FOOD, NUTRITION & SAFETY MAGAZINE

PFNDAI BULLETIN DEC 2025

SPECIAL ISSUE

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Finamul 4087L: Functional Emulsifier System for Cookies

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Cookies are the most sought-after snack in India. However due to its higher fat content (+20%) consumer trend is more toward low fat options. Hence, manufacturers are finding ways to reduce the fat content without affecting textural & sensorial attributes.

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Parameters	Control	T1	T2
Fat (%)	100	100	**90**
Emulsifier		Lecithin (322)	**Finamul 4087L**
Cream density	0.618	0.569	**0.557**
Avg. height of 10 biscuits (cm)	8.4	9.4	**9.5**
Avg. Weight of 10 biscuits (g)	111.2	111.5	**114**
Avg. Diameter (cm)	5.6	5.5	**5.5**
Spread ratio	0.66	0.56	**0.58**
Bite	Slight hard	slight crispy/soft	**Soft/crispy**

10% lower fat with excellent textural properties

Advantages of Finamul 4087L :

- Increased stack height
- Less crumbly
- Improves surface texture
- Improved machinability
- Controls cookie spread
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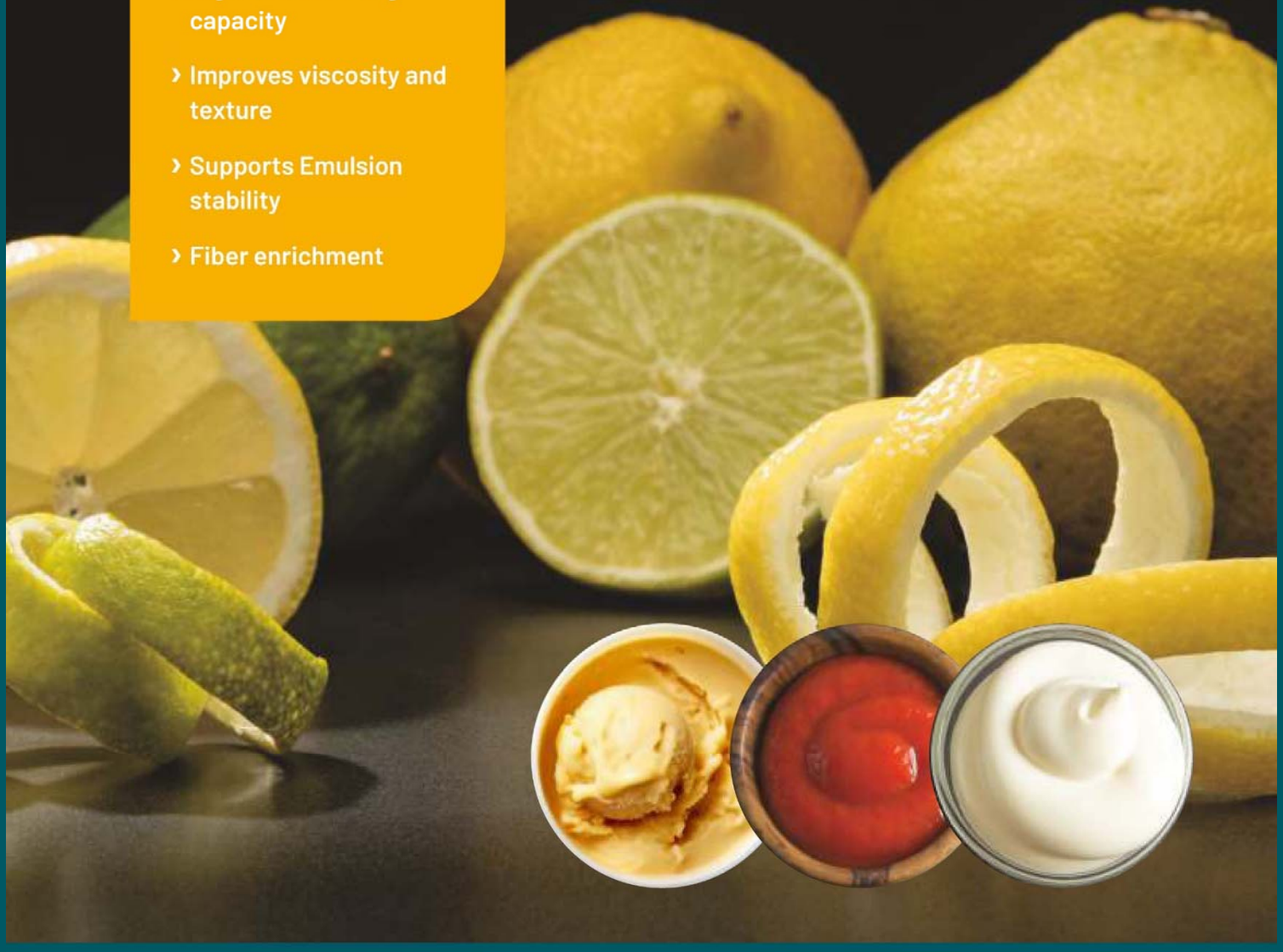

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REFORMULATION FOR HEALTHIER CHOICE

There is a global problem facing people with increasing non-communicable diseases such as overweight, obesity, hypertension, diabetes, cardiovascular diseases and many others. Yes, there is a large impact of sedentary lifestyle with very little physical activity because of modern conveniences as well as lack of infrastructure and time-constraint that discourages physical activity. This is evident at all ages from childhood to adults and in schools as well as offices.

This does not take away the problems of diets and foods that are consumed today. There is a trend for tastier food with very little thought to nutrition and health. We are consuming much more calories from fats and carbs, and there is a big portion of sugars in carbs. There is an increasing lack of dietary fibre along with the deficiency of protein. India has not yet faced the brunt of the problem like the west, but the trend shows our population is headed in that same direction unless we do something to avert that.

We need to create awareness about the diet and advise people how they can make changes in the diet to turn around to healthier direction. We cannot tell them to make total changes and eat what they are not used to. Drastic changes in diets are only possible in hospitals and prisons. We cannot apply those ways for common people. We need to consider the diversity of diets not just within the country and states but also within regions. In already prevalent diets, we can make small changes which become successful.

FSSAI has realised this and has encouraged fortification of staples. This is a great initiative started from iodised salt. Now FSSAI is encouraging industry to go for wheat flour, milk, oils and rice. These could be fortified with vitamins and minerals and product can display the FSSAI approved logo of fortification on label. This minor change will not make a great difference in the diet pattern but will make it healthier. Similar process can be applied for fortification with protein and dietary fibre.

People are going to protein products not knowing how much to use. Too much of protein in diet is also harmful. So if FSSAI can come up with similar fortification logo for products to which FSSAI recommended amounts of protein and dietary fibre, it would help consumers get adequate protein and fibre without much change in their diet. Consumers do not have to listen to activists or gym trainers who may not have adequate qualification or training to advise people on nutrition.

Even industry can reformulate some of its products that come under HFSS to make them healthier. It is not easy to suddenly reduce salt, sugar and fat in a very delicious product as these ingredients not just affect taste but also flavour, texture and other properties that affect the mouthfeel and other desirable properties of food products. This will be a slow change but will certainly go a long way in avoiding the problems the population in the western countries are facing today.

Finally, PFNDAI has decided to start printing our magazine in hard copies as before. We thought that our articles have something that needs to be preserved on our bookshelves for referencing. As the trial, we are printing quarterly Special Issues as we got many requests from our members. Initially, we will be sending hard copies only to our members as the appreciation of their support. Our well-wishers will get soft copies as before. We thank our members who have stood with us all these years, even through difficult times of pandemic. We owe a lot to their unstinted support.

Prof Jagadish Pai, Editor, PFNDAI

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AT WHAT POINT DOES COMPLIANCE BEGIN?

AUTHOR

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A recent controversy over attaching ORS to brand names highlights the widespread practice of not following the principles and procedures established by law. Governments depend on regulatory institutions to protect citizens, which is why Parliament enacted a science-based law (FSSA, 2006), following another controversy. Rigid legislation is a deliberate policy choice to ensure the strict proportionality of consumer safety and fair trade. Consumers are protected from unsafe events when risk assessment precedes rulemaking. For businesses to comply, regulatory texts must explain exactly what constitutes strict compliance; there is no room for ambiguity. Knowing beforehand the risks revealed through scientific risk assessment, the distinctive medicinal intent of ORS, and the consequences of misleading labels, the orders of July 2022 (2) and February 2024 (3) could not have been made. But they were.

In April 2022 (1) - noting the risk to consumers especially children suffering from diarrhoea—directions were issued to Commissioners of Food Safety to serve improvement notices on packages of drinks and beverages bearing the term 'ORS' to comply with FSS(LD 2020); "Pre-packaged food shall not be described or presented on any label or in any labelling in a manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect." It confirmed that ORS, conforming to the WHO formulation, is classified as a drug under its respective law. It cited several other sections of the Act that were violated by its label, implying medicinal or therapeutic claims, false or misleading representations concerning its necessity or usefulness, and promising efficacy without adequate scientific justification. The direction aligns with the applicable regulations and statutes.

Despite the April 2022 directive emphasising harm, the July 2022 Order allowed the continued sale of such products while awaiting an opinion on trademarks. Eighteen months later, the February 2024 order justified these products based on FSS(AC) 2018 - 4(7), which states, "Where the meaning of a trademark, brand name, or fancy name containing adjectives such as "natural", "fresh", "pure", "original", "traditional", "authentic", "genuine", "real", etc., appearing in the labelling, presentation, or advertising of a food, is such that it is likely to mislead consumers about the nature of the food, in such cases .... a disclaimer in shall be given at appropriate place on the label stating that – "This is only a brand name or trade mark and does not represent its true nature". ORS is considered a priority medicine by the WHO for childhood diarrhoea treatment in many high-burden countries. It is neither an adjective nor a claim. Claims are optional. The effort to accommodate ORS in the name of the product, despite the risk of harm, is inexplicable. If a disclaimer stating its label name does not reflect the true nature and substance of a food, how should consumers make an 'informed choice'?

FSSA is an engagement model that respects scientific evidence, follows mandated process, and values global alignment. It ensures a coherent compliance strategy at every level, from statutes and regulations to businesses, to keep consumers safe. Ultimately, a court order (October 2025) was required. At what point compliance begins begs no answer, but whether we are into systems governance required under FSSA, 2006, does.

