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The Future of Instant Soups: Millet-Based Innovations for Health and Wellness

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Abstract
The growing need for accessible and healthy food alternatives has prompted the creation of instant millet-based soups, which provide a better alternative to traditional processed meals. Millets are rich in essential nutrients, including carbohydrates (60.09-70.04 g), proteins (6.2-7.3 g), fibre (3.7-9 g), and minerals such as calcium (364 mg in Finger Millet), iron (4.62 mg in Finger Millet), and phosphorus (274 mg in Sorghum Millet). These grains also include bioactive compounds such as polyphenols, flavonoids, and catechins, which serve as antioxidants, have anti-diabetic properties, and improve cardiovascular health. The instant soup market is expected to develop at an 8.1% CAGR from 2025 to 2035, reaching USD 5,347.2 million, driven by urbanisation and the need for quick meal options. Millet soups are more digestible and nutritious when processed using procedures such as soaking, drying, roasting (up to 170°C), and fermentation. To increase shelf life and product quality, innovative methods such as vacuum packing, freeze-drying, and bio-fortification are required. According to research, instant millet soups produced with Foxtail (2.14 g), Barnyard (5.76 g), and Kodo Millet (7.11 g) have a low glycaemic index (41.85), making them ideal for diabetics and health-conscious customers. With a rising desire for gluten-free, high-fiber diets, millet-based quick soups have a large commercial potential.

Key words: Instant Soup, Millets, Phytochemicals, Infrared Drying, Glycemic Index, Rancidity

1. Introduction

In India Now a day, particularly people who resides in large cities, want an active and pragmatic lifestyle in practically every aspect, particularly in food preparation and food consumption. It generates a culture that prefers quick food products, such as those that are ready to cook and consume. Nutrition Rich Instant Soup is a prospective product for development as an instant meal. Some of the earliest foods that humans likely drank was soup. It is a swift cooking method. The procedures of boiling to extract flavour and heat-induced formulation reaction are both part of the making of soup. Originating from the Italian expression suppare, which means, "bread soaked in the broth," comes the magical word "soup" [18]. In the present day, it is simple to replace traditional culinary processes with modern processing technologies. The homemade soups are replaced with Canned, Dehydrated, Frozen and Instant Soups. Nowadays, the market offers a variety of soups ranging from tomato to multi-millet flavoured Soups. Instant soups can be consumed for breakfast, lunch, snacks, or dinner. Because of its ease of preparation, short serving time,

high energy and nutrient content, instant soup has become the greatest alternative diet for city dwellers. Instant mixes can be stored for 2 months in laminated pouches under normal room temperature [18]. Millets are nutrient-dense, drought-resistant grasses from the Poaceae family. They are mostly produced in arid and semi-arid parts of India since they require less water than other crops like as both wheat and rice. Millets are recognized because of their nutrient-rich and medicinal benefits. Millets are high in fibre, protein, vitamins, and minerals. Millets provide several general health advantages, such as lowering insulin levels, strengthening the body's immune system, lowering the risk of cardiovascular disease, improving digestion, and acting as an antioxidant. In many regions of the world, especially Asia and Africa, millet is a staple grain. With almost 5000 years of cultivation, millets were formerly a major component of the Indian cuisine. Millets need less water to develop and are good for the environment [1].

2. Comparison of Millet Varieties: Nutrients, Health Benefits and Processing Effects

Millets are high in vital nutrients like carbohydrates, proteins, lipids, and fibre, as well as vitamins and minerals like calcium, iron, magnesium, manganese, phosphorus, and potassium, compared to other grains. Millet has high levels of important amino acids, particularly sulphur-containing ones like methionine and cysteine. Essential amino acids improve protein quality in tiny millets. Millet is high in nutritional and nutraceutical components, as well as the phytochemicals that consist of phenolic substances, flavonoids, catechins, phytic acid, and phytosterols. These phytochemicals are known to prevent lifestyle-related ailments such as cancer, heart disease, hypertension, diabetes, and provide high antioxidant activity [1].

