medicine study. In particular, increased legume intake and decreased meat, fish and poultry eating were most strongly linked to weight loss.

The vegan diet helped participants lose an average of 13 lb and 9.1 lb fat mass. The group that did not adjust their diet did not lose weight or fat mass. "These findings should prompt the nutrition industry to focus on encouraging consumers to eat a more plant-based diet, especially more fruits, vegetables, grains and legumes, for good health," Hana Kahleova, co-author of the study and director of clinical research at the Physicians Committee for Responsible Medicine, tells NutritionInsight.

"Conducting more research like this is important because it adds to the mounting evidence showing that a plant-based diet is best for overall health." Legumes are rich in protein and research shows that swapping animal-based protein sources for plant-based protein is beneficial for overall health, Kahleova explains. "Eating more legumes – as well as fruits, vegetables and grains – also improves overall health because they contain disease-fighting fibre, antioxidants and other nutrients."

Data analysis of different diets

The study included 244 overweight adults randomly allocated to either make no dietary modifications or follow a low-fat vegan diet consisting of vegetables, grains, legumes and fruits, with no calorie restrictions.

The researchers monitored diet quality, body weight, fat mass and insulin sensitivity. The quality of the vegan group's diet, as measured by the Alternative Healthy Eating Index-2010 (AHEI) score, improved by six points on average, compared to no significant change in the non-vegan group.

Harvard School of Public Health researchers created the AHEI to uncover dietary patterns linked to a lower risk of chronic disease. The index includes items that should be consumed more frequently, such as fruits and vegetables, as well as those that should be consumed less frequently, such as red and processed meat. The lesser the risk of chronic diseases, the higher the AHEI score. "Research shows that legumes are beneficial for cardiovascular disease, Type 2 diabetes and weight management," adds Kahleova. "Additionally, they satisfy hunger more than meat. Beans also have a low glycemic index, which helps keep blood sugar from spiking."

Weight loss fuelled by legumes and whole-grains

An increase in fruits, legumes, meat alternatives and whole-grain intake, as well as a decrease in animal products, added oils and animal fats, was linked to weight loss in the vegan group. The study findings unveiled that whole fruit consumption was linked to a reduction in body weight. Additionally, eating more legumes was linked to decreased fat mass and visceral adipose tissue. More consumption of animal alternatives, such as tofu, tempeh and veggie burgers, resulted in a reduction in body weight.

A higher intake of whole grains was linked to lower body weight and fat mass. Lower consumption of eggs was associated with lower body weight. The study also found that reduced high-fat dairy consumption was attributed to a reduction in body weight and fat mass. Reductions in total meat, fish and poultry intake were linked to weight loss and a reduction in fat mass. Meanwhile, a lower intake of added animal fats was linked to lower weight and fat mass, while a reduced intake of added oils was similarly linked to weight and fat mass loss.

Food as medicine and increased life expectancy

Food has been pegged as having the potential to treat certain illnesses. An IDEO's Design for Food studio expert previously noted that food could potentially treat health ailments. Similarly, an American College of Lifestyle Medicine research affirmed that a range of chronic diseases could be addressed by incorporating healthier, functional food into diets.

NutritionInsight previously reported on a University of Bergen study that consumers who start eating healthier earlier in life could gain up to a decade of life expectancy (LE), with legume consumption adding 2.2 LE years to females and 2.5 to males.

By Nicole Kerr

Better eye health and lifespan expectancy linked to restrictive diets, study reveals

07 Jun 2022 Nutrition Insight

A study published in Nature Communications by the Buck Institute for research on aging has revealed a relationship between dietary restrictions, eye health, circadian rhythms and prolonged lifespan expectancy.

These synergies were demonstrated in a study on the fruit fly Drosophila melanogaster. The findings evidence the potential benefits of particular lifestyle choices, such as intermittent fasting. "We are now showing that not only does fasting improve eyesight, but the eye actually plays a role in influencing lifespan," says Pankaj Kapahi, professor and senior author at the Buck Institute.

Surprising correlation

The study aimed to clarify dietary changes and their effect on circadian processes in the body, while further investigating how lifespan expectancy can be improved through a restrictive diet. The flies were found to be protected from the lifespan-shortening effects of photoreceptor activation – when photoreceptor proteins in the eye cell absorb photons, triggering a change in the cell's membrane potential – when they were on a restrictive diet.

On the contrary, photoreceptor inactivation – achieved when housing flies in constant darkness – was found to extend the lifespan of flies reared on a high-nutrient diet. The study piqued the researchers' curiosity regarding the extent to which dietary restrictions impact circadian function among humans, and if it can be helpful for healthy neuronal function throughout life and aging.

It has been previously proven that there is a correlation between eye disorders and poor health in humans. In the newly published study, the authors argue that there is more to this outcome, as dysfunction of the eyes can also lead to dysfunctions in other tissues.

Life-extending benefits of restrictive dieting

Intermittent fasting has been in the spotlight of trending restrictive diets. Focusing on when to eat rather than what to eat, it is considered more as an eating pattern rather than a diet. Earlier research has shown that it contributes to improved glucose regulation, stress resistance and has anti-inflammatory effects. Previous research has evidenced how reducing the intake of calories and fatty acids to a limited amount of hours per day decreases the speed of cancerous growth. Other studies have shown health benefits such as lower blood pressure and more stable insulin levels.

