Role of Functional Foods and Nutraceuticals in Sustainable Food Systems :A Technological Scenario

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Abstract

Functional Foods and nutraceuticals are a class of products with benefits beyond essential nutrition. These products are a rising trend in the food industry, with the global market reaching USD 275.77 billion by 2025. Sustainabiity of the functional foods is an emerging issue as functional fooda is a preventive regime for non-communicable diseases. The dynamic changes in the technological environment have transformed the scenario of sustainability by bringing new technologies such as blockchain, artificial intelligence, expert systems, nanotechnology, and the emerging field of nutria-genomics that find varied applications across food systems. Different stakeholders get benefitted immensely, like manufacturers, suppliers, supply chain managers, retailers, customers, and government publics. At the same time, critical analysis is required how these technologies interact with the three pillars of sustainability –economic, social, and environmental. The result indicate that although the emerging disruptive technologies provide greater efficiency , ethical sourcing , prevent wastage , create awareness and provide more personalized nutrition on one hand there may be concerns regarding their sustainability as they may drive up economic costs among other concerns.

Keywords:

1. Introduction

Globally, food systems are confronted with plethora neo liberal pressures in the consequence of environmental degradation, climate change, and urbanization, and globalization, societal and political pressures. the food system may be considered to be the set of processes that occur between field and fork. Sometimes, this is shown as a linear sequence, while in many other cases, as here, the food system is considered to be at least partly cyclical. Researchers through their holistic approach can reiterate importance of sustainability in food systems and can affect its transformation with adequate participation of institutional structures and stakeholders in the food systems. The assemblage of sustainable systems can be premeditated through the right mix of three pillars of sustainability namely: environmental social and political. The systems level approach can help us infinitesimally review the present practices and intercede redesigning and recreation of new food systems practices and methodologies that can fittingly deal with myriad pressure of modern era

Technology continues to create opportunities to improve the productivity and sustainability of the food system. Perhaps the most exciting and most controversial technological innovation is biotechnology, specifically genetically modified organisms (GMOs).

The adoption of the Sustainable Development Goals (SDGs) by all nations will provide a powerful framework that will guide decision-making on policies and budgets by governments, private sector, and civil society to 2030. These goals hold the potential to set the global food system on a more sustainable path.(Denning and Fanzo 2016)

1.1 Functional Foods and Nutraceuticals

The term 'Functional food' was proposed in for foods that lead to life prolongation, improved wellbeing and prevented some chronic non communicable diseases (Grajek, Olejnik, and Sip 2005).This term originated in mid 1980s in Japan and these foods were termed as (FOSHU)

According to FSSAI, Nutraceuticals are foods that are formulated or developed to meet a certain diet requisite because of some underlying physical, physiologic condition or a disease.(Doyon and Labrecque 2008) They include: 1. Nutrients: Products with well-known nutritional utility, such as amino acids, fatty acids, minerals and vitamins 2. Herbals: Herbs or botanical products as concentrates and extracts.3. Reagent substances manufactured from other sources, serving specific functions, such as diet supplements, weight loss and obesity control supplements, meal replacement sports nutrition. (Tupas, Catherine, and Otero 2020)

1.2 Sustainable Food Systems

Food systems involve various actors and their value adding activities such as production , collection , processing, distribution , consumption and disposal of food products that have origins in agriculture, forests or fisheries in the backdrop of their economic, societal and natural environment .

Sustainable Food systems are engaged in delivering food security and nutrition to all in a way that they are economically, socially, and environmentally sustainable for current as well as the future generations.

