DOI: https://doi.org/10.21323/2414-438X-2022-7-3-200-213

Available online at https://www.meatjournal.ru/jour
Review article
Open Access

Received 01.09.2022
Accepted in revised 21.09.2022
Accepted for publication 26.09.2022

ASPECTS OF LIFE CYCLE IN ITS PROJECTION ONTO PRODUCTION OF MEAT AND MEAT-CONTAINING CANNED FOOD: SYSTEMATIC REVIEW

Tatyana V. Gustova
V. M. Gorbatov Federal Research Center for Food Systems, Москва, Россия

Keywords: *meat and meat-containing canned food, life cycle model, life cycle terminology, retrospective, perspective*

Abstract
While choosing one or another product from a wide variety on the market, we intuitively focus on the quality of the food product, we pay attention to its source, raw material and how this food is made. At the same time, the same questions are being asked by food manufacturers as they want to be sure of the quality and safety of purchased raw materials and ingredients. In both cases, decisions should be based on the consequences they could entail. It must be acknowledged that any failure in the field-to-shelf chain system may harm the consumers' health, as well as may lead to disruptions and losses in the food industry. Producers and consumers are increasingly concerned in the terms of life cycles. The life cycle is the most expressive and comprehensive approach to achieve the highest usefulness of the made decisions. The fact is that life cycle problems can be solved, and product life cycles can be managed, controlled and regulated. This is widely applied, for example, by the use of life cycle methodology in solving environmental problems highlighted in this article. However, in the meat processing industry the standards of the ISO 9000 series are not supported by this methodology. It was necessary to find and define the problem-exposed stages from the full life cycle of production of meat and meat-containing canned food within the system "from the field to the shop shelf". Those problem-exposed stages are responsible for safety and quality of canned food and responsible for maintaining the safety and quality of ready-to-eat food products, as the most relevant stages in the meat processing industry. Here the author proposes for consideration three stages of the life cycle of canned meat and meat-containing food, including its pre-production, production process and post-production. It is assumed that the impacts at certain limited stages of the canned food production cycle will be representative in terms of consequences of applied decisions.

For citation: Gustova, T.V. (2022). Aspects of life cycle in its projection onto production of meat and meat-containing canned food: systematic review. *Theory and Practice of Meat Processing*, 7(3), 200-213. https://doi.org/10.21323/2414-438X-2022-7-3-200-213

Funding:
The article was published as part of the research topic No. FNEN-2019–0006 of the state assignment of the V. M. Gorbatov Federal Research Center for Food Systems of RAS.

Acknowledgements:
The author expresses gratitude to Valentina B. Krylova, Doctor of Technical Sciences, Professor for significant advice and recommendations during the research and the design of this article.

Introduction

The phrase "life cycle" is widely used in the natural sciences, in the humanities and social studies. However, it can be considered that the "life cycle" in relation to food products is not actually "life" one, since the food product does not belong to living organisms and is not a "cycle" in the classical interpretation of this word [1–7], since it is not closed like real cycles. The application of this term in various spheres of knowledge or in regulatory documents has a number of features. It is interesting to analyze the terminology and the possibility of its application in terms of its projection to meat and meat-containing sterilized canned food. The results of this research will determine the vector of development of the scientific direction in the food canning industry.

For the first time in economics the term "cycle" was used by K. Juglar. Being a physician by his education, he established the length of economic cycles equal to 7–10 years long [8–10], and divided them into periods or stages as presented below in the Figure 1.

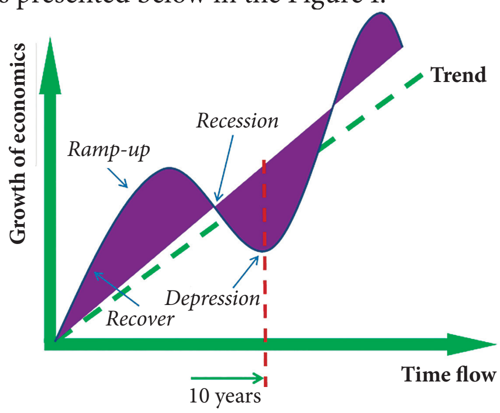

Figure 1. The economic cycle after K. Juglar (based on the materials of K. Juglar [9])

In Soviet engineering V. Burkov and V. Irikov defined the term "full life cycle model" as follows: "The full life cycle model of an individual object is a description of the sequence of all phases and stages of its existence, starting from its conception and appearance ("birth") to its disappearance ("dying off")" [11,12].

In the field of systems and software engineering the standard of series ISO/IEC24748 gives the modern interpretation gives the following definition of the term "life cycle model" and "system life cycle":

- "life cycle model: Structural base for the processes and activities related to the life cycle, which also serves as a common reference for communication and mutual understanding between the parties";
- "system life cycle: Development of the system under consideration in time, starting from its conception to its decommissioning".

The model, being a specific object under regulated conditions, shall remain unchanged. And thus, each specific model of the life cycle (LC) of an object is nothing more but just a projection of the full LC onto a certain type of human activity. The number of life cycle stages (LC) in various fields of science for objects varies. Life cycle models attract the attention of not scientists only, but of practitioners also.

Objects and methods

The object of research was the life cycle of sterilized meat and meat-containing canned food.

When studying the object, an analytical method was used from the standpoint of epistemics, which allows clarifying the concepts of "life cycle of meat and meat-containing canned food" and "stages of the life cycle of meat and meat-containing canned food" for the sterilized canned food.

The prijection of the "life cycle" methodology onto the production of meat and meat-containing canned food is a new problem. Therefore, the research used the works of scientists in the field of economics, management, ecology and regulatory documents as the theoretical foundations. The first stage in the sphere of this research was the selection of relevant publications on the information platform *Elsevier*, the national information and analytical portal eLIBRARY.RU for the period 1999–2022. The design of a systematic review, based on the principles of the PRISMA Guidelines (Preferred reporting items for systematic reviews and meta-analyses), is presented below in the Figure 2.

The following were selected as criteria for inclusion: (1) compliance with the research topic by reference points: life cycle, life cycle stages, life cycle model, food product, canned meat; (2) areas of knowledge, enveloped into food production; (3) original research results and reviews in peer-reviewed journals.

The following were selected as criteria for exclusion: (1) research conducted in the sphere of social studies and sciences; (2) research conducted in the sphere of natural sciences (chemistry, physics, biology, geology); (3) research conducted in the sphere of technical sciences; (4) research conducted in the sphere of social sciences and humanities (except for economics).

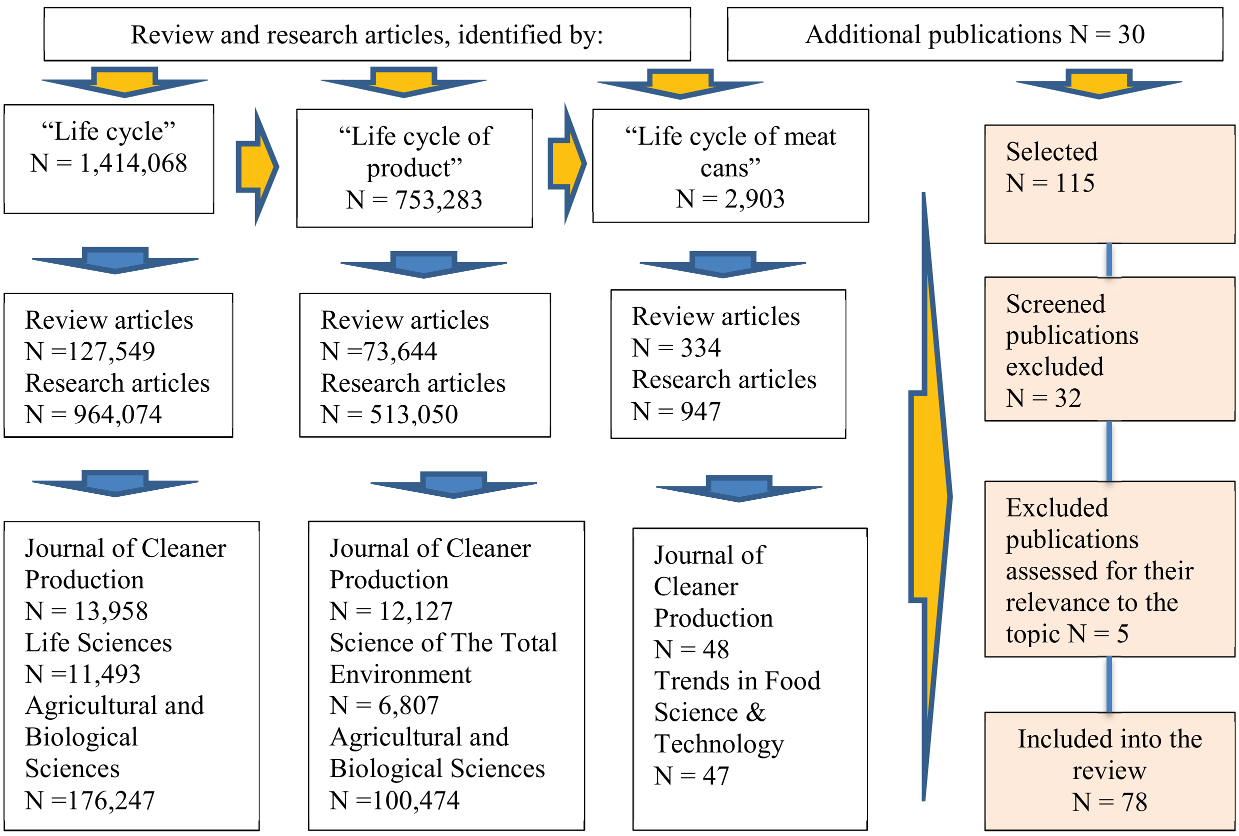

Figure 2. Design scheme of systematic review

Retrospective of the use of the life cycle method in different fields of knowledge

Aspects of the life cycle of enterprises / organizations

In order to define priority directions for development of an enterprise or organization, it is possible to assess its target state at each specific point in time. Five successive stages of the life cycle are arranged along in the popular model of L. Greiner [13]. These are: creativity, directive management, delegation, coordination and cooperation. In this case, each stage takes place after the "revolution" which stems from a crisis. The "revolution" is explained by strategic changes in the organization's management, which are confronted with active internal resistance. This leads to the fact that managerial decisions that lead the organization out of the crisis, at the next stage, will become the cause of this crisis [13]. The works of L. Greiner on determining the stages of the life cycle are based on theoretical approaches, like most similar works.

