

AMURCON 2021
AmurCon 2021: International Scientific Conference**CLASSIFICATION DEVELOPMENT OF INNOVATIONS IN THE
FOOD INDUSTRY ACCORDING TO CONTINUITY CRITERION**

Alexey V. Aleshkov (a)*
*Corresponding author

(a) Khabarovsk State University of Economics and Law, 134, Tihookeanskaya St., Khabarovsk, Russia,
aleshkovalexey@gmail.com

Abstract

The possibility of applying the innovation continuity criterion for the classification of innovative food products is shown, which is important for the further development of the theoretical foundations of innovation management, commodity science, food technology and biotechnology, allowing to streamline the array of innovations and determining the main vectors of further innovative development of food industry enterprises, including reserves for commercialization of the designed products. By the developed and substantiated classification, food products obtained by genetic engineering, synthetic biology, nanotechnology, in vitro, 3D and 4D printing methods, molecular cuisine products, innovative types of packaging for the food industry, the vast majority of food additives, analogues, substitutes for imitation of traditional food products. Substitute innovations include fortified and specialized food technologies, the use of traditional ingredients with new types of raw materials. Cancelling innovations include certain names of food and biologically active additives withdrawn from circulation after receiving additional information about their safety. The position of attribution of biologically active additives (dietary supplements), organic crop production, animal husbandry, beekeeping and functional food products to the innovations of the return type is explained. Confessional food products are classified as retro innovations. During the research, such logical methods of scientific cognition as analysis and systematization were used. The practical significance of this study is to simplify the problems with reporting for food industry enterprises, opening up further opportunities for identifying innovative food products.

2357-1330 © 2022 Published by European Publisher.

Keywords: Classification, Continuity, innovative food products, innovation

1. Introduction

The generation of new knowledge in the field of food technology is closely related to the innovative development of the food industry, associated with high-tech processing, involvement in the circulation of new types of raw materials and secondary resources, the introduction of bio-, nano- and organic technologies, expanding the range and intensifying the production of enriched, specialized and functional food products with desired characteristics, as well as readiness for technologies that have not yet received public recognition (Aleshkov et al., 2020a). An impressive arsenal of innovations introduced in recent years in the food industry has caused an urgent need to streamline the array of these data, since so far in the literature sources available to us, including fundamental works in the field of food technology, biotechnology, commodity science, on the one hand, and, innovation management, on the other hand, innovative food products and technologies are not comprehensively described and systematized.

This situation leads to several difficulties not only in the reporting of food industry enterprises but also in the direction of the general awareness of consumers about modern food products and technologies. The absence of the food industry in the list of priority areas for the development of science, technology and technology, and in it - a clear classification system for innovative food products, leads to a misunderstanding of the essence of the object (food products) as an innovation, and also makes it difficult to teach the relevant sections of the disciplines "Innovative technologies in the food industry", "Food technologies", "Theoretical foundations of commodity science", etc. in higher educational institutions. The most acceptable method for achieving this goal is classification, that is, the division of a set of objects into subordinate subsets based on their similarity or difference.

1.1. The concept of innovative food products

The basis of the developed classification of innovative food products was based on accumulated knowledge about current trends in the development of its assortment abroad and our country. The classification is based on the terms given in the technical regulations of the CU, the EAEU; and in their absence, the author's definition of concepts based on domestic and foreign experience is proposed (Bigliardi & Filippelli, 2022; Guerrero et al., 2022; Rosenthal et al., 2021).

In our study (Aleshkov et al., 2020a), a definition of innovative food products is proposed – new or significantly improved food products introduced to the market, including food products of a new type, in the production of which new or improved technologies were used (Figure 1).