Edited by Beatrice Wihlander

Millet consumption reduces cholesterol, cuts risk of hyperlipidaemia and obesity – Study

By Nurul Ain Razali 28-Jun-2022- Food Navigator Asia

The consumption of millets reduces total cholesterol and lowers body mass index (BMI), compared to other staples such as rice, wheat and quinoa.

These findings were put forward in a systematic review and meta-analysis titled "Are Millets More Effective in Managing Hyperlipidaemia and Obesity than Major Cereal Staples? A Systematic Review and Meta-Analysis" in the journal Sustainability. "There is a recent resurgence in attention to the need for increasing biodiversity on farms and in diets, including revamped interest in millets, as supported by scientific promotion of millets being smart food that is 'good for you, the planet, and the farmer'.

"Their nutritional and health benefits are widely recognised, and several pieces of evidence were recently produced to validate those claims. Millets help in managing Type 2 diabetes, moderating blood lipid profile, raising haemoglobin levels, and thereby reducing anaemia," said the researchers.

Therefore, this review aimed to strengthen the thesis by utilising the difference-in-difference method, by which the treatment group consumed millets and the control group consumed other major staple foods.

The study period was limited to 3 October 2017 to 1 December 2021, coupled with the usage of a 27-item PRISMA checklist. The tests examined included RCTs involving the carbohydrate comparison; subjects of any age, gender or ethnic group that tested for the effects of millet on blood lipid profile; and had reported on BMI. A total of 12 studies were shortlisted for this review out of the potential 831 papers.

The reduction in total cholesterol levels was recorded to be 6.6% in the millet-consuming group, while there was no significant change for the control group that consumed other staples. The decrease was highlighted by 10 studies. For instance, Roopashree's team analysed the consumption of barnyard millet in individuals with Type2 diabetes. They found a significant reduction in "bad" cholesterol low-density lipoprotein (LDL) after a 28-day intervention. Similar but marginal changes were observed in experimental non-diabetics. Four studies showed an impact on BMI among millet consumers, but it was not significant. In the RCT, sorghum intake was analysed in 24 overweight men. Nonetheless, it proved that the extruded sorghum consumption reduced body fat and increased daily carbohydrate and fibre intake among subjects.

Nine of the 12 studies reported the amount of millet consumed, which was from 40 to 200g spanning 28 to 120 days. The meta-analysis identified significant benefits of consuming millet on total cholesterol, LDL and HDL levels, thereby managing hyperlipidaemia. The control groups only had diets consisting of rice, wheat and quinoa.

"It is noteworthy that all the studies except one reported more than 60g of millet consumption per meal, and that to have sustainable benefit, it is important to continue after experiencing the reduction in lipid profile to manage it continuously… This implies that millet consumption can potentially contribute to reducing the risk of cardiovascular disease (CVD) and non-alcoholic fatty liver disease (NAFLD)," said the researchers. The team recommended further studies to accumulate evidence and deepen the insights into the efficacy of dietary millets.

FOOD SCIENCE & INDUSTRY NEWS

New processing technique could make potatoes healthier

Approach is designed to slow starch digestion to avoid blood sugar spikes

Science Daily June 14, 2022

Researchers announced early tests of a new potato processing technique designed to make our bodies digest potato starch more slowly. Laboratory demonstrations show that the approach blocks certain digestive enzymes from reaching the potato starch as quickly, leading to a more controlled release of dietary glucose.

"There is a perception that potato foods are unhealthy because eating a large amount of some potato foods can cause a rapid increase in blood sugar, which is a risk for people with diabetes or those who want to control body weight," said Amy Lin, PhD, the study's principal investigator and lead of the Food Carbohydrate Program of the Singapore Institute of Food and Biotechnology Innovation (SIFBI) at A*STAR.

"Our team revealed that toggling the accessibility of two digestion enzymes --α-amylase and mucosal α-glucosidase -- in the small intestine is a successful strategy to make dietary glucose slowly and continuously release from potatoes."

Andrea Gomez Maqueo Cerecer, postdoctoral research fellow at A*STAR, will present the findings online at NUTRITION 2022 LIVE ONLINE, the flagship annual meeting of the American Society for Nutrition held June 14-16. The study was supervised by Lin, and other research team members included Grace Ng, Ru Min Bek and Jei Xi Wong. For the new processing technique, researchers cut potatoes into cubes and blanched them in hot water with a food grade ingredient for 30 minutes. The ingredient used in the solution has been designated "generally recognized as safe," a standard established by the U.S. Food and Drug Administration for substances considered safe for use in food.

This process causes a reaction with pectin, a water-soluble fibre in potatoes, creating a gelling structure that acts as a barrier between starch granules and digestive enzymes. This protective layer is porous, and the processing method allows the size of the pores to be controlled to moderate how quickly α-amylase is able to penetrate the potato parenchyma cells and degrade starch to small molecules.

Converting starch molecules to glucose relies on mucosal α-glucosidase, which is too big to penetrate those pores. Therefore, the elevation of dietary glucose of processed potatoes depends on the how quickly small starch molecules leach out of parenchyma cells and are digested by mucosal α-glucosidase.

"Without our treatment, enzymes move freely in and out of cells, and starch is quickly degraded by both enzymes and rapidly converted to glucose," said Lin. "The treatment allows the starch to be slowly degraded to prevent a spike in glycemia and then fully converted to glucose to meet our energy and nutritional needs."