Table 1 Nutrient Content of the Millets [20]

Nutrients	**Barnyard Millet**	**Finger Millet**	**Fox Tail Millet**	**Kodo Millet**	**Little Millet**	**Pearl Millet**	**Proso Millet**	**Sorghum Millet**
Carbohydrate (g)	65.55	66.82 ± 0.73	60.09	66.19 ± 1.29	65.55 ± 1.29	61.78 ± 0.85	**70.04**	67.68 ± 1.03
Protein (g)	6.20	7.16 ± 0.63	12.30	8.92 ± 1.09	8.92 ± 1.09	10.96 ± 0.26	**12.50**	9.97 ± 0.43
Fat (g)	2.20	1.92 ± 0.14	4.30	2.55 ± 0.13	2.55 ± 0.13	**5.43 ± 0.64**	1.10	1.73 ± 0.31
Fibre (g)	-	11.18 ± 1.14	-	6.39 ± 0.60	6.39 ± 0.60	**11.49 ± 0.62**	-	10.22 ± 0.49
Energy (kcal)	307	1342 ± 10	331	1388 ± 10	1449 ± 10	**1456 ±18**	341	1398 ± 13
Aluminium (mg)	-	**3.64 ± 0.69**	-	1.07 ± 0.83	-	2.21 ± 0.78	-	2.56 ± 0.78
Arsenic (mg)	-	-	-	-	0.49 ± 0.15	0.97 ± 0.24	-	**1.53 ± 0.04**
Cadmium (mg)	-	**0.004 ± 0.004**	-	-	0.001 ± 0.000	0.003 ± 0.001	-	0.002 ± 0.002
Calcium (mg)	-	**364 ± 58**	-	15.27 ± 1.28	16.06 ± 154	27.35 ± 2.16	-	27.60 ± 3.71

Chromium (mg)	**0.090**	0.032 ± 0.019	0.030	0.021 ± 0.027	0.016 ± 0.006	0.25 ± 0.006	0.020	0.01. ± 0.003
Cobalt (mg)	-	0.022 ± 0.009	-	0.005 ± 0.003	0.001 ± 0.00	**0.030 ± 0.015**	-	0.012 ± 0.007
Copper (mg)	0.60	0.67 ± 0.22	1.40	0.26 ± 0.05	0.34 ± 0.08	0.54 ± 0.11	**1.60**	0.45 ± 0.11
Iron (mg)	-	4.62 ± 0.36	-	2.34 ±0.46	1.26 ± 0.44	**6.42 ± 1.04**	-	3.95 ± 0.94
Lead (mg)	-	0.005 ± 0.002	-	-	-	0.008 ± 0.002	-	**0.008 ± 0.003**
Lithium (mg)	-	**0.003 ± 0.003**	-	0.027 ± 0.46	-	0.003 ± 0.001	-	0.001 ± 0.001
Phosphorous (mg)	-	210±58.4	-	-	-	-	-	**274 ± 35.7**

The table compares the nutritional makeup of many millet crops, including Barnyard, Finger, Foxtail, Kodo, Little, Pearl, Proso, and Sorghum millet. Carbohydrates, proteins, lipids, and fibre are mentioned with mineral content including calcium, iron, and phosphorus. Carbohydrate content is highest in Proso millet (70.04 g) and lowest in Foxtail millet (60.09 g), whereas protein level varies, with Proso millet having the highest (12.50 g). Fat content is quite low across all millet kinds, with Pearl millet having the largest amount (5.43 g). Pearl Millet (11.49 g) and Finger millet (11.18 g) have very high fibre content, making them suitable options for digestive health. Energy content varies substantially, with Pearl millet having the greatest (1456 kcal) and Barnyard millet having the lowest (307 kcal). Finger millet has a high calcium content (364 ± 58 mg), making it a great source of this crucial vitamin. Other minerals, such as iron and phosphorus, exhibit substantial diversity, with Pearl millet having the greatest iron concentration (6.42 mg) and phosphorus levels varying greatly amongst millet varieties. The table also includes trace elements such as chromium, cobalt, copper, and lithium, which are present in minute amounts. The table also provides information on potentially harmful elements such as aluminium, arsenic, cadmium, and lead, which are either absent or present in extremely small concentrations. The presence of these components in variable amounts indicates the importance of carefully selecting and processing millet to assure food safety [20].