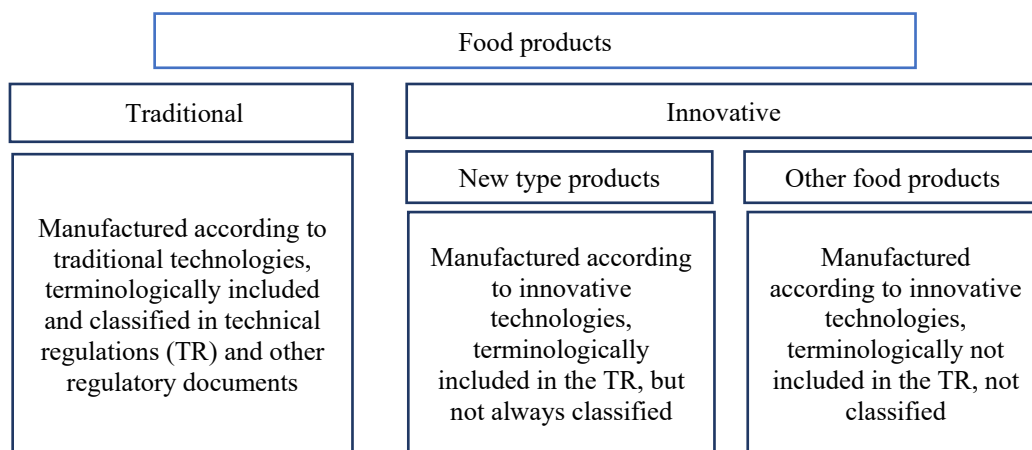


Figure 1. The place of innovative food products among food products

It is shown that it includes both new names of food products (product innovation) and the result of a new or significantly improved technological process (process innovation)-figure 2.

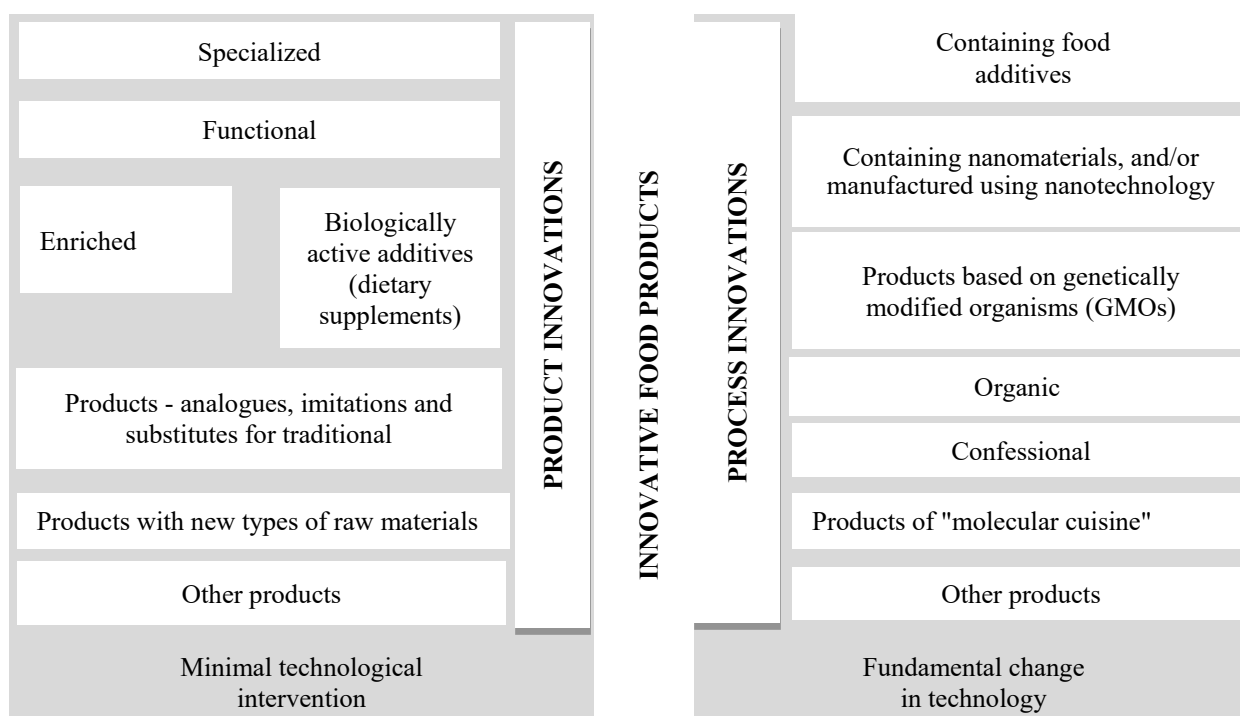


Figure 2. Classification of innovative food products by areas of application of innovations (Aleshkov et al., 2020b)

1.2. Relevance of the proposed study

Statistical data show that the volume of food production in 2020 in the Russian Federation amounted to 5.65 trillion rubles, including 268 billion rubles of innovative food products (Figure 3).