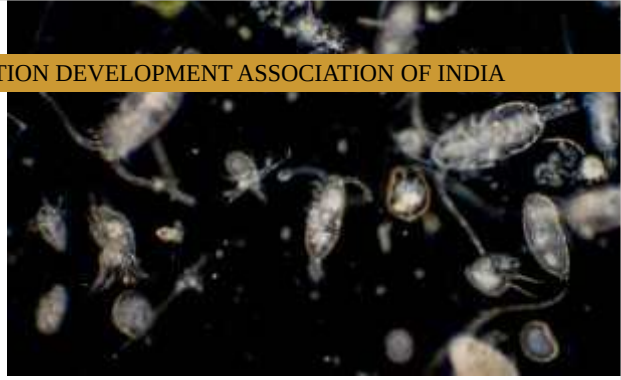
The technique is not designed to prevent the potato from being digested, but rather to slow digestion to avoid a rapid increase in blood sugar. Researchers say the modification could also help consumers feel full for a longer period after eating the treated potatoes, helping to avoid overeating. Researchers report that the method performed well in tests with a simulated digestion process in the laboratory. Treatment increased the fraction of the starch that is considered slowly digestible from 10% to 35% and significantly reduced the ability for the enzyme a-amylase to access starch within the cell walls.
Since the process essentially pre-cooks the potatoes, treated potatoes are not shelf-stable but could be frozen and then cooked or further processed for dishes such as roasted potatoes, hash browns, soups or stir-fry, researchers say. Initial taste tests had good results in terms of digestibility and texture. As a next step, the researchers are preparing to further test impacts on digestibility in a clinical trial. They also plan to study whether a similar approach could be used to improve other staple foods.

Global warming can impact omega 3 availability, ocean researchers flag

27 Jun 2022 Nutrition Insight

Climate change could result in a decrease of omega 3 acids available for both fish and humans, a study by the Woods Hole Oceanographic Institution (WHOI) reveals.

Scientists took samples from subtropical waters to the Antarctic shelf and found that ten of the major classes of lipids formed by plankton became less abundant in warmer waters. “The future decrease in omega 3 fatty acids we predicted for organisms at the bottom of the food web could ultimately affect the availability of these key nutrients in human diets,” Dr. Benjamin Van Mooy, oceanographer and senior scientist, WHOI, tells NutritionInsight.



Feeling the impact

The researchers found that the percent abundance for eicosapentaenoic acid (EPA) species showed a strong relationship to temperature. Amid loss of sea ice, accelerated sea level rise and longer and more intense heat waves as a result of global warming, the researchers predict that the amount of available eicosapentaenoic acid (EPA) will suffer a significant decrease over the course of the next century. When this hypothesis was tested against the worst-case climate change scenario, climate scenario SSP5-85, the simulation forecasted that some ocean areas would lose up to 25% of their available EPA.

“We found that the composition of lipids in the ocean is going to change as the ocean warms. That is a cause for concern. We need those lipids that are in the ocean because they influence the quality of the food that the ocean produces for humanity,” underscores Van Mooy.

These essential plankton that produce EPA and docosa-hexaenoic acid (DHA) are at the base of the food web. They produce the lipid which other fish and ocean life absorb as they consume them. Humans, in turn, receive omega-3 fatty acids when they consume fish and other seafood. In essence, these plankton are the nutrient's only source as the human body is unable to produce it.

Searching for the source

The researchers were able to identify 1,151 different species of lipid-producing plankton and analyzed 930 samples from across the globe, stating that there were "hundreds to thousands" of species within each sample. The researchers say that the survey reveals "there were, until now, unknown characteristics of these plankton species. Specifically, that warmer water temperature seems to drastically reduce the amount of lipids available." "This is just one example of the many unexpected impacts of global warming on human food sources," states Mooy.

Health importance for omega 3s

The study comes at a time when a separate team of researchers recently announced that seafood consumption in the US has fallen far below the guidelines, which state that fish should be consumed twice a week to maintain healthy omega 3 levels. The results reveal that as much as 90% of US citizens fail to make this goal, "likely caused by high seafood prices," according to the researchers.

Omega 3 fatty acids are called so because there are three main types. Two of them, EPA and DHA, come mainly from fish. The third other omega 3 is called alpha-linolenic acid (ALA) and is much more abundant than the other two. ALA can be found in vegetables, nuts and even in some animal fats.

EPAs and DHAs are important, and the US Food and Drug Administration (FDA) recently found the evidence that these two omega-3s may lower blood pressure and reduce the risk of heart disease to be "sufficiently trustworthy." The FDA issued further guidance that they may be especially effective for those who are already hypertensive.

Previous studies have found that omega 3 can increase immunity and may even reduce the risks of some cancers when combined with vitamin D3 and exercise. Some companies are already looking for more sustainable, even synthetic processes, to supplement omega 3 in the human diet. However, they have stated that our bodies may react differently to synthetic nutrients. "Unless we reverse global warming, we can add the future scarcity of omega-3 fatty acids to the list of stressors on important fisheries," concludes Mooy.

By William Bradford Nichols

Indian scientists explore 3D printing tech to enhance the efficacy of nutritional supplements

10 Jun 2022 Nutrition Insight

Scientists from the Indian Institute of Food Processing Technology (IIFPT) are using 3D printing technology to transport resveratrol and curcumin around the human body as they are difficult for the body to absorb.

The researchers have now explored using a 3D printed beeswax-based medium-chain triglycerides (MCT) oleogel as a co-delivery carrier for the nutrients.