Sustainable food systems constitute undeniably important link for the achiving the food security as outlined by the sustainable development goals of the UN.The Global food systems need to be revamped to be more productive , inclusive , environmentally sustianble and able to delved sustainable nutrition to all. This calls for actions at national , regional and global levels.(Food and Agriculture Organization of the United Nations (FAO) 2018)

1.3 Challenges of Food Systems

The challenges current food systems are facing involve growing population and demand for food, urbanization, changing consumption patterns , globalization , depletion of natural resources. Some of undesirable challenges have emerged from rapid developments in the food systems suscch rising consumption of highly processed foods low in nutrition , inadequate access of small scale produce and food enterprises to viable markets, food wastage, food safety, human and animal health, growing energy demands in food supply chains.Tadiditinal food systems focus on food insecurity through supplementing supply of food .Focussing on this factor other root causes of food system inadequacy cannot be ignored. In contrast systems thining incorporates a holisitic view of the food system . Value chain approach uses systems thinking to capture what value each step creates in the food chain.Market systems approach views markt as diverse adaptive systems and tries to explain the systemic constraints to market linkages .Food system approach

A holistic food system considers all elements , sectors, susbsystems , dicisplines , their relationships and related effects.It includes all relevant causal variables and social, environmental and economic impacts of solutions.This helps policymakes to get the bigger picture and promotes multi stakeholder collaboration and poicy coordination.A food system may be sustainable if its activites are economically viable . All stakeholdes must received the economic value added for the like workers, governments, enterprises, and consumers,It is sociall viable when economic vale so created gets distributed equitably. The food system activities must advace socio cultural outcomes such as nutrition , health , albour condition s, and animal welface. The environmental sustainability considers biodiversity , water, soil, animal , plant health , the cabon emissions, water usage , food loss and toxicity.

Figure 1: Sustianble Food Systems
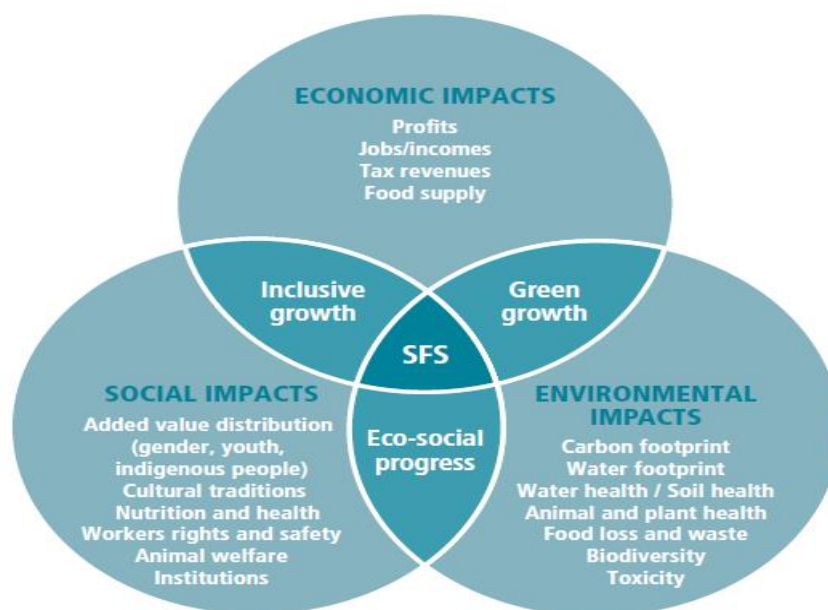
Source:FAO,2018

The food system is conceptualized around FAO's main goals, which include poverty reduction; food security and nutrition. The core consisists of the food products and servces flows via series of activities such as production, aggregation, processing, distribution and consumption, including waste disposal.These activities are supported by societal environment that includes the policies, laws, regulations, laws, cultural norms, infrastructure and organizations. The natural factors supporting these activities include the water , soil, sir climate , ecosystem and genetics.(Food and Agriculture Organization of the United Nations (FAO) 2018)

Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources. Sustainability is not just environmentalism. Embedded in most definitions of sustainability we also find concerns for social equity and economic development.. Sustainability is commonly characterized in terms of the interdependence among three broad dimensions—environment, economy, and society—while considering both present and future generationsWhile Paris agreement has givn the momentum to the reduction Green house gases .These days it is vital to assess the carbon footprint of the products that are consumed