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- Cereals, pulses and its products
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- Animal origin, fishery and its products
- Alcoholic and non alcoholic products
- Oil seed, oils and its produts
- Sweets.,confectionary and its products
- Bakery products
- Sugar, Honey & jaggery
- Process, canned food products
- Feeds
- Water
- Ready to eat
- Infant substitute
- Skim Milk Powder

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- Synthetic food colour
- Antioxidents
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- Drinking water as per IS 10500
- Process water IS 4251
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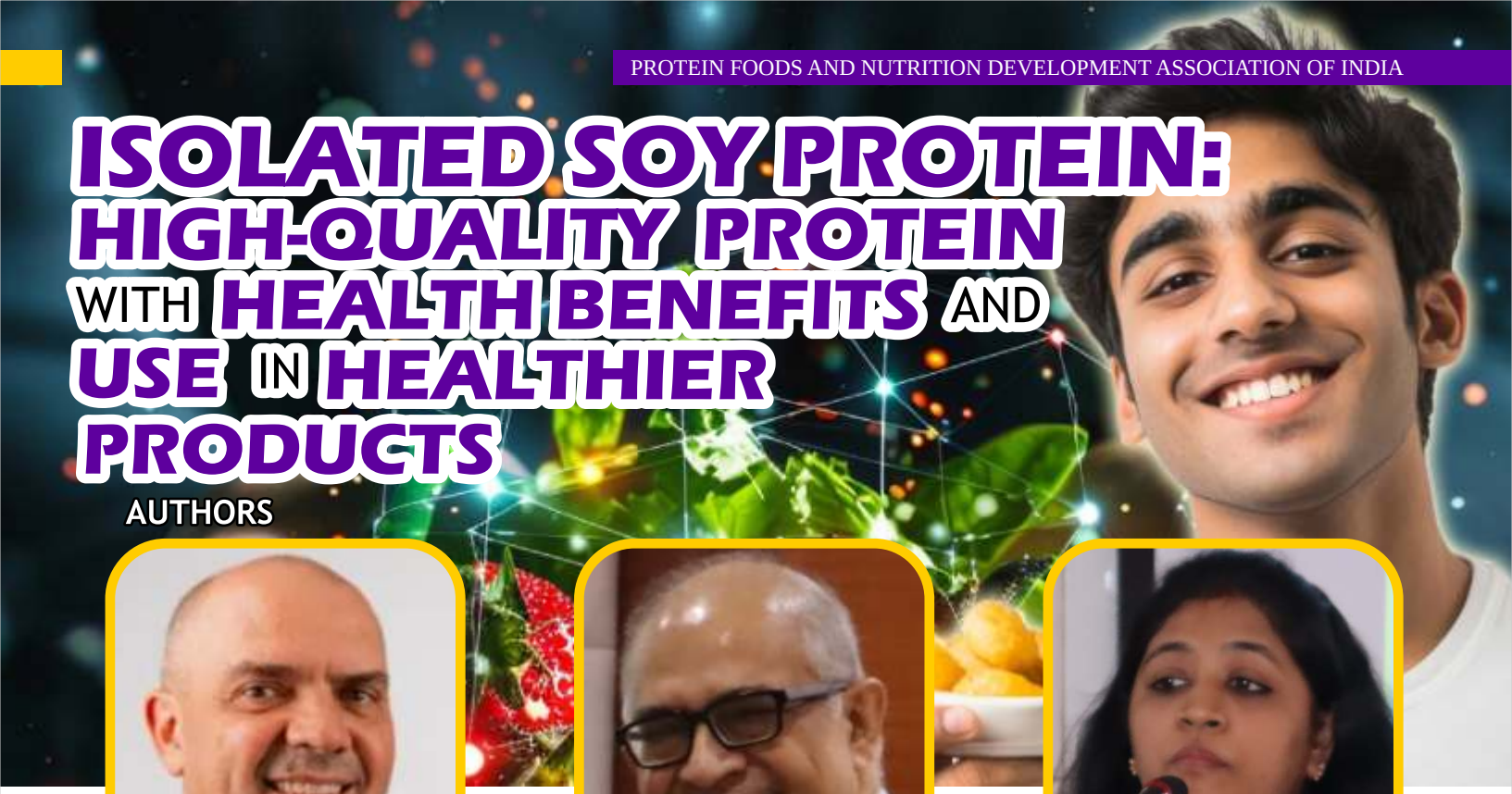
ISOLATED SOY PROTEIN: HIGH-QUALITY PROTEIN WITH HEALTH BENEFITS AND USE IN HEALTHIER PRODUCTS



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Abstract

Isolated soy protein (ISP) is a complete, high-quality plant protein with a PDCAAS score of 1.00, equivalent to milk and egg proteins. Scientific evidence supports ISP's nutritional quality, established health benefits, and emerging roles in liver, kidney, metabolic, and skin health. ISP also offers sustainability advantages, making it an ideal ingredient for product development. Clinical evidence and meta-analyses confirm its efficacy in cardiovascular health, weight management, and muscle synthesis, while some research highlights its impact on gut microbiome and chronic disease risk reduction (Anderson et al., 2011; Panasevich et al., 2017).

Introduction

Consumer demand for plant-based proteins is increasing globally, driven by health, sustainability, and dietary diversity trends. Protein quality is critical for supporting growth and maintenance, assessed by PDCAAS scores. Soy protein stands out as the only widely available plant protein that is complete and highly digestible (Hughes et al., 2011). For industry innovation, ISP offers opportunities for protein enhancement by replacing dairy proteins without compromising nutritional quality. Consumer research across nine countries in 2024 to understand consumer intentions and perceptions around plant-based proteins (IFF Research).

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Globally, 54% of consumers are actively trying to consume more plant-based protein, but India stands out with 78% making this effort. The top reason for Indian consumers is "to improve overall health and nutrition," followed by "to improve the quality of protein in my diet." When it comes to soy protein specifically, 88% of consumers globally have a neutral or positive perception, compared to 95% in India—and among consumers in India who regularly seek protein, this rises to 97%. Messaging that most improves purchase intent for Indian consumers includes: (1) is plant-based, (2) is a high-quality protein, and (3) is heart healthy.

Protein Quality Evidence

ISP achieves a PDCAAS score of 1.00, equivalent to milk and egg proteins, confirming its ability to provide all essential amino acids in sufficient amounts for 2-5 year olds(FAO/WHO, 2013). Processing steps can help remove anti-nutritional factors, improving digestibility and bioavailability. DIAAS values for soy protein isolates also approach those of animal proteins, reinforcing ISPs classification as a high-quality protein source (Hughes et al., 2011). PDCAAS continues to be the globally accepted scoring system while DIAAS is a recommended system that will continue to be evaluated in the future. The new method will be important for vulnerable populations to show where complementary plant proteins can be combined to provide essential amino acids for nutrition and health benefits.

Established Health Benefits

Cardiovascular Health:

Meta-analyses and FDA-reviewed trials show that consuming 25 g/day of soy protein reduces LDL cholesterol by 4–6 mg/dL and total cholesterol by 4–7 mg/dL, while modestly increasing HDL cholesterol (Anderson et al., 2011 and others). These effects contribute to reduced cardiovascular risk and have led to approved health claims globally. New data continue to confirm that ISP is an important heart healthy source of protein. Research continues to show ISP can lower LDL and total cholesterol while preserving HDL cholesterol (new dossier for General Level Health Claim in Australia/New Zealand, 2025)

Weight Management:

Soy protein helps support satiety, abdominal fat reduction, and lean mass preservation during clinical studies designed for weight loss and weight management (Speaker et al, 2018 and others). Clinical trials demonstrate soy protein performs comparably to animal proteins in weight loss interventions. The advantage of soy protein is the cardiometabolic improvements reported beyond the weight loss (LDL cholesterol reduced). With new interest in GLP-1 medications it will be an opportunity for plant-based proteins like ISP to be used in special formulations to promote healthy body composition (lose fat; maintain muscle) during weight loss and weight management.

The clinical data support the use of high-quality ISP to help individuals who are trying to lose fat, especially abdominal fat which is the most important fat depot for metabolic health benefits.

Muscle Health: Soy protein stimulates muscle protein synthesis similarly to whey (Messina et al, 2018). Blending soy with dairy proteins in a 'Golden Ratio' (25% soy, 25% whey, 50% casein) extends amino acid delivery for up to 4 hours post-exercise, enhancing recovery and growth (Reidy et al., 2016).

When subjects consumed a soy-dairy blend at the Golden Ratio for 3 months with resistance exercise the blend promoted some benefits for muscle growth and strength. These unique clinical data support the use of ISP for muscle health benefits and could help individuals who want to consume diverse proteins for muscle growth during resistance exercise training.

Emerging Health Benefits

ISP has been studied more than any other plant protein and the number of studies shows the unique nutritional benefits. Emerging research highlights additional benefits of soy protein beyond its established role in cardiovascular and weight management/ muscle health.

Soy protein has been shown to attenuate non-alcoholic fatty liver disease (NAFLD) by reducing hepatic lipogenesis and improving liver metabolic health (Zhou et al., 2014; Panasevich et al., 2017). In clinical and preclinical studies, soy protein consumption supports kidney function by improving glomerular filtration rate (GFR), reducing C-reactive protein (CRP), and lowering systemic inflammation (McGraw et al., 2016; Anderson, 2008).

Furthermore, soy protein positively influences gut microbiome composition in pre-clinical studies, increasing microbial diversity and promoting a cardiometabolic profile associated with better health outcomes (Butteiger et al., 2016).

Compared to whey, soy protein elicits a lower insulin response, making it a favorable option for individuals managing blood glucose levels (Sucharita et al., 2017). Additionally, soy protein containing isoflavones has demonstrated cosmetic benefits, improving skin hydration and reducing signs of photoaging in postmenopausal women (Kim et al., 2023). These emerging areas of research underscore soy protein's potential to support whole-body health across multiple systems.

Sustainability

Preserving the environment is becoming more of an advantage for consumers and industry as well.

Many proteins used in the food industry will impact the environment and one way of showing the effect on the environment is doing life cycle analysis of a protein. ISP's carbon footprint is approximately 2 kg CO_2e/kg protein, compared to 178 kg for beef and 24–26 kg for pork and chicken (Poore & Nemecek, 2018). This positions ISP as a key ingredient for sustainable product innovation.

Opportunity for Protein Enhancement with ISP

It is critical to consider protein enhancement using ISP based on the health benefits and nutrition that ISP can offer to all age groups. Optimization of products by replacing some dairy proteins with ISP or by blending them together in formulations maintains protein quality.

The clinical evidence on ISP supports heart health when compared to animal proteins which again is an opportunity to promote more plant-based proteins (ISP) for an enhanced benefit to consumers. Applications include high-protein beverages, bars, meal replacements, and sports nutrition products leveraging soy-dairy blends for extended anabolic benefits (Reidy et al., 2016).

The Rise of High-Protein RTD Beverages In India Market

High-protein RTD beverages have moved far beyond being niche fitness products. High-protein ready-to-drink beverages

- are becoming a smart everyday choice for people who want quick, healthy nutrition without cooking or planning.
- Convenient: Just open and drink—perfect for busy mornings, office breaks, and travel.
- Protein for everyone: Earlier seen as "gym drinks," protein RTDs now support energy, immunity, weight control, and overall wellness for all age groups.
- Tastier than before: Modern RTDs are smooth and come in flavours like chocolate, mocha, vanilla, and fruity blends.
- Healthier options: Many are low-sugar, high-fibre, and made with plant proteins like soy or pea.
- Great for routines: Works as a quick breakfast, snack, or post-workout fuel.
- Growing trend: Fits perfectly with today's preference for clean, convenient, and nutritious foods.
- Consumer Acceptance: Soy protein products are well accepted from both a sensory and well known plant based protein source globally.

Crafting a Good High protein RTD

Developing a great-tasting High protein RTD goes beyond simply mixing protein and flavour. It involves:

- Texture and Smoothness: Ensuring the drink feels creamy, not chalky.
- Right combination of protein sources to make it tasty and cost-effective formulation
- Flavour Blending: Using warm or bold flavours—like chocolate, coffee, vanilla, or berry—to complement soy's natural taste.
- Balanced Sweetness: Preferring low-sugar or naturally sweetened options to keep the drink guilt-free.
- Long Shelf Life: Using heat-stable proteins and stabilizers so the drink stays uniform and smooth.

Isolated soy protein is a versatile, high-quality protein, and complete amino acid profile packed with proven health benefits. Perfect for everything from beverages, nutrition bars and processed meat to plant-based meat and dairy alternatives. Being plant-based and high quality differentiates ISP from other plant proteins with a PDCAAS 1.00 and consumers will get a product that has science to support health benefits.