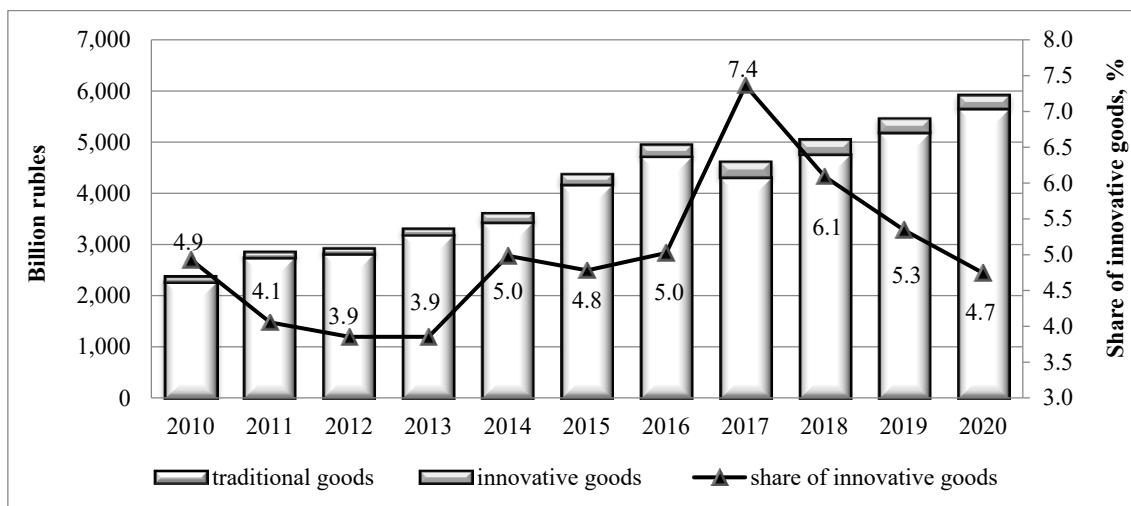


Figure 3. The share of innovative products in the structure produced by the food industry of the Russian Federation in 2010-2020. (Nauka i innovatsii..., 2020)

The weighted average share of innovative food products in the total volume of goods produced by the food industry of the Russian Federation during the observation period is 5.2%. This is significantly lower than the indicators observed in the automotive (30.3%), aerospace (22.3%), medical (21.4%), electronic (13.3%) industries.

The need to develop a classification of innovative food products is caused by the following reasons:

1. The lack of clear terminology about innovative food products. The development of the classification will lead to the need to define the terms used in this area.

2. The essence of classification as a theoretical method of cognition is the systematization and ordering of accumulated knowledge in a certain area. Therefore, the development of a classification system for innovative food products is conceptually conditioned by the need to streamline the array of product and process innovations accumulated in a particular industry - the food industry, as an element of the development of the theoretical foundations of innovation management and food technologies.

3. Systematization of innovative food products makes it possible to determine the main vectors of further innovative development for food industry enterprises, including showing reserves for commercialization of the designed products.

4. Solving problems with reporting for food industry enterprises and the industry as a whole. By Rosstat Order No. 391 dated 05.08.2016 (Prikaz Rosstata ..., 2016), organizations engaged in manufacturing industries (including the food industry) report annually on Form No. 4-innovation (small enterprises report once every two years on Form No. 2MP-innovation). The most significant disadvantage of consolidated statistics on innovations in the food industry is the indication in these registers of innovations at the local level (that is, innovations first applied at the level of the reporting firm), even if this innovation has been widespread in the market for a long time. This leads to a visible increase in the level of innovation due to "double counting" in the whole country, without reflecting the real picture of their implementation at the industry level. The second problem is the lack of clear criteria for identifying innovative food products.