According to Yu. Ovanesova [14] there are relatively few researches focusing on the development of empirical life cycle models. These include, for example, the researches of H. Hanks. H. Hanks and co-authors [15] defined four stages of organization growth and defined life cycle stages as a unique configuration of variables related to the situation which the organization is located in, and its structure.

The Russian scientist G. Shirokova applied different approach, but consonant with H. Hanks's one, to creation of an empirical model of the life cycle of an organization [8]. It defines the stage of the life cycle of an organization as follows: "the configuration of internal variables that characterizes the specific state of the organization at a specific point in time and that changes during the transition to the next stage of development". For Russian companies that started their activities "from scratch", the author defines three stages — the stages of formation, growth and formalization (bureaucratization) [16, 17].

Not all proposed models of the life cycle of an organization feature stage of recession or crisis.

One of the first scientists who introduced the stage of a company's extinction, was I. Adizes, the largest business consultant in the field of management. He identified ten stages in the life cycle of an organization: courtship, infancy, go-go, adolescence, flourishing, stability, aristocracy, early bureaucratization, bureaucratization, death (Figure 3). Quoting [18] I. Adizes: "I believe that each system, "breathing" or not, has its own life cycle. We know that living organisms — plants, animals, people — are born, they grow, get old and die. The same thing happens with organizations". So we come to the conclusion that he acknowledges the organization as a living organism, therefore, the stage of extinction or death is also inherent to the organization, but unlike a living organism, the organization has the opportunity to get out of a crisis situation. But for a living organism death is inevitable [19]. In accordance with I. Adizes's concept, a company is able to start a new life cycle after attracting the attention of large investors at the moment of its financial attractiveness.

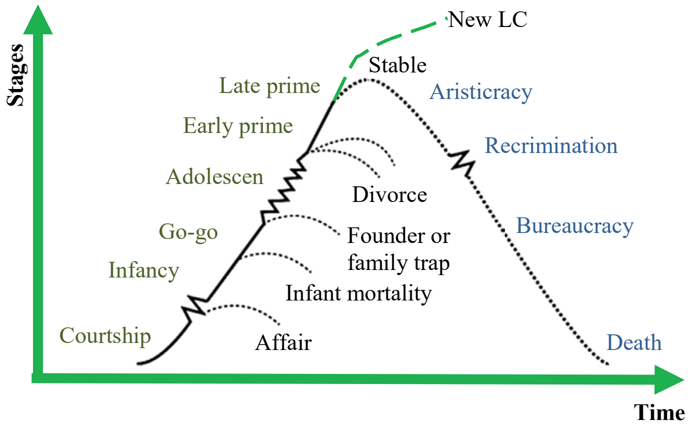

Figure 3. Stages of the life cycle of an organization (according to I. Adizes's materials of [18])

From the financial side, the life cycle of an organization is reviewed by V. Dickinson. He specifies five stages with unequal ratio of funds obtained from various types of company's activities: its emergence, growth, maturity, turbulence and decline [20].

It's necessary to change style of managing a company at each stage of the life cycle, and the same is applied to the sources of its funding. This assumption was put forward by M. Scott and R. Bruce in their work "Five Stages of Small Business Growth" [21].

Basing on the financial parameters at each stage of the life cycle, I. Ivashkovskaya and D. Yangel [22] proposed an aggregate indicator of company's growth. As for the parameters of the life cycle stage, a specific weighting value was defined, which determines the significance of the parameter and the degree of its influence on the company's growth rate. The calculated index is obtained by multiplying the specific weight and the actual value of the chosen parameter, which in total gives the integral value of the growth factor related to the period corresponding to the stage of the life cycle.

Thus, it allows tracing the value of both the financial approach and strategic management in modeling the life cycle of a company. Both approaches are important for practice and for the theoretical analysis of company's management. The relevance of empirical research for development of new models of the life cycle is obvious.

The life cycle of an organization directly depends on the life cycle of the product and the resources used.

Product Marketing Life Cycle Aspects

T. Levitt, who published the concept of the product life cycle, states that the product exists on the market only for a certain period of time, and sooner or later will be replaced by a more perfect product [23]. Just as an organization goes through certain stages in its development, the concept of the product life cycle describes the stages of the emergence of an idea (concept) of the product, and its introduction to the market until its production is stopped (Figure 4).

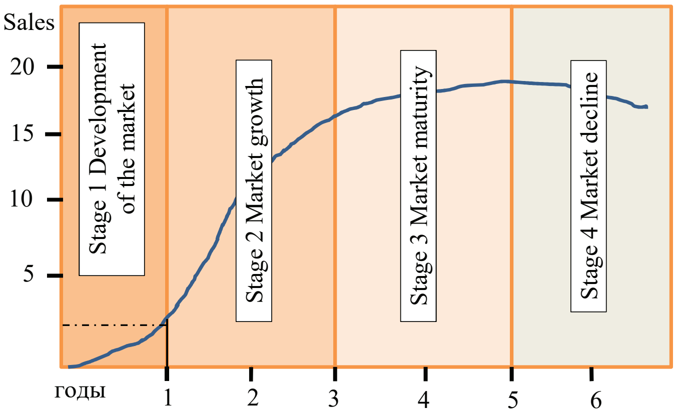

Figure 4. Product life cycle — the entire industry (according to T. Levitt [23])

T. Levitt [24] also identified four reference points in planning of marketing researches, which are presented below in the Figure 5.

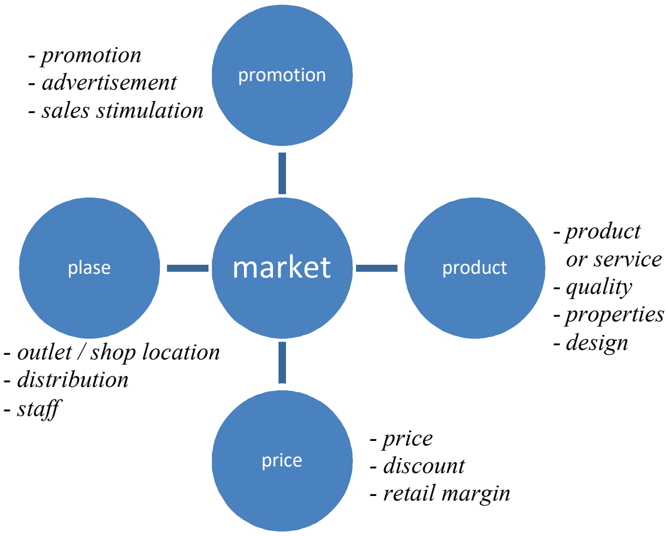

Figure 5. Benchmarks of Product Marketing Planning (Based on T. Levitt)

As a concept the product life cycle guides managers to analyze the activities of the enterprise, forms a strategy at each stage of the product life cycle.

The marketing company *Nielsen* noted that 76% of consumer goods released in the period from 2011 to 2013 did not last more than one year on the market [25]. When developing new food products, the companies used consumer-oriented approaches. These consumers' response tests [26,27] took into account new food trends that influenced consumers' choice. At the same time, demographic, economic, sociocultural or technological preferences of the consumers were taken into account. However, at the present stage, the question often arises of how consumers' preferences are taken into account after the product is launched on the market, i. e. at the stages of the product's life cycle. The scientists aimed to clarify what interests of consumers and at what stages of the product life cycle were taken into account by European companies. Based on the conceptual model, the frequency of using demographic, economic and technological factors at the development stage and stages of the product life cycle was shown. The results are shown below in the Figure 6 [28].

The researchers conclude that there is a lack of consumers' involvement at the stages of the product life cycle. It is proposed to use computer modeling to integrate consumers' preferences of all sphere and directions.

The result of consumers' preference research conducted by Ingredion showed that approximately 2/3 of consumers read labels to get to know the ingredients when buying, for example, cosmetics and 50% expect to see the composition without "unnecessary" ingredients [29]. Manufacturers start to take into account the sources of the used ingredients, the capacities of production, emissions, and the potential capacity of packaging [30]. So, to reduce water

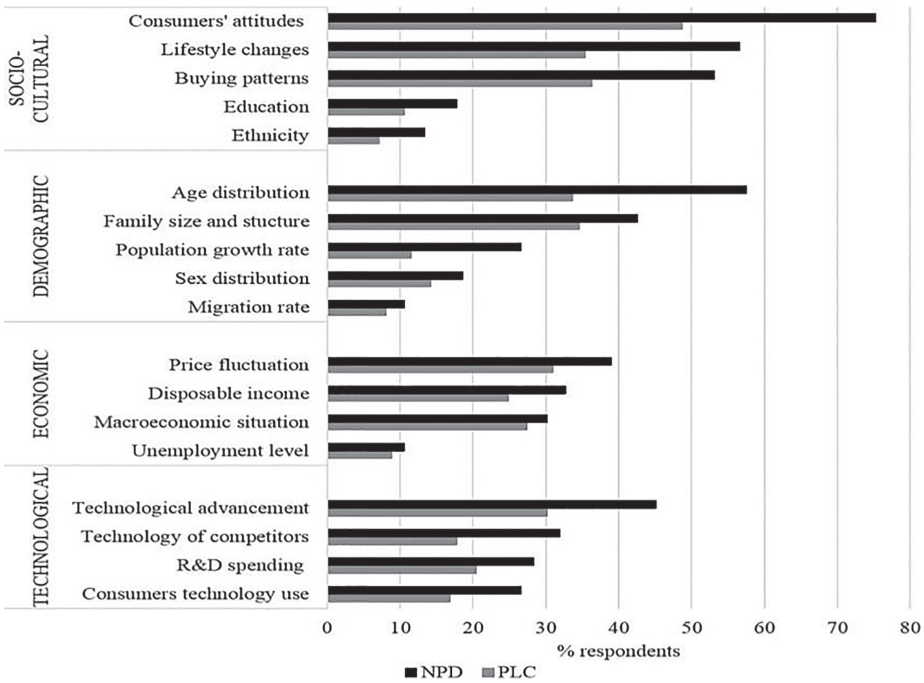

Figure 6. Frequency of using the various environmental factors (sociological, cultural, demographic, economic and technological) in new product development (NPD) and product life cycle (PLC) [28]

