

Values in Food Processing Technology – Historical and Recent Innovations in New Product Development

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Abstract:

The values that people hold are the most important factor in deciding whether they endorse sustainable development. At the same time value orientations are likely to change over long time periods. The evolution of food science over the centuries has resulted in the development of various food processing technologies to ensure nutritious, fresh, and safe food. Modern times, however, bring new challenges and it is not easy to distinguish between what is good (or what is still acceptable) and what is not; for example, genetic engineering, experiments on humans, polluting the environment and lives in excessive wealth. Among the findings, the article highlights how the concept of food values has evolved to accommodate the features and behaviors of specific markets. Nonetheless, one can group food values into three distinct clusters. This review provides an overview of the development and invention of technology to the present.

Keywords: Food Processing, Innovation, Food Cultural, Practices and Values.

Introduction:

The values that people hold and base their conduct on are probably the most important factor deciding whether they do or do not endorse sustainable development. At the same time, this factor is also the most difficult to grasp (Paval, 2013). Value orientations are likely to change over long time periods (decades to hundreds of years). The set of principles and rules that indicate to people how they should behave in their interaction with others is called ethics. Ecological ethics, or rather environmental ethics, is the set of principles and rules that indicates to people how they should behave in their interaction with the entire non-human world (Kohak, 1998). Innovation is essential to gaining a competitive advantage and creating value, and its outcomes can be both tangible (Sam, 2011). Product innovation could be a differentiating major success factor in today's aggressive and competitive food markets (Suwannaporn and Speece, 2010). Innovation is frequently driven by pressure from the external environment so that the company adapts its behavior and organization so as to maintain or improve its performance and relative position. The external factors that most pressure the company are competition, deregulation, scarcity of resources and customer demand (Dmanpour and Schneider, 2009). The practice of food processing is likely to have existed for a very long period among archaic humans from the early and middle Pleistocene periods (Huebbe and Rimbach, 2020). Adapting food systems for a growing population from farm to fork is essential for ensuring nutrition and consumer satisfaction (Misra et al., 2016; Akhila et al., 2022). Innovation in the food sector faces higher challenges than some other areas. Food neophobia, which is the fear of new foods, is such an example. Although this is a phenomenon with particular expression in children, for some people food neophobia persists into adulthood, and thus forms one dimension of the overall consumer population (Guine et al., 2016). While consumer research and marketing have paid special attention to those interested in new products, the neophobic consumers must not be neglected during the new product development process and marketing studies (Guine et al., 2013; Henriques et al., 2009). Food processing means operations used on raw materials

obtained from plants or animals into various food or food ingredients. The food sector—one of the largest sectors in world economies—encompasses a complex network of activities related to the supply, consumption, and catering of food services. As one of the world’s most dynamic sectors, food undoubtedly plays a key role in the economic development of any nation (Eccles, 2021; Sadiku et al., 2019). In this regard, it is important to highlight the variables that influence consumers’ food-related decision-making processes (Opeyemi et al., 2022). Indeed, businesses in the sector need to properly tailor their products, marketing strategies, and business models around consumers’ constantly changing needs, desires, and demands. For this reason, one whole research stream is devoted to assessing how consumers behave in response to operators’ food strategies (Garber et al., 2003; Lusk and Briggeman, 2009; Logue, 2015; Martinez-Ruiz and Gomez-Canto, 2016). Since agriculture and animal husbandry were established postharvest procedures and are necessary to preserve for a longer time the increasing food supplies getting from fields and domesticated animals. Food is one of the best culture mediums for many microbes that causes spoilage to the food and prevention of food spoilage whether it is caused by microbes and/or enzymes is very essential (Vitale and Schillaci, 2015). In this vein, the concept of food values, first proposed by Lusk and Briggeman (2009), offers a useful framework for understanding these decisions. Their work represents a landmark contribution in the relevant literature. The authors proposed a food values scale, which expresses abstract attributes that can explain consumer purchases over time. According to this view, consumers base their product choices on a set of inferred food values, which often encompasses numerous physical attributes simultaneously, such as naturalness, taste, price, safety, convenience, nutrition, origin, fairness, tradition, appearance, and environmental impact. Lusk and Briggeman’s (2009) work led to an influx of academic papers that have investigated the concept of food values from various perspectives.

Values Compatible with Sustainable Living

Josef Vavroušek (1993) attempted to define a framework of key values that are typical for an industrial society and stimulate the emergence of global and regional problems. He assigned alternative values to them, which should be compatible with a sustainable way of life.