5. Realization of the right of consumers to education in the field of consumer protection. The development of a classification system for innovative food products with a detailed description of innovations will allow consumers to better navigate when choosing a product.

2. Problem Statement

Before our study (Aleshkov et al., 2020b), there were no unified approaches to the classification of innovative food products in the domestic and foreign literature, and the existing ones were based on traditional criteria for the classification of food products, developed primarily by Nikolaeva (2022).

The classification of food products by Nikolaeva (2017) was based on the criteria of destination and origin of goods, which is not clearly distinguished in the educational literature but is crucial for the classification system. Food products are divided into vegetable (grain, fruit and vegetable, flavouring, sugar, starch, confectionery, oils and margarine products), animal (fats, meat, fish, dairy, eggs), combined (baby food products are singled out separately as a specialized element, food concentrates) and auxiliary products (food additives). Other classification criteria are not considered, therefore, today its author also notes the imperfection of the classification of goods developed by her (Nikolaeva, 2017), associated with the absence of certain types of innovative food products, not always consistent with the latest changes in the regulatory framework, with international experience. Thus, in this classification there was a place for combined and specialized (partially, as a group of combined) innovative food products, as well as food additives classified as auxiliary goods, however, for example, functional and enriched food products were not included in it.

Therefore, in our study, it is proposed to consider the criteria for the classification of innovative food products through the methodological apparatus of the theory of innovation management. The classification of innovative food products by application areas was developed earlier and presented in paragraph 1.1 of this article. In the proposed study, a classification of innovative food products has been developed according to the criterion of continuity of innovations by Prigozhin (1989).

From the standpoint of the system-activity approach of innovation management, groupings of innovations on various grounds should not only specify the structure of the object under study but also identify problematic links between them, defining a new subject of study. According to Prigozhin (1989), the problematic nature of such relations is the main result of the undertaken systematization, and the most optimal way to achieve it is to divide the set of innovations into subsets according to the criterion of continuity, that is, into the opening, replacing, returning, retro innovations and cancelling.

Opening innovations involve the development of products that have no analogues and predecessors, replacing - the complete replacement of obsolete products due to more efficiency, including those produced using new technology, cancelling - the complete exclusion of any product without replacing it with a new one, return - a return to the previously existing production technologies; retro-introductions, or retro-innovations, reproduce technologies that have long been exhausted at the present level (Guiné et al., 2021).

3. Research Questions

The object of the study is the whole set of innovative food products, the subject is its classification, where the criterion is a sign of continuity of innovations, that is, manifestations of dialectical connections between them in the process of development (the relationship of innovation to its predecessor, according to Prigozhin (1989)).

4. Purpose of the Study

The purpose of the work is to develop a classification of innovative food products according to the criterion of continuity

5. Research Methods

In carrying out this research, such logical methods of scientific cognition as analysis (study of individual elements of innovative food products) and systematization were used, carried out by classifying innovative food products, that is, dividing its sets into subsets based on similarity or difference.

6. Findings

The results of our study are presented in Table 1.

By them, the opening innovations in the field of food technologies include molecular cuisine products (including those obtained by espumization, centrifugation, tenderization, thickening, cook-in, cryo-freezing, thermomixing, packojeting, sous-vide, enzymatic transformation, spherification technologies), innovative types of packaging for the food industry (edible, self-heating and self-cooling, equipped with signal sensors, biodegradable) the vast majority of food additives. This classification category is best met by analogues, substitutes and imitations of known food products, food products produced by genetic engineering methods (including products of synthetic biology), using nanotechnology, in vitro (cell cultures, including meat grown in vitro), by the 3- D and 4D printing are so-called “process” innovations using technologies that did not exist before (Cummings et al., 2021; Keränen et al., 2021; Oral et al., 2021).