Table 2 Key Nutrients, Processing Methods, and Benefits of Different Millets

Millet	**Scientific Name**	**Origin**	**Key Nutrients**	**Processing Methods**	**Health Benefits**	**References**
Barnyard Millet	Echinochloa frumentacea	India	Protein, fiber, calcium, phosphorus, antioxidants	Soaking (4-10 hrs), germination (24 hrs), roasting (110°C, 10 min)	Anti-inflammatory, anti-microbial, antioxidant, aids digestion	[1, 4, 8]

Finger Millet	Eleusine coracana	Ethiopian Highlands	Fiber, calcium, tannins, polyphenols, vitamins B & E	Soaking (1-2 days), NaOH/distilled H_2O (8 hrs), roasting (150°C), fermentation, germination	Anti-diabetes, hypocholesterolemic, prevents chronic illnesses	[14]
Fox Tail Millet	Setaria italica	China	Protein, fiber, iron, copper, polyphenols, phytates	Soaking (12 hrs), drying (260 min at 60°C), roasting	Gluten-free, improves digestion, antioxidant-rich	[1, 9, 19]
Kodo Millet	Paspalum scrobiculatum	India	Fiber, protein, iron, magnesium, antioxidants	Soaking (2 hrs), drying (60°C, 15 min), roasting (150-170°C, 1.5 min)	Anti-inflammatory, supports cardiovascular health, gluten-free	[1, 11, 16]
Little Millet	Panicum sumatrense	India	Carbs, fiber, Protein, B-vitamins, minerals	Soaking (2-4 hrs, 18.5 hrs at 30°C, or 3.5 hrs at 70°C), steaming (100°C, 15 min), drying (45°C, 4-6 hrs)	Aids digestion, weight loss, reduces risk of chronic diseases	[1, 15]
Pearl Millet	Pennisetum glaucum	Africa	Fiber, protein, calcium, iron, magnesium, antioxidants	Soaking (18 hrs), drying (60°C), roasting (110°C, 60 sec)	Anti-inflammatory, gluten-free, improves digestion	[1, 5, 13]
Proso Millet	Panicum miliaceum	Asia	Fiber, protein, iron, magnesium,	Soaking (19 hrs at 30°C, 4 hrs at 70°C), roasting (110-150°C)	Drought-resistant, enhances digestion, gluten-free	[1, 6]

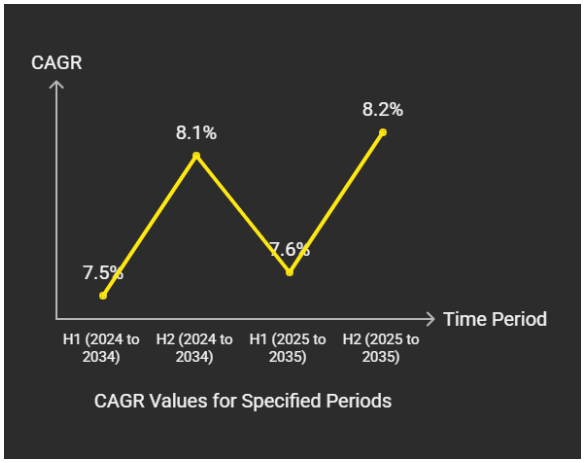
			antioxidants			
Sorghum Millet	Sorghum bicolor	Africa, Asia	Fiber, protein, iron, magnesium, phosphorus, phenolic compounds	Soaking (16 hrs, 25°C), drying (40-50°C for 6-12 hrs), roasting (161-179°C, 12-15 min)	Prevents chronic diseases, enhances taste and shelf life, gluten-free	[1, 2, 7, 12]

Millets are nutrient-dense ancient grains having origins in India, Africa, China, and the Ethiopian Highlands. They include critical elements such as protein, fibre, calcium, iron, magnesium, and antioxidants, making them an important component of a balanced diet. Each species of millet has its own processing processes, such as soaking, germination, drying, roasting, steaming, and fermentation, which improve digestibility and nutritional value. Barnyard, Finger, Kodo, and Little millet are high in fibre and protein, and they also have anti-inflammatory qualities, promote digestion, and provide cardiovascular support. Finger millet is notable for its high calcium content, which promotes bone health, whereas Kodo millet is noted for its heart-healthy characteristics [1]. Foxtail and Proso millet are gluten-free choices high in polyphenols and iron, which aid digestion and antioxidant activity. Pearl millet, native to Africa, is high in fibre, protein, and vital minerals such as magnesium and iron, which aid digestion and reduce inflammation. Proso millet, a drought-resistant Asian grain, is a sustainable solution that improves digestion and is gluten-free friendly. These millets, when properly processed, have considerable health benefits such as diabetes management, weight control, and a lower risk of chronic illnesses. Foxtail and Proso millet are gluten-free choices high in polyphenols and iron, which aid digestion and antioxidant activity. Pearl millet, native to Africa, is high in fibre, protein, and vital minerals such as magnesium and iron, which aid digestion and reduce inflammation. Proso millet, a drought-resistant Asian grain, is a sustainable solution that improves digestion and is gluten-free friendly. These millets, when properly processed, have considerable health benefits such as diabetes management, weight control, and a lower risk of chronic illnesses [1].