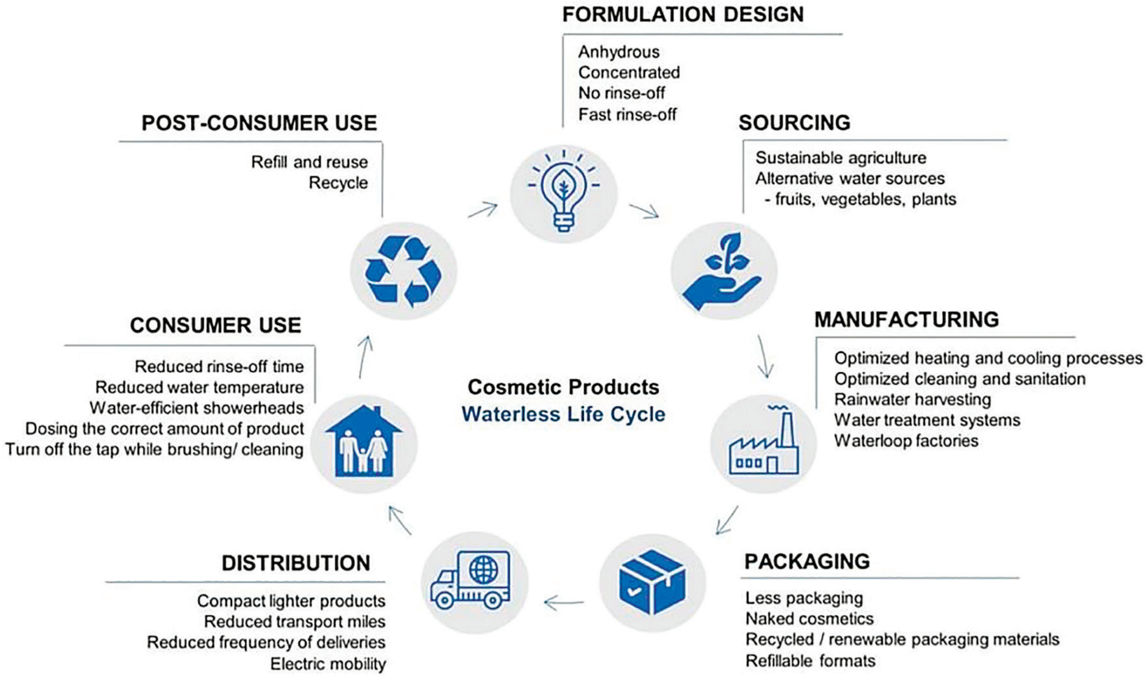

Figure 7. Anhydrous life cycle of cosmetic products [31]

consumption in the cosmetic industry, it is proposed to reduce its amount in the product composition; it is also proposed to use additional insulation in heating systems to avoid energy losses [31]. Figure 7 shows the sustainability of a water resource, used during the life cycle stages of cosmetics. In addition to changing the composition of the product, manufacturers keep looking for raw materials, ways of packaging, ways of its promotion, method of use and disposal of the product.

Standardization specialists, in order to help the competencies of employees of Russian enterprises and companies responsible for product management processes, have developed the standard GOST R58537[1]. This standard helps focus on problems and develop new solutions along the life cycle of the product. Meanwhile this standard determines the following:

— “product life cycle”: <in the context of its stages> The cycle, that covers four main stages of the product — “launch”, “growth”, “maturity” and “decline” — and that is associated with the active marketing of the product in the market.
Note: Sometimes the product life cycle is based on a process which includes five stages — launch, growth, maturity, saturation and decline”;

— “product life cycle: <in the context of time> The time from the observation stage (including the stage of a product creation) till the stage of bringing the product to market. This time includes, in addition to the stage of market observation, designing of idea, development of the product and its productions that precede marketing, including the phase of the product’s leaving the market that follows the stage of active marketing.

[1] GOST R 58537-2019 “Product management. Fundamentals”. Moscow: Standartinform, 2019. — 23 p. Retrieved from https://docs.cntd.ru/document/1200167818 Accessed August 25, 2022. (In Russian)

Although the recommendations of the standard apply to technical products, they can be useful in the sphere of food production.

Aspects of the life cycle in ecology

The ecological state of the planet makes the scientific community worry for a while already. Ways to address global threats to humanity are being actively discussed. The agricultural sector consumes a significant share of water and energy resources at all stages of the life cycle of manufactured products, which has a significant impact on the environment. To satisfy the vital needs of the modern population without reducing the opportunities for the future generation is a model of sustainable development [32]. A systematic approach to the analysis of the ecological state of the production process throughout its entire life cycle underlies the method of LCA (Life Cycle Assessment). The negative impact of some production processes on the environment served as prerequisite for the development of the method (Figure 8).

At the first time life cycle of food products was assessed in the early 1990s. Since then, life cycle assessment has been used as an environmental performance tool to determine

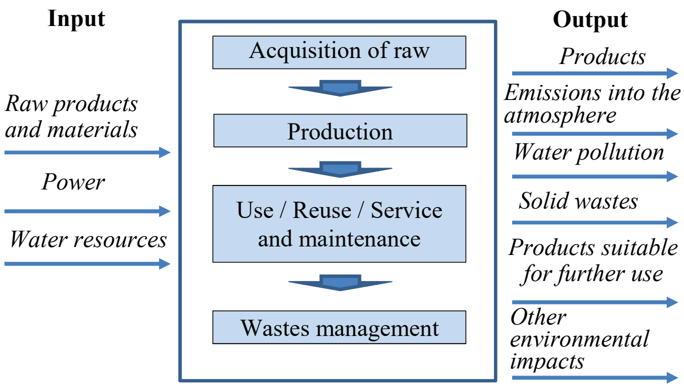

Figure 8. Functional model of the production system in the method LCA [32]

the stages of the product cycle that make the greatest negative impact on the environment.

International standards of the series ISO 14000 contribute to the implementation of the LCA methodology. More than one product has been assessed in reference to the requirements of these standards. Milk [33, 34], animal and vegetable oils [35, 36], bread [37], meat [38, 39], chicken [40], eggs [41], alcoholic beverages [42, 43].

Thus, the ecological attributes of pork have been studied in almost all European countries [44, 45, 46]. Scientists in Portugal focused their attention to the life cycle of pork production, since this type of meat makes up 45% of the country's total production [47]. And they focused their research on the cradle-to-gate segment of the life cycle (Figure 8). They excluded the stages of packaging, retail, consumption and disposal from the system. The boundaries of the system under research are shown below in the Figure 9 [48].

The life cycle of pork production has been divided into three main stages: growing crops and production of forage (S1), livestock production (S2) and slaughter (S3).

The results of the studies showed that among three stages of pork production life cycle, it is forage production (S1) that makes the greatest contribution to the environment. This is attributed to the peculiarities of growing crops like wheat, barley, corn and soybeans. In order to reduce the load onto the environment, the authors proposed to find alternative sources of protein, for example — to use the leguminous crops in the forage. The livestock stage (S2) was characterized mainly by on-farm emissions and emissions related to manure management. The activities at this stage have potentially contributed to climate change, eutrophication and acidification, respectively 30%, 40% and 75% of livestock stage emissions.

The complexity and global nature of environmental problems makes it impossible to understand quickly and easily all the details of the problems and challenges. Anthropogenic activities, among other things, increase the concentrations of greenhouse gases in the atmosphere, which persist for a long time [49, 50].

Quite few studies have been published on processed and ready-to-eat foods.

The food industry is developing now, and according to some authors about 20% of global greenhouse gas emissions come from the food industry [51]. According to the Australian Department of Industry, 21% of the entire food industry accounts for the production of meat and meat products in the country. It is the production and consumption of meat, according to Troy and Kerry [52], which are associated with climate change and exert the influence on the environment. In Australia the popularity of the life cycle assessment method keeps growing [53].

Canon Foods products were examined with the help of the Life Cycle Assessment method. The research was aimed to determine the categories of environmental impact: carbon footprint and embodied (operational) energy. Frozen, pre-baked, ready-to-eat "Swedish meatballs" (beef) and "Chicken breasts with crispy garlic" were analyzed. Figure 10 below shows the system life cycle boundaries for "Swedish meatballs". Similar boundaries are defined for "Chicken breasts with crispy garlic" [54].

The solid-lined boxes in the Figure 9 indicate that the data is obtained from surveys and consultations with manufacturers. The dashed-lined boxes indicate that the data is obtained from the key reference literature and widely acknowledged databases.

The global warming impact of 1 kJ equivalent caused by production of Swedish meatballs produced by *Canon Foods* and delivered to Barrow Island, is estimated at 1.09 g CO_2 eq/kJ carbon footprint and 4.15 kJ embodied energy [54]. At the same time, it was found that beef (the