India amongst the middle income countries ranks at 66.4(4th rank) in food sustainability Index but poorly in the sustainable agriculture little over average at 65.5(13 th rank) and in nutritional challenged at 52.5(19 th rank)

Among the various forces shaping the global food systems are degradation of the natural resources, Climate change, U rbanization, Globalization, Consumer behavior, Culture and tradition, Government and policies, conflict and technology. These forces interact and create a complex mesh of a system that further complicated the issues in food systems. Rise of non communicable diseases, food security and wastage, unsustainable means of production and distribution and change of inadequate nutrition for adults and children can negatively impact the global food systems .Among other solutions Technology can lead the way by providing solutions to

1)   Improve efficiency

2)   Introduce more biodegradable materials

3)   Productivity

2.Research Objectives

1.   To critically examine the various technologies and their applications in food systems especially in functional foods

2.   To explore how these technological applications impact the sustainability in functional foods

3. Review of Literature

Bengtsson et .al(2017)Sustainable consumption and production (SCP), may be expressed as two approaches —one focused on promoting more efficient production methods and products (mainly through technological improvement and informed consumer choice) and the other stressing the need to consider also overall volumes of consumption, distributionalissues, and related social and institutional changes. Research shows that while the efficiency approach contains essential elements of a transition to sustainability it has to be in tandem with social sustainability, Ding et al. (2015) Respondents who has beliefs that the health was under their own control has greater propensity towards the functional foods. Higher the trust in the food system lesser were the negative perceptions of GMO foods. Capone et al(2014) reported the connections and linkages between food sustainability and food security. There are very strong linkages between food and nutrition security, responsible environmental stewardship and greater fairness in food management.Galanakis C.M.(2013) Agricultural by-products were considered for many years as undervalued substrates. Nowadays, the urgent demands for sustainability in the food and agricultural sectors led them to be as a source of nutraceuticals. Emerging technologies promise to lead towards broad commercial implementation of emerging technologies in this particular application. Ares and Gambaro (2007) studied that Carrier enrichment interaction is significant and has an impact on perceived healthiness or willingness to try when added to different carriers for functional foods.

4.Research Methodology

According to Guba (1994) the research paradigms can be characterized through their Ontology or What s the reality? Epistemology of research referring to what and how cans the reality or knowledge be known or discerned? Theoretical perspective indicating the approaches that can be used to obtain the knowledge .The methodology, or the procedures and tools are used to acquire the knowledge and finally the sources of data that from where the data may be collected? The sources of data may be primary or secondary. This study is based on secondary sources of data that is the journals, books, research papers, websites and conference proceedings.

5.Stakeholders in Food Systems:

Major stakeholders in functional foods and nutraceutical industries include the food industry; both manufacturers and retailers; consumers; health care sector professionals; and governments. Each has different, but strongly interdependent interests.

5.1 Health Care Sector:

Studies indicate that the trust of consumers is greatest in the health practitioners be it the doctors , nutritionists , dieticians or certified gym trainers . According to the Natural Marketing Institute's (NMI) 2017 Health and Wellness Trends Report, physician recommendation was single most important factor driving consumers towards natural products..Evidence suggests that nutrition plays an important role in disease prevention and management. Globally, the rise in Non communicable diseases that has further necessitated the emphasis on nutiriotn and health . So merely providing better and more healthcare facilities is not sufficient response to the looming threat of Non communicable diseases. While fucntinal foods and nutraceutical markets emerging in the world the science and technology has given birt to nutrigenomics .there are two types of nutrigenomics applications: diagnostic genomics tests and nutritional products stemming from them both with different consequences for consumer acceptance. So practitioners especially in public health looking for promotion of public health and provision of personalized nutrition .