Resveratrol and curcumin are known as nutraceuticals, a form of dietary supplement claiming to have health benefits. According to the researchers, the combination of these two compounds is "well-studied and widely considered a synergistic health booster." Unfortunately, resveratrol and curcumin have low water solubility and processability makes it difficult to package them into ingestible formulations for human absorption.

Testing samples

To create a stable emulsion formulation, the researchers added varying amounts of gelatin and gellan gum to an MCT oleogel and tested the results. They also added potato starch and whey protein to make the beeswax-based carrier gel extrudable and then 3D printed a set of nutraceutical-dosed samples with it. It was discovered that increasing the gellan gum content made the emulsion more stable, and it even turned out to be a critical parameter in the 3D printing process.

In-vitro experimentation revealed that 3D printed carrier systems improved curcumin bioaccessibility by 1.13 times and resveratrol bioaccessibility by 1.2 times compared to a control MCT oil sample. This study, which is the first of its kind, deals with 3D printing of emulsion-templated oleogel containing curcumin and resveratrol for synergistic benefits in the customized structure of consumer preference.

3D printing gains traction in nutrition space

The researchers believe the study is critical to understanding insights into the 3D printing of emulsion templated oleogel as nutraceutical carriers. Earlier this year, NutritionInsight reported that 3D printing could unlock custom textures, flavours and nutritional content in nutritional foods. Still, cost, capacity and lack of printable ingredients are holding the technology back from taking over the market. Blendhub also partnered with Essence Food, a specialist in transforming surplus food into functional products using 3D technology. Last October, Colorcon Ventures invested an undisclosed sum in UK-based Remedy Health, which specializes in 3D printing personalized gummy stacks.

In similar developments, Nourished previously added ADM's postbiotic to 3D-printed gummies for personalized metabolic support. Meanwhile, tech-backed personalized nutrition and new delivery formats continue to gain traction in the nutrition arena.

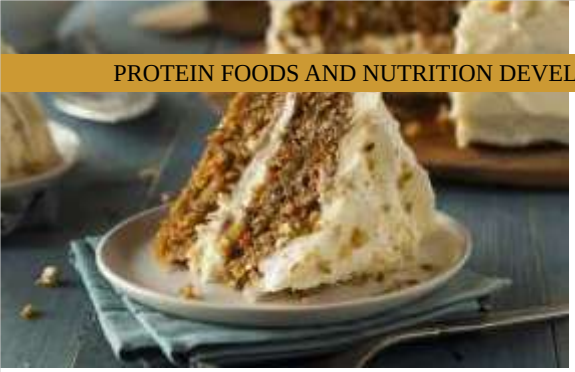
Edited by Elizabeth Green

Protein-fortified snack innovation bulks up as consumers crave functional pastries, donuts and chips

07 Jun 2022 Nutrition Insight

Accentuated appetites for foods fortified with functional benefits is growing the commercial potential for protein-boosted snacks into new product segments – such as health-haloed pastries, donuts and chips. These findings are evidenced in new market analysis published by ingredient supplier Glanbia Nutritionals.

According to Glanbia, 46% of consumers believe protein bars count as a healthy snack, while 16% of consumers are now using protein-fortified snacks – such as protein bars, powders, cereals and pancakes – once a week.



Branching out of the traditional protein format

Glanbia's research – which polled 3,000 people across Germany, France, Sweden and Italy – reveals that across Europe, consumers are cutting down on "less healthy" snacks, such as soft drinks, candy, chocolate and chips, and leaning toward nourishing snacks, like protein bars. An important consideration for protein bar consumers is the product being filling (deemed essential for 33% of consumers). Furthermore, low/no sugar as well as "good source of vitamins and minerals" claims are particularly attractive among bar consumers.

"Increasingly consumers are looking for protein-fortified products which are seen as a benchmark for health, with Ready-To-Drink (RTD) protein shakes and bars currently leading the way, most likely thanks to the easy-to-use formats of both products and the fact that they can be consumed on the go," explains Sonja Matthews, senior manager of strategic insights EMEA & ASPAC at Glanbia Nutritionals.

Noting "this is just the beginning" for industry's diversification of protein formats, she highlights: "We are seeing new products hitting the shelves from protein cookies to protein-fortified chocolate bars, showcasing that if a product is innovative and exciting, tastes great and has the health benefits consumers are looking for, it can really cut through the competition." European protein bar users are showing an interest in protein cookies (50%), brownies (47%) and protein chips (34%).

Baked goods such as protein-fortified pastries and donuts (30%) are also rated highly, as well as small, bite-sized formats like protein bites (30%) and balls (24%), while protein spreads are another opportunity, with 34% expressing an interest in this type of product. Taste remains a "non-negotiable" aspect, Glanbia stresses – with this benchmark remaining the number one requirement for protein products, followed by it being high in protein and low/no sugar across both RTD protein shakes and bars.

Multifunctional snack and bar solutions

Glanbia Nutritionals offers snack and bar solutions for the European market, which aid the creation of soft indulgent protein bars, savoury extruded protein snacks and creamy protein beverages.

The supplier has a range of dairy and plant proteins in its BarPro, BarFlex and BarHarvest range. These functional protein solutions are designed to help create protein bars and snacks with the specific texture and flavour requirements desired by the on-the-go health-conscious consumer. The solutions also extend the shelf life of nutrition bars while minimizing bar hardening. "They provide an excellent source of high-quality protein that improves bar texture and supplies a clean flavour profile," the company details.