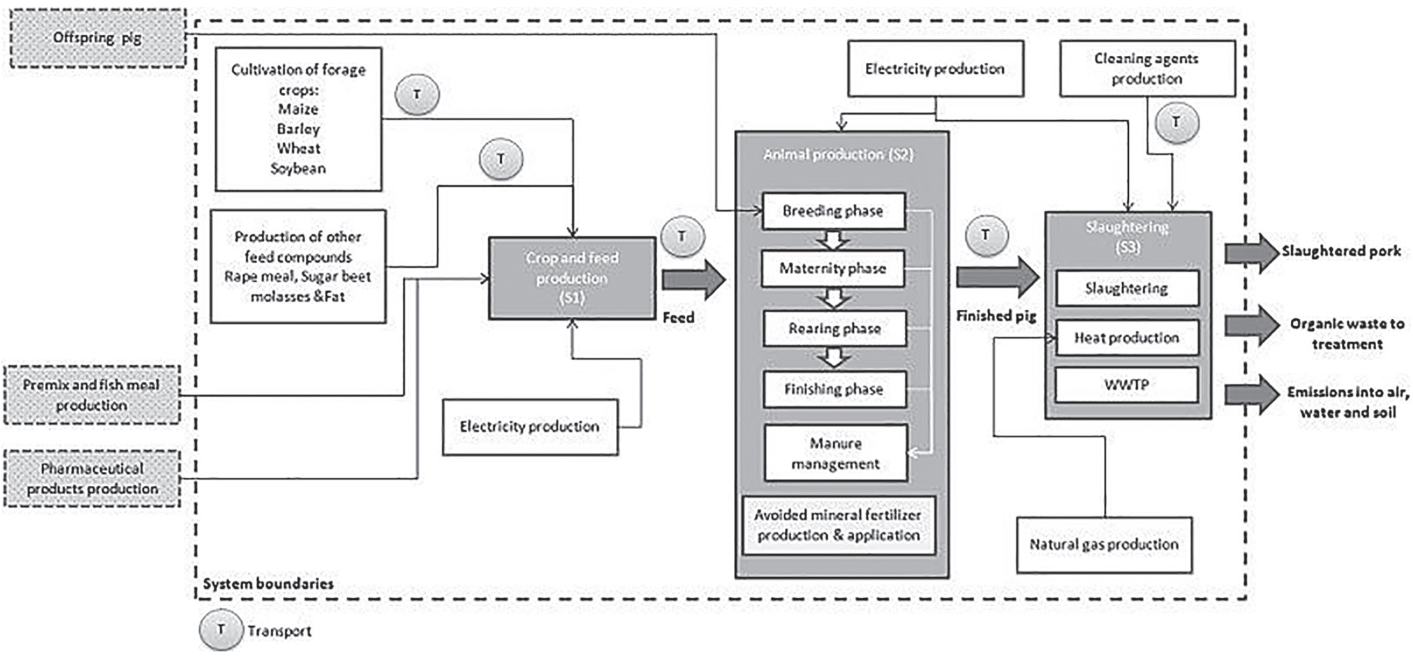

Figure 9. Boundaries of the Portuguese pork production chain system (reference script). The dashed rectangles correspond to processes excluded from the assessment [48]

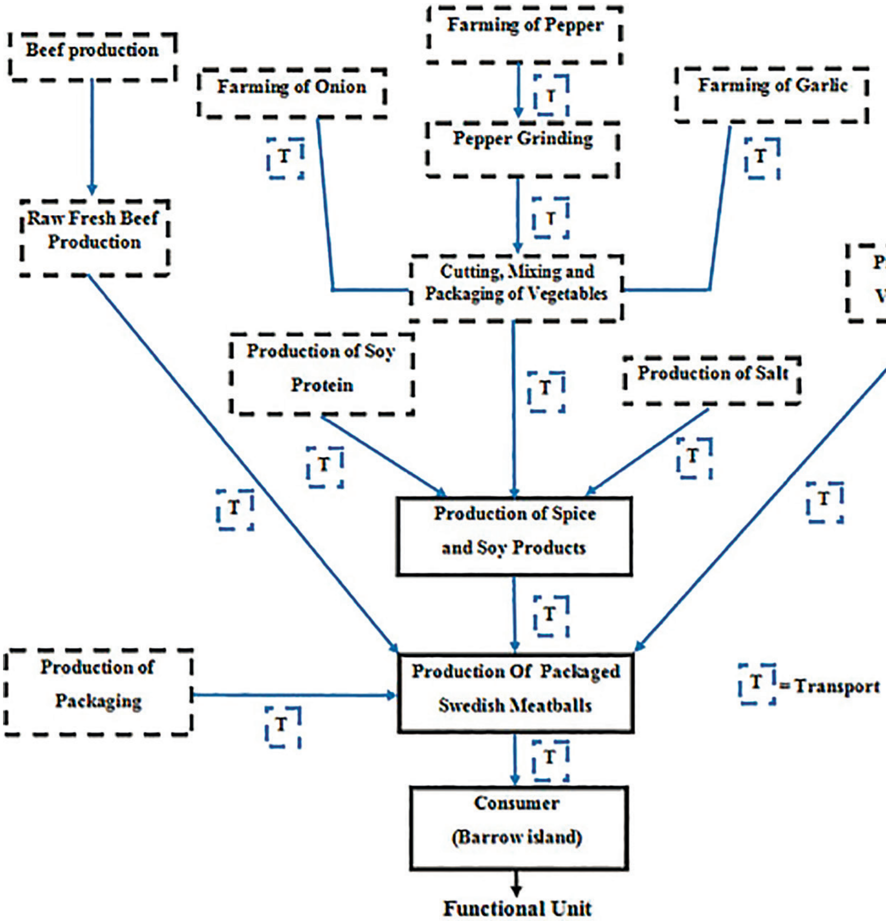

Figure 10. Visualization of the system boundaries for the "Swedish meatballs" life cycle [54]

ingredient of meatballs) accounts for 91% of the total carbon footprint. It is followed by 4% — transport, 2% for electricity and 2% for packaging, and <1% vegetable oil. The rest of the carbon footprint caused by the production of spices and soy mixture, as well as process water. 48% of the total embodied energy also comes from beef, 22% comes from transport, 11.4% each from packaging and vegetable oil, and 7% from processed-related electricity.

There are publications on the study of processed food products that have undergone heat treatment, i. e. sterilization: various types of legumes, seafood, products that include raw meat.

For example, studies have been conducted on food produced from beans, peas and chickpeas, packaged and sterilized in glass jars and metal cans [55]. The reviewed system included the stages of the supply chain, starting from the cradle till the gates of a factory, as well as disposal of primary packaging, presented below in the Figure 11.

According to the life cycle, the environmental impact of sterilized canned beans was assessed in terms of non-renewable energy requirement (NRED), global warming potential (GWP), water scarcity index (WSI), human toxicity potential (HTP) and freshwater aquatic ecotoxicity potential (FAETP).

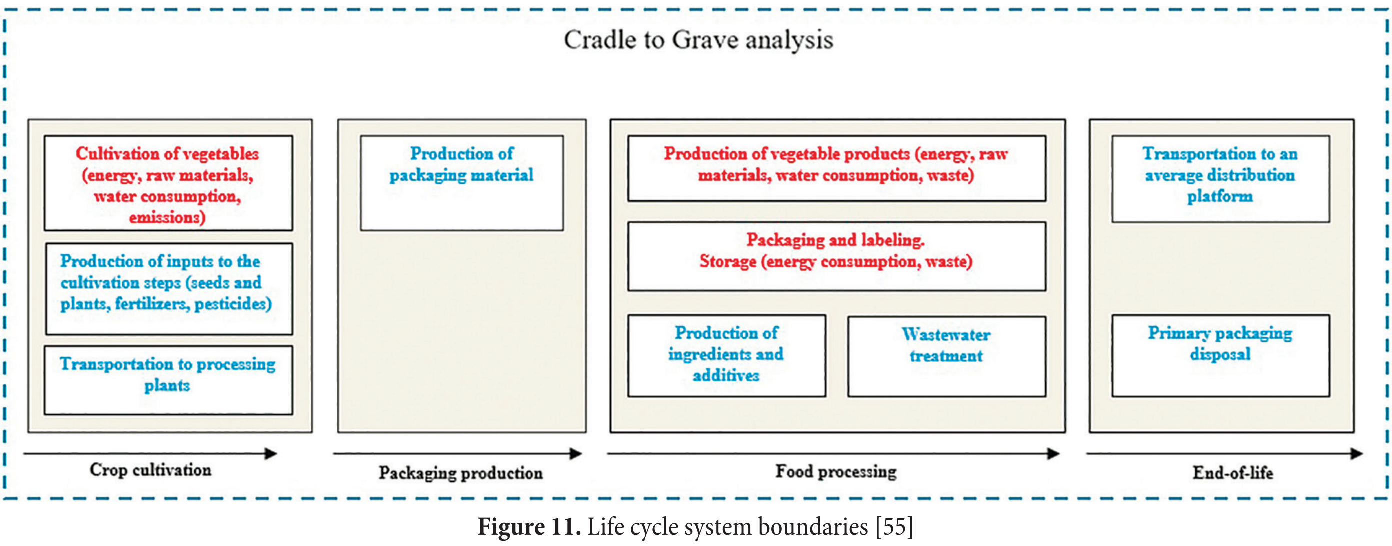

Figure 11. Life cycle system boundaries [55]

The comparable results were obtained for the stages of the product life cycle in terms of non-renewable energy and global warming potential. It is shown that the production of the food package accounts for more than 70% of the total negative impact on the environment. High energy consumption in the production of metal and glass packaging leads to high emissions of CO_2. It was noted in the metal package under review, the largest weight of the negative impact lies on packaging made of chrome-plated tin. The authors proposed to switch to less energy-consuming materials like paper or plastic package and change the format of food package. By the way, chrome-plated tin is prohibited in the meat canning industry in Russia.

The experience of the method of assessing the seafood life cycle in the analysis of their impact on the environment happened to be interesting. Previously this method was justified to be relevant [56]. In a further study, the authors focused on the comparative ecological properties of the life cycle of fresh and canned mussels. As for the canned food, the authors emphasized the potential danger to the environment of fuel production and electric power generation in the process of food canning, as well as during the transportation of ready canned food. The special significance of mussel cultivation in the ecological situation is emphasized as well. Based on the obtained results, the authors summarize the prospects and importance of using the method of assessment of the life cycle in the production of mussel food [57].

Among other types of seafood, tuna is one of the most widely available canned foods on the market. There is information about the assessment of this product from the point of its environmental properties. In particular, the recycling stage was noted as the largest contributor to the environmental impact. The important and the least environmentally friendly aspects of production are production and transportation of tinplate. Tinplate is the main material for cans production. In order to reduce the impact on the environment, the authors proposed to use the alternative package, for example, plastic. However, the consumers were not ready for these changes in their habits. It took some efforts of the professional marketing companies to introduce the obtained results of the research into practice [58].

The authors who studied the environmental load of anchovy canned food, came to the similar conclusions in the context of production diversification. The system under research was divided into stages of the life cycle, conventionally named Cradle to Gate, Gate to Gate and Gate to Grave [59]:

- from cradle to gate, including anchovy harvest, energy, water and fuel used, ingredients used and packaging (consumer and transport), transport of raw materials, ingredients and packaging;
- door-to-door, including the production of canned anchovies and the management of sewage and fish waste;
- from the gate to the grave, including the distribution of the finished product and its use.