A Simple Choice for Better Living

From young professionals who want a quick morning fuel, to people managing their health goals, to anyone looking for a wholesome snack on-the-go—High Protein RTD drinks formulated with ISP are quietly becoming a part of daily routines. The story of ISP in beverages is not just about protein content, it is about quality nutrition which is finding its way into modern lifestyles, one bottle at a time.

Alternative to Meat and Dairy

There continues to be new innovations to bring “meat-like” and “dairy-like” products to market. ISP can be used in these types of products and with new flavor and texture innovation from IFF there are opportunities to expand these types of products without using meat or dairy. Consumers will need to show the way on what specific products they would accept, but the future of protein products will likely be with more plant-based protein and with less animal-based ones.

Conclusion

Isolated soy protein (ISP) is not only a high-quality, sustainable protein but also one supported by robust clinical evidence across multiple health domains. Meta-analyses confirm that daily intake of 20-25 g of ISP significantly reduces LDL cholesterol, total cholesterol, and triglycerides, supporting cardiovascular health and reducing long-term disease risk (Anderson et al., 2011 and GLHC Dossier ANZ, 2025).

Clinical trials demonstrate ISP’s ability to preserve lean mass and promote satiety during weight management interventions, making it ideal for high-protein meal replacements and snacks (Speaker et al., 2018). For muscle health, ISP performs comparably to whey in stimulating muscle protein synthesis, and when combined in optimized blends (Golden Ratio), it extends amino acid delivery for superior recovery and growth (Reidy et al., 2016).
Emerging research adds further value: ISP attenuates NAFLD, improves kidney function, enhances gut microbiome diversity, and supports glycemic control, while isoflavones improve skin hydration and reduce photoaging (Panasevich et al., 2017; McGraw et al., 2016; Rizzo et al., 2023).

These findings justify increased incorporation of ISP into product formulations—not only to meet consumer demand for plant-based options but also to deliver clinically validated benefits for heart health, metabolic wellness, and physical performance. For the food industry, leveraging ISP in beverages, bars, and medical nutrition products represents a strategic opportunity to combine science-backed efficacy with sustainability goals.

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REFORMULATION: MEETING CONSUMER EXPECTATIONS AND REGULATORY SHIFTS

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Food reformulation is the process of changing the ingredients, composition, or processing of a food product to improve its nutritional profile, meet new regulations, respond to consumer expectations, or enhance sustainability while keeping the product acceptable in taste, texture, and appearance. (Buttriss, 2012)

In an era where consumers are increasingly health conscious and regulators are concerned about food safety and wholesomeness; the food industry is undergoing a significant transformation. Reformulation redefining the composition of existing foods is emerging as a critical strategy to improve nutrition without demanding radical changes in eating habits. (Fanzo et al., 2023). Food reformulation is a multi-disciplinary strategy used by the food industry to make products healthier, safer, compliant with regulations, and aligned with consumer trends without compromising taste or product quality. Van Gunst, Roodenburg, and Steenhuis (2018) argue that successful food reformulation necessitates coordinated efforts across several domains, including nutrition, food technology, legislation, and consumer perspectives.

Reformulation has been the subject of many different studies in the areas of nutrition and health, legislation, food technology or consumer science. There are several studies on food reformulation, dealing with either technological aspects of sodium, sugar or saturated fat reduction, consumer aspects, such as

food choice and human behaviour or legislative aspects, (Buttriss, 2012; Grasso et al., 2014). There are very few studies that take an inter-disciplinary approach to analysing the barriers and enablers of product reformulation. However, food technology and consumer perspectives have been integrated to develop a concept of consumer-driven food product development.

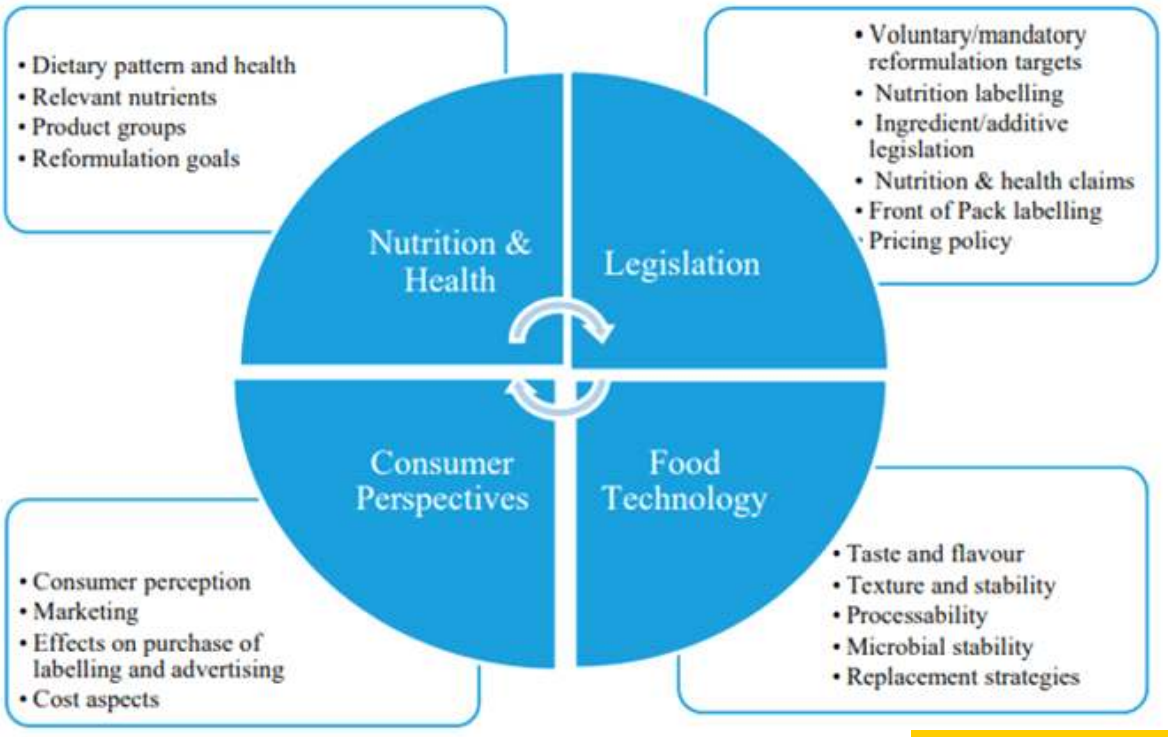
Grasso et al. (2014) discussed not only the technological aspects but also the legislation and consumer perceptions of reformulation in meat products. They combined the public health challenges of diets with the technological aspects of reformulation. Similarly, Buttriss (2012) highlighted these combined efforts.These studies illustrate the value of a multidisciplinary approach to analysing the technical, legal, and social challenges to product reformulation.

In agreement with this, Van Gunst proposed the 'Framework for Reformulation' as an integrated approach encompassing four key disciplines: Nutrition & Health, Food Technology, Legislation, and Consumer Perspectives (Van Gunst et al. 2018).In Figure 1, the four disciplines of a reformulation process (the Framework) are shown. Drawing on the existing literature, we have proposed the 'Framework for Reformulation' as an approach that integrates factors that food companies must consider in undertaking product reformulation efforts from different domains. This paper seeks to empirically test whether the Framework accurately reflects the issues taken into consideration by food companies when undertaking product reformulation.

However, food technology and consumer perspectives have been integrated to develop a concept of consumer-driven food product development (Grasso et al., 2014) disciplines of a reformulation process (the Framework) are shown.

Therefore, the aim of the present qualitative study was to determine whether this 'Framework for Reformulation' accurately reflects the challenges faced by food companies in undertaking product reformulation.

Figure 1: Four disciplines of a reformulation process (from Van Gunst, et al. 2018)



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Consumer Expectations: Health, Transparency and Changing Lifestyles

Today's consumers driven by rising nutrition awareness, lifestyle diseases, and a desire for healthier living expect more from the foods they buy. They are looking for products that deliver on taste and convenience (Frontiers in Nutrition, 2025) without compromising health. For many, reformulated products offer a bridge familiar flavors and formats, but with less salt, sugar, or sat fats, or with added nutritional benefits (Wang et al., 2020).

Research supports that when done right, reformulated products are generally accepted and purchased by consumers. A review of 59 real-world studies (excluding purely modelling studies) found that reformulation led to improved nutrient intakes in about 73% of cases, especially reducing sodium and trans-fat intakes.

Thus, consumer expectations go beyond "just healthiness" they demand comparable sensory quality, transparent labelling, and value for money.

Trust and clear communication often via labels or marketing are crucial for success. As one commentary argues, to succeed, reformulation must not only eliminate harmful nutrients but also consider opportunities to add positive nutrients or ingredients.

Regulatory Shifts: Drivers from Policy, Public Health & Labelling:

A recent review highlighted that reformulation and fortification of processed foods are among the most promising levers for improving dietary and nutrition outcomes especially when combined with broader policies that promote access to healthy foods, dietary guidelines and consumer education (Fanzo et al., 2023).

Reformulation should not only reduce "less desirable" nutrients it should ideally move products toward better overall nutritional quality and less processing. Thus, regulatory shifts labelling rules, nutrient thresholds, bans or limits on harmful ingredients, and new nutrition-policy frameworks are major catalysts for reformulation (Federici et al., 2019). As noted in the public-health literature, combining reformulation with broader strategies (education, food access, dietary guidelines) yields the most meaningful benefits.

Sustainability Trends & Broader Food-System Considerations

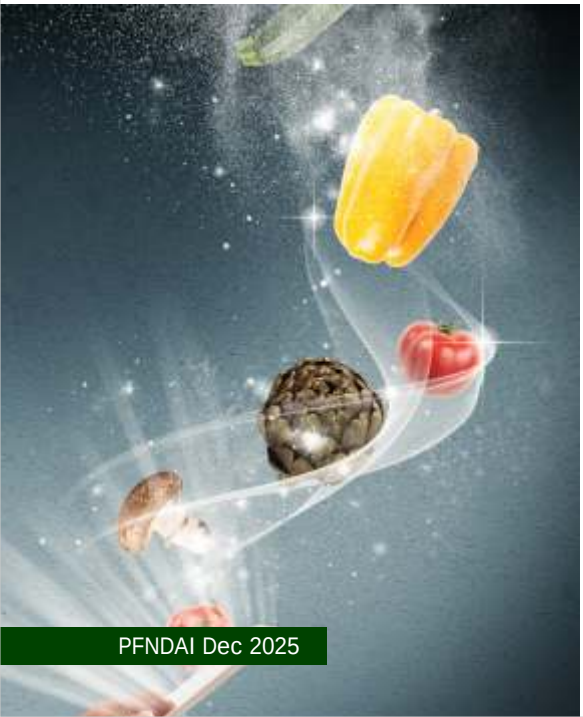
In parallel with health and regulatory drivers, sustainability is emerging as a central dimension shaping reformulation strategies. As the global food system seeks to feed a growing population without exacerbating environmental degradation, reformulation and reformulation-driven innovation can help reconcile health, nutrition, and sustainability goals. (Fanzo et al., 2023).

According to the review of reformulation and fortification(Fanzo et al., 2023), when processed foods are reformulated to include more whole-food ingredients, fibre, micronutrients and less excess energy, they can contribute to healthier diets while reducing reliance on resource-intensive products.

Moreover, sustainability concerns are also prompting innovation beyond simply reducing “bad” nutrients.