Glanbia's snack product innovation, Crunchie Milk Protein Crisps, are ideal for bar and snack inclusion, delivering texture and crunch to a product. With consistent shape, size and a light colour appearance, this ingredient contains greater than 74% high-quality milk protein, for an extra protein boost. The company also offers custom premix solutions that are also available to create a unique blend of vitamins, minerals and

Novel protein-packed hero ingredients

Innova Market Insights highlights that savoury snacks are still somewhat more likely to feature boosted nutrient claims than sweet snacks (6% versus 4% of total snacks launched globally in 2021) and are also growing faster at a CAGR of 8% from 2017 to 2021 versus 4% for sweet boosted nutrition claim snacks.

The market researcher highlights that boosted nutrition snacks may only cite generic "source of" claims, or note the specific fibre and protein content, while others feature specific hero ingredients or make explicit links between fibre or protein and health benefits.

One example of a protein-rich novel hero ingredient is milk thistle, found in Danone's Deliciest Rahka Maisku Valkosuklaavadelma (White Chocolate Maisku Bar) in Finland. This decadent treat combines a thin white chocolate icing on top, a fair dose of soft fresh milk curd and a raspberry heart inside into a "convenient casserole-like snack" for both children and adults.

Meanwhile, conventional protein powder is seeing a clean label makeover. "Good For You – Better For The Planet" is how Green Protein promotes its Green Protein Sport Pea Protein Powder in India. Pea protein production, the company states, is "highly cost effective and sustainable, requiring less water and land, compared to meat and whey".

Traditional protein shakes are also increasingly targeting mainstream consumers outside of the bodybuilding category. Last April, nutritional shake brand Boost partnered with Cinnabon to introduce the Boost High Protein Cinnabon Bakery Inspired Flavoured Nutritional Drink. The functional RTD beverage is packed with the same protein, vitamins and minerals as Boost High Protein Nutritional Drink and inspired by the flavor of the classic Cinnabon cinnamon roll.

In other moves, precision fermentation technology is changing the cruelty free protein scene forever, highlights Innova. US-based ArboryPharm Foods – which has just launched "No Cow - All Science" Natreve Mooless Animal Free Whey Protein – describes the production process as follows: "Microflora are given an exact copy of DNA corresponding to cow's milk protein." "In fermentation tanks, the flora grazes on flora food and converts it into animal free milk protein. Finally, the flora is filtered out, leaving pure, animal free whey protein that is identical to the protein found in cow's milk."

By Benjamin Ferrer

No culture or context: Too many plant-based firms 'over-engineering ingredients' amid aggressive expansion

By Nurul Ain Razali 27-Jun-2022- Food Navigator Asia

Too many plant-based firms are 'over-engineering ingredients' and 'forcing solutions' on investors and consumers, without paying enough attention to Asian culture and context, according to a regional expert in the alternative protein space.

That was the view of the CEO and founder of Singapore-registered plant-based foodtech firm Dynamic Foodco and ex Quorn exec, Dr Andy Kusumo. He believes too many firms are pushing for consumers to give up meat without 'thinking out of the box'.

"The trend among consumers is that they are aware of sustainability issues, but they do not want to give up meat. Plant-based firms are jumping too quickly to achieve the end-goal of sustainability without understanding what it takes, like grasping culture and context.

"What we see in the market now are firms forcing solutions onto investors and consumers with the over-engineering of ingredients and without thinking out of the box. Asia is diverse and complex, what with the usage of different spices in each country," he said.

He argues that plant-based food is not a trend or fashion, but should be viewed as a solution. "Consumers demand taste, affordability, convenience and versatility. What they love in meat must be there. Firms come up with sustainable alternatives, but it forces consumers to make a hard choice.

"Hence, I created Dynameat under Dynamic Foodco so people won't have to make that hard choice. To me, real sustainability is about creating synergy and impact. Our production philosophy is that the tech starts from the consumer. I've always believed in tech, and I want to use it to solve human issues," said Dr Andy, 42 years old.

Established in early 2021, Dynamic Foodco leverages his experience as the first scientist and researchand development (R&D) head in Asia for plant-based pioneer Quorn. The Indonesian native, who holds a PhD in chemical engineering from Carnegie Mellon University in the US, has been active in the Singapore plant-based protein space since 2016. Before Quorn, he worked in pharmaceutical giants Merck and Amgen.

"As I was from pharma and biotech, I know how to create textures, handle materials and understand material behaviours. I intend to work with partners and OEM manufacturing and put this business at the forefront as a sustainability change-maker. Asia usually consumes beef, chicken, fish and seafood. I want Dynameat to be number five on that list," he said.

Dynameat, a plant-based chicken alternative made of wheat and soy, is set to launch in Singapore for the Singapore market around September 2022. Its R&D, which involves understanding consumer preferences and rigorous development of prototypes, took 14 months.

The firm's proprietary tech named Taste and Texture (TnT) claims to manipulate ordinary ingredients with protein and grain content into sustainable food solutions for the masses. "In the plant-based scene, I feel there's a disconnect between science and humans. I'm here to use advanced tech that's not ingredient-specific to produce tasty, nutritious, versatile and convenient food. Wheat and soy are not new; it is a matter of how you put it together," he said.