The results of studies on canned anchovies showed an increased demand for natural resources in production of aluminum cans, which is 8 times higher than the cost of food being canned with sauce. In addition, the production of olive oil requires a large amount of water for growing olive trees. These stages of the life cycle require appropriate measures to be taken. Like in tuna production, the authors suggest replacing metal package with plastic package, but there is a problem of deterioration in quality of the product and its rejection by the consumers. Replacing olive oil with sunflower oil also raises a number of questions. Sunflower oil production is energy intensive and has more negative environmental impact due to the use of pesticides and herbicides in cultivation.

In the few publications on the evaluation of the life cycle of the processed and sterilized product, the following studies can be distinguished regarding meat and meat-and-vegetable canned food. A characteristic was given from an environmental point of view of the stages of production of canned food "Lean pork" and "Meatballs with peas" [60]. The system included all stages of the product life cycle: production of meat — manufacturing of product — product distribution — product consumption — waste disposal. Canned food life cycle diagrams are shown below in the Figures 12 and 13.

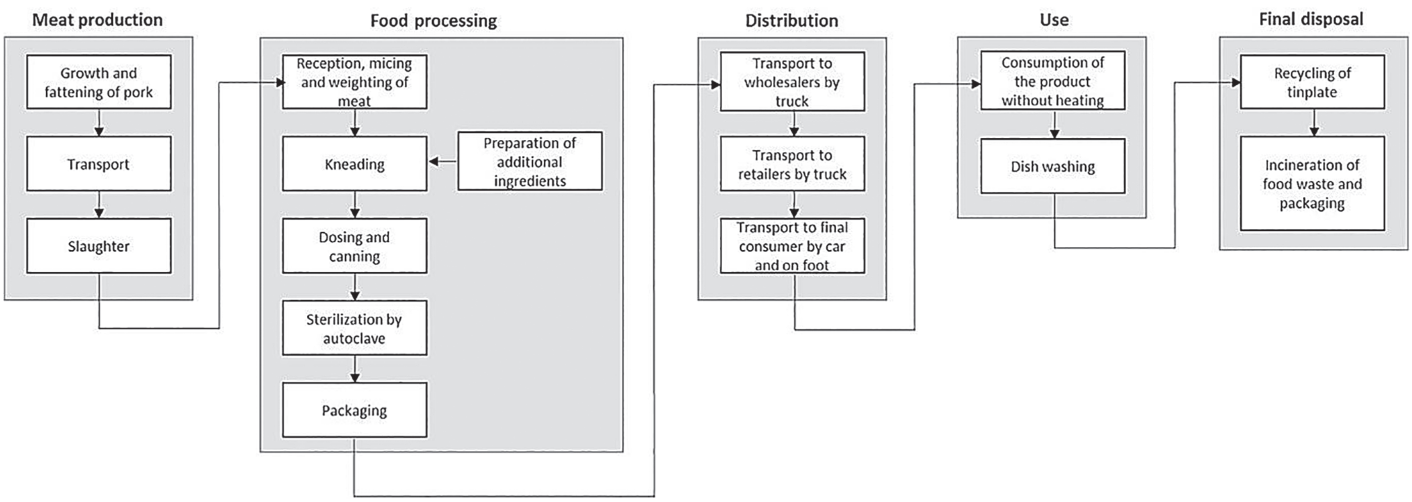

Figure 12. Scheme of the life cycle of canned food "Lean pork" [60]

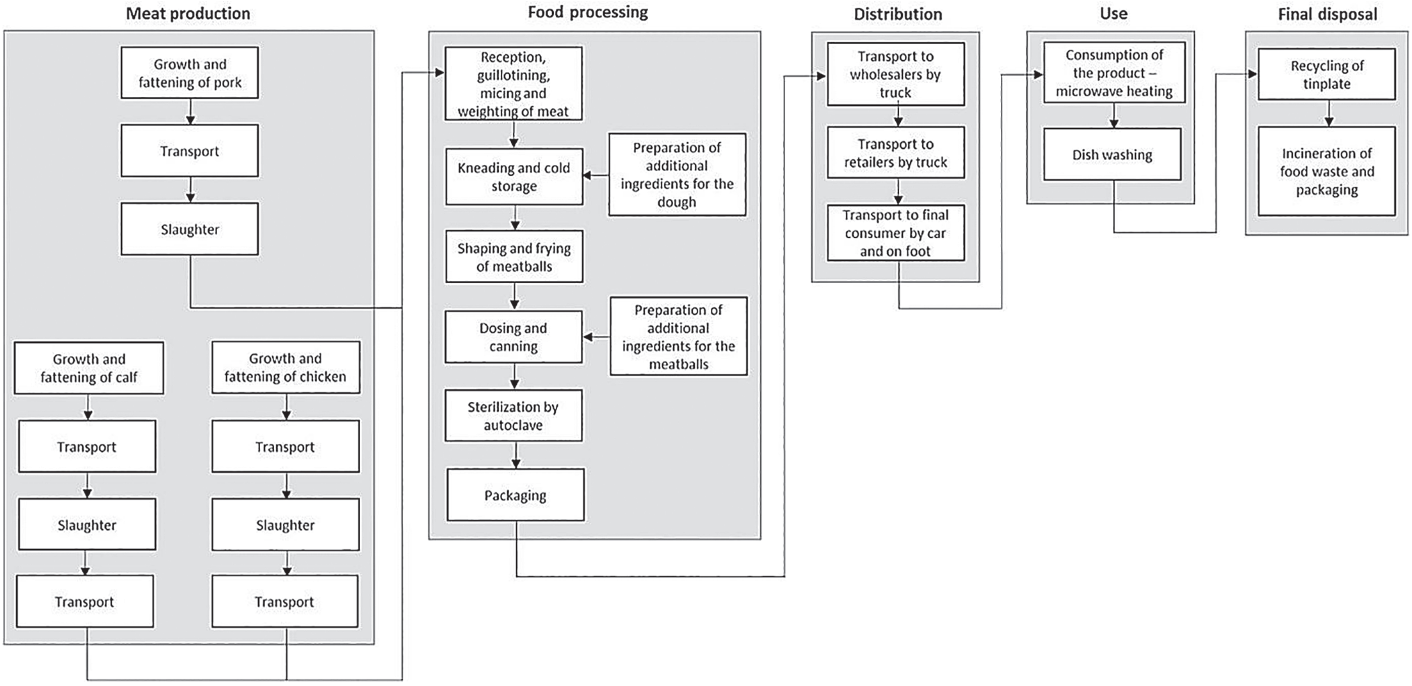

Figure 13. Scheme of the life cycle of canned food "Meatballs with peas" [60]

The assessment of potential environmental impacts of canned food were assessed in 18 categories: climate change (CC), ozone depletion (OD), land surface acidification (TA), freshwater eutrophication (FE), marine eutrophication (ME), human toxicity (HT), formation of photochemical oxidants (POF), formation of particulate matter (PMF), terrestrial ecotoxicity (TET), freshwater ecotoxicity (FET), marine ecotoxicity (MET), ionizing radiation (IR), agricultural land use (ALO), urban land use (ULO), natural land conversion (NLT), water depletion (WD), metal depletion (MD), and fossil depletion (FD).

The main conclusion based on the results of studies on canned food "Lean pork" was made by the authors in relation to the greatest environmental impact of dosing and sterilization processes. These two stages together accounted for 75% of the impact across all categories, and over 90% in 15 categories. The reason for this is the production of tinplate cans and high consumption of steam and electric power respectively.

The authors came to the same conclusions regarding the production of "Meatballs with peas". But in the production of this product, an additional contribution is made by the preparation of herbal ingredients. Additional ingredients are important contributors in the categories of terrestrial ecotoxicity (TET) and natural land conversion (NLT) with a contribution of 57.7% and 69.2% respectively. In addition, the used ingredients affect the category of agricultural land employment (ALO) with its contribution of 66.7%.

Having set the goal of becoming the first environmentally neutral continent by 2050, the European Union included the target of reducing greenhouse gas emissions by 55% by 2030 [61]. Therefore, the search and development of alternative food products with a lower environmental impact will be important for the EU [62].

The farmed meat was subjected to a life cycle assessment taking into account the need for nutrients during experiments on the proliferation and differentiation of muscle cell line cultures [63]. The boundaries of the system under study included the acquisition of raw materials and the production of muscle cells. According to the results of the research, it was revealed that the production of amino acids provides the greatest impact on the environment. Theoretical studies of scientists have demonstrated scripts for the production of farmed meat with the potential to reduce environmental impact, for example in relation to the production of canned beef food.

Thus, life cycle assessment as a tool for determining the environmental sustainability of agricultural products, processed food products or various technologies is widely applicable [64, 65, 66]. Criteria in food development and food system selection should be minimal environmental impact and efficient use of natural resources. Steps are also being taken to apply the life cycle assessment methodology, which does not have a standardized form for food products [67].

In the early 2000s, the standards of the ISO 14000 series were adopted in Russia, but these standards were not appropriately developed and applied, perhaps due to the lack of the necessary relevant information and a methodological basis for assessing the life cycle of products. But the standards provide concepts and terminology that can be used in further research work or can serve as a basis. So, in accordance with GOST R ISO 14040 the following terms have the following meaning:

- "life cycle: The successive and interrelated stages of a product life cycle system from its acquisition or its production from natural resources or raw materials to its final disposal in the environment";
- "system boundary: The set of criteria defining unit processes that are part of a product life cycle system";

- "product system: The set of singular processes with elementary flows and product flows, which perform one or more certain functions, and which models the life cycle of a product".

The forerunners in application of the process approach to managing an organization or evaluating the environmental profile of products were the standards of quality management standards — series ISO 9000. The process is managed through the Deming cycle Plan-Do-Check-Act (PDCA), and it is recommended to apply risk-based thinking when developing the process controls. The process approach of quality management is illustrated below in the Figure 14.