5.2 Manufacturers:

Manufacturers of functional foods and beverages include Abbott Nutrition (USA)Amway Corporation (USA),Archer Daniels Midland Company (USA),Arla Foods amba (Denmark),BASF SE (Germany),Coca-Cola Co. (USA),Monster Beverage Corporation (USA),Danone SA (France),Del Monte Pacific Limited (DMPL) (Singapore),Dr Pepper Snapple Group, Inc. (USA),General Mills, Inc. (USA),GlaxoSmithKline Plc (UK),MaxiNutrition (UK),GNC Holdings, Inc. (USA),Hangzhou Wahaha Group Co., Ltd. (China),Herbalife International, Inc. (USA),Kellogg Company (USA),Meiji Holdings Co., Ltd. (Japan),Natural Products, Inc. (USA),Nestl S.A. (Switzerland),Nestl Nutrition (Switzerland),Otsuka Pharmaceutical Co., Ltd. (Japan),PepsiCo Inc. (USA),The Quaker Oats Company, Inc. (USA),Red Bull GmbH (Austria),Unilever plc (UK),Yakult Honsha Co., Ltd. (Japan) toname a fewas per report "Functional Foods and Drinks: Global Market Analysis, Trends, and Forecasts" 2019.The common applicationsfor technologies for manufacturers are as below.

Table:1. Tehnologies used in Various Processes Accociated with Sustainable Food Syatems

PRODUCTION,	AGGREGATION,	PROCESSING	DISTRIBUTION	CONSUMPTION,
1)Hydroponic Systems 2)Demand management and demand forecasting 3)New Nutritional Products	1_)SRM 2)Raw material segregation	1)Laser ablation 2)Packaging(nanotech) 3)Biosensors 4)Food Pairing Technology 5)Biotechnology	1)Block chain 2)Suuply chain tracing using RFID	1)CRM 2)Cloud technology to reduce waste 3)Consumer Educations

6.Applicatiosn of Technologies in Various Activties in Sustianble Food Systems

6.1. Inventory Control and Planning

The dynamic and complex data of supply chain is difficult to capture and disseminate at different levels in supply chain . Artificial Intelligence techniques such as expert systems is capable of capturing inventory patterns throughout the supply chain in surprising detail. This capability enables inventory managers to accurately forecast the Inventory at each stocking point without causing a bullwhip effect. (Datta 2017)This enables a firm to manage its inventory at a minimum cost and making the whole operation fully sustainable by fulfilling the customer orders timely. For example, expert system at the material requirement planning stage can store data of previous production schedules, bills of materials, and order patterns and then develop systematic lot-sizing rules to estimate the optimal level of future orders and the optimal timing of inventory replenishments.(Conn et al. 2020)

6.2.Purchasing and Supply Management

A make-or-buy decision is primarily concerned with weighing the options of producing goods or services internally or purchasing those from the external sources of supply to better utilise the firm's given resources (e.g., capacity and personnel) .It gives rise to various scenarios that how much output is a company wiling to achieve?The amount and type of investment required by the company the run the business ans provide the services .The risk in developing and adopting the new technologies and the level of competition that is faced in the market.(Barjolle et al. 2013)

6.3 Customer Relationship Management

Since CRM has a profound impact on the firm's profitability, it would be necessary for the firm to assess the costs of sustaining CRM and weigh its benefits against costs. Baxter et al. (2003) proposed an agent-based model that simulated interaction between members of customer populations and business environments in which they were contained. Their agent-based model considered the communication of customer experiences between members of a social network and then incorporated the powerful influence of word-of-mouth reputation on the purchase of products and services. By doing so, it aided the firm in assessing the extent of its return on investment in CRM and enhancing its customer acquisition efforts.