Dynameat will be sold in two formats – as a base "raw" protein for food service, firms and manufacturers, and semi-prepared, ready-to-cook protein with flavours like the perennial favourite satay. He declined to share other flavours the firm has up its sleeves. Besides having a production plant and an R&D lab run by 15 persons in Singapore, Dynamic Foodco is backed by an advisory board comprising food industry veterans.

"Our priority is to offer chicken lovers a plant-based alternative that won't break the bank or burden the environment. Our prices are between organic kampung (village) chicken and conventionally-farmed ones," he added.

According to research, revenues from alternative proteins could reach USD$290 billion by 2035. However, its adoption in Asia has been hampered by taste, pricing and supply chain issues. For instance, Malaysia halted the export of 3.6 million whole chickens monthly to stabilise production and prices on 1 June. The move created a furore in Singapore, which has a staggering chicken per capita consumption of 36 kilogrammes in 2020, based on data retrieved from the Singapore Food Agency (SFA).

Additionally, the consumption of meat and seafood in Asia is expected to increase 78 per cent by 2050; hence, the issues need to be addressed now with the next generation of plant-based meat alternatives that cater to taste buds first, said Dr Andy. "Asia is very complex and diverse. It is an exciting space for us. I want Dynameat to bring credibility and trust to the plant-based industry. We want to be a company of inspiration, understanding how people eat and who people eat with," he said.

To conclude, Dynamic Foodco has kick-started a fundraiser for SGD$5m (USD$3.6m) to enhance the core team, build its IP facility and improve the technology used to bolster scalability. Dr Andy also hopes to enter the Malaysian and Indonesian markets by 2023 and India and China within five years.

"Dynameat is made for Asians. To me, it is about focus. But tech-wise, we can go to any market. I'm targeting to be number one in Singapore within two years and number one in Asia in five. "There's a big market, but you need to tap it the right way. Plant-based consumption is already big in Asia. As a start-up, we need to be different in running our projects. Tap markets that are ready for us," he said.

REGULATORY NEWS

Can we save more lives if we let resistant bacteria live?

Science Daily June 22, 2022

Antibiotic resistance is a ticking bomb under public health. WHO predicts that in 2050 more people will die from infections than from cancer -- and we are talking about infections that we today consider harmless; infections that occur in a cut or wound -- or perhaps cystitis.

The reason is that bacteria are masters at adapting. When their existence is threatened, they mutate into a new and improved version of themselves that can no longer be threatened by e.g. antibiotics. Consequently, many disease-causing bacteria today are resistant to antibiotics. "That's bacteria for you. They always find a way! Of course, resistance will occur; that's how evolution works," says professor and head of research, Birgitte Kallipolitis, who studies disease-causing bacteria at the Department of Biochemistry and Molecular Biology at University of Southern Denmark.

The talents of fatty acids

And that's exactly why, like other researchers around the world, she thinks it's time to find new ways to fight or neutralize the perpetually mutating bacteria. For some years now, she and her research group have studied a particular type of fatty acid, which has proven itself interesting in this context. The researchers use Listeria as a bacterial model to test the effect of these fatty acids. Elsewhere in the world, colleagues are using salmonella and cholera bacteria for similar tests. The particular fatty acids are interesting not only because they can kill the Listeria bacteria in Kallipolitis' laboratory, but they can also turn off their ability to infect and spread infection.

The researchers' experiments have shown that the fatty acids have an antimicrobial effect, ie that they can kill Listeria bacteria. At first, this sounds good, but then there is the mutation thing; trying to kill the bacteria only makes it mutate into a new and resistant version of itself. Enter the special talent of the fatty acids: They can make the resistant bacteria harmless, so that no infection occurs at all. "Thus, the resistant bacterium is no longer a bacterium that we must try to kill -- instead, we prevent it from spreading and making us sick," Birgitte Kallipolitis explains.

No more spreading

The concept of making a disease-carrying bacterium unable to spread or make us sick is called turning off its virulence. When you turn off the virulence of a bacterium, you prevent it from producing proteins like adhesins and invasins, which the bacterium needs to attach to a cell so that it can enter the cell. "If a Listeria bacterium cannot enter a cell, it cannot spread, and then no infection will occur," Birgitte Kallipolitis explains.

Extra help for the elderly and weak

The Listeria bacteria in Kallipolitis' experiments are only harmless as long as their virulence is switched off. When they are no longer exposed to the fatty acids that turn off their virulence, they regain the ability to spread "But this may be the extra help that allows a patient to cope with an infection. Antivirulent medication or supplements could be good for the prevention of infections, especially in the elderly and weak," says Birgitte Kallipolitis. The fatty acids that she and her colleagues work with, are so-called medium and long free fatty acids.

In nuts, plants and seeds

"We have especially focused on

the free fatty acids, palmitoleic acid and lauric acid, which are found in nuts, seeds, plants and milk, etc. In our experiments, they show an antivirulent effect," she says. Kallipolitis points out that you cannot eat your way to an antivirulent effect by, for example, eating nuts and seeds containing palmitoleic acid and lauric acid. "The fatty acids must be in the free form, and that does not generally occur in food. You can buy free fatty acids as supplements but be aware that most fatty acids in supplements are locked and not in the free form.