There is shifting interest toward upcycled ingredients (using food-industry by-products), plant-based alternatives, and minimally processed components aligning reformulation with environmental, ethical and circular-economy goals.

While this broader “sustainable reformulation” remains nascent, it reflects evolving consumer values and global imperatives.



Challenges & Limitations: What Reformulation Alone Cannot Do

Despite its promise, reformulation is not a solution. As observed in public-health literature, reformulation even when widely adopted is unlikely to solve the complex problem of poor dietary patterns or nutrient deficiencies on its own (Wang et al., 2020).

Particularly for such foods, reducing salt, sugar, or fat might not improve overall diet quality if the products remain heavily processed, use artificial additives, or lack essential micronutrients.

Moreover, technical challenges abound reformulating often demands complex adjustments in taste, texture, stability, shelf-life, and manufacturing processes difficulties that may deter or limit food producers.

Even when reformulated products are introduced, consumers may not always accept them partly because of taste difference, partly because of perceived value or trust concerns.

Many consumers remain sceptical of “healthier” versions of familiar foods, especially if communication focuses on nutrients removed (less salt/sugar), rather than added nutritional or sensory benefits (Buttriss, 2012).

Conclusion: Toward a Balanced, Strategic Path

Reformulation stands at a critical intersection of consumer demand, public health policy, and sustainability imperatives, presenting a robust tool for the food industry to address all three.

Embracing reformulation involves more than merely altering recipes; it entails aligning products with evolving consumer expectations, regulatory requirements, and global sustainability objectives.

However, reformulation must be approached thoughtfully, not just as a reductionist exercise of cutting salt, sugar, or fat, but as part of a broader commitment to nutritional quality, ingredient transparency, processing discipline, and ecological responsibility.

Supported by clear labelling, education, and a shift towards wholesome foods, reformulation can guide dietary patterns towards improved health and sustainability, without compromising taste or consumer acceptance.

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FROM HERITAGE TO HEALTH: MILLETS IN REFORMULATED PRODUCT DESIGN

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Millets are an ancient group of small-grained cereals traditionally grown in dry land regions of Asia and Africa. In India, crops like finger millet (ragi), pearl millet (bajra) and sorghum (jowar) have long been staples in semi-arid agriculture. These nutri-cereals are prized for their resilience and rich nutrient profile containing high levels of protein, essential fatty acids, dietary fibre, B-vitamins and minerals such as calcium, iron, zinc, potassium and magnesium. They are naturally gluten-free and nutrient-dense, offering quality protein and fibre along with antioxidants. Such attributes help millets confer multiple health benefits.

Research studies report that millet-based foods can reduce post-meal blood glucose, regulate blood pressure and mitigate risks of diabetes, cardiovascular disease, celiac disease and other metabolic disorders (Dayakar et al., 2016). Despite this, millet consumption declined markedly over the past few decades in India as green-revolution-era policies favoured rice and wheat and modern lifestyles shifted diets. The rising global focus on nutrition and sustainability culminated in the UN's declaration of 2023 as the International Year of Millets, reaffirming their status as heritage crops that now drive health-oriented food innovation (Harish et al., 2024).

Historical Significance and Revival: Millets have a rich heritage in India. Archaeological evidence and ancient texts (Vedas and Mughal-era records) show millet cultivation and millet-based dishes were integral to Indian diet and culture for millennia. They symbolized fertility and wealth at harvest festivals like Makar Sankranti, and remain central to ethnic cuisines (e.g. ragi ball in Karnataka, bajra roti in

Rajasthan). Over time, colonial and post-independence agricultural policies marginalized these crops, reducing cultivation and knowledge. As a result, traditional millet foods survived mainly in tribal and rural communities (Mittal et al., 2024).

Recent years have seen concerted efforts to bridge this gap between tradition and modern diets: researchers emphasize that removing cultural, technical and financial barriers can "unleash the promise of this ancient grain" for contemporary food systems (Chapke et al., 2020).

In India, government programs (such as increased MSP, food processing incentives and awareness campaigns) now explicitly support millet production and value-added processing. This convergence of historical appreciation and modern health science is redefining millets from "forgotten grains" into nutritious ingredients for next-generation food products (Mittal et al., 2024).

Types of Millets and Nutritional Composition:

Millets comprise a diverse family of cereal crops. In India, the major millets include pearl millet (Pennisetum glaucum), sorghum (Sorghum bicolor) and finger millet (Eleusine coracana), which are relatively large-seeded and usually "naked" (no hard husk). The minor millets such as foxtail (Setaria italica), proso (Panicum miliaceum), little (Panicum sumatrense), kodo (Paspalum scrobiculatum) and barnyard (Echinochloa frumentacea), have smaller grains often covered by a tough hull requiring dehulling. These are drought-tolerant crops adapted to poor soils.

Nutritionally, all millets are nutrient-dense: they contain roughly 60–75% carbohydrates (mainly starch and resistant starch), 7–12% protein and 2–5% fat, along with 8–20% dietary fibre. Importantly, they pack micronutrients in high amounts: for example, finger millet is extraordinarily rich in calcium, pearl millet in iron, and many millets contain appreciable B-vitamins and antioxidants. Millets are also "non-glutinous and non-acidic" and are among the least allergenic grains. Their profile of complex carbohydrates, fibre and phytochemicals (polyphenols, flavonoids, lignans and phytosterols) contributes to slow glucose release and antioxidant effects. The combination of nutrients makes millets a "nutri-cereal" far superior in many respects to refined grains like white rice and wheat flour (Dayakar et al., 2017; Harish et al., 2024).

Millet Proteins and Gluten-Free Quality:

Millet grains typically contain around 7–9% protein (some varieties up to ~12%), with a balanced amino acid profile. Millet proteins are free of gluten-forming prolamins, making them ideal for celiac or gluten-sensitive consumers. Although the essential amino acid lysine is somewhat limiting in cereals, millets contribute other essential amino acids like methionine and leucine. For instance, proso and foxtail millets are among the richest sources of protein in the family. The albumin and globulin fractions in millet protein give them high digestibility, and because they lack gluten they do not trigger celiac reactions.

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This makes millet flours a nutritious alternative protein source for vegetarian diets, often exceeding wheat protein in quality and without the saturated fats of animal proteins (Dayakar et al., 2017). Thus, millets enhance dietary protein diversity and complement other grains and pulses when used in formulations.

Processing of Millets:

Millet grains are typically processed before consumption in several stages. Primary processing involves cleaning and dehulling. Farm-harvested millets are cleaned (destoned, graded, aspirated) to remove dirt, stones and light impurities.

Grains then pass through dehullers or abrasive mills to remove the indigestible outer husk or bran layer. This decortication step is critical: it makes the grain easier to cook, concentrates nutrients by removing fibrous hulls, and drastically reduces anti-nutritional factors (for example, dehulling can eliminate 27–53% of millet phytic acid). The cleaned, dehulled grain can then be milled with hammer or roller mills into flour or semolina (suji).

Recent protocols describe hammer milling of pearl millet, finger millet and foxtail millet into fine flours (yield ~89%, bran by-product ~11%) rich in fibre, protein and minerals (Mittal et al., 2024). Alternatively, controlled polishing or abrading may leave some bran layers on (whole-grain flour).

Secondary processing refers to traditional or novel transformations of the millets or their intermediates.

This includes soaking, germination (malting), fermentation (e.g. for dosas or beverages), roasting, puffing and popping, parboiling, baking and extrusion. These processes create value-added foods like malted millet extracts for drinks, baked goods, puffed snacks or extruded breakfast cereals. Recent literature states that millet semolina (coarse, medium or fine) can be used to make upma, khichidi, laddus, idlis, dosas and sweet dishes, retaining high protein, fibre and micronutrient content.

Likewise, millet flours have been developed specifically for rotis and bakery items. Tertiary processing involves final product manufacturing (like mixing, baking, packaging ready-to-eat foods) (Ankita and Seth., 2025; Mittal et al., 2024). Modern food-technology equipment namely twin-screw extruders, hot air dryers, sifters are increasingly used to produce millet-based biscuits, noodles, pasta and snacks.

By creating convenient products, processing overcomes the traditional “inconvenience in preparation” that once held millets back.

Processing enhances both the functionality and nutrition of millets.

Removing husks improves digestibility and bioavailability of protein and starch, while also reducing grain bulk for easier cooking. Grinding or flaking enlarges surface area so digestive enzymes act faster, making energy and nutrients more accessible (Dayakar et al., 2016). Importantly, processing enables fortification: nutrients lacking in local diets can be added to staple millet foods (e.g. B-vitamins or minerals mixed into millet flours).

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Advanced techniques like extrusion cooking can even improve the nutritional quality, e.g. higher extrusion temperatures inactivate anti-nutrients and yield a more expanded, porous product (Soni et al., 2024). Several research studies endorsed that processing transforms millets into “novel value-added foods” without compromising their nutrient density. In practical terms, milling into whole-grain flour or semolina makes millets drop-in replacements for wheat in many recipes, improving product shelf-life and consumer acceptance.
A critical industry consideration in millet processing is the challenge of lipid-induced rancidity, particularly in pearl millet, which contains higher levels of unsaturated fatty acids and active lipase and lipoxygenase enzymes.

Once millets are dehulled and milled, these enzymes are exposed and rapidly catalyse hydrolysis and oxidation, leading to off-flavours, reduced consumer acceptance, and shorter shelf-life of flours and ready mixes (Yadav et al., 2012). Studies from ICAR–IIMR and other peer-reviewed work show that untreated pearl millet flour can develop perceptible rancidity within weeks at ambient storage, posing a constraint for manufacturers handling large volumes for long-term use (Reddy and Sravani., 2023; Vinutha et al., 2022).

To overcome this, recent research recommends grain stabilization through thermal or microwave treatments, hot-air/radio-frequency (HARF) processing, infrared roasting, or enzyme inactivation protocols before milling, all of which significantly slow rancidity development. Industries adopting these stabilization techniques, combined with low-moisture storage, vacuum or modified-atmosphere packaging, and just-in-time milling, have reported improved shelf-life of intermediate products (Yarrakula et al., 2022).

As millet-based value chains scale up, integrating stabilization units into primary processing lines will be essential to ensure consistent quality, minimize losses, and enable year-round procurement and storage without compromising product sensory characteristics.

Health Benefits of Millets:

The nutritional features of millets translate into concrete health benefits. Their high soluble and insoluble fibre content, combined with a slow-release carbohydrate profile (low glycemic index), helps regulate blood glucose levels making millets beneficial for diabetes prevention and management. In human and animal studies, millet diets have reduced post-prandial glucose spikes and improved insulin sensitivity. Soluble fibre and plant sterols in millets bind cholesterol in the gut, lowering serum LDL cholesterol levels.

Antioxidant compounds (phenolics, tannins, vitamins A/E) in millet grains and bran combat oxidative stress and may reduce risks of chronic conditions like heart disease and cancer. For example, epidemiological studies link millet consumption with lower incidence of cardiovascular disease and obesity-related inflammation.

Millets also help address micronutrient deficiencies: finger millet's exceptional calcium content supports bone health (especially in women and children), and pearl millet's iron and zinc levels can alleviate anemia and boost immunity (Dayakar et al., 2017). All these benefits come without gluten, and millet-based diets have been found to be easy on the digestive system even for sensitive individuals. Hence, millets are considered nutraceutical or functional foods, whole grains that promote satiety, improve gut health and contribute to overall nutritional security.