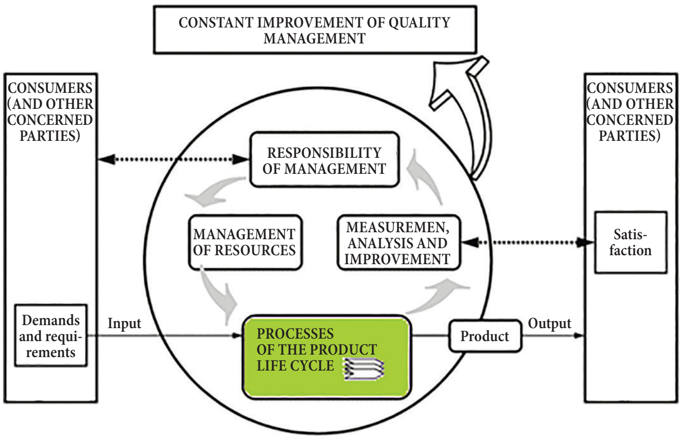

Figure 14. Model of a quality management system based on a process approach (GOST R ISO 9000) ⟶ — value-adding activity; ⋯⋯▶ — data flow.

However, the process approach of ISO 9000 series quality systems does not provide for either product life cycle models or life cycle analysis, which is important and efficient in problems solving.

Perspective of the life cycle method in the projection of the production of meat and meat-containing canned food

The life cycle, being a complex system, is applicable in various fields of knowledge. Of all the many models and concepts of the life cycles of objects or systems, none of them has been used in analyzing or studying certain aspects of the production process of meat and meat-containing canned food. The environment is changing, business media is changing, political and economic situations constantly keep changing, legislation is also changing, consumer expectations are changing, suppliers are being replaced by imposed sanctions, and all this does not have the best effect on the targets of enterprises. It is necessary to promptly and correctly respond to all changes — external and internal. The epistemological approach to aspects of the life cycle made it possible to judge how correctly the term "life cycle" is applicable to the production of canned food. The term "cycle", mentioned in explanatory and encyclopedic dictionaries, is a certain period of time after which phenomena or processes are repeated in the same order. Or, according to the philosophy terminology, "cycle" means "…reproduction of the structure of changes that repeat with a certain periodicity. For example, cycles of economic development, solar activity, seasons, etc. The cyclic changes, left unattended, maintain the existence of their beings in a certain balance. Emergence of a new quality in result of development can break the previous circles (cycles) and give start to new cyclic structures" [68]. In the natural sciences, the life cycle is understood as a set of stages of development, after which the body gives rise to a new generation, closing the life cycle. Thus, any terminology regarding the life cycle, adopted in different fields of knowledge, reveals semantic coincidences and enables us to speak of the life cycle as a temporal function of an object from a set of arguments. In the context of this approach, the canned food as an object has its own life cycle. There is no cyclic repetition, of course. But canned food has a beginning of its production and its final consumption.

The life cycle of any object requires a systematic approach during the process of its study. The use of a systematic approach to assessment of canned food technology has previously made it possible to define the issue of getting a safe and stable product quality as multifaceted and systemic issue [69]. But it is not possible to cover the entire system from the field to the shop shelf or to review the entire life cycle of canned food within the framework of one research; though it is not required at this stage of research. It is known that the more indeterminates in a problem, the more difficult it is to solve. It is necessary to determine the boundaries of the system under review, adopting the experience of environmental management. Or in other words, it is necessary to develop a model of the life cycle of canned food, which is part of the system, and which will cover a range of criteria that define singular processes.

While moving in this direction, it is necessary to clarify some generally acknowledged and regulated formulations in the standards, projecting them onto meat and meat-containing canned food.

Let's accept that:

- Life cycle of meat and meat-containing canned food: The cycle of successive and interrelated stages of pre-production, production process and post-production, changing and shaping the state of canned food;
- Stage of the life cycle of meat and meat-containing canned food: The part of the life cycle of meat and meat-containing canned food, characterized by an aggregate of implemented activities and their final results.

We clarify that:

1. The pre-production stage is a prerequisite for solving problems to meet the goal set for the company. This stage includes: the idea and concept of the product, research and development (R&D) — analysis of existing developments; development of the composition and technological production chart; feasibility study, justification and development of heat treatment modes, taking into account the shelf life of the products in certain storage conditions; production of a prototype, its revi-

sion if necessary; analysis of marketing research results; drawing of necessary documents; development of technical specifications.

2. The stage of the production process is a complex process of the combined actions of people and tools for transformation of raw materials, ingredients, resources and other items into finished products. In its turn the technological process is a part of the production process that contains purposeful actions to change and (or) determine the state of the object of labor.
3. The post-production stage is a set of storage and transportation processes that maintain and preserve the quality and safety of the finished product. This stage requires thorough attention, including the cases of unforeseen challenges that require quick solution.

Author of the book "System coaching of organizations. Organization under the microscope. View from within" O. Weinberg [70] graphically visualizes the problem (Figure 15). In his diagram the degree of the problem understanding is stretched along one axis. The other axis defines the degree of understanding how to solve the problem. The problem as a whole, according to the author, is divided into the "known" part, i. e. this part is understandable, the organization can realize what it is; and the "unknown" part, when the organization sees and understands the negative consequences and manifestations of a problem, but it has no idea of what exactly the problem is. The author defines the problem as a kind of mismatch, a gap between what we want and what we really have [70]. This definition is quite fair and applicable to the canned food technology. The model of the life cycle of canned food in a visual form can be shown in the Figure 16. Preserving the safety and quality of canned food in various situations remains a problem everywhere in the modern world. Each stage of the life cycle of canned food has a certain problem that needs to be solved on the basis of a structured study that does not have an unambiguous solution. The analytical way of presenting information as a source for finding solutions is a feature of the problem-oriented approach.

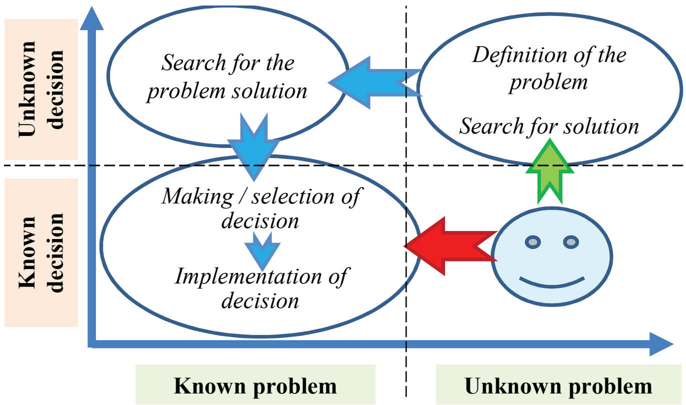

Figure 15. Matrix of problem solution (based on materials [70])

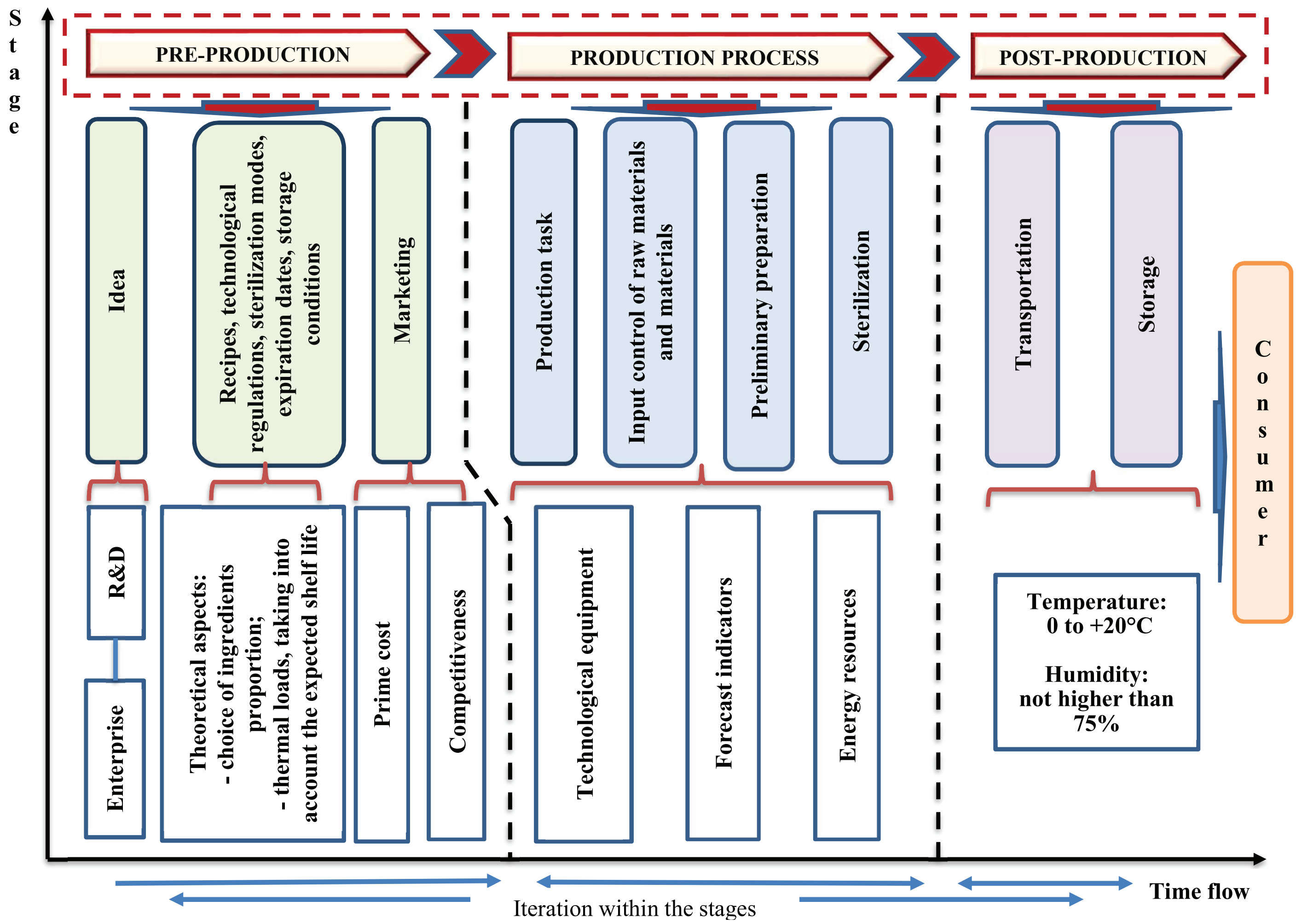

Figure 16. Model of problem-oriented stages of the life cycle of canned food

Thus, pre-production is the stage where ideas are born; the market and the target audience are studied, the main characteristics of the product are determined, technological regulations and recipes are developed, heat treatment modes and patterns are substantiated and tested, the shelf life of products is defined. At this stage, it's necessary to run the maximum number of iterations of canned food production in order to make it innovative and competitive. To competently rank the new products by groups and types at the pre-production stage, to lay down the correct ratios of ingredients when designing a recipe on the basis of a deep analysis of technologies and regulatory documents for the first time in the food canning industry has developed two types of standards of the general technical conditions for homogeneous groups of meat and meat-containing food products: GOST 34177[2] "Canned meat. General technical conditions" and GOST 32245[3] "Meat-containing canned food. General technical conditions". These standards supplement technical regulation TR TS034/2013[4] "On food safety of meat and meat products" in terms of terminology. For each type of canned food the important parameters like "mass fraction of meat ingredients" are regulated by normative documents. In addition, the range of food packages today is quite versatile. Based on the results of both research activities and verification in course of canned food production, a modern version of the GOST 13534[5] "Package, marking and transportation" standard has been developed. This version of standard provides for requirements for both classic types of packaging and for modern ones as well: polymeric and combined ones. And this is a small part of preventive measures aimed at solving the problem of canned food quality and safety formation.