6.4 Supplier Identification

It is a challenge for a nutraceutical or functional food manufacturer to ensure that its supplies are sourced ethically sustainably and in time. A company may e aware of its Tier -1 suppliers but may not be aware of Tier – II or Tier – III suppliers .The risks of reputational damage and business closure are too huge to be ignored under this gap. The brands need to actively monitor their suppliers till the basic standards are met.(Reardon et al. 2019) Globally the attitudes of the consumers towards the socio cultural and ecological impacts of products is growing. For this sustainable approach towards agriculture and Man to nature balance as to "Man–nature balance".(Datta 2017)For these individuals, the sustainable approach to agri-food products was represented by the protection of ecosystems, minimizing the human footprint on the quality and quantity of available water, soil and air. The ecological aspect became a priority for these individuals for the definition of sustainability. Thus Blockhain technology is fining increasing application in this scenario

6.5 Laser Ablation in Food Production Technologies

This work considers the possibility for using laser ablation in food technologies. It was found for the fruits and vegetables under study that laser ablation provided an efficient peeling of the materials while preserving the

organoleptic properties, such as freshness, naturalness, and texture.After a laser treatment of citrus fruit (oranges and lemons), the fruits were peeled and pectin was extracted from the peels via a classical type of extraction in HCl water solution. As a result of the treatment of fruits and vegetables with CO_2 laser, a number of aroma substances were released and they could be captured and used.Industrial relevanceThe work described in this research is relevant to the laser ablation of peeled fruit and vegetables used in food technologies. Laser treatment for peeling fruit and vegetables can be used not only by food processing enterprises, by catering companies and by fast food establishments as a preliminary treatment of fruit and vegetables, but also by pectin producers. There is also a prospect for the application of laser ablation in extracting aroma substances from various materials, as well as in obtaining edible films.

6.6 Food Suply Chain Traceability

Food traceability in logistics arena refers to an application enabling stringent control over the food safety, and quality via capturing, storage and transmission of relevant information in milieu of food , its sources, at all stages of upstream and downstream the channel linkages.Blockchain technology ,originally developed to serve as a ledger for crypt currency bit coin is increasingly finding applications in across fields. Food and beverages industry is witnessing sharp rise in adoption and expansion of this technology with applications such as seamless data integration, credentials of origin and quality of products. Future may behold label that may enable consumer connect with producers using smart digital identifier and even allow interaction and e money.

6.7 Raw Material Segregation

Artificial Intelligence find application in sorting the rawmaterials acoording to size and suitatability of product for further processing or packaging .This can have direct bearing on product quality by utilizing caamers and sensors to generate data that increases efficiency and cuts costs. It utilizes cameras and near-infrared sensors to view food in the same way that consumers do, and sorts it based on this data, saving time and money and improving product quality(Stoica et al. 2017)

6.8 Demand Forecasting

Retailer can increase accuracy of demand forecasting by AI-enabled demand forecasting, enabling faster movement of products the preventing spoilage and food waste. This allows for quicker adjustment in order quantities, fulfillment execution, logistics around efficient transport routes and more in the supply chain, which ultimately reduces waste.(Stirling 2015)

AI leverages artificial intelligence, machine learning and rich data management to help retailers reduce waste and spoilage of perishable goods and prepared foods."

6.9 Demand Management

The nutraceutical supply chain is global and encompasses a wide variety of products. A nutraceutical company may know its tier one suppliers, but might not know its suppliers' suppliers and their suppliers. It's important for companies to do their homework and make sure a reliable IT system is in place to collaborate with all suppliers to ensure good manufacturing practices are in place for all suppliers, as well as ensuring that ingredients are being sourced correctly and timely, and ethically. In addition, real-time visibility throughout the entire supply chain is necessary as well as tracking shipments, inventory and more. Business consulting firm Armanino suggests that an enterprise resource planning tool (ERP) can be useful to track events such as out-of-specification reports, deviations, non-conformances, corrective actions and complaints

6.10 Packaging

As By 2025, the global market for nutraceutical products is projected to reach $578.23 billion (Grand View Research, Inc,2017). Among the growing demand for these products the packaging must also evolve at same pace.