Post- harvest Losses:

The benefit of India’s large agrarian base remains untapped due to inadequate processing facilities and infrastructure. The processing of cereals and fruits and vegetables is quite low (1%-2%). The post-harvest losses are quite huge. According to a report on “Assessment of Quantitative Harvest and Post-harvest Losses of Major Crops and Commodities in India” by CIPHET the wastage is almost INR 920 billion (USD 13 billion) per annum. Such losses have implications for other associated losses.

Malnutrition:

Despite rapid economic growth and Food Security, hunger and poverty still persist in India. India houses 25% hungry and poor population of the world! Enough food availability does not translate to access of sufficient nutrition. More than 70% of Indian population consume less than 50% of the RDA of micronutrients. Food wastage is a significant contributor to malnourishment and hunger.

Technological Development History in Food Science:

As humans became more energy-demanding, thermal processing became increasingly important (Truninger, 2013). There is evidence of opportunistic fire from 1.8 million years ago in Africa and Eastern Asia, albeit interpretations of the excavations are controversial (Huebbe and Rimbach, 2020). Traditions to ferment food, bread, and cheese evolved along with grain cultivation and early milk production. There is archaeological evidence that beer brewing and bread making began approximately 14,000 years ago, while cheese making began approximately 8000 years ago in Europe (Liu et al., 2018). In 1810, Nicholas Appert invented canning, becoming a major advance in food science (Misra et al., 2016). Napoleon Bonaparte found a need for thermally preserved food for his soldiers during lengthy sea voyages. He offered a reward to any scientist who could come up with a food preservation method. Leistner introduced the hurdle concept in the literature, and the same author published the hurdle technology in 1985.

Food Processing:

Food processing industries help in checking post-harvest losses, provide food and nutrition security, allow enjoyment of food over longer shelf life. enable consumers across the world to enjoy foods sourced from anywhere, ensure safety of food products and empower women as they have to spend less time on cooking. It is possible to address some of the health issues like malnutrition, celiac disease, IBS etc. through processed foods. The size of food processing industry is about INR 5.1 trillion and it is growing at the rate of about 17.8%. However, the share of processed food industry in total food consumption in India is 32% only. With change in lifestyle this is likely to go up. Food processing is required to increase shelf life of foods, enhance bioavailability of some nutrients and quality, and reduce the postharvest losses and waste (Floros et al., 2010; Johnston et al., 2014). Since prehistoric times, food processing has been a key aspect of the food production chain that links agricultural production with the provision of food to people in the form and at the time it is required (Floros et al., 2010). Some of the common industrial processes used in food manufacturing include milling, cooling/freezing, smoking, heating, canning, fermentation, drying, extrusion cooking. Processing causes changes to the components of food and some of these changes can result in both detrimental as well as beneficial effects on the food quality, depending on the process used (Radha et al., 2022).

Preservation by control atmospheric / Modified Atmospheric techniques:

The storage of fresh foods has been extended by changing the gas composition inside the container in direct contact with the food. For short shelf-life products susceptible to chemical or enzymatic degradation, like oxidation, and shelf life of products can be extended by evacuating oxygen from the package (Floros, 1990).

Food and Nutrition value:

A better understanding of the molecular alteration during food processing and the resulting nutritional and safety consequences is needed to optimize advantageous effects such as bioavailability, food quality, and food safety, and to minimize the development and facilitate the inactivation of deleterious compounds (Augustin et al., 2016). Food processing/cooking can have significant effect on the carbohydrates too. Some polysaccharides get hydrolyzed and it may also alter the rate and extent of digestion of starch and dietary fibre during the processing. Food processes like heating and frying lead to polymerization of fats and oils that

