Functional Foods and Smart Proteins – The Future of Nutritional Security in India

Mains: *GS II – Issues Relating to Development and Management of Social Sector/Services relating to Health/Nutrition/hunger*

Why in News?

Food and nutrition have always been central to human development, but society's relationship with food has evolved dramatically over time and the concept of functional foods and smart proteins gained attention recently.

What are functional foods?

- **Functional foods** – It refer to foods that are enriched, fortified, or modified to provide additional health benefits beyond basic nutrition.
- They are not just sources of calories but are designed to promote physical well-being and reduce the risk of lifestyle diseases.
    - **For example**, Rice enriched with vitamins helps tackle micronutrient deficiencies.
- Milk fortified with omega-3 fatty acids supports heart and brain health.
- **Supportive technologies** – These foods are made possible due to the advancement of several scientific disciplines and technologies such as:
    - **Nutrigenomics** – It studies how nutrients interact with genes.
    - This allows the possibility of designing diet plans and foods that are suited to the genetic profile or disease risk of specific individuals or populations.
    - **Bio-fortification** – It is where the nutrient content of crops is improved through selective breeding or biotechnology.
    - Unlike conventional fortification, which adds nutrients during processing, bio-fortification enhances nutritional value at the crop growth stage itself.
    - **3D Food Printing** – It uses customised nutritional formulations to create food with controlled nutrient distribution.
    - **Bioprocessing** – It is where biological systems are used to enhance nutrient bioavailability, improve digestibility, or reduce anti-nutritional factors.
    - Thus, functional foods are not just diet supplements, but they are part of a strategy to integrate nutrition into everyday eating patterns.

What are smart proteins?

- **Smart proteins** – They represent an innovative category of proteins developed using biotechnology to reduce reliance on conventional protein production from livestock.

- They are called "smart" because they offer a sustainable and ethical method of producing nutrient-rich foods with lower environmental impact.
- **Major forms** – They exist in 3 major forms
    - **Plant-based proteins** – These are extracts from cereals, legumes, and oilseeds that are processed and restructured to mimic animal-based products such as meat, milk, and eggs.
    - This allows consumers to enjoy familiar textures while reducing animal consumption.
    - **Fermentation-derived proteins** – Microorganisms are used to produce specific proteins through fermentation.
    - These can replicate components found in dairy or meat, such as casein and whey, without involving animals.
    - **Cultivated meat** – It is also called cell-based meat, this is produced by growing animal cells in controlled bioreactors.
    - This allows the creation of real meat without slaughtering animals.

Smart proteins allow us to produce high-quality protein foods with a much lower land, water, and carbon footprint compared to traditional livestock farming.

Why India needs functional foods and smart proteins?

- **Prevailing nutritional deficiency** – Despite having self-sufficiency in food production, a large portion of the population suffers from nutritional deficiencies.
- Over one-third of Indian children are stunted, indicating chronic malnutrition.
- **Urban-Rural Gap** – Although adult protein consumption is improving, the gap between urban and rural protein intake remains wide.
- Shifting food preferences – As incomes rise and people become more health conscious, the public expectation from food is shifting.
- Food can no longer be evaluated only on calorie content, it must contribute to improved health and wellness.
- India therefore needs to transition from **food security**, which focuses on filling stomachs, to **nutritional security**, which focuses on nourishing bodies.
- **Environmental challenges** – Meeting protein and micronutrient needs through conventional livestock-based systems leads to higher greenhouse gas emissions, excessive land use, water depletion, and biodiversity loss.
- Smart proteins offer a solution, they allow us to meet rising protein demand while lowering environmental impact.

What is the current status of India?

- **Officially recognized** – Functional foods and smart proteins are officially acknowledged as thematic focus areas under the *Biotechnology for Economy, Environment, and Employment (BioE3) policy*.
- **Funding and innovations** – The Department of Biotechnology (DBT) along with the *Biotechnology Industry Research Assistance Council (BIRAC)* has launched funding programmes and innovation challenges dedicated to these domains.

- **Progress in Functional Foods –** Indian scientists are actively developing bio-fortified crops.
- Zinc-enriched rice has been developed at the Indian Institute of Rice Research (IIRR) in Hyderabad.
- Iron-rich pearl millet has been developed at ICRISAT.
- These crops are particularly relevant for a population vulnerable to micronutrient deficiencies.
- The private sector is also expanding its footprint.
- Companies such as Tata Consumer Products, ITC, and Marico are investing in fortified staples and health-focused food products.
- This indicates that functional foods are moving beyond experimentation and into mainstream markets.
- **Progress in Smart Proteins –** India's smart protein ecosystem is growing rapidly.
- By 2023, India had around *377 alternative meat, egg, and dairy products* being sold by over *70 brands.*
- Startups like GoodDot, Blue Tribe Foods, and Evo Foods are producing plant-based meat and eggs that cater to increasing consumer interest.
- Zydus LifeSciences entered the smart protein segment in 2024 by acquiring a 50% stake in Sterling Biotech, signalling corporate interest in fermentation-based protein.
- The Centre for Cellular and Molecular Biology received a *₹4.5 crore DBT grant for research on cultivated meat.*

	Global Experiences
Japan	It conceptualised functional foods as early as the 1980s and developed regulatory frameworks that enabled their commercial rollout.
Singapore	It became the first country in the world to approve commercial sale of cultivated chicken in 2020, demonstrating regulatory agility
The European Union	It is investing strongly in sustainable protein production as part of its “Farm to Fork” environmental strategy.
China	It views alternative proteins as a strategic priority within its food security and innovation policies.

- India can learn from these approaches to create a supportive policy environment.

What are the underlying challenges?

- **Lack of regulation** – The Food Safety and Standards Authority of India (FSSAI) has not yet issued clear regulations on the approval process, labelling, or safety evaluation of new food categories such as cultivated meat and precision-fermented proteins.
- **Limited arrangements** – Infrastructure for fermentation, quality certification, and consumer testing is still limited, restricting commercial scaling.

What should be done?

- **Regulatory framework** – Establishing a *national regulatory framework under FSSAI* for novel foods, with clear definitions, safety protocols, and labelling standards.

- **Coordination –** Ensuring *inter-ministerial coordination* so that agricultural, biotechnology, and food safety bodies work in alignment.
- **PPP** – Encouraging *public–private partnerships (PPP)* to scale biomanufacturing infrastructure and indigenise key technologies such as precision fermentation.
- **Inclusion** – Involving *farmers and rural communities* in new value chains to ensure equitable benefits.
- **Campaigns** – Conducting *public education campaigns* to build trust and address concerns about "lab-made" foods.

What lies ahead?

- Functional foods and smart proteins represent a significant leap in India's journey toward *nutritional security*.
- They offer a means to combat malnutrition, improve health outcomes, generate employment, and support environmental sustainability.
- The challenge now is not technological but regulatory and institutional. India must act quickly to build trust, strengthen policy frameworks, and scale manufacturing capacity.
- If implemented effectively, this nutrition and biotechnology revolution can help India move from merely feeding its population to **nourishing** it, setting the stage for healthier citizens and a more sustainable future.
- Economically, the global plant-based foods market is expected to reach *between $85 billion (UBS estimate) and $240 billion* (Credit Suisse estimate) by 2030.
- India, with its agricultural diversity and biotechnology capacity, could become a global supplier and generate vast employment opportunities in agriculture, processing, manufacturing, and logistics.
- Environmentally, smart proteins could significantly reduce emissions, land degradation, and water stress.

Reference

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