Millets in Food Product Development:

In product formulation, millets are being used to "reformulate" conventional foods with a healthier profile. In India, traditional millet dishes (ragi porridge, jowar roti) are now augmented by modern convenience products. For example, pre-mixed millet flours are marketed for ready-to-cook rotis, dosas and idlis, these can contain single or multiple millets. Researchers have developed multi-millet biscuits and cookies by partially substituting wheat flour with pearl or finger millet flour; these retain consumer acceptability while boosting fibre and micronutrients. The IIMR reports on flour technology reported that the blended millet flours (ragi, bajra, korra) are richer in magnesium, zinc, iron and protein than wheat, and yield good-quality rotis and bakery items. Similarly, millet semolina (suji) prepared from ragi, bajra or foxtail millet is used in ready-to-cook upma and khichidi mixes (Dayakar et al., 2016). Millets are also entering Western-style products: companies are launching millet-based noodles, pasta and breakfast cereals, taking advantage of their gluten-free nature. Several extruded snack products have been made by combining pearl millet and sorghum flours with corn and rice, producing crispy sticks and puffs that consumers enjoy (Soni et al., 2024). Other innovative uses include sprouted millet ingredients, fermented millet beverages (both alcoholic and probiotic), malt powders and snack bars made with popped millets. Even novel products like millet vermicelli, pasta and millet-based noodles are gaining traction. Across all these, the common theme is that millets can enrich everyday foods (bread, biscuits, pastries, snacks) with protein, fibre and phytonutrients, effectively converting them into "functional foods".

Scope and Future Opportunities:

The future looks bright for millet-based innovations. Growing health consciousness and the rise of plant-based diets are driving demand for ancient grains. Millets fit well into sustainability goals: as climate-resilient crops requiring less water and inputs, they appeal to eco-sensitive consumers. Analysts note that leveraging millets can help address global malnutrition and food security issues. Technological advances open new avenues: for example, research is underway on processing millets into protein isolates, prebiotic fibres and low-sugar sweeteners. Food processing equipment is evolving too with improved dehulling machines and precision grinders for small grains which will reduce processing losses, while novel approaches like micronization or cold plasma treatment may further enhance functional properties (Ankita and Seth., 2025; Harish et al., 2024).

At the policy level, India's recent initiatives including the Nutri-Cereals programme, PMFME and PLISMBP, are mobilizing funding, incentives and credit-linked support for millet value chains; certain states have additionally offered interest-subvention schemes for millet processors. These measures, combined with scientific research on millet genomics and processing, aim to create higher-yielding varieties and value-added products. For food entrepreneurs, millets offer creative scope: start-ups are innovating millet-based chocolates, health drinks, infant foods and pet products. In short, the stage is set for millets to go main stream in global and Indian markets, driven by their nutritional merits and heritage appeal.

Processing Equipment and Infrastructure:

Effective processing requires appropriate equipment at each stage. At the farm or village level, primary-processing units are being promoted to clean and dehull millets as soon as harvested. Key machines include destoner/ aspirator/ graders that remove stones, chaff and dust from raw grains (Mittal et al., 2024). Specialized millet dehullers ranging from single-stage abrasive units for tiny grains to multi-stage roller mills strip away the husk layer. After dehulling, grains may be polished in a grain polisher or directly milled. ICAR-IIMR has documented equipment specifications: for example, a combination destoner-grader (500 kg/h capacity) is suitable for all millet types. For secondary processing, common food-industry equipment applies: hammer mills or stone mills grind millets into flour, while sieves classify particle sizes. Extruders (often twin-screw) have been used to make millet-based snacks and pastas. The use of such machinery is critical: mechanized processing increases efficiency and consistency, and reduces the drudgery once associated with hand-processing of millets. Indian research consortia and institutes (CFTRI, IIMR, IITs etc) are actively developing and demonstrating affordable millet milling and extrusion technologies (Dayakar et al., 2016; Harish et al., 2024). At the policy level, India's recent initiatives including the Agriculture Infrastructure Fund are channelling investment into primary-processing and value-addition infrastructure (such as millet processing plants), thereby helping to scale up millet-based product manufacturing. In rural contexts, assembling millets into farmer-producer organizations (FPOs) with shared processing units can create a backward link, ensuring farmers benefit from value addition.

Way Forward: Millets stand at the crossroads of India's past and its dietary future. As one conclusion notes, these "entrenched" grains with cultural significance and health potential can re-shape food systems if challenges are addressed. Going forward, multi-disciplinary efforts are needed: plant breeders must improve millet yields and grain quality; food technologists must optimize formulations and shelf-life; and market linkages must connect producers with consumers. Nutritional education campaigns can reframe millets not as "poor man's food" but as super foods celebrated in traditional folklore.

Festivals, cooking shows and school programs that highlight millet recipes and innovations will build consumer demand. Encouragingly, policies are aligning: increased minimum support prices for jowar, bajra and ragi, along with incentives for millet product startups, are signalling official commitment. Researchers emphasize that realizing millet's promise will require "removing cultural, technological and financial obstacles" and integrating millets into mainstream diets. By leveraging India's rich millet heritage and combining it with modern science, "From heritage to health" can truly become the motto, ensuring millets find their way into reformulated foods that are nutritious, sustainable and loved by consumers.

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SWEET INNOVATION: HEALTHIER CONFECTIONERY THROUGH SMART REFORMULATION

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Introduction

Confectionery items are sweet food primarily made using sucrose and other sugars. These items are made through processes like boiling, baking, or moulding and include ingredients such as sugar, flour, eggs, and dairy.

Confectionery is generally categorized into two main types: sugar confections (like candies, chocolates, and chewing gum) and bakers' confections (like cakes, cookies, and pastries). Confectionery products are primarily composed of sugar, water, colouring, and flavouring and include chocolates, marshmallows, nougats, hard boiled candies, soft candies, Turkish delights etc.

Indian sweets are similar to candies and confectionery sweets of the western countries. The major ingredient is sugar along with milk or pulses or cereals. Some sweets are made as fried products and subsequently dipped into sugar concentrates. A high-boiled candy contains cane or beet sugar (the major component) with glucose syrup as a secondary ingredient. Glucose syrup varies according to dextrose equivalent (DE) which affects not only the sweetness value but also other functional properties such as viscosity and nutritive value. The advantages, together with low price, compared to other sweeteners, have made refined sugar the sweetener of choice in many food products.

Functionality of sugars in confectionery (1)

Sugar participates not only in forming the taste and aroma of products but also has functional and technological significance. For example, in the technology of flour confectionery products, sugar acts as a stabilizer of the foam structure of the dough, contributes to an increase in the gelatinization temperature of starch, and reduces the degree of swelling of flour proteins.In addition to providing sweet taste, sugar binds water, increases boiling temperature and lowers and lowers freezing temperature of aqueous

2 cups of Bournvita contains 50% RDA of Vitamin D, Iron and Zinc that support bones, cognitive and immune function thus supporting strength. For children (7-9 yrs.), ICMR -NIN, 2020. For more details, refer to the pack.

solutions, increases viscosity and alters texture of food products, provides bulk, serves as energy for fermentation, provides glaze and sparkle, serves as a precursor for flavour and colour development, and more.

Taste

Refined white crystalline sugar provides a clean sweet taste with nominal characteristic odour. It has excellent shelf life (if protected from moisture) and is easy to handle. Sugar can balance the sour, salty, and spicy tastes in “less sweet” products (marinades, salad dressings).

Colour and flavour

Caramels are produced by heating carbohydrates like sugar above 110°C. Caramelization is generally a desirable process that produces tan to dark brown colour, pleasant aromas, and flavours (through production of small volatile compounds responsible for flavour).

Texture

The main functional properties of sugars that contribute to desired texture in a wide variety of food products are (a) ability to exist in amorphous and crystalline states and (b) ability to interact with water. Depending on how melted sugar is processed, the molecules can reform either in a crystalline or an amorphous state. Sucrose naturally tends to be crystalline (table sugar is an example). However, in specific food processing methods involving rapid cooling or the addition of "doctoring agents" like glucose syrup (corn syrup), the sugar is prevented from crystallizing, resulting in an amorphous (glassy, non-ordered) state.

Examples of Indian sweets that typically contain amorphous (non-crystalline) sucrose are Jalebi, gulab jamun, petha, traditional Indian hard candies (glucose is added to sucrose to inhibit crystallization). The Indian sweet known as Badusha (or Balushahi in North India) is a deep-fried pastry that is soaked in sugar syrup, resulting in a distinct crystalline sucrose coating on the outside giving its characteristic texture and taste. The process of cooking of Mysore pak, a popular south Indian sweet involves carefully managed crystallization of sucrose. The hard and porous version (available commercially) results from achieving a concentrated or multi-string sugar syrup, allowing air bubbles to be trapped and a firm crystalline structure to form upon cooling. In essence, the sucrose structure, managed through precise cooking techniques, is fundamental to creating the unique and varied texture of Mysore pak.

Interaction with water

The amount of water bound to sugar is proportional to the amount of sugar molecules in solution. This is easily observed as increased viscosity of sugar solutions. At lower concentrations commonly used for sweetening of beverages (5% to 10%), this increase in viscosity is perceived as a “mouthfeel,” (compared to unsweetened beverages), but at higher concentrations, such as in syrups (60% to75%), the thickening effect is obvious. The binding of water by sugars results in an elevation of the boiling point of a solution and depression of the freezing point.

The ability of sugars to depress freezing point is nicely utilized in ice cream making. With lactose naturally present in milk (approx. 5%) plus added sucrose (10% to 16%), sugars in ice cream mix help reduce formation of large

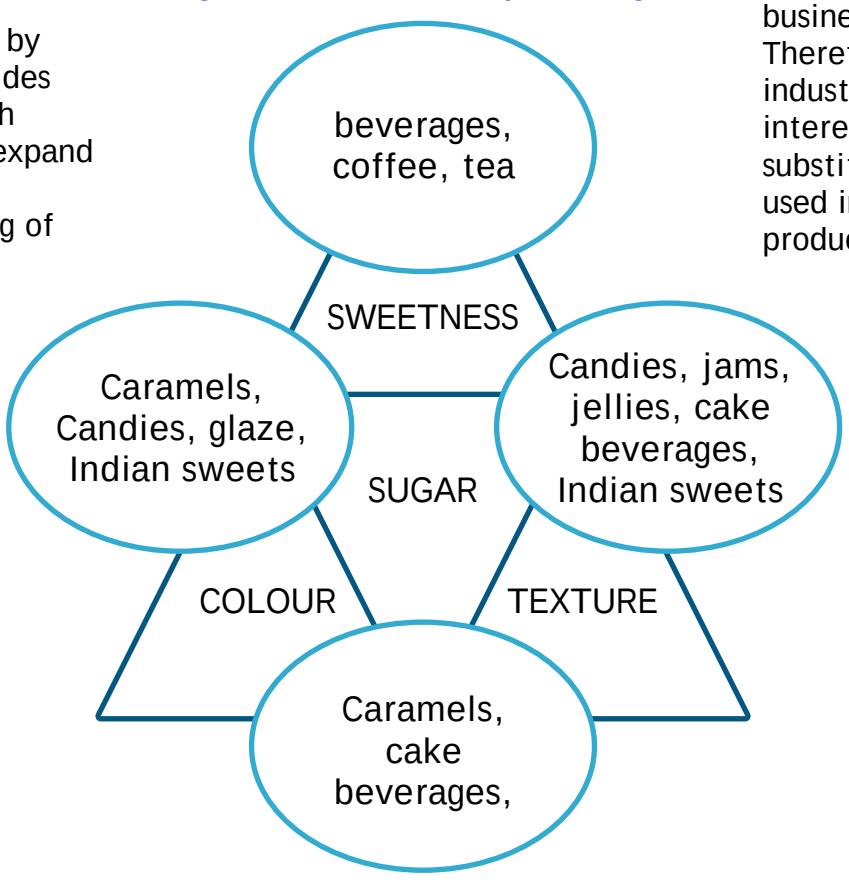
ice crystals that contribute to a gritty mouthfeel, and keep bound water from freezing at the temperatures of home freezers (-15 to -18°C). If all water was frozen, the ice cream would be too hard and almost impossible to scoop.