leads to change in molecular weight, color, refractive index and viscosity of the fat and oil used. Processing can alter the solubility of the fibre by dropping its molecular weight, enzymatically or mechanically, such as during extrusion by applying different shear forces (Lue, et al., 1991; Quaglia, and Carletti, 1995; Esposito et al., 2005; Napolitano, et al., 2006). The subject matter “food values” appears to have been discussed using concept papers and review papers. In addition, qualitative and quantitative analysis techniques have been utilized to disseminate the existing knowledge. The conceptual paper by Dagevos and van Ophem, (2013) provided a consumer-centered conceptual framework to elucidate the sets of food values as postulated by Lusk and Briggeman (2009). Martinez-Ruiz and Gomez-Canto. (2016) analyzed the most important external influences that consumers may encounter in food shopping environments. With a spotlight on the COVID-19 pandemic and the meat supply sector, Hobbs (2021) highlighted that consumers’ underlying influences may shape their reaction to vulnerability during a pandemic, which is a lesson for food manufacturers looking to proactively delineate the weaknesses inside their production framework. Atkinson, and Alaimo, (2019) focused on a group of vegetable gardeners to discuss what values influenced their decision to harvest more vegetables from their gardens rather than purchase them from the grocery store. Shahriari et al., (2019) deviated from Lusk and Briggeman (2009) and Bazzani et al., (2018) by finding that the strongest predictors of attitude toward purchasing organic food were naturalness in the US and price in Iran. Likewise, other authors Silva et al., 2019) found that consumers ranked taste, nutritional value, price, and appearance as more influential over their purchasing decisions than sustainability attributes related to production and origin. There is a study that explains how food values and other variables related to dietary acculturation influence purchasing decisions of foreign students in Spanish universities (Tirelli et al., 2013). This study revealed that, although these factors had a significant influence on purchasing decisions, there were some differences depending on the geographical origin of foreign students. In another study focused on the Czech Republic, consumers were revealed to devote more attention to the nutritional value and the composition, as well as the food’s origin (Jezovicova et al., 2017). Finally, in a comparative study of imported fruit preferences between Japan, Taiwan, and Indonesia, food safety certification and freshness appeared to be the first and second most important food values for the majority of those consumers (Yang et al., 2021). To conclude, in a case study focused on the contingent of Australia (Oceania), the authors showed that university students treated taste, cost, and convenience as the greatest determinants of food choice (Tam et al., 2017).

Emerging technologies

Based on earlier literature, food processing, manufacturing, and packaging have been advanced and rationalized to an unprecedented degree in food sectors (Navaf et al., 2022).

Allergens and Food Processing:

A variety of allergens related to various foods peanuts, tree nuts, cows’ milk, hens’ eggs, soy, wheat and mustard have also been reviewed. Bu et al. (2009) found that IgE-binding by α -lactalbumin and β -lactoglobulin increased significantly after pasteurization at temperatures between 50 and 90 °C, compared to non-heated milk, by means of indirect competitive enzyme-linked immunosorbent assays (ELISA). Allergenicity of soybean and products exists that it may be reduced or retained by food processing, but yet there has been no indication for

increased allergenicity due to food processing (Yang et al., 2010; Cuadrado et al., 2011; Takacs et al., 2013; Ladics et al., 2014). Apart from highly refined soybean oil and other soybean products in which the level of soybean proteins is reduced below clinically relevant levels, one-step processing may not fully abolish soy allergenicity. Allergens involved in wheat food allergy were identified among the different wheat protein fractions. A combination of physical- and thermal treatment can suppress allergenicity of mustard seed allergens by extracting the potential allergens from oil. Edible oils that are bleached and deodorised are devoid of allergenicity (Palomares et al., 2005; Jyothi et al., 2007; Lee et al., 2008).

Enhancement of Nutrition in Food Processing:

The fortification, enrichment and supplementation of foods with some basic nutrients during the processing have beneficial effects on population health. The shelf-stable encapsulated fish oil ingredients have been enabled by Sanguansri et al. (2015) into a wide range of food products including infant and toddler formula, breads and baked goods. Processing like fermentation and sprouting etc. also enhance the bioavailability of some nutrients of the food like iron, vitamins etc.

Detoxification Treatments during Food Processing:

Several processing techniques of established (mostly physical treatments) have been in use as mycotoxin reduction form a long time. Mycotoxin mitigation methods currently related to human food. Detoxification of mycotoxins can also be done by various enzymes (He et al., 2015). Detoxification of grain mycotoxins during food processing has recently been reviewed (Kaushik, 2015).

New Food Processing Technology Quality, Nutrient Contents and Environment:

Important characteristics of the food that determines the marketability of the products, such as appearance, texture, taste and nutritional content are strongly influenced by the method used for processing foods. Some of the non-thermal food technologies like High Hydrostatic Pressure Technology and Pulsed Electric Field (PEF) Processing Technology have the advantages of enhancing the safety, quality, nutritional, and functional properties of foods with minimal deleterious effects on their nutritional and organoleptic characteristics. A combination of processing technologies can be used for higher benefits. Conventional animal agriculture poses substantial threats to human health, the environment, and animal welfare. It is a leading cause of environmental destruction – including deforestation, ocean dead zones, and water and air pollution – and contributes more greenhouse gas emissions than the entire global transportation sector.