3. Overview of the Current Market Landscape for Soup Powders

The worldwide dried soup market is expected to be valued USD 2,453.9 million in 2025 and USD 5,347.2 million by 2035, growing at an 8.1% CAGR from 2025 to 2035. The dried soup business is rapidly expanding, owing to customers' choice for fast and quick meal alternatives. To accommodate increased demand, firms like, Campbell Soup Company, Nestlé, and Unilever are establishing new processing facilities and implementing innovative drying technologies to improve product quality and shelf life. Instant dried soups dominate the sector, accounting for 58% of the global dry soup market in 2025.

Figure 1 CAGR expected Growth from 2024 - 2035



The market's leading segment is the consequence of rising customer demand for quick and convenient meals. Instant soups have grown in popularity, particularly in North America and Europe, due to urbanisation, fast-paced lives, and greater job obligations. In Global market, some of the leading Dried Soup Brands are Nestlé S.A, Unilever PLC, Campbell Soup Company, General Mills, The Kraft Heinz Company, B&G Foods, Ajinomoto Co., and Baxter's Food Group [21].

4. Existing Soup Products in the Market

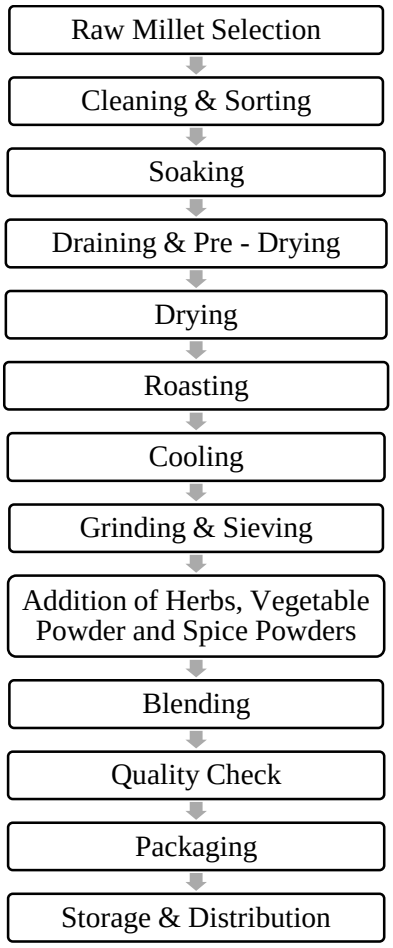
Indian cuisine provides a wide variety of soups that are both flavourful and healthy, making them appropriate for every season. Wide Range of Food Brands provides a selection of 100% clean, ready-made soup mixes prepared with high-quality, natural ingredients that include no artificial additions or preservatives. Their soups, made in ISO-certified facilities, appeal to health-conscious consumers looking for both convenience and nutrition. Notable soups include Hot & Spicy Tomato Soup, Spinach & Broccoli Soup, Cashew & Moringa Soup, Pepper Mushroom Soup, and Orange & Carrot Soup, each with a distinct combination of veggies, spices, and superfoods. These instant soup mixes, meant to feed 2-3 people per box, require just hot water to prepare, giving them a quick and nutritious dinner choice without sacrificing flavour or quality [23]. Indian soups are high in nutrients and provide a number of health advantages. Vegetables such as tomatoes, onions, carrots, and zucchini include critical vitamins, antioxidants, and fibre that aid digestion, immunity, and heart health. Lentils and rice are great sources of plant-based protein and energy, so soups like Dal Soup and Mulligatawny Soup are both substantial and healthful. Meanwhile, aromatic herbs like garlic, ginger, turmeric, cumin, and coriander have potent anti-inflammatory and antibacterial qualities, which promote general health and digestion. These soups also hydrate the body and promote recovery. Chicken broth has critical nutrients, but coconut milk contains healthful fats that aid in brain and heart function. Spices such as black pepper and red chilli powder improve metabolism and respiratory health [22].