"We do not yet know if you can achieve the effect by consuming free fatty acids. Maybe the fatty acids are metabolized before they reach the battle ground in the intestinal system, where the fight against many resistant bacteria takes place. Maybe we need pharmacists or chemists to find a way to transport the fatty acids to the scene of the battle," she explains. Hence, a special dietary supplement or tablet is not just around the corner, she emphasizes. Before we get there, a number of tests are needed. “The next step will be to test the antivirulence effect in a laboratory system reminiscent of the human intestinal system; here we will add Listeria bacteria and see if the fatty acids will make them avirulent. If this works, it goes on to mouse experiments, and eventually it can hopefully be used prophylactically in humans," says Birgitte Kallipolitis.

What is multi-resistant?

Some bacteria are resistant to several different kinds of antibiotics and are therefore called multi-resistant. Examples are staphylococci, acinetobacter, pseudomonas and E. coli, which can cause fatal infections if left untreated.

EU sugar-reduction drive gaining traction amid reformulation investments

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The European soft drinks sector has delivered a 17.7% reduction in average added sugars in the last seven years based on the bolstered health and nutrition commitments set out by the Union of European Soft Drinks Associations (UNESDA). About 3.6% of that figure was achieved in only two years as the sector strives to reduce these sugars by another 10% by 2025.

“This will represent an overall reduction of 33% in average added sugars over the past two decades,” Nicholas Hodac, director general, UNESDA, tells FoodIngredientsFirst. “As we progress with our sugar reduction efforts, it is important to ensure that our consumers keep a tasteful experience. Reducing the average added sugars in our soft drinks is always a gradual process. Consumers need to follow us and accept the new portfolio of reformulated beverages and new products with no and low-calorie products.”

The sugar reduction gains have been realized using low-calorie sweeteners, which have been evaluated as safe by the European Food Safety Authority and authorized by the European Commission.

"They are key ingredients to reduce the sugar intake from our drinks while allowing consumers to enjoy the same level of sweetness," says Hodac.

Going sweet on reduction commitments

Europe's soft drinks sector has achieved an average market share of over 29% of no-and-low calorie products in Europe, with some markets as high as 40 to 50%. "Our commitment applies to all soft drinks categories under UNESDA's remit, including still drinks, fruit drinks, carbonates, energy drinks, sports drinks, dilutables, iced teas and coffees, and flavoured waters. It excludes bottled waters, 100% juices, milk-based and hot beverages," Hodac continues. According to Innova Market Insights, concern over sugar intake and interest in sugar reduction drive a sophisticated approach to sweetening foods and beverages. The market researcher says there is a clear focus on three parallel areas: natural sweeteners, less sweetening and no sweetness.

UNESDA corporate members have made significant investments in reformulation and new product development to reduce average added sugars in their drinks to provide consumers with healthier drink choices. The value of the investments has not been disclosed. The sector has achieved a 26% reduction in average added sugars since 2000. "This shows that over the past two decades, we have committed to helping consumers manage their intake of added sugars from soft drinks and enable moderate consumption patterns through smaller pack sizes," explains Hodac.

Conduct that leaves a sweet aftertaste

While the European soft drink sector is not the largest contributor to the total added sugars intake of Europeans, it will continue to promote healthier dietary habits, UNESDA reports. The industry has made a recent sugar reduction commitment under the EU Code of Conduct on Responsible Food Business and Marketing Practices under the EU Farm to Fork Strategy umbrella. The code of conduct is one of the first deliverables of the EU Farm to Fork Strategy to encourage sustainable practices across the food supply chain and UNESDA is among its first signatories. Hodac continues: "Encouraging consumers toward healthier dietary habits is also a core part of our contribution to the European Commission's objective of achieving a healthier and more sustainable food system." "It also demonstrates our ongoing commitment to encourage consumers toward healthier drink options by offering them more no- and low-calorie products,'' adds Ian Ellington, president of UNESDA Soft Drinks Europe and senior VP for PepsiCo in Europe.

Nutrition and circularity goals

UNESDA's health and nutrition commitments include responsible advertising and marketing practices to children under 13 across all media, intensified actions to act responsibly in EU primary and secondary schools to achieve full compliance and easy-to-understand front-of-pack nutrition labelling to help consumers make informed dietary choices. On the sustainability side, UNESDA has pledged to achieve full circularity for beverage packaging by 2030. UNESDA's Circular Packaging Vision 2030 states that beverage packaging will be recyclable by 2025 and PET bottles will contain 50% recycled content.

By Inga de Jong

Sodium reduction a "challenging" task, KHNI flags, amid calls for industry action

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The Kerry Health and Nutrition Institute (KHNI) is highlighting the health priority of governments to reduce sodium intake across the globe to battle the main cause of high blood pressure, leading to strokes and heart diseases – standing for the highest mortality rates globally.

Consumers have an increased health awareness, driving the demand for healthier products.

The World Health Organization (WHO) also advises governments on initiatives to follow. However, industry engagement is required to make a significant difference in the process. "Sodium reduction can be very challenging. There is no silver bullet, not one solution that can be applied across various products and applications. Saltiness is perceived by the ion channel that responds to sodium. This sodium channel is particular. Therefore it's unlikely any substance could fully replace sodium," comments the KHNI. "In addition to salty taste, salt is a highly functional ingredient, so there's a need for a combination of solutions to address sodium reduction. Salt is an efficient, clean label preservative. It binds water and inhibits microbial growth. This water-binding capability also lends to a more succulent product."