Jams are an example of food product where the interaction of sugar with water is important for the texture. Dry sugar is mixed with the hydrocolloid (pectin) for effective hydration when added to an aqueous solution (for example, fruit juice). For the production of jams, jellies, and preserves, this relates to about 60% of product weight as added sugar and 1% to 3% pectin.

In cakes water bound by sugar molecules provides elasticity of the dough allowing gas cells to expand during baking, which prevents the rupturing of the cells and results in more uniform cell size. The larger amounts used in cake recipes also delay starch gelatinization. Slower gelatinization during baking keeps the batter fluid and elastic for a longer time, which allows gas cells to expand, forming a good, sponge-like texture of the baked cake.

In meringues, sugar stabilizes the egg white foams by suppressing the mobility of proteins, due to binding large amounts of water within the walls of air cells, and helps form the air-protein interface. During baking, water evaporates from the air cell walls, and the sugar—egg white mixture slowly coagulates making the soft meringue foam stable. The functionality of sugar is summarized in Fig 1. The interaction of sugar with water reduces the water activity of the product thereby helping in preservation and improved shelf life.

Fig 1: Functionality of sugar



Sugar replacement for healthier options

Modern consumer market demands and increasing consumer awareness of healthy food products dictate new tasks for manufacturers to produce healthier quality products that meet consumer demand. A competent offering of therapeutic, dietary, and healthy food products to consumers will allow manufacturers to achieve additional business growth. Therefore, the food industry shows growing interest in sucrose substitutes that will be used in low-sugar products.(2)

Technological exclusion of sugar from formulations of flour and sugar confectionery is a difficult task. Each of the currently known sweeteners and sugar substitutes has its advantages and disadvantages.

When sucrose is used primarily for its sweetness (for example, in coffee, tea, juices, sodas), it may be replaced with other sweeteners.

However, the natural caloric sweeteners will add their own flavor and function to the product (sometimes desired but sometimes not). In addition, even if the sugar is used in relatively smaller amounts just for taste (usually 5% to 10%), it provides "mouthfeel," a sensation of a thicker, a slightly more viscous, "fuller" liquid. Replacing sugars with high intensity sweeteners will result either in the absence of the "mouthfeel," or will require bulking agents. When a sugar is added to "not-sweet" products (for example, salad dressings, marinades, and barbecue sauces) to balance sour, salty, and/or spicy tastes and build texture, replacing it with other natural sweeteners or a high intensity sweetener may alter flavour, and the texture would need to be adjusted using other additives.

In addition, if a sugar were included in the recipes as a colour and flavour precursor (for example, marinades and glazes), eliminating sugar or replacing it with a high intensity sweeteners will significantly reduce browning, diminish flavour development, and alter mouthfeel.

Products such as jams and jellies can be prepared with less or no added sugar (or with adding any other sweetener including high intensity sweeteners), but in this case, low-methoxyl pectin has to be used and gel is formed by the addition of calcium salts. Importantly, in these "no added sugar" products where the high water-activity (>0.80) favours spoilage in this kind of food matrix, other ingredients, technologies, packaging materials, or even edible films may be applied to provide antimicrobial protection in the finished products.

Replacing sugar with sugar substitutes in traditional recipes for confectionery products requires selecting a specific type of sugar substitute, determining its dosage, modifying the recipe, and establishing technological modes and parameters. Considering many functional possibilities of sugar in food product technologies, it is not always possible to exclude or replace sugar without affecting the quality and stability of certain food products. Excluding sugar from the recipes of flour and sugary confectionery products is a complex task from a technological standpoint.

In literature, sugar substitutes and sweeteners are often used as synonyms. The main difference between sugar substitutes and sweeteners is that sugar substitutes have energy value and are metabolized in the body with a lower insulin requirement than sugar. Sweeteners (required in small quantities) do not have energy value and are metabolized without insulin involvement.

A wide range of sweeteners and sugar substitutes, such as lactitol, sodium saccharinate, erythritol, and stevioside, have found extensive application in confectionery production. They are used in both sugary and flour confectionery technologies, as well as in chocolate. Isomalt and lactitol proved effective in chocolate production when used under optimal technological conditions.

The effect of various combinations of sugar substitutes has been studied in chocolate recipes. Replacement of sucrose with stevioside and erythritol resulted in typical aftertaste. Addition of maltitol as a sugar substitute after the conching process resulted in melting temperature 35 °C with satisfactory rheological properties.(3)

Sugar substitution in Indian sweets with amorphous sugar can be made with polyols in combination with high intensity sweeteners. Maltitol has 70% of the sweetness of sugar with a similar sensory profile which makes this polyol a sugar substitute of choice for Indian sweets. The concentration of high intensity sweetener to be used is very small so that its own flavour or after taste is masked in the final product.

Preparation of low-calorie milk sweets with replacement of sugar has been reviewed (4). Technical challenges and possible measures of sugar substitution in milk sweets have been summarized in table 1.

Sugar substitution in milk-based sweets was possible with acceptable taste as well as analytical parameters. Moisture sorption characteristics of milk barfi was studied using sugar substitutes, polydextrose, sorbitol or a combination of polydextrose and maltodextrin. Aspartame was added for sweetness equivalent to sugar.The isotherms followed a sigmoidal shape characteristic of sugar rich products. Sugar was substituted with high intensity sweeteners in kalakand. The product had acceptable sensory scores.

Table 1: Technical challenges and possible measures of sugar substitution in milk sweets (4)

Technical challenges	Measures
1. Dry and hard texture especially Khoa Bland flavour Lower yield due to reduced water holding capacity	Use of whey protein concentrate and hydrocolloids
2. Reduced shelf life due to higher water activity	Use of preservatives
3. Reduced bulk due to lower concentration of high intensity sweeteners	Use of bulking agents such as polyols
4. Lower processing temperature due to heat sensitivity of sugar substitute	Modification of processing parameters
5. Off taste from high intensity sweeteners	Addition of flavours for masking
6. Reduced typical colour (as in caramel)	Addition of colours (caramel)
7. Bulking agents can give laxative effect	Label to mention, use of combination of bulking agents

Sugar free basundi was prepared using combinations of sorbitol, maltodextrin and polydextrose and high intensity sweeteners for sweetness. The traditional process was required to be modified by addition of bulking low calorie as well sweeteners after concentration of milk solids. The product was similar to that with sugar.

Replacement of sugar syrup in preparation of gulab jamun with a combination of sorbitol and aspartame was studied. Best results were obtained with a sugar strength of 55°Brix ad soaking for 3 hours at 65°C compared to gulab jamun prepared with sugar syrup of 51°Brix strength, at 54°C and soaking for 4 h (5).

Due to its physical and technological properties, such as a mild, sugar-like taste (0.4 to 0.6 as compared to sucrose) and low hygroscopicity, Isomalt is an ideal sugar substitute for many foods such as confectionery or dry and soft baked goods.Isomalt is commonly used in the food industry to produce sugar free hard candies and other confectionery product. An important characteristic is the low solubility of isomalt, which allows isomalt to remain in crystalline form in the chewing gum mass. This results in a better product stability and less hardening of the centre during shelf-life (6).

Chewing gum manufacturers often use isomalt in combination with other sugar alcohols for this reason Isomalt has also been successfully used as sugar substitute in Mysorepak and soanpapdi products that require the crystalline state of sugar for the characteristic texture. High intensity sweeteners were added to enhance the sweetness.

Studies on isomalt as a sugar substitute jelly candies proposed the optimal ratio of isomalt to syrup in the syrup as 1.2:1. It was observed that reducing substances are formed (about 18%). This contributes to the preservation of a jelly-like consistency for a long time without moisture on the surface of the products, achieving the best plastic strength – 30–40 g/cm². The sweet taste was ensured by a combination of sorbitol and glycosylated stevioside.

Inulin and oligofructose prebiotics belonging to a group of nondigestible carbohydrates referred to as inulin-type fructans have sweetness value of 30%–40% of that of sucrose. Due to their physicochemical properties,and almost zero glycemic index inulin-type fructans and short-chain fructooligosaccharides have been widely used in the food industry as partial replacements for both fat and sugar.

Inulin and long chain oligo saccharides due to their greater degree of polymerization (DP) and resulting water-binding properties can form fat-mimicking gels at concentrations >10%–20% providing reduced fat foods with similar textural and sensory characteristics of full-fat versions.

Applications are in cakes, muffins, ice cream, yogurt, fruit juices among others. Short chain fructo-oligosaccharide (scFOS) due to its shorter chain length and greater solubility combined with possessing a sweetness profile similar to sucrose makes it suitable as partial replacement for sugar (7).Steviosides and other high intensity sweeteners can be used in small concentrations to increase the sweetness. This combination is useful in Indian milk sweets.However, since the concentrations of sugar are high in Indian sweets and high concentrations of these oligosaccharides can result in laxative action, other bulking agents are required to replace volume of sugar.

Summary

Replacing sugar with sugar substitutes in traditional recipes for confectionery products requires selecting a specific type of sugar substitute, determining its dosage, modifying the recipe, and establishing technological modes and parameters. Sweeteners used as sugar substitutes in food products may cause changes in the technological, organoleptic, or physicochemical properties of the new product. Considering many functional possibilities of sugar in food product technologies, substitutes may differ depending on the food product.

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FLAVOUR SOLUTIONS FOR REFORMULATING HEALTHIER PRODUCTS

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It is often said that we eat with our eyes first; taking orange as an example, the bright orange colour is the first thing that attracts us, suggesting freshness and juiciness. As we bring it closer, the citrus smell strengthens our expectation of a sweet–sour taste. When we finally eat it, the full flavour experience comes from taste, smell, and texture working together. This shows that flavour is more than taste alone, and it helps us decide whether we like a food.

Flavour perception also has important psychological and physiological functions. Psychologically, it shapes emotions, reward pathways, and desire for food. Physiologically, flavour triggers responses that prepare the body for digestion, influencing appetite, salivation, enzyme secretion, and ultimately nutrient absorption.

Key Roles of Flavours in Healthier Formulations

Because flavour strongly influences acceptance, it plays an important part in product reformulation. When reducing sugar, salt, or fat, maintaining good flavour ensures that healthier products remain enjoyable. Flavour is also important for masking off-notes in certain products, like plant-based proteins, which can have natural bitterness or beany aromas.

- **Salt Reduction:**

Salt reduction strategies often rely on ingredients that enhance flavour without increasing sodium content. Developing a salt substitute that taste salty without containing sodium is difficult because the mechanisms of salt taste are complex, unlike sweet taste, which is easily mimicked by many alternative sweeteners. Potassium chloride is the most commonly used non-sodium compound with a salty taste. Because it can develop bitterness at higher levels, it is typically blended with regular salt. Salt enhancers can be used

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in reduced salt formulations to boost saltiness perception. Although these enhancers are not salty on their own, they intensify the salty taste of small amounts of sodium chloride, allowing for greater sodium reduction without compromising flavour. Herbs, spices, umami-rich components, and acidic ingredients, such as lemon juice, can enhance the perception of saltiness or provide a satisfying richness, allowing for significant sodium reduction without compromising consumer acceptance.