Table 1. Proposed classification of innovative food products according to the succession of innovations

Group designation	Examples of innovative food products
Unfolding	GMOs of plant, animal and microbiological origin Analogues, substitutes and imitations of traditional products Food products produced in vitro ("in vitro") Food products obtained by synthetic biology methods Nutritional supplements Molecular cuisine products Products in innovative types of packaging Food products obtained by 3D and 4D printing methods

	Products manufactured using nanotechnology and nanomaterials
	Enriched food products
Substituting	Products with new types of raw materials
	Specialized food products
	Biologically active additives
Refundable	Organic products of crop production, animal husbandry, beekeeping
	Functional food products
Retroinnovations	Confessional products (lean, kosher, halal)
Cancelling	Separate names of food and biologically active additives

Substitutive innovations involve the gradual or partial displacement of traditional food products from circulation through the development of food products enriched with functional food ingredients - food and biologically active substances (intended for a wide segment of healthy consumers) and specialized (for specific consumer segments, for example, athletes, pregnant and lactating women, older people) food products. The gradual replacement of traditional food products is offered by food technologies aimed at the use of new types of raw materials. The modern arsenal of the food industry is ready to provide today more than 100 types of previously unused raw ingredients of plant and animal origin, including a wide range of cakes and legume meals (chickpeas, lupine, alfalfa, lentils, beans), nuts, taiga wild plants (aralia, eleutherococcus), mosses (moss) and lichens (parmelia), hydrobionts (jellyfish, mollusks and algae). The concept of the Foodnet market within the framework of the national technology initiative 2035 involves the use of insects as a new raw material source of protein.

Cancellative innovations are typical for food products in case of obtaining new information about their danger. There is a certain amount of food and biologically active additives that were previously approved for circulation, but were banned after additional safety studies (for example, among food additives E 924a, E924b - potassium and sodium bromates, E217 - Sodium propyl para-oxybenzoate, among dietary supplements - products containing hellebore *Helléborus*, etc.).

The place of functional foods in their classical sense, that is, initially containing functional food ingredients in a certain amount, is among return innovations. Formally, the innovation here consists only in assigning the appropriate term to products known since ancient times. For example, meat is one of the first functional foods known to mankind, containing protein and iron as functional food ingredients, but thirty years ago it was not defined that way. Enriched foods, that is, containing specially added ingredients with biological or other activity, while replacing innovation, which is characterized by the development of innovative food products based on existing ones.

The production of organic products (that is, made without the use of pesticides, chemical fertilizers, growth and fattening stimulants, antibiotics and veterinary drugs, hormones, GMOs that have not been treated with ionizing radiation) in terms of animal husbandry, crop production and beekeeping can be attributed to returning innovation, characterizing a return to former types, methods, methods of production (for example, during the reign of Catherine II, absolutely all agricultural products could be called organic due to the lack of the above methods and technologies). At the same time, for example, organic aquaculture does not fall under the definition of reverse innovation, because the very concept of aquaculture is quite new. It is also curious to consider dietary supplements as a return innovation - as a modern version of ancient Russian potions, banned by Peter I back in 1701.

We include confessional food products, the production and consumption of which is associated with religious norms and prohibitions, as retro-innovations that reproduce ancient knowledge at the modern level. It is assumed that the technology of halal (in Islam), lenten (in Orthodox Christianity), kosher (in Judaism) food products, which has been an important element of religions almost since the birth of religions, is now reaching a new level thanks to marketing and advertising, becoming in demand among consumers, unrelated to religion (Motamedzadegan et al., 2018).

7. Conclusion

Thus, to the previously developed classification of innovative food products according to the criterion of application, we have added the criterion of continuity of innovations implemented in the food industry. The possibility of applying the criterion of a succession of innovations for its classification is shown, which is important for the further development of the theoretical foundations of such sciences as innovation management, commodity science, food technology and biotechnology, since it allows to streamline the array of innovations and determine the main vectors for further innovative development of food industry enterprises, in including showing reserves for the commercialization of the designed products. The practical significance of this study lies in simplifying the reporting problems for food industry enterprises, opening up further opportunities for identifying innovative food products.