The expanding reliance on e-commerce, the need for products to stand out on crowded shelves, continued demands for sustainability, and advancements in protective properties are all potential game-changers for brands looking to succeed in the nutraceuticals space.(Ramundo, Taisch, and Terzi 2016)

6.10.1.Nanotechnology in Packaging

Several types of nanosensors used in the food packaging industries include nanopaticles based sensors, electronic noses, array biocensors, nanocantilevers, nanoparticle in solution, and nano-test strips. Packaging with nano-sensors is useful to trace the external or internal conditions of food products, pellets and containers throughout the food supply chain. Nanosensors in plastic packaging can detect gases in food when it spoils and

packaging itself changes the color to alert the consumer. Further, film packed with silicate nanoparticles can reduce the flow of oxygen into the package and leaking of moisture out of package can keep the food fresh. It can prevent the growth of mould inside the refrigerator. Sensors have been developed to detect Escherichia coli contamination in packaged foods. Nanotechnology can reduce the packaging waste associated with processed foods and also support the preservation of fresh foods and thereby extending their self-life. He current technology can detect the microbial pathogens in food products in 2 to 7 days. In addition, it is used for detection of toxin, pesticide, and spoilage [4]. Nanotechnology would be used to manufacture smart packaging for extending shelf life of the product and enable it to transport even further. Smart packaging containing nanosensors and antimicrobials is being developed to detect food spoilage and release Nano antimicrobials to extend shelf life, enabling supermarkets to keep food for even longer periods before its sale [6]. Attempts should be made to develop low cost packaging by using nanotechnology.

6.11 Cloud Technology In Reducing Wastage

Waste is one of the top issues when talking about food sustainability. In the European Union only, nearly 90M tonnes of food are spoiled annually. Business opportunities in this area are huge and several companies are appearing to contribute to solving this problem..Nima sensors are being used to construct the data sensors that can ensure tracing of food and reducing wastage.(Lehmann, Reiche, and Schiefer 2012)

6.12 New Nutritional Ingredients And Products

. As consumers increasingly focus on digestive issues and increasing gut health, Packaged Facts said they have gravitated to fermented and probiotic-rich foods and beverages like yogurt, Kefir, kombucha, and kimchi. While cereal is not in this realm, cereal makers have joined some in other food categories that are incorporating probiotics and other gut-healthy ingredients into new products.(Gruenwald 2009)

6.13.Quality Delivery

Food can be understood as sensory stimulus with certain physicochemical characteristics that are function of ingredients, processing and storage .Hence , foods fall under preview of technology and food science . The food related expectations of consumers can be narrowed to its sensory as well as hedonic qualities. In other words the consumers expect food to be having certain sensory attributes with respect to appearance, temperature, taste, texture and aroma . (Hobbs 2002)In addition it is expected the food shall be liked or disliked to certain extent. (Costa, Garcia, and Ibanez 2007)Thus functional food and nutraceuticals companies have to ensure the products sensory and hedonic attributes vary only slighty or moderately from the consumer expectations .(Bureau International Markets 2010)In order to meet this challenge nano technology applications such as Nanoporous membranes, nano fibers and nano crystals that can be employed in food processing to improve food texture.Nanocapsules and nano-emulsions for nutrient delivery and active packaging that is antimicrobial or provides sustained release of the antimicrobials to improve the shelf life of product .(Mihindukulasuriya and Lim 2014) Nano-particles and nano-coating that can ensure food safety using sensor and intelligent packaging technology can further address concern of increasing food shelf life.(Jezewska-Zychowicz and Królak 2015) This adds to sustainability by improving bioavailability of adequate nutrition , prolong shelf life protects functional food ingredients .Another challenge being faced is over nutrition in affluent class s and nutritional deficiencies in the underprivileged. Relatedly, thinkThin's new line of protein and probiotic hot oatmeal promotes overall wellness and digestion with 6g of fiber, 10g of protein, and 1 billion CFUs of live probiotics. The oatmeals are non-GMO, gluten-free, and have no artificial flavors or sweeteners.