A prominent example of an added compound is glutamic acid. When combined with sodium, it forms monosodium glutamate (MSG), a flavouring compound that imparts umami as well as enhances the salty taste of food. Umami-rich ingredients such as yeast extracts, mushrooms can similarly enhance overall flavour, allowing for a reduction in salt content.

Yeast extract is a particularly notable natural umami and salt enhancer obtained through the enzymatic autolysis of yeast, and it is widely used in meat products and flavourings. Yeast extract is rich in taste peptides, and a variety of umami, salty, and kokumi peptides have been identified from it. When sodium levels are lowered in food formulations, taste intensity can diminish, but the overall palatability contributed by yeast extracts helps counterbalance this by intensifying umami and savoury notes, effectively masking the absence of salt and enhancing the overall flavour experience. Yeast extracts are recognised for their versatility and are used in soups, sauces, snacks, and meat products. In a study on salty crackers, yeast extract successfully replaced added salt, and sensory testing showed that crackers with 50% reduced salt were indistinguishable from the full-salt control. These findings support yeast extract as an effective, edible salt-reduction strategy without compromising flavour (1,2).

- **Sugar Reduction:**

Sugar is a primary source of sweetness, enhancing flavour and texture in foods. Besides sweetness, sugar influences product smoothness, chewiness, or hardness, acts as a preservative by lowering water activity, and contributes to colour and flavour through caramelization and Maillard reactions. One of the most common ways to reduce or replace sugar in food products is by using alternative sweeteners. However, high-intensity sweeteners, while effective at providing sweetness, do not deliver the bulk and body that sugar naturally provides. Hence, bulking agents such as maltodextrin and starch are used to restore the bulk and body lost when sugar is reduced, without adding sweetness. They help improve texture and mouthfeel in the final product.

Polyols such as maltitol and xylitol, while sweeteners themselves, are often combined with high-intensity sweeteners to create a more rounded and balanced sweetness profile. Polyols, along with dietary fibres like fructo-oligosaccharides (FOS) and inulin, function as sweeteners and bulking agents and also as prebiotics, as they are non-digestible and are beneficial for gut health. Some sweeteners can also lead to off-flavours (e.g. bitterness, metallic taste) and may not always satisfy consumer taste expectations. Hence, newer methods aim not merely to replace sugar but to enhance perceived sweetness so that foods with less sugar still taste sweet.

There are several ways to enhance the sweetness perception:
1. Odour-induced sweetness enhancement - Odour-induced sweetness

enhancement (OISE) is a key cross-modal effect (process in which different senses work together to influence perception) in which certain aromas make foods taste sweeter without adding more sugar. Research shows that fruity and floral aromas such as methyl-2-methylbutyrate, ethyl 2-methylbutyrate,can significantly increase the sweetness of sucrose solutions. In one of the studies, a beverage containing just a hint of mango flavour and very little added sugar was perceived to be just as sweet as another drink made with noticeably more sugar. Sweet-enhancing effects have also been found with aromas from sweet oranges and bananas, showing that the effect depends on how the brain combines taste and smell rather than on "sweet" smells alone. Sweet taste comes from molecules activating the TAS1R2/TAS1R3 receptors on the tongue, while aromas trigger smell receptors in the nose. Sweetness enhancement mainly happens during chewing, because aromas released in the mouth are perceived together with taste, making the brain combine the signals and interpret the food as sweeter. Since OISE increases sweetness without adding calories or causing off-tastes, it offers a promising approach for reducing sugar in food and beverage products.

2. Taste-induced sweetness enhancement occurs when combining two or more sweeteners produces a sweetness intensity greater than one sweetener alone, a phenomenon known as sweetness synergism. This approach is especially useful because many high-intensity sweeteners, such as Steviol glycosides or sucralose, can taste bitter or have flavour profiles that differ from sucrose when used at higher levels. By combining multiple low-calorie sweeteners, manufacturers can achieve stronger sweetness, mimic the clean taste of sucrose, and reduce bitterness. Many combinations, including acesulfame-K with sucrose, and mixtures of sucralose and various rebaudiosides with bulk sweeteners, also show strong synergistic effects. This synergy happens because the sweet taste receptor has several binding sites, so different sweeteners can work together and boost the overall sweetness signal.

3. Some other ways to enhance sweetness are adding spices like vanilla, cinnamon, nutmeg, and cardamom or cooling agents like menthol that suggest sweetness without added sugar. Colour can also boost sweetness through multisensory expectations: red and pink hues are strongly associated with sweet foods, making sucrose solutions taste sweeter, while colours like green do not. Another strategy involves positive allosteric modulators (PAMs), which are not sweet themselves but intensify the sweetness of sugars. Compounds such as SE-1, SE-2 can significantly enhance sweetness, allowing large reductions in sweetener use without off-flavours. Proteins like miraculin and thaumatin also alter sweetness, providing yet another way for sweetness enhancement (3,4).

Fat Reduction:

Fat plays a central role in foods controlling sensory attributes such as creaminess, mouthfeel, and texture. However, as consumers increasingly seek low-fat or fat-free products for health reasons, simply cutting fat often leads to poor sensory quality. Recent research shows that high-quality fat replacers such as corn dextrin, inulin, polydextrose or whey protein can successfully mimic many of fat's functional properties while drastically reducing calories. They help maintain good mouthfeel and stable emulsions, and with corn dextrin or whey protein, aroma release remains close to full-fat products, making reduced-fat versions much more acceptable (5).

Fat perception is shaped not just by actual fat content

but also by how flavours interact with our senses. In pea-based protein emulsions with 0–3.5% fat, even small fat differences were detectable, with higher fat giving stronger creamy, thick sensations. Milky-creamy flavours did not alter this detection or physical properties, but they increased creaminess only when smell was involved. With olfaction allowed, these flavours enhanced fatty aroma and mouthfeel through cross-modal effects, making low-fat samples seem richer. Without smell, the effect disappeared, showing that aroma strongly shapes fat perception. This allows formulators to use fat-congruent flavours to boost creaminess in plant-based drinks without adding fat (6).

Reducing fat in foods like chocolates, creams, sauces, or dairy products often lowers the creaminess, mouthfeel, and flavour, because many aroma compounds dissolve in fat. With the right combination of fat replacers and flavours, reduced-fat foods can remain enjoyable and close to their full-fat versions. For example, a study found that adding limonene oil extract to reduced-fat chocolate makes it less hard and improves melt properties, helping it taste closer to full-fat chocolate.

For baked products such as cakes and cookies that have moved from hydrogenated fats to trans-free fat, flavours are often infused to compensate for the fat reduction to create an authentic mouthfeel.

For vegans or lactose-intolerant consumers who want cheese-like products, dairy and cheese flavours are widely used in vegan cheeses, dips, and snacks, creating balanced products without the fat or lactose of real cheese. Butter popcorn made with only butter flavour is another familiar example, where aroma provides sensory satisfaction while keeping products affordable and healthier. In cooking, oil and butter are common bases for sautéing, but low-fat nonstick sprays containing flavours and oleoresins offer a lighter alternative. These sprays lubricate pans, simplify cooking, and replace lost flavour. Cuisine-specific sprays such as barbecue, Chinese, Indian, or continental have become increasingly popular among calorie-conscious consumers.

Herbs and spices, too, make healthier, reformulated foods just as appealing as their higher-salt, higher-fat products. In one study, ten commonly eaten dishes were modified to reduce fat, sodium, and added sugar, and enhanced with specific herb-and-spice blends, such as onion powder, garlic powder, ground paprika, and cayenne. When tested by consumers, seven dishes were liked as much as, or more than, the originals, proving that strategic seasoning can successfully preserve flavour and increase liking, allowing for meaningful reductions in salt, sugar, and fat without compromising consumer enjoyment (7,8).

Masking Off-Flavours in Foods:

Flavours play a key role in masking off-notes in many foods, especially functional food and beverages and plant-based proteins, which often develop bitter, beany or metallic tastes from ingredients like soy protein, omega-3s, vitamins and minerals, etc. Bitter blockers are commonly used; they contain compounds such as Adenosine 5'-Monophosphate that stop bitter receptors on the tongue from activating, helping mask bitterness from caffeine or the lingering aftertaste of sweeteners like sucralose and aspartame(9).

Mimicking the flavour and texture of animal meat in plant-based meat is complex. Yeast extract, spices, and herbs are often used for this purpose. Yeast extract contains compounds

such as 2-Methyl-3-furanthiol and 2-Furan methanethiol, which contribute to the typical meaty flavour. Functional foods and beverages are also on the rise. Ingredients like ashwagandha, curcumin, etc., known for their antioxidant and anti-inflammatory benefits, are becoming popular. To improve flavour and consumer acceptance, formulators frequently add citrus flavours, vanilla, or spices like nutmeg and cinnamon to balance and mask their off-notes.

Protein drinks or protein isolates are often bitter in taste. Hence, flavours like chocolate, vanilla are used to create desirable products that are palatable and appeal to consumers who are often driven by taste. Forother products like a protein bar, adding chocolate flavour along with a caramel note can create a more complex, robust flavour that minimizes protein off-notes. Or for a plant-based yoghurt, unwanted green notes from the plant-based protein can be compensated by using a fruity flavour like Aldehyde C16to impart strawberry flavour.

Conclusion:

Flavours play a key role in making healthier foods more enjoyable. They help improve taste, aroma and mouthfeel, reducing the bland, bitter or beany notes often found in low-sugar, low-salt, low-fat and plant-based products. In the fast-growing health and wellness market, especially natural, organic and plant-based foods, flavours help mask off-notes from proteins, vitamins and minerals while boosting overall sensory appeal.

They also influence psychology: pleasant flavours trigger dopamine, create positive memories and encourage people to choose healthy foods more often. As clean-label demand rises, companies increasingly use natural flavours from fruits, herbs, spices and botanicals, which also provide functional compounds like capsaicin, curcumin and limonene with added health benefits. Many consumers worry that reducing sugar, salt, or fat will affect taste, so sudden reformulation can lead to rejection.

Gradual changes, supported by flavour enhancement and masking, can help maintain the original eating experience while shifting consumers toward healthier options.

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BEYOND THE CRUNCH- RETHINKING SNACK FOODS FOR HEALTH, INDULGENCE, AND INNOVATION

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Snacks are becoming a very important part of our diet. At one time it used to be something to keep you going until major meals, such as around mid-morning and mid-afternoon. It used to be very modest biscuit along with tea or coffee. This has gone over the years to something that becomes a fairly significant part of the diet and also there is no specific time for the snacks.

The need for snacks arises when a few hours after the last meal, the stomach starts growling and our energy levels dip a little. These problems could be taken care of by a small bite to keep us going until the next meal. But nowadays, we just look forward to the taste of snacks as there are so many varieties of snacks that have delectable taste that people just love to keep eating them (1).