References

- Aleshkov, A., Ivashkin, M., Zhebo, A., & Burik, M. (2020a). Technology and characteristics of boiled sausages enriched with dietary fibres of *Plantago Psyllium* l. *Biointerface Research in Applied Chemistry*, 10-4, 64-75. <https://doi.org/10.33263/BRIAC104.715723>
- Aleshkov, A. V., Kalenik, T. K., & Zhebo A. V. (2020b). *Nauchno-prakticheskie osnovy tekhnologii innovatsionnoy pishchevoy produkcii iz myasnogo syr'ya* [Scientific and practical basis of technology of innovative food products from meat raw materials]. Khabarovsk. RITsKhGUEP. 308 s.
- Bigliardi, B., & Filippelli, S. (2022). Open innovation and incorporation between academia and the food industry. Innovation Strategies in the Food Industry (Second Edition). Chapter 2. *Academic Press*, 17-37. <https://doi.org/10.1016/B978-0-323-85203-6.00003-7>
- Cummings, C. L., Kuzma, J., Kokotovich, A., Glas, D., & Grieger, K. (2021). Barriers to responsible innovation of nanotechnology applications in food and agriculture: A study of US experts and developers. *NanoImpact*, 23. <https://doi.org/10.1016/j.impact.2021.100326>
- Guerrero, L., Claret, A., Verbeke, W., Sulmont-Rossé, C., & Hersleth, M. (2022). Chapter 6 - Innovation in traditional food products: Does it make sense? Innovation Strategies in the Food Industry (Second Edition). *Academic Press*, 87-95. <https://doi.org/10.1016/B978-0-323-85203-6.00010-4>
- Guiné, R. P. F., Florença, S. G., Barroca M. J., & Anjos O. (2021) The duality of innovation and food development versus purely traditional foods. *Trends in Food Science & Technology*, 109, 16-24. <https://doi.org/10.1016/j.tifs.2021.01.010>
- Keränen, O., Komulainen, H., Lehtimäki, T., & Ulkuniemi, P. (2021) Restructuring existing value networks to diffuse sustainable innovations in food packaging. *Industrial Marketing Management*, 93, 509-519. <https://doi.org/10.1016/j.indmarman.2020.10.011>
- Motamedzadegan, A., Ebdali, S., & Regenstein, J. M. (2018). Halal and Kosher Regulations for Processing and Marketing of Vegetables. In *Handbook of Vegetables and Vegetable Processing*. <https://doi.org/10.1002/9781119098935.ch42>
- Nauka i innovatsii. Federal'naya sluzhba gosudarstvennoy statistiki*. [Science and innovation. Federal State Statistics Service.]. (2020). <https://rosstat.gov.ru/folder/14477>

- Nikolaeva, M. A. (2017). Innovatsionnyye podkhody k klassifikatsii prodovol'stvennykh tovarov [Innovative approaches to the classification of food products]. *Tovaroved prodovol'stvennykh tovarov*, 4, 40-46.
- Nikolaeva, M. A. (2022). *Teoreticheskiye osnovy tovarovedeniya* [Theoretical foundations of commodity science]. Yur.Norma, NITS INFRA-M.
- Oral, M. O., Derossi, A., Caporizzi, R., & Severini, C. (2021) Analyzing the most promising innovations in food printing. Programmable food texture and 4D foods. *Future Foods*, 4, <https://doi.org/10.1016/j.fufo.2021.100093>
- Prigozhin, A. I. (1989) *Novovvedeniya: stimuly i prepyatstviya: sotsial'nyye problemy innovatiki* [Innovation: Incentives and Barriers: The Social Problems of Innovation]. Politizdat.
- Prikaz Rosstata ot 05.08.2016 g. № 391 «Ob utverzhenii statisticheskogo instrumentariya dlya organizatsii federal'nogo statisticheskogo nablyudeniya za deyatel'nost'yu v sfere obrazovaniya, nauki, innovatsiy i informatsionnykh tekhnologiy» [Rosstat Order No. 391 dated 05.08.2016 “On approval of statistical tools for organizing federal statistical monitoring of activities in the field of education, science, innovation and information technology”]. (2016). http://www.consultant.ru/document/cons_doc_LAW_203560/
- Rosenthal, A., Guedes, A. M. M., Olbrich dos Santos, K. M., & Deliza, R. (2021). Healthy food innovation in sustainable food system 4.0: integration of entrepreneurship, research, and education. *Current Opinion in Food Science*, 42, 215-223. <https://doi.org/10.1016/j.cofs.2021.07.002>