5. Processing Techniques for Soup Powder

Multiple phases are involved in the production of instant millet soup powder to assure quality, safety, and nutritional content. It begins with selecting high-quality millets that are free of contaminants obtained. The grains are next cleaned and sorted mechanically to eliminate dirt, stones, and other undesired particles. Soaking increases digestibility and lowers anti-nutritional components, followed by draining and pre-drying to avoid microbial development. To obtain appropriate moisture levels, the millets are dry using

controlled processes such as hot air or infrared drying. Roasting improves flavour and shelf stability, and the grains are cooled before grinding and sieving to produce a fine, smooth texture. Blending in dried veggies, spices, and minerals is optional, but it improves the flavour and nutritional profile of the finished product.

Figure 2 Methodology for Formulated Instant Soup Mix [1]



Moisture analysis, microbiological testing, and sensory evaluation all contribute to a thorough quality check that assures safety. Finally, the powder is packed in airtight, moisture-resistant packaging and kept under ideal conditions to ensure freshness before delivery.

6. Instant Soup Mixes

Instant soups are often prepared with dried veggies, spices, and herbs. Soaking, roasting, grinding, and mixing millets in various amounts results in instant millet soup powders. Soup powders can be preserved for months or years due to their low water activity. Instant soup mixes are made from foxtail millet, pearl millet, finger millet, sorghum, oats, maize, dry vegetable mix, pepper, onion flakes, garlic flakes, coriander powder, cumin powder, black salt, and herbs in varying amounts. Because LDPE Pouches have good moisture and water vapour barrier qualities, little moisture absorption occurs without any colour change [18]. It is also possible to create prebiotic and low glycaemic index millets utilising foxtail, barnyard, and kodo millet. Millets prevent type 2 diabetes because they have a higher quantity of magnesium than rice

and wheat. The quick millet soups made with 2.14 g of foxtail, 5.76 g of barnyard, and 7.11 g of kodo millet had a low glycaemic index of 41.85. Soups with a low glycaemic index (GI < 55) have high prebiotic action. These soups are very healthful and suitable for persons who are obese or diabetic [10].

7. Market Challenges and Competitive Barriers

The manufacture of instant millet soup powders has various hurdles, including shelf life, moisture sensitivity, and nutritional retention. Millets have a greater lipid content than other grains, which makes them susceptible to rancidity. Furthermore, soup powders absorb moisture from the surroundings, resulting in clumping and microbial development. To address these difficulties, new packaging technologies like, vacuum sealing and modified environment packaging are required. Another key problem is to preserve nutritional and sensory quality throughout processing. High-temperature drying and roasting processes can degrade vital elements like as vitamins and antioxidants. To maintain balance between flavour improvement and nutritional retention necessitates optimal processing processes. The processing technique itself has limits, since standard milling and grinding procedures might result in uneven particle size and loss of bioactive chemicals. Specialised grinding, sieving, and blending procedures are necessary to provide a smooth, homogeneous texture suited for instant soup granules. Furthermore, drying and dehydration operations are energy intensive, raising manufacturing costs. Another significant problem is customer acceptability and market competitiveness. Millet-based goods, particularly soup powders, are relatively new to the convenience food industry. Consumers are more familiar with traditional soup bases such as wheat or rice; therefore, it is important to educate them about the health advantages of millets. To compete with well-known instant soup brands, special attention to texture, flavour, and simplicity of preparation is required to match customer expectations. Raw material availability and standardisation have an influence on manufacturing. Climate, storage conditions, and agricultural techniques all have an impact on millet quality variability, which affects the uniformity of the finished product. Finally, cost and affordability remain important considerations. Millet soup powder manufacturing entails several processes, including drying, roasting, and packing, all of which increase production costs. Making these items cheaper to a wider user base necessitates cost-effective solutions such as mass production, increased efficiency, and potential government subsidies.