Conclusion

In the food industry nowadays insufficient attention is paid to those production processes that affect formation of quality and safety of finished food products. And hardly any attention is paid to the stage of maintaining quality and safety of food products. Inconsistency and lack of continuity in the regulatory framework, scattered nature of practical skills for appropriate decision-making in conditions that go beyond the normalized values revealed the necessity of a unified methodological basis for identifying and applying preventive measures in the problem-oriented production stages, which ensure production of competitive products. To solve problems based on a systematic approach and the life cycle method, the innovations of various nature (technological, organizational, etc.) and of various scales (from elementary scale to system-wide) shall be developed and implemented. The formation and preservation of food quality and safety at production stages and at post-production stages of the canned food life cycle will be the subject of further publications. Yet the measures covered in this article, taken in due time at the stage of pre-production, allow fixing, eliminating and avoiding serious and costly mistakes in the evolution of meat and meat-containing canned food.

[2] GOST 34177–2017 "Canned meat. General specifications" Moscow: Standartinform, 2018. — 23 p. Retrieved from https://docs.cntd.ru/document/556309635. Accessed September 27, 2022. (In Russian)

[3] GOST 32245–2013 "Meat containing cans. General specifications" Moscow: Standartinform, 2019. — 14 p. Retrieved from https://docs.cntd.ru/document/1200107342 Accessed September 27, 2022. (In Russian)

[4] TR CU034/2013 Technical Regulations of the Customs Union "On the safety of meat and meat products" Retrieved from http://docs.cntd.ru/document/499050564. Accessed August 15, 2022. (In Russian)

[5] GOST 13534–2015 "Meat and meat containing cans. Packing, marking and transportation" Moscow: Standartinform, 2019. — 11p. Retrieved from https://docs.cntd.ru/document/1200133272 Accessed September 27, 2022. (In Russian)

REFERENCES

1. Ozhegov, S.I., Shvedova, N. Yu. (2000). Explanatory dictionary of the Russian language. Moscow: Azbukovnik, 2000. (In Russian)
2. Ushakov, D.N. (1996). Explanatory dictionary of the Russian language. Moscow: Terra Publishing Center, 1996. (In Russian)
3. Pavlenkov, F. (1907). Dictionary of foreign words included in the Russian language. St. Petersburg: Printing House of Y. N. Erlich, 1907. (In Russian)
4. Big Russian Encyclopedic Dictionary. (2009). Moscow: Great Russian Encyclopedia. Retrieved from http://niv.ru/doc/dictionary/encyclopedic/index.htm Accessed July 12, 2022. (In Russian)
5. Borisov, A.B. (2006). Big Economic Dictionary: Dictionary. Moscow: Book World, 2006. (In Russian)
6. Great Russian Encyclopedia. (2004–2017). Retrieved from https://bigenc.ru/ Accessed July 15, 2022. (In Russian)
7. Cambridge University Press. Cycle. In Cambridge English-Russian dictionary. Retrieved from https://dictionary.cambridge.org/ru/словарь/англо-русский/cycle Accessed July September 06, 2022.
8. Shirokova, G.V. (2010). Life cycles of Russian entrepreneurial firms: research methodology and main stages. Author's abstract of the dissertation for the scientific degree of Doctor of Economics Sciences. St. Petersburg: St. Petersburg State University, 45 p. Retrieved from https://gsom.spbu.ru/files/upload/doctoral_program/avtoreferat/shirokova.pdf Accessed August 12, 2022. (In Russian)
9. Abramova, T. A. (2011). Cycles in social development. *Economic History*, 4(15), 69–75. (In Russian)
10. Juglar, C. (1889). Commercial Crises and their Periodic Return in France, England and the United States. Paris: Guillaumin and Co. bookstore, 1989. (In French)
11. Berg, D.B., Ulyanova, E.A., Dobryak, P.V. (2014). Life cycle models. Ekaterinburg: Ural Federal University. Retrieved from https://elar.urfu.ru/bitstream/10995/28886/1/978-5-7996-1311-2_2014.pdf Accessed July 12, 2022. (In Russian)
12. Burkov, V.N., Irikov, V.A. (1994). Models and methods of managing organizational systems. Moscow: Science, 1994. (In Russian)
13. Greiner, L.V. (2002). Evolution and revolution as organizations grow. *Vestnik of Saint Petersburg University. Management,* 4, 76–92. (In Russian)
14. Ovanesova, Yu.S. (2013). Influence of the stage of the life cycle of organizations on the efficiency of IPO in developing capital markets. Author's abstract of the dissertation for the scientific degree of Doctor of Economics Sciences. Author's abstract of the dissertation for the scientific degree of Candidat of Economics Sciences. Moscow: National Research University "Higher School of Economics", 2013. Retrieved from https://www.hse.ru/sci/diss/101871951 Accessed July 25, 2022. (In Russian)
15. Hanks, S. H., Watson, C. J., Jansen, E., Chandler, G. N. (1994). Tightening the life-cycle construct: A taxonomic study of growth stage configurations in high-technology organizations. *Entrepreneurship Theory and Practice*, 18(2), 5–29. https://doi.org/10.1177/104225879401800201