Sodium in common foods

Processed food stands for the highest sodium intake, and take-away food or food consumed outside the home. Globally, a significant amount of sodium comes from bread, processed meats, dairy products and other foods. The WHO advises a daily salt intake of maximum 5 g of salt (2 g of sodium). However, the global average daily consumption is between 9-12 g of salt, data from the WHO shows. Heart disease and stroke are among the leading causes of death. Both are worsened by high blood pressure, which is often caused by a high sodium intake. In the UK, a voluntary salt reduction was implemented in the early 2000s, resulting in 9000 lives saved. In South Africa, a mandatory salt reduction scheme was implemented resulting in a significant decrease in salt intake over a five year period.

What is being done?

Countries around the globe are tackling the sodium threat in different ways. Tax implementation and voluntary reduction initiatives are common approaches. For increased taxes, the aim is to make the products not necessary for public health more expensive. Mexico is one example of an 8% tax on high-calorie "non-essential" foods. Thailand took a similar approach, with plans to introduce a tax on salty products. However, it got put on hold as the economy needed time to recover after the COVID-19 pandemic. The department of health in the Philippines proposed a higher tax as well. However, lawmakers rejected that due to a lack of interest.

Salt reduction has been referred to as a critical public health strategy in the UK. Organizations are pushing for additional salt taxes, which were rejected recently as the government does not wish to raise food prices during ongoing inflation. Front-pack labelling has also been introduced, including warning labels on the front of product packaging to ensure consumers are informed. Latin American countries are the "leaders" in this approach. The labels indicate if the products contain high levels of salt, sugar, fat or energy.

Industry needs to step in

For industry, continuous innovation is ongoing in the area. Common methods used are stealth reduction, mineral salts – such as replacing sodium with potassium chloride – and yeast extracts, according to the KHNI. Another standard method is "salt crystal shape alternation." This approach's primary effect is to dissolve salt crystals in the mouth. "This involves altering the size and shape of the salt crystals to create a saltier perception during taste. A smaller salt crystal size increases adhesion capabilities, and hydrophobicity is the main attribute linked to increasing the perception of saltiness," KHNI notes.

Even though industry and governments across the globe have shown progress in sodium reduction, the KHNI stresses that "there is still some way to go." The sodium intake levels are still way too high compared to the recommendations from the WHO, and blood pressure-related diseases still run as the most elevated mortality factors in the world.

Edited by Beatrice Wihlander

South Korea nutrition claims: Tougher criteria imposed for RTE and RTC products

By Pearly Neo 15-Jun-2022-Food Navigator Asia

The South Korean government has imposed tougher criteria on ready-to-eat (RTE) and ready-to-cook (RTC) instant products that want to make healthier nutritional claims on pack, in an expansion of rules first placed on instant noodles earlier this year.

South Korea has been on the warpath against high-salt and high-sugar foods and beverages for the past several years, especially within the instant convenience foods space. This culminated in the development of strict standards to define low-salt and low-sugar foods and beverages last year which were enforced starting with instant noodles or ramen earlier this year, this being a staple food for the nation.

Several months on, the government has now prepared to expand the reach of these healthier product labelling standards to more products in the country, starting with RTE and RTC instant foods. "We already know from a 2021 consumer perception survey of 2,147 consumers that 85.7% are willing to reduce their consumption and/or purchase of foods high in sodium and sugar, and 89.9% of respondents are willing to purchase products that are low-sodium and low-sugar," Ministry of Food and Drug Safety (MFDS) Minister Kim Kang-lip said via a formal statement.

"So far we have enforced stricter standards on making healthier product claims such as low-salt and low-sugar to instant noodles, but now we will be expanding this to apply to several more categories including RTE instant foods such as triangle gimbap and RTC instant foods such as soups (e.g. beef seaweed soup, radish soup,ribs/galbi-tang, etc.), stews (e.g. kimchi stew, soybean/doenjang-jjigae, etc.) and hotpots (e.g. dumpling/manduhotpot, intestines/gopchang hotpot, etc.). "Apart from food manufacturers and processors, distributors will now also be able to use healthier labelling if their products meet the required standards. It should also be noted that the next item in the pipeline for this change is frozen rice."

According to MFDS' latest standards, products are considered to have met sodium and sugar reduction labelling standards if these are: 1) Reduced by 10% or more from the average value of products on the market, or 2) Reduced by 25% or more compared to the other similar products manufactured by the firm. Upon meeting these criteria, the products will then be allowed to be labelled with claims including 'less sweet', 'less salty', 'reduced sodium' and so on.

To further emphasise South Korea's determination to bring down the sodium and sugar consumption levels in its population, the ministry has also established two specific 'Low Sugar and Low Sodium Practice Headquarters' in the country, aimed to equip the public with more knowledge to make the right purchasing choices. "The Low Sugar and Low Sodium Practice Headquarters have been inaugurated as a private consultative body composed of experts from the medical, academia, industry, media, and consumer groups, with the aim of spreading a culture of practicing healthy eating in South Korea," Kim said at the recent launch of the second headquarters.

"[This is an important development because] although public awareness of low-sugar and low-salt practices has spread through various efforts, South Koreans' sodium intake at around 3,220mg still remains 1.6 times higher than the recommended standard of 2,300mg. "The sugar intake of children and adolescents is also very high, so we have found it necessary to more effectively promote policies [and bring these closer to the public] so as to further reduce sodium and sugar consumption in the future." South Korea aims to reduce its national average sodium consumption to 3,000 mg by 2025, from the 3,220 mg identified by the National Health and Nutrition Survey in 2020.