8. Future Perspectives

Instant millet soup powders have a bright future, with plenty of prospects for innovation and commercial growth. Processing technology is one of the most rapidly evolving fields. Modern drying procedures, like freeze-drying and vacuum drying, can help to maintain nutrients and extend shelf life Nano-encapsulation of essential minerals may increase bioavailability, ensuring that customers receive the full health benefits of millets. Millet soup powders can be fortified with protein isolates, vitamins, minerals, and probiotics, making them more nutritious and attractive to health-conscious customers. Incorporating functional nutrients like prebiotics, dietary fibres, and plant-based proteins might boost their health benefits, especially for digestion and weight control. Additionally, bio fortification of millet crops, such as producing iron- and zinc-rich millet cultivars, can aid in the treatment of micronutrient shortages. Innovations like moisture-resistant, biodegradable, and active and intelligent packaging will improve product safety and attractiveness. Vacuum-sealed or nitrogen-flushed packaging can help prevent oxidation and increase shelf life, while edible coatings can provide an extra layer of protection. With increased consumer demand for sustainability and clean-label products, millet soup powders can benefit from their natural, gluten-free, and minimally processed properties. Adopting environmentally friendly

manufacturing practices, utilising organic and non-GMO components, and guaranteeing label clarity will all help to attract health-conscious customers. There is a big chance to disseminate millet soup powders into abroad markets since we know that instant soups originated in other nations and people in other countries consume more instant soup. These products can be marketed as gluten-free and high-fiber alternatives to traditional instant soups. Strategic marketing initiatives emphasising the benefits of millets, such as their high nutritious content, low glycaemic index, and sustainability, can assist improve market demand. Consumers with specific health concerns, such as diabetes or cardiovascular disorders, can obtain personalised recommendations for millet-based soup powders that meet their nutritional needs.

9. Conclusion

In urban markets, the growing appetite for quick, nutritionally dense, ready-to-eat food products has elevated instant millet soup to the status of a viable functional meal. Millets, which are strong in dietary fibre, protein, essential amino acids, vitamins, and minerals, provide important health advantages such as glycaemic management, cardiovascular support, and antioxidant characteristics. Instant millet soup powders are made by strategically combining millet flours (foxtail, barnyard, kodo, and others) with dried vegetables, spices, and functional additives to improve flavour and nutritional value. However, important problems in product development include lipid oxidation-induced rancidity, moisture sensitivity, nutritional degradation during heat processing, and establishing uniform particle size distribution.These difficulties need the use of modern food processing methods, such as freeze-drying, vacuum drying, and nano-encapsulation, as well as modified environment packaging, to preserve nutrients and increase shelf life. Furthermore, developing biofortified millet varieties and including prebiotic and probiotic components might improve the functional qualities of instant soups. Market adoption is important, necessitating focused consumer education on millet-based nutrition and smart positioning against traditional instant soup alternatives. The combination of sustainable sourcing, cost-effective manufacturing processes, and clever packaging solutions will be critical in increasing production and market penetration, both locally and globally.

10. Author's Biography

M V Hruthik Sai a final-year M.Sc. student studying Food Science and Technology at Babasaheb Bhimrao Ambedkar University (A Central University) in Lucknow. With a solid academic background in food chemistry, microbiology, and new food processing technology. I am enthusiastic in advancing research into food quality, safety, and innovation. Our academic interests concentrate on combining classical food science concepts with new technological breakthroughs in order to improve the efficiency and sustainability of food systems. With a strong interest in functional foods, new preservation techniques, and regulatory elements of food production, I hope to contribute to the changing landscape of food technology through research, innovation, and industry engagement.

Dr. Priyanka Shankar is an assistant professor at Babasaheb Bhimrao Ambedkar University (A Central University) in Lucknow. She specialises in Food and Nutrition and has an extensive academic and research background. She made major contributions to the discipline through papers, conferences, and academic collaborations. Dr. Shankar's work is to promote research and innovation, guide academics, and advance scientific understanding.

Dr. Anu Ram Kailash Mishra is a famous academic and resource person at Babasaheb Bhimrao Ambedkar University (A Central University) in Lucknow. With a background in Food and Nutrition, her research focusses on human nutrition, functional foods, and food safety. Her contributions to the discipline include scholarly articles, conference presentations, and academic projects. Dr. Mishra is devoted to improving nutrition science research and promoting evidence-based approaches to health and food sustainability.

Puja Kumari is a dedicated researcher who is now pursuing her Ph.D. at Babasaheb Bhimrao Ambedkar University (A Central University) in Lucknow. With a strong interest in Food and Nutrition, she is committed to investigating novel ways to important difficulties in the subject. She has actively contributed to academic debate over the years, including research papers, seminar talks, and partnerships with specialists. Her intellectual activities are motivated by a dedication to excellence and a desire to make significant contributions to the academic community.

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