16. Shirokova, G. V. (2007). Characteristics of the stages of the life cycle of Russian companies created from scratch. *Russian Management Journal,* 5(4), 3–20. (In Russian)
17. 17 Shirokova, G.V. (2008). Organizational life cycle: concepts and Russian practice. St. Petersburg: Higher School of Management, 2008. (In Russian)
18. 18 Adizes, I. (2007). Corporate Lifecycles: how and why corporations grow and die and what to do about it. St. Petersburg: Piter, 2007. (In Russian)
19. Adizes, I.K. (2014). Managing Corporate Lifecycles: How to Get to and Stay at the Top. Published by Embassy Books. Ventura, CA, U.S.A, 2014
20. Dickinson, V. (2011). Cash flow patterns as a proxy for firm life cycle. The *Accounting Review*, 86(6), 1969–1994. https://doi.org/10.2308/accr-10130
21. Scott, M., Bruce, R. (1983). Five stages of growth in small business. *Long Range Planning,* 20(3), 45–52. https://doi.org/10.1016/0024–6301(87)90071–9
22. Ivashkovskaya, I.V., Yangel, D.O. (2007). The life cycle of organization and the average growth factor. *Journal of Corporate Finance Research*, 1(4), 97–110. (In Russian)
23. Levitt, T. (1965). Exploit the product life cycle. *Harvard Business Review*, 43, 81–94.
24. Levitt, T. (1986). The marketing imagination (New expanded). Free Press; Collier Macmillan, 1986.
25. Dijksterhuis, G. (2016). New product failure: Five potential sources discussed. *Trends in Food Science and Technology*, 50, 243–248. https://doi.org/10.1016/j.tifs.2016.01.016
26. Busse, M., Siebert, R. (2018). The role of consumers in food innovation processes. *European Journal of Innovation Management,* 21(1), 20–43. https://doi.org/10.1108/EJIM-03–2017–0023
27. Moskowitz, H. R., Saguy, I. S. (2013). Reinventing the role of consumer research in today's open innovation ecosystem. *Critical Reviews in Food Science and Nutrition*, 53(7), 682–693. https://doi.org/10.1080/10408398.2010.538093
28. Horvat, A., Granato, G., Fogliano, V., Luning, P. A. (2019). Understanding consumer data use in new product development and the product life cycle in European food firms — An empirical study. *Food Quality and Preference*, 76, 20–32. https://doi.org/10.1016/j.foodqual.2019.03.008
29. Yu, C., Anigbogu, C. (2020). How waterless beauty is changing consumer behavior and addressing sustainability. *Cosmetics & Toiletries*, 135(9), 51–52. Retrieved from https://drive.google.com/file/d/1PhdBRQw3m7iCJ0JgimCMwdfWjU8n6k3b/view Accessed July 31, 2022.
30. Bom, S., Ribeiro, H.M., Marto, J. (2020). Embracing sustainability: Important practices and impact in cosmetics. *Cosmetics & Toiletries*, 135(3), 41–47.
31. Aguiar, J.B., Martins, A.M., Almeida, C., Ribeiro, H.M., Marto, J. (2022). Water sustainability: A waterless life cycle for cosmetic products. *Sustainable Production and Consumption,* 32, 35–51. https://doi.org/10.1016/j.spc.2022.04.008
32. Omelchenko, I.N., Brom, A.E. (2013). System of an assessment of life cycle of production. *Vestnik of Volzhsky University named after V. N. Tatishchev,* 2(21), 29–34. (In Russian)
33. Eide, M. H. (2002). Life cycle assessment (LCA) of industrial milk production. *Doktorsavhandlingar Vid Chalmers Tekniska Hogskola*, 1812, i+1–53.
34. De Boer, I. J. M. (2003). Environmental impact assessment of conventional and organic milk production. *Livestock Production Science*, 80(1–2), 69–77. https://doi.org/10.1016/S0301–6226(02)00322–6
35. Flysjö, A. (2011). Potential for improving the carbon footprint of butter and blend products. *Journal of Dairy Science*, 94(12), 5833–5841. https://doi.org/10.3168/jds.2011–4545
36. Avraamides, M., Fatta, D. (2008). Resource consumption and emissions from olive oil production: a life cycle inventory case study in Cyprus. *Journal of Cleaner Production*, 16(7), 809–821. https://doi.org/10.1016/j.jclepro.2007.04.002
37. Espinoza-Orias, N., Stichnothe, H., Azapagic, A. (2011). The carbon footprint of bread. *International Journal of Life Cycle Assessment*, 16(4), 351–365. https://doi.org/10.1007/s11367–011–0271–0
38. Núñez, Y., Fermoso, J., García, N., Irusta, R. (2005). Comparative life cycle assessment of beef, pork and ostrich meat: A critical point of view. *International Journal of Agricultural Resources, Governance and Ecology,* 4(2), 140–151. https://doi.org/10.1504/ijarge.2005.007196
39. Winkler, T., Schopf, K., Aschemann, R., Winiwarter, W. (2016). From farm to fork — A life cycle assessment of fresh Austrian pork. *Journal of Cleaner Production*, 116, 80–89. https://doi.org/10.1016/j.jclepro.2016.01.005
40. Bengtsson, J., Seddon, J. (2013). Cradle to retailer or quick service restaurant gate life cycle assessment of chicken products in Australia. *Journal of Cleaner Production*, 41, 291–300. https://doi.org/10.1016/j.jclepro.2012.09.034
41. Weidemman, S.G., McGahan, E.J. (2011). Environmental assessment of an egg production supply chain using life cycle assessment. AECL (Australian Egg Coporation Limited). Retrieved from https://www.freeranger.com.au/uploads/7/4/2/0/7420102/aecl_carbon_footprint.pdf Accessed August 06, 2022.
42. Pattara, C., Raggi, A., Cichelli, A. (2012). Life cycle assessment and carbon footprint in the wine supply-chain. Environmental Management, 49(6), 1247–1258. https://doi.org/10.1007/s00267–012–9844–3
43. Takamoto, Y., Mitani, Y., Takashio, M., Itoi, K., Muroyama, K. (2004). Life Cycle Inventory Analysis of a beer production process. *Technical Quarterly and the MBAA Communicator,* 41(4), 363–365.
44. Basset-Mens, C., van der Werf, H. M. G., Robin, P., Morvan, Th., Hassouna, M., Paillat, J. M. et al. (2007). Methods and data for the environmental inventory of contrasting pig production systems. *Journal of Cleaner Production*, 15(15), 1395–1405. https://doi.org/10.1016/j.jclepro.2006.03.009
45. Nguyen, T.L.T., Hermansen, J.E., Mogensen, L. (2011). Environmental assessment of Danish pork. Retrieved from https://dcapub.au.dk/djfpublikation/djfpdf/ir_103_54761_indhold_internet.pdf Accessed August 22, 2022.
46. Reckmann, K., Traulsen, I., Krieter, J. (2013). Life Cycle Assessment of pork production: A data inventory for the case of Germany. *Livestock Science*, 157(2–3), 586–596. https://doi.org/10.1016/j.livsci.2013.09.001
47. Instituto Nacional de Estatísitca (INE). (2013). I.P., Estatísticas Agrícolas 2012. Statistic Portugal, Estatísticas Oficiais, Lisboa. (p. 178). Retrieved from https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpub_boui=153380933&PUBLICACOESmodo=2 Accessed August 22, 2022. (In Portuguese)
48. González-García, S., Belo, S., Dias, A. C., Rodrigues, J. V., Costa, R. R. D., Ferreira, A. et al. (2015). Life cycle assessment of pigmeat production: Portuguese case study and proposal of improvement options. *Journal of Cleaner Production*, 100, 126–139. https://doi.org/10.1016/j.jclepro.2015.03.048
49. Fedorov, Y. A., Sukhorukov, V. V., Trubnik, R. G. (2021). Review: emission and absorption of greenhouse gases by soils. *Ecological problems Ecological problems. Anthropogenic Transformation of Nature,* 7(1), 6–34. https://doi.org/10.17072/2410–8553–2021–1–6–34 (In Russian)
50. Sukhomlinova, N. B., Cheshev, A. S. (2019). Ecological-reclamation activities in the areas of soil erosion *Economy and Ecology of Territorial Formations*, 3(1), 35–45. https://doi.org/10.23947/2413–1474–2021–5–2–59–65 (In Russian)
51. Hertwich, E. G., Peters, G. P. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science and Technology*, 43(16), 6414–6420. https://doi.org/10.1021/es803496a
52. Troy, D. J., Kerry, J. P. (2010). Consumer perception and the role of science in the meat industry. *Meat Science*, 86(1), 214–226. https://doi.org/10.1016/j.meatsci.2010.05.009
53. Renouf, M. A., Fujita-Dimas, C. (January 22, 2013). *Application of LCA in Australia agriculture — a review*. The 8th Life Cycle Conference — Pathways to Greening Global Markets. Australia, Sydney, 2013.
54. Biswas, W. K., Naude, G. (2016). A life cycle assessment of processed meat products supplied to Barrow Island: A Western Australian case study. *Journal of Food Engineering,* 180, 48–59. https://doi.org/10.1016/j.jfoodeng.2016.02.008
55. Del Borghi, A., Strazza, C., Magrassi, F., Taramasso, A. C., Gallo, M. (2018). Life Cycle Assessment for eco-design of product–package systems in the food industry — The case of legumes. *Sustainable Production and Consumption*, 13, 24–36. https://doi.org/10.1016/j.spc.2017.11.001
56. Lozano, S., Iribarren, D., Moreira, M. T., Feijoo, G. (2009). The link between operational efficiency and environmental impacts. A joint application of Life Cycle Assessment and Data Envelopment Analysis. *Science of the Total Environment*, 407(5), 1744–1754. https://doi.org/10.1016/j.scitotenv.2008.10.062
57. Iribarren, D., Moreira, M. T., Feijoo, G. (2010). Life Cycle Assessment of fresh and canned mussel processing and consumption in Galicia (NW Spain). *Resources, Conservation and Recycling,* 55(2), 106–117. https://doi.org/10.1016/j.resconrec.2010.08.001
58. Hospido, A., Vazquez, M. E., Cuevas, A., Feijoo, G., Moreira, M. T. (2006). Environmental assessment of canned tuna manufacture

with a life-cycle perspective. *Resources, Conservation and Recycling*, 47(1), 56–72. https://doi.org/10.1016/j.resconrec.2005.10.003
59. Laso, J., Margallo, M., Fullana, P., Bala, A., Gazulla, C., Irabien, Á. et al. (2017). When product diversification influences life cycle impact assessment: A case study of canned anchovy. *Science of the Total Environment*, 581–582, 629–639. https://doi.org/10.1016/j.scitotenv.2016.12.173
60. Perez-Martinez, M. M., Noguerol, R., Casales, B. I., Lois, R., Soto, B. (2018). Evaluation of environmental impact of two ready-to-eat canned meat products using Life Cycle Assessment. *Journal of Food Engineering*, 237, 118–127. https://doi.org/10.1016/j.jfoodeng.2018.05.031
61. European Commission EU Climate Action and the European Green Deal. Climate Action (2020). Retrieved from https://unfccc.int/sites/default/files/resource/2020_Yearbook_final_0.pdf Accessed August 25, 2022.
62. Saget, S., Costa, M., Santos, C. S., Vasconcelos, M. W., Gibbons, J., Styles, D., et al. (2021). Substitution of beef with pea protein reduces the environmental footprint of meat balls whilst supporting health and climate stabilisation goals. *Journal of Cleaner Production,* 297, Article 126447. https://doi.org/10.1016/j.jclepro.2021.126447
63. Tuomisto, H. L., Allan, S. J., Ellis, M. J. (2022). Prospective life cycle assessment of a bioprocess design for cultured meat production in hollow fiber bioreactors. *Science of the Total Environment,* 851, Article 158051. https://doi.org/10.1016/j.scitotenv.2022.158051
64. Gava, O., Bartolini, F., Venturi, F., Brunori, G., Zinnai, A., Pardossi, A. (2018). A reflection of the use of the life cycle assessment tool for agri-food sustainability. *Sustainability (Switzerland),* 11(1), Article 71. http://doi.org/10.3390/su11010071
65. Silva, V. L., Sanjuán, N. (2019). Opening up the black box: A systematic literature review of life cycle assessment in alternative food processing technologies. *Journal of Food Engineering*, 250, 33–45. https://doi.org/10.1016/j.jfoodeng.2019.01.010
66. Omolayo, Y., Feingold, B. J., Neff, R. A., Romeiko, X. X. (2021). Life cycle assessment of food loss and waste in the food supply chain. *Resources, Conservation and Recycling,* 164, Article 105119. https://doi.org/10.1016/j.resconrec.2020.105119
67. Degieter, M., Gellynck, X., Goyal, S., Ott, D., De Steur, H. (2022). Life cycle cost analysis of agri-food products: A systematic review. *Science of the Total Environment*, 850, Article 158012. https://doi.org/10.1016/j.scitotenv.2022.158012
68. Sagatovsky, V.N. (1999). Philosophy of developing harmony (philosophical foundations of worldview). St. Petersburg, LLC “Petropolis”, 1999. (In Russian)
69. Krylova, V. B., Gustova, T. V., Bataeva, D. S. (2019). Systemic risk analysis of complex meat systems. In IOP Conference Series: Earth and Environmental Science (Vol. 333). Institute of Physics Publishing. https://doi.org/10.1088/1755–1315/333/1/012071
70. Weinberg, O.M. (2018). Systemic coaching of organizations. Organization under the microscope. Inside view. Ekaterinburg, Ridero. Retrieved from https://www.litres.ru/oleg-vaynberg-149534/sistemnyy-kouching-organizaciy-organizaciya-pod-mikro/chitat-onlayn/ Accessed August 22, 2022. (In Russian)

AUTHOR INFORMATION

Tatyana V. Gustova, Candidate of Technical Sciences, Docent, Leading Scientific Worker, Department of Scientific-Applied and Technological Developments, V. M. Gorbatov Federal Research Center for Food Systems. 26, Talalikhina str., 109316, Moscow, Russia. Tel.: +7–495–676–95–11, (227), E-mail: t.gustova@fncps.ru
ORCID: https://orcid.org/0000–0002–6313–6963

Completely prepared the manuscript and is responsible for plagiarism.

The author declare no conflict of interest.