6.14 Consumer Awareness

Consumer education is very important tool that digital technology through mobile apps and social media can provide necessary awareness for importance of nutrition and reucing food waste. Digital technologies offer a way of delivering this education efficiently and cheaply. As consumer preferences change the demand for earth functional foods will increase leading to more environment friendly sustainable manufacturing and such products. Driving forces shifting the interest in food tech include climate change, digitalization opportunities, as well as health-focused consumers. The reality of climate change and its global impact is fostering innovative startups eager to make change. With the rapid evolution of technology, digitalization opportunities - in a traditionally low-tech, complex industry- open a variety of applications to the global chain. An increase in desired wellness has also resulted in changes in consumer diets, facilitating the rise of vegetarianism and veganism..

6.15 Food Education and Communities

Food awareness and education is a skyrocketing trend and more and more organizations are getting the importance of creating "food hubs and online communities" around the world, which are eventually connected.

Knowledge is proving to be one of the most impactful weapons to shape a sustainable system.(Vella et al. 2014)Short food supply chains involve very few intermediaries, boost the rural economy, create new ways of selling local products and attract new types of customers. This seems essential in the face of our rising global population.(Food and Agricultural Organization of the United Nations 2009) Companies who are trying to make it as easy as possible for the final customer are popping up, tackling the issue from different perspectives.

6.16 Foodpairings.

Deep learning technologies by combining two recurrent neural networks (RNNs) were used by , Dodo Pizza AI to find non-obvious connections between pizza ingredients, understand how to pair ingredients and how the presence of each influences the combinations of others.Gastrograph AI uses machine learning and AI to understand consumer's sensory perception of flavor and predict consumer preference of food and beverages (In is crucial when talking about nutritional sustainability. An interesting example in the space is Foodpairing. Working with aromas (80% of what we call taste is actually aroma) they are able to profile specific ingredients through gas chromatography coupled mass spectrometry (GC-MS), and pair them through data analysis and machine learning. The goal is to empower everyone to make the best food choices in terms of taste and nutritional value.

6.17 Food Sensors

Until now, labels were giving information about origin ingredients, ignoring the result of cooking processes. Massive public and private structured-data infrastructures have been built around the medicinal value of drugs, while the role of food, diet, and lifestyle has been largely undervalued. The scene is quickly changing. The democratization of nutritional information is here to stay. The final goal is to achieve food security and knowledge to the largest scale possible, both leveraging on sensors, analysis system and applications such as Tellspec or Scio, detecting the presence of specific nutrients — such as gluten in Nima Sensor — and building data infrastructures to create a world common food-print

6.18 Bioinformatics

Food is increasingly associated with the world of health. From probiotic beverages to functional food, edible solutions that help prevent or cure various pathologies are quickly emerging. It is called bio-informatics trend and the goal is to unlock food sources, providing natural, sustainable and scientifically proven health solutions. Nuritas is doing that in Ireland using artificial intelligence and DNA analysis; Chloè Rutzerveld's Digestive Food project designs food in service of the digestive system, using digital fabrication. The design of a new food system plays a crucial role in minimizing food consumption while maximizing its nutrient injection.

6.19 3d Food Printing

Different from robotics-based food manufacturing technologies (which are designed to automate manual processes for mass production), 3D food printing integrates technology and digital gastronomy techniques to manufacture completely customized food products. This introduces countless opportunities: from streamlining cooking activities (like what Natural Machines is doing with Foodini, the first 3D food printer) to producing new shapes impossible without these techniques (like what TNO is doing with pasta), to leveraging precision nutritional opportunities.

7 .Conclusion

Increasingly Technological environment is undergoing changes with disruptive technologies changing the way functional food systems operate. They bring increased efficiency by solving issues of responsible resource usage, distribution, spreading consumer awareness and cost savings translating to environmental social and economic impacts of sustainability . However issues like higher cost , overdependence on technology and ethical usage remain areas of concern.

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