Technologies have been developed for reducing sugar and salt in food and beverages. While products providing umami flavor can be used to reduce salt while still retaining the taste, high intensity sweeteners can be used as substitutes for sugar.

Product Innovation:

Consumer-driven food and beverage innovation, which designs products to meet consumer needs, can be achieved through a company culture focused on the consumer and by applying appropriate consumer input throughout the innovation process (Kemp, 2013). Co-innovation involves cooperation and integration of existing knowledge from different organizations across food supply chains. Estrada-Flores (2010), discusses the advantages of using a concerted approach to food co-innovation, and how this approach should recognize the highly dynamic

nature of the food manufacturing industry, the benefits of market driven innovation and the usefulness of policy as an instrument to encourage innovation.

Consumer and sensorial acceptance:

A well-established and long-standing program of research on sensory analysis and consumer acceptance of foods supports the R&D activities in the food sector (Meselman and Schutz, 2003). Recent research has been focused on the study of the intrinsic and extrinsic factors that influence consumer acceptance of both 9 conventional and novel foods, including the role of sensory, cognitive, and situational variables (Cardello et al., 2000; Cardello, 2003). Sensory evaluation is often described like a scientific method used to evoke, measure, analyze and interpret those responses to foods as perceived through the senses of sight, smell, touch, taste and hearing. Sensory characteristics comprising appearance, odor, flavor and texture are included within the important attributes that contribute for the perceived quality of food products Guine et al., (2010). For food scientists to perform tests that will accurately predict consumer behavior at the point of purchase, it is necessary that they include in their experimental designs a certain set of marketing variables in their experimental design specifications, to assure that the right consumers will respond appropriately to new products Garber et al., 2003).

Innovation in Food Industrial Sector:

Many studies have been implemented on the consumer acceptance of food innovations, particularly related to technology-based innovations in many areas and also within the food area, with some recent technology-based innovations having been adopted easily and others essentially rejected by consumers (Cardello, 2003). Ronteltap et al., (2007) have presented a conceptual framework for consumer acceptance of technology-based food innovations, according to which the consumer decision to accept or reject the innovation is determined by the intention to use it. Radio frequency (RF) heating involves electromagnetic energy at a frequency range of 1–300 MHz. This electromagnetic energy can be converted into heat in foods (Jao et al., 2014). The heating by RF is directed to the product and not to the surrounding air, whereby the interior of the food heats up faster than the surface and thereby promotes the release of water from the interior of the food without overheating or dehydration of the surface. Pedersen et al., (2016) investigated the use of OH for processing of shrimps, for different field strengths and salt concentrations of the brine solution, and their results showed that ohmic heating could be used as a unit operation for the shrimp processing industries without affecting the texture and other quality attributes. Industrial implementation of pulsed electric field electro-technology (PEF) for food preservation has been rather slow, despite its potential to produce safe, nutritious and high-quality products (Gongora et al., 2002). Pandrangi et al., (2014), refer that High pressure processing (HPP) holds the potential for preserving foods by a combination of elevated pressures and moderate temperatures over a short period of time. They discuss the effects of HPP on selected ready meals, salads dressings and dips. High pressure processing can inactivate yeasts, molds and most vegetative bacteria including pathogens, while having a minimal effect on compounds with low molecular weight, such as flavor compounds and vitamins. Regarding the influence of HPP on color, it varies between a full retention of the fresh color and color change similar to thermally processed foods, depending on the product. Pulse light technology is an emerging nonthermal process that has a

considerable potential to be implemented in the food industry for decontaminating food products, food packaging materials and water (Baranda et al., 2012; Lasagabster and Maranon, 2013; Lasagabster et al., 2011; Levy et al., 2012). Paniwnyk, (2014) reviews the most recent uses of Ultrasound processing Technology in the food industry. The potential use of this novel technology to produce permanent changes in the material is discussed with respect to liquid systems. Edible biopolymer coatings and films provide an additional protective coating for fresh products and also give equivalent effect as modified atmosphere storage by modifying internal gas composition (Park et al., 2014). Genovois et al., (2016) applied edible coatings to pumpkin fortified with iron and vitamin C and observed an improvement in the overall quality of the product, which was microbiologically safe and showed reasonable color and textural properties. Active, as well as intelligent, packaging systems are continuously evolving in response to growing challenges from a modern society. Realini and Marcos (2014) review the different categories of active and intelligent packaging concepts and currently available commercial applications, the latest packaging research trends and innovations, and finally the growth perspectives of the active and intelligent packaging market. Nanotechnology can extend and implement the principal packaging functions – containment, protection and preservation, marketing and communications. Applications of polymer nanotechnology can provide new food packaging materials with improved mechanical, barrier and antimicrobial properties, together with nano-sensors for tracing and monitoring the condition of food during transport and storage (Silvestre et al., 2011). Siegrist et al., (2007) evaluated the influence of affect and trust on public acceptance of nanotechnology foods and food packaging. Overall, the participants in the study were hesitant to buy nanotechnology foods or food with nanotechnology packaging.