Snack Food Market

Although many western snacks have become very popular such as cookies or biscuits, chips or wafers, ice cream, candy, popcorn, soft drinks, crackers, cake, donuts, and a large number of extruded baked or fried products. Health professionals, however, recommend healthy snacks such as fruit, nuts and seeds, milk, cheese and yoghurt. Indian snacks are not lagging behind. Right from the traditional snacks such as chakli, khakhra, dhokla, jalebi, milk or fruit-based sweets, roasted nuts & chickpeas, banana chips, dosa, idli and many others to more modern vada pav, samosa, pav bhaji and spicy variations of Chinese noodles, among others. The list keeps growing as vendors keep trying variations of Indian as well as global snacks to suit the Indian palate.

According to one estimate, Indian snack market was around Rs 46,000 crores ($ 5 billion) in 2024 and is expected to double by 2033 (2). While this is tiny compared to the global market reaching near $ 700 billion and expected to grow beyond $ 900 billion by 2030 (3). Overall, the snack food industry is growing rapidly and people are depending more on snacks for their nutritional needs due to their changes in lifestyle both at workplaces as well as at home. Thus, the developers must understand that although good taste will certainly make consumers want more, but if it ends up in overeating leading to certain non-communicable diseases,

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then consumers are going to look for something that is healthier as well as tasty. Already this trend has started and developers are looking for various ways to make their products healthier. Snack makers have realised this and the market for healthy snack is also increasing steadily. Global healthy snack market size was around $ 95 billion and is expected by one estimate to increase to $ 144 billion by 2030 (4, 5).

Should Snacks Be Avoided?

There are pros and cons of snacking. Snacks provide a boost of energy if there are large gaps between meals and one continues to work. Snacks avoid dropping blood glucose to very low levels. Also it curbs appetite that avoids overeating at the next meal. It provides nutrients especially when healthy snacks like fruits and nuts are chosen. It also can provide adequate nutrition for people with poor appetite and cannot eat full meals for example during illness. Snacks can complement meals so balanced diet could be achieved. This also may be the case of someone who cannot have regular meal timings due to highly erratic work schedule.

There are negatives also for snacking habit. When portions or frequency of snacking is too much that adds excess calories leading to weight gain. Too much snacking also reduces hunger so healthy meals are either avoided or consumed inadequately. This may cause losing out on essential nutrients. Regular consumption of snacks with high amounts of salt, sugar and fat would lead to excess consumption of calories leading to many non-communicable diseases. Also, since healthy meals are reduced or avoided, essential nutrients are deficient in diets, so deficiency diseases may erupt.

There may be many reasons for overeating of snacks. Size of snack packs have increased over years and people tend to finish the pack. Serving size sometimes are much smaller so in a snack pack there may be 2-3 servings while buyer may think one pack is one serving. There are also many varieties of snacks so people tend to eat more compared to when limited varieties are offered. People also tend to eat while watching TV, video or playing games on phone etc. without being aware of eating. Also, when partying or drinking, snack accompaniments are overeaten. All of these lead to excess consumption especially when snacks are easy to eat and tasty.

Changing Trend of Snacking

Snacking used to be an occasional event just to keep you going until the next meal. However, now meals are not really eaten at traditional breakfast, lunch and supper times. The workstyle has changed and people work round-the-clock because of global connections as well as work-pressures like dead-line projects. People also work in places that do not have facilities for traditional meals and many times eating on-the-go is the only way to keep hunger away. People eat at odd places such as during travel, waiting for something or someone, taking a break from outdoor project, during or between the meetings and these do not allow for traditional meals. So people eat snacks when possible and whatever is available.

This promoted the vending machines to provide easily all kinds of snacks. The easiest were the packs of chips, bars or cookies that could be eaten anytime and anywhere and also carried in your pockets conveniently.

This practice of increased snacking also created problems of overeating as usually these snacks would be very tasty and containing a lot of calories from fat and sugar and also with salts. Pandemic also added to the problem of availability of fresh produce to prepare meals at home so people had to rely more on what was available especially the omnipresent snacks. After a while people and health professionals realised the problems that such snacks were creating especially among youngsters. So healthy snacks were gaining traction along with the mindful snacking. Where snacks were the main or only option, healthy snacks became popular. Where snacks were just being consumed as stop-gap arrangement, mindful snacking was promoted so it would not replace meals.

Because of busy lifestyle especially with reference to working in and out of office, increased urbanisation and changes in the dietary preferences. All these are increasing the demand for convenience along with on-the-go snack options. Consumers want snacks that could be taken anywhere easily, that could be quickly consumed without any paraphernalia and also easily taking care of dietary preferences and restrictions. People want healthier options in snacks that satisfy all these requirements.

Indian Snack Food Scenario

The Indian scenario is slightly different, as per one analysis (6). Up to 2023-24, there was a healthy growth in snack food market. After that several factors such as high costs of ingredients and post-pandemic reaction, caused a slight shift in the growth of different types of snacks. Increase in cost of snacks certainly caused some slow-down, but post-pandemic normalisation did affect snacking by people eating more traditional meals than snacks. Also there was an increasing demand for healthier snacks because of health professionals linking high fat, salt and sugar in most snacks to increase in lifestyle diseases.

Consumers started demanding healthier snacks that had lower contents of fat, salt and sugar and higher contents of dietary fibre, protein and some micronutrients. Baked snacks were preferred over fried and traditional ingredients such makhanas and millets became attractive ingredients in snack foods. Inclusion of fruits, vegetables, pulses, nuts, etc. into biscuits/cookies and other snack items as well as in traditional snacks like khakhra became attractive to consumers.

There were also other factors like gluten-free and vegan that were promoted on social media as healthier options. All these started reflecting in the market space of snack foods in Indian stores. So developers need to consider these changes when formulating new products or reformulating old ones.

Creating Products for Better Health

It is not as simple to reduce fat, sugar and salt from snack foods as health professionals may think. Reduction of fat from bakery products causes changes in dough matrix that directly cause changes in the final product. Puffing, crunch, snap, crispy, crumbly natures of many snacks are dependent on the fat content and type. By reducing fat and changing solid fat to liquid oil will drastically change the product to become hard, tough, chewy and difficult to eat.

Many sweets depend on the fat for their creamy, soft, mouthfeel that needs to be restored by using additional ingredients that mimic the properties of fat.

Saturated fat provides creaminess and pleasant mouthfeel. Previously, partially hydrogenated fat was used as substitute as it would provide higher solid fat index at lesser saturation. People thought it would be healthier as it still has unsaturation and needed lesser quantity. However, later it was proved that trans fats formed in partial hydrogenation were worse than saturated fat so these were highly restricted. Gums and modified starches are now being used to replace fat. Also, proteins, especially whey proteins in micro and nano-particulate form can mimic fat (7, 8).

Sugar and salt have a great impact on taste as well as on their preservative effect on products. So when these are reduced, the taste will be immediately affected but more importantly safety of the product will be compromised. Hence when these are reduced, some compensation must be made by substitutes to improve the taste but also safety must be ensured by additives or other means of processing.

There are sweeteners of all kinds. Some have been there for quite some time and consumers feel they are artificial chemicals and are wary of them even though they have been tested for their safety. More recently some natural sweeteners have made appearance such as stevia, and some sweet proteins like brazzein, thaumatin, monellin and miraculin have been developed as sugar substitutes. FOS has already been used to produce sugar-less products and is prepared enzymatically from sugar or inulin. This not only is sweet but also is a dietary fibre so can work in many ways in food products besides reducing sugar content.

Classical reduction of salt is by using potassium chloride (KCl) but beyond some extent KCl is bitter so it can only be used to reduce salt to some extent. There are other ways to reduce salt and/or sodium. Both umami and spicy flavour ingredients reduce the need for salt so reduction can be achieved. Some additives could be replaced by potassium salt instead of sodium salt with similar effectiveness. This also reduces sodium content of food (8).

There are some technological advances using smaller particle size, even to nano-particle level, that allows use of lesser amounts of sugar or salt with similar sensation. This also helps to reduce these ingredients to make the product healthier.

Adding of Healthier Ingredients

In addition to reducing the fat, sugar and salt, one can make snacks healthier by adding healthier ingredients and essential nutrients. It has been mentioned that many snacks have appeared with added dietary fibre, proteins and millets, fruits, nuts and such things as botanical extracts etc. When these substances are added commonly the flavour and taste of the product is affected adversely besides texture and mouthfeel.

As taste has to be acceptable for snacks masking agents are necessary to overcome the undesirable sensation of the added ingredient (9). This process is probably a critical part of making the healthier snack likeable because if the snack does not taste good, it will not be acceptable.

Flavour masking agents distract the palate from unwanted flavour notes while flavour blockers bind with taste receptors and stop from experiencing the off flavour. Herbs and spices are natural flavour modifiers and yeast extract, amino acids etc. work as flavour potentiators. Glutamic acid is present in mushrooms, seaweed, tomato, cheese, yeast extract, soy sauce etc. can boost umami flavour. Fermented mushroom has substances that work as bitter blockers. Many such natural or synthetic substances could be used to make the product acceptable in presence of many strong undesirable sensations (10, 11).

Conclusion

People are going to keep on consuming snacks both at increasing times and the amounts. It is very convenient and pleasant way of curbing the hunger between meals but snacks are beginning to overtake the place of meals as they could be consumed at any place and any time. Overconsumption will create problems so sensible snacking is essential. Secondly, snacks should be nutritionally adequate and healthy if they become large proportion of the diet. Many new variants have already appeared that satisfy hunger and also provide nutrients and healthy ingredients. Future developments will be very interesting as opportunities in snack food industry are enormous.

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REGULATORY ROUND UP

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Dear Readers,

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

Advisory on Environmentally Compliant Disposal of Seized, Rejected, and Expired Food Items : This advisory is intended for FBOs to ensure that the seized, rejected, and expired foods are disposed in an environmentally compatible manner. The approved disposal methods must be followed in coordination with the local municipal authority/ Panchayat or any other statutory body.

The methods could be: a) Incineration using incinerators compliant with the Central Pollution Control Board norms, B) Landfill in a designated leachate control, and c) Composting or anaerobically digesting the Biodegradable waste. The disposal should be supervised by a Food Safety Officer (FSO) duly authorised by Designated Officer (DO). The FSO shall submit the certificate of disposal to DO, with a copy to the concerned commissioner of Food Safety and FBO.

Every DO shall identify a suitable facility for disposal and coordinate with State Pollution Control Boards for high-volume disposals. States/ UTs must submit monthly disposal compliance reports by the 5th of every month, flagging deviations to the Food Authority.

Food Safety and Standards (Import) First Amendment Regulations, 2025 relating to Method of Analysis and Signing Authority : This gazette notification is an amendment to FSS(Import) Regulations and is regarding the analysis of the samples and the signing authority. This amendment allows the use of alternative validated methods mentioned in standard analytical books such as AOAC, ISO, Pearson's, Food Chemicals Codex, etc., if a method for a particular parameter is not available in the manual. The notified or referral laboratory shall provide the report signed by the analyst or Director in Form 2 within five days from the date of receipt of the sample.

Hydroxymethylfurfural (HMF) to be considered as a quality parameter in Honey : As per clause 2.8.3 (1) of FSS(FPS and FA) Regulations, the maximum permissible limit of HMF in Honey is 80mg per kg. The analysts are reporting the non-compliant samples as either "unsafe" or "substandard".

However, the scientific panel is of the opinion that with the available current scientific evidence, it is not possible to arrive at the safety implications of consuming HMF at higher levels. Therefore, the non-compliant samples regarding HMF shall be categorised as "Substandard."

Validity Order of FSSAI notified Food Testing laboratories as on 17th November 2025 :This order provides the latest list of FSSAI-approved laboratories with validity of their accreditation as on 17.11,2025.