New trends in Healthier Foods:

One of the most radical revolutions in the culinary industry has occurred in the last two decades, due to the knowledge and practices promoted by the avant-garde movement commonly called “Progressive cuisine”, “techno–emotional cuisine,” “molecular cuisine” or even “Modernist” cuisine (Pilar, 2012). Vega and Ubbink, (2008) note a distinction between molecular gastronomy and science-based cooking. Whereas the first relates to the scientific understanding of the cooking and eating processes, the latter refers to the application of the principles and tools from science for the development of new dishes, particularly in the context of haute cuisine. In developed countries, typical diets have been evolving towards highly caloric foods, rich in saturated fats and sugars, which have been associated with a number of chronic diseases (Sisson et al., 2016; Beilharz et al., 2016). The functional foods and nutraceuticals have been given considerable attention these past decades, as means to improve nutrient intake as well as the ingestion of compounds with bioactive effects beneficial for the human health (Smith and Charter, 2010; Dewapriya et al., 2014). Presently, the functional food and nutraceutical industries represent the most dynamic natural product-based segment in the food sector, evolving towards a more research-oriented patterns, similar to pharmaceutical industries (Dewapriya et al., 2014; Schieber, 2012).

Food and Cultural Studies traditions:

Existing food studies credit food consumption for a vast array of cultural process from the reproduction of a stable society (Lupton, 1996; Goody, 1982), the decoder of the unconscious

attitudes of a society (Levi Strauss, 1994), of nationality (Barthes, 1967), as an indicator of class (Mennell et al., 1992; Bourdieu, 1984), social significance (what is important in a given society) (Douglas, 1982), to the relation of food in feminist studies and body shape (Adams, 1990). A study by Giddens (1991) takes a wider view, outlining that the agency of consumers is emphasised over both the social and economic structures in which they find themselves, and this is a crucial means of establishing an individual's identity.

Food Economy:

The framework of a "New Economy" based on cultural values with labels such as Experience Economy or Dream Society has been launched during the last decades. We will discuss some of the major writings in order to define their usefulness for understanding an emerging "New Food Economy with cultural production of added value as a common denominator. concept discussed by Pine & Gilmore in 1993, they outline the construction of experience 'spaces' as key in the eliciting of emotion for economic gain. In this world, no one sells mere commodities they sell 'lifestyles. That the spaces Producers develop to sell their products are in part to create emotion further embeds them in the experience economy (Rebecca et al., 2013).

Conclusion:

We may perhaps say that we must strive for a substantial change in our value orientations and lifestyles if we want people in the future to have the chance to live their lives with dignity, quality and creativity. We are still 'hungry' for a higher material standard of living. Innovation through the creation, diffusion and use of knowledge has been recognized as a key driver of economic growth. Innovation through the creation, diffusion and use of knowledge has been recognized as a key driver of economic growth. In the food industry, like any other industry, product and process development is considered a vital part of a smart business strategy. To the best of our knowledge, this review is one of the first studies to assess the evolution of the food values concept. It is not surprising then that the applications of this research are numerous and diverse. Among others, these include new foods' development, food manufacturing, and selling. There is no doubt that this greater knowledge about food values can enhance all of the processes, operations, and activities included in the complete value chain. The author uses the concepts of "re-socialization" and "re-localization" of food in order to express the public intervention in the food production and distribution chain, with the purpose to maintain the traditional knowledge and to solve the food anxieties. The performance of many traditional food processing techniques reaches its maximum capacity during a time when consumer demands expand, and regulations related to food and environmental sustainability are increasingly strict. Modern food production/processing industries and the society seem to be facing tough trade-offs. Decrement and recovery of food losses throughout the food chain from production to consumption and improvements in preservation, transportation, nutritional content, safety and shelf life of foods will be key strategies to combat food and nutrition demands of the future. The main aim is to improve health of the consumer and to achieve healthier ageing for the population. The paper is an original insight into the food system in a globalized world, bringing into our attention hard topics and offering solutions to what is now only the first phase of the